AVIATION IN THE XXI-ST CENTURY

INTERNATIONAL CIVIL AVIATION ORGANIZATION
NATIONAL ACADEMY OF SCIENCES OF UKRAINE
MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
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PROCEEDINGS

THE FOURTH WORLD CONGRESS "AVIATION IN THE XXI-st CENTURY"

"Safety in Aviation and Space Technologies"

Volume 2

September 21-23, 2010
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RADAR METHODS AND SYSTEMS WORKSHOP (RMSW-2010)

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V.V. Sterlyadkin (MGUPI, professor)

METHODS OF DOPPLER TOMOGRAPHY IN RADAR METEOROLOGY

The problem of Doppler tomography for reconstruction of a wind field in atmosphere by using a continuous wave Doppler radar is discussed. The additional possibilities to improve the accuracy of reconstruction by using a radiation, which has a known extinction by atmospheric gases, are shown.

The problem of Doppler tomography consists of the reconstruction of space velocity field from the Doppler spectra of scattered radiation detected with a continuous wave measuring system at various orientations relative to the object.

According to our information the first statement of the Doppler tomography problem was made in 1982 when authors encountered these problems in developing methods for the wind field reconstruction using Doppler spectra detected by Doppler radar systems with no modulated continuous wave radiation [1-3]. In these papers a strong dependence of a Doppler spectra forms on sounding directions were shown. The principles of variance of spectra envelope on profile and sounding direction were investigated. On the basis the stated principles authors were able to solve the inverse problem – wind profile reconstruction by a set of Doppler spectra.

In our earlier paper [4] the Doppler tomography problem was stated in a general mathematical form, and ways of solving it for different models of wind field were considered. The spectral power density of Doppler spectra, assuming narrow antennas directivity pattern is related to the characteristics of the sounded object and the measurement system by the next integral equation:

$$S_\lambda(\upsilon) = c\int_L \sigma_\lambda(R) P_\lambda(\ell)\omega[\upsilon, \vec{V}(\vec{R})]dl, \qquad (1)$$

where the integration is performed along the path of the radiation L; instead of Doppler frequency f_d we use the projection of scatterers velocity on sounding direction $\upsilon = f_d \lambda/2$;

C – is a constant that depends on the characteristics of the radar unit;

$\sigma_\lambda(R)$ is a scalar field of the backscattered cross section of a unit volume, which in general depends on the wavelength λ of the sounding radiation;

$\omega[\upsilon, \vec{V}(\vec{R})]$ – distribution of projections of the scatterers velocities υ in the part of the sounded region in question, which depends on unknown desired vector field v(R);

$P_\lambda(\ell)$ – describes the dependence of received power on a distance ℓ. In the wave zone for a set of scatterers

$$P_\lambda(\ell) = \frac{1}{\ell^2}\exp\left[-2\int_0^\ell \gamma_\lambda(\ell')d\ell'\right], \qquad (2)$$

where $\gamma_\lambda(R)$ is a linear extinction coefficient.

Based on its meaning $S_\lambda(v)$ is an integral Doppler projection of velocity field on a line L, which takes into consideration the distribution of scatterers along a line and attenuation of received power on distance. The Doppler tomography problem is a reconstruction of an unknown vector field V(R) from set of Doppler spectra, registered on some family of lines.

For the problem of wind measurement in atmosphere the equation (1) may be simplified using the model of wind field homogeneous in horizontal plane. This field is defined by two scalar functions: V(H) – the dependence of a wind velocity module on a height H and $\alpha(H)$ – the dependence of azimuth direction on a height H. It was shown, that the use of the dependence of the boundary frequencies of Doppler spectra $V_{min}(\alpha)$ and $V_{max}(\alpha)$ on azimuth α and those for the spectral singularities enable us to reconstruct fully the hodograph curve for the wind profile $V(\alpha)$ in polar coordinates V, α. The further linking of the hodograph curve with height H uses the full forms of all Doppler spectra.

Nevertheless this method has limitation conditions, concerned with the monotonic type of function for projection of wind profile on some sounding directions and demands homogeneous distribution of reflectivity in measurement space.

In this paper some ways to increase the accuracy of the solution of the inverse problem based on using of radiation, which has a known extinction by atmospheric gases are considered. As example, one can use the 5 mm wave range, where the extinction coefficient may be as large as 14dB/km.

In this case function $P_\lambda(\ell)$ in the far-field region of the radar may be given by:

$$P_\lambda(\ell) = \frac{1}{\ell^2}\exp(-2\gamma_\lambda \ell), \tag{3}$$

where γ_λ – a linear extinction coefficient.

Using the tilt sounding with the variance elevation angle β, one can extend or reduce the distance ℓ to the given wind layer (ℓ = H/sinβ) and attenuate or increase its contribution to spectrum.

Under these assumptions the spectral density, forms by the lay (H, H+dH), may be described by the next equation:

$$dS(\upsilon,\beta) = \frac{c\sigma_\lambda(H/\sin\beta)}{H^2}\exp\left(\frac{-2\gamma_\lambda H}{\sin\beta}\right) * \left|\left(\frac{d\upsilon(H)}{dH}\right)^{-1}\right|, \tag{4}$$

where υ(H) – a projection of a desired wind profile on sounding direction.

The sounding with the small elevation angles changes the corner of integral equation and gives one the opportunity to remove component of higher wind layers and partially reconstruct the low part of a desired wind profile. As the elevation angle is increasing, the components of the higher layers are added to the solution. Each next step of solving takes into account the reconstruction results for lower layers.

The mathematical modeling of the Doppler tomography problem for the wind reconstruction proved the correctness of this procedure and revealed solution stability even with considerable inaccuracy of measurements data.

Conclusion

The use of Doppler tomography methods in radar meteorology enables us to measure wind profile by continuous wave no modulated Doppler systems, which in contrast to pulse-coherent systems has no restrictions on using wave length, on height, may detect wind velocity beginning from ground lays. This method may be used even in optical band. It opens wide possibilities to create technically simple, small-size wind velocity profilers.

References

1. *Sterlyadkin V.V.* Determination of the wind in precipitations by continuous wave Doppler systems. Dissertation Dr. physics-mathematics sciences. Moscow, 1982, 164 pp.

2. *Gorelik A.G., Sterlyadkin V.V.* Determination of the wind in the atmospheric boundary layer with continuous wave Doppler systems. Meteorology and Hydrology, №4, 1984, pp. 46-52.

3. *Gorelik A.G., Sterlyadkin V.V.* Wind sounding of the atmosphere by means of Continious Doppler System. Izvestiya, Atmospheric and Oceanic Physics. Vol. 22, №7, 1986, pp. 556-561.

4. *Gorelik A.G., Sterlyadkin V.V.* Doppler tomography in radar meteorology. Izvestiya, Atmospheric and Oceanic Physics. Vol. 26, № 1, 1990, pp. 28-33.

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APPLICATION OF DOUBLE FREQUENCY RADAR FOR MEASUREMENTS OF RAIN PARAMETERS

The paper is devoted to consideration of peculiarities of double frequency radar sensing of rain. The consideration is performed for two cases of drop size distribution – narrow (almost monodisperse medium) and wide (polydisperse medium) in approximation of incoherent scattering and spherical drop shape (Mie theory). The calculations of differential radar cross section are performed in dependence on wavelength, temperature and microphysical characteristics of rain. Also experiments with double frequency radar were performed at 8 mm and 3 cm wavelengths for single drops that confirms the applicability of the Mie theory and accuracy of double frequency method.

Information about intensity and amount of liquid precipitations is of great interest in meteorology, climatology etc. At that use of radar is very attractive to obtain information for large area. Method for measurement of rain intensity I based on, so called, radar reflectivity-intensity relation $Z=xI^y$ is quite popular. But the main disadvantage of such approach is weak correlation between intensity and reflectivity and that is why the double frequency method was proposed to reduce measurement errors [1, 3, 4]. The goal of the present paper is to establish the frameworks of such method applicability and its peculiarities.

1. Monodisperse medium

In the case of "narrow" distribution of drop dimensions $\Delta D/\overline{D} << 1$, where ΔD is width of distribution law and $\overline{D}$ is mean diameter, it is possible to use effective diameter of drop $D \cong D_{ef}$. In this case the specific radar cross section (SRCS) can be written in approximation of incoherent scattering [5] as $\sigma_0(D_{ef}) = N_0\sigma_p(D_{ef})$, where $\sigma_p(D_{ef})$ is RCS of single drop with diameter D_{ef}, N_0 is drop concentration (number of drops per unit volume, 1/m^3). To improve informativity of radar sensing it was suggested to introduce a differential RCS (DRCS) [1] as the ratio of SRCS measured at two wavelengths λ_1 and λ_2

$$\sigma_D = \frac{\sigma_0(D_{ef}, \lambda_1)}{\sigma_0(D_{ef}, \lambda_2)} = \frac{\sigma_p(D_{ef}, \lambda_1)}{\sigma_p(D_{ef}, \lambda_2)}. \quad (1)$$

As it was shown in [3, 4] the DRCS monotonically depends on drop diameter in some range of their dimensions and allows to obtain the effective drop diameter using (1). Measurement of drop size permits to calculate important parameters of rain, including drop concentration N_0, water content W (g/m^3) and rain intensity I (mm/h).

Dependences of DRCS of single water drop on its diameter are presented in fig. 1 for different values of temperature and for λ_1=8 mm and λ_2=3,2 cm. These dependences were calculated using Mie theory [6]. They show weak temperature dependence of DRCS in wide temperature range $-30^\circ\text{C} \le T \le 30^\circ\text{C}$. For example for T=10ºC the mean relative error of effective drop diameter is not more than $\delta_r = \left|(D_{ef} - D_0)/D_0\right| \cdot 100\% \le 3\%$ in the temperature range $0^\circ\text{C} \le T \le 20^\circ\text{C}$ (D_0 is effective drop diameter measured at T=10ºC).

For experimental verification of method the work bench (fig. 2) was developed which includes radar for measurement of DRCS, camera and electronic balance to measure drop mass. The calibration of the work bench was performed by spherical metal ball with diameter 3,165 mm that

corresponds to the RCS: 21,61 mm^2 at λ=8 mm and 8,48 mm^2 at λ=3,2 cm. The measurements of drop mass m were used for calculation of root-mean-cube diameter of equivalent spherical drop $D_{rmc} = 2 \cdot \sqrt[3]{(3m)/(4\pi\rho_0)}$ (ρ_0 = 1 g/cm^3 – density of water).

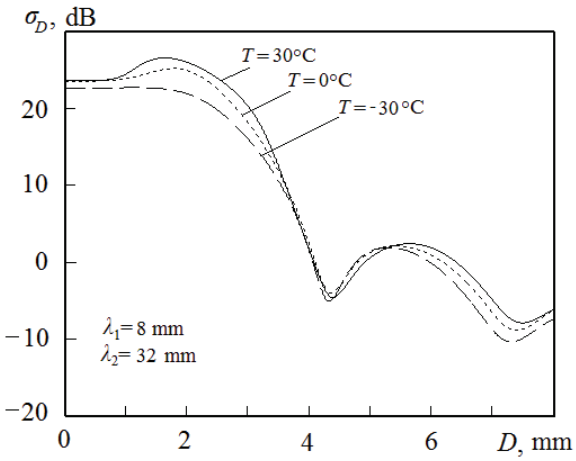

Fig. 1 Dependence of DRCS for a single water drop

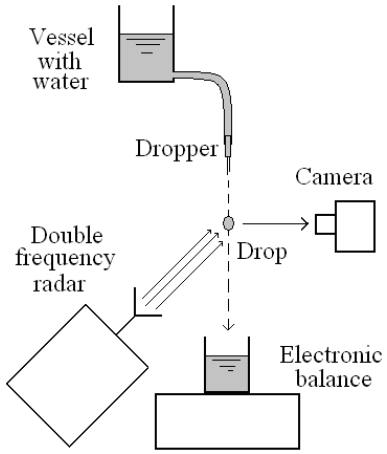

Fig. 2. Structure of the work bench

The double frequency Doppler radar operating in CW mode at λ_1=8 mm and λ_2=3,2 cm was used for remote measurements of drop size. For increasing of SNR the filtration of received signals was used by means of pass band filter with frequency band 100 Hz, center frequency 315 Hz for λ=8 mm and 110 Hz for λ=3,2 cm. The comparison of drop radius measurements is presented in Table 1, where columns “Balance”, “Camera” and “Radar” corresponds to measurements of drop sizes by contact methods using balance and camera, as well as radar. Unfortunately due to lack of radar power budget it was impossible to measure drops of small diameters (2,66 mm and 2,93 mm). Nevertheless use of double frequency method provides good agreement with contact measurements – all measurement errors are less than 3,5 %. The fig. 3 shows the dependence of measured drop diameters on calculated root-mean-cube diameter of equivalent spherical drop, where asterisks correspond to the camera measurements, dots – to radar measurements, solid line – to spheric drops.

Table 1. Measurement results

Balance, mm	Camera, mm	Radar, mm
2,66	2,62	–
2,93	2,79	–
3,78	3,68	3,66
4	3,94	3,9

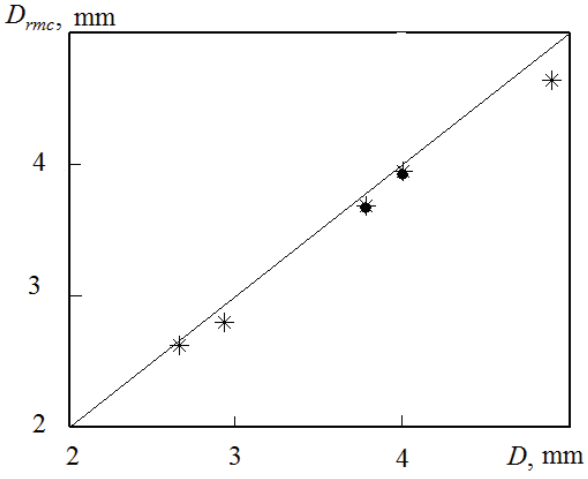

Fig. 3. Results of measurements

As one can see the measured diameters lie under the line for spherical drops that means the shape of drops is nonspherical and oblong in vertical plane.

2. Polydisperse medium

Real rain, of course, consists from drops of different sizes, so let us consider the influence of polydispersity on the use of double frequency method. At the last time the 3-parameters gamma distribution [7, 8] is widely used to describe polydisperse medium. But the problem is here: it is impossible to measure all three parameters using double frequency radar. That is why the only two

possibilities exist: to fix one of the parameters on the base of some auxiliary information or to use connection between the two [9]. The differential reflectivity is written

$$Z_D = \left(\frac{\lambda_1}{\lambda_2}\right)^4 \left|\frac{\dot{\varepsilon}(\lambda_1,T)+2}{\dot{\varepsilon}(\lambda_1,T)-1}\right|^2 \left|\frac{\dot{\varepsilon}(\lambda_2,T)-1}{\dot{\varepsilon}(\lambda_2,T)+2}\right|^2 \sigma_D; \qquad \sigma_D = \frac{\sigma_0(\lambda_1)}{\sigma_0(\lambda_2)} = \frac{\int_0^\infty \sigma_p(D,\lambda_1,)F(D,I)dD}{\int_0^\infty \sigma_p(D,\lambda_2,)F(D,I)dD} \tag{2}$$

where $\dot{\varepsilon}(\lambda_{1,2},T)$ – complex permittivity of water at temperature T°C, $F(D)$ – normalized gamma distribution

$$F(D) = \frac{D^\alpha}{\Gamma(\alpha+1)\,\beta^{\alpha+1}} \exp\left(-\frac{D}{\beta}\right),\ D>0 \tag{3}$$

where α, β – distribution parameters that depend on rain intensity; $\Gamma(\alpha+1)$– gamma function. As it was shown in [10] the mentioned parameters are not independent and to find the connection between them we used data of contact measurements [11] that permits to express distribution parameters by means of rain intensity: $\alpha = 2{,}24I^{-0{,}46}$ and $\beta = 0{,}25I^{0{,}42}$. In the fig. 4a, b these relations are shown and in fig. 4c the relation between parameters is presented.

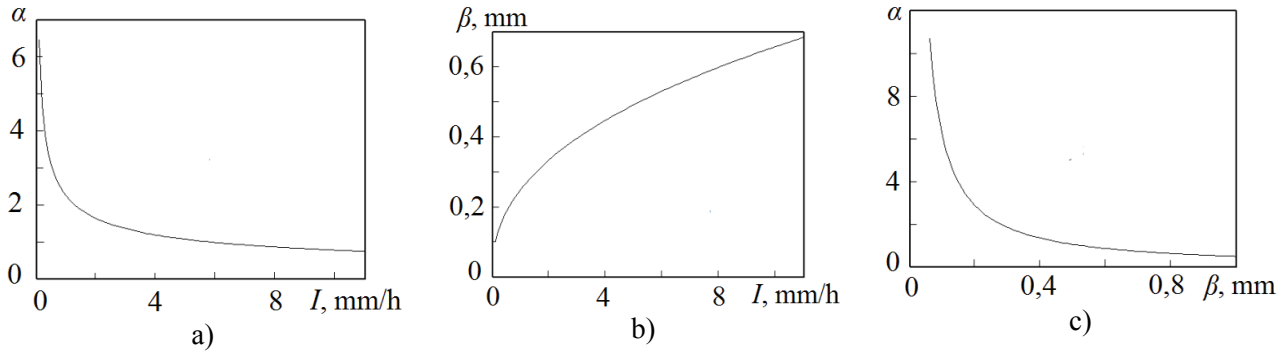

Fig. 4. Parameters of gamma distribution

This permits to reduce the number of unknown parameters and to realize renewal of rain microstructure parameters using double frequency radar by numerical solving of transcendental equations (2). In particular the values of λ_1=8 mm and λ_2=3 cm are the best choice for measurement of rain intensity [11] in connection with this we numerically solved equations (2) and the results are shown in fig. 5. As one can see the obtained solution provides single-valued measurement of rain intensity in the range 0,2 mm/h ≤ I ≤15÷20 mm/h, which is characterized as moderate precipitations for St and Cu clouds. At that the ambiguity of measurements is taken place for small intensity I≤ 0,2 mm/h (modal diameter – D_{mod}=0,6 mm, width of drop spectrum – ΔD=0,31mm) due to specific behavior of differential reflectivity.

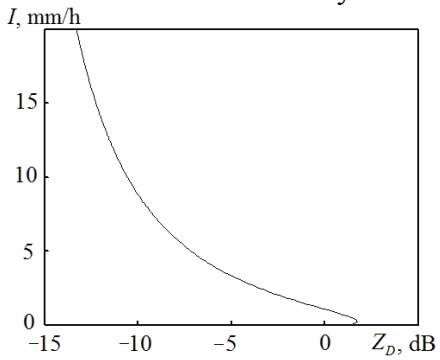

Fig. 5. Dependence of rain intensity on differential reflectivity (λ_1=8 mm and λ_2=3,2 cm).

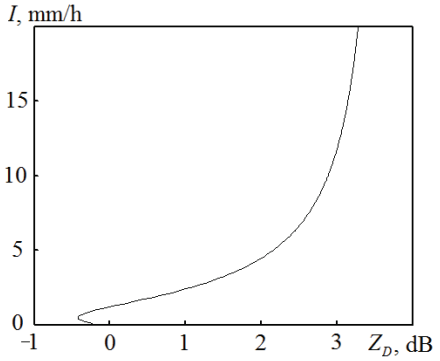

Fig. 6. Dependence of rain intensity on differential reflectivity (λ_1=3 cm and λ_2=10 cm).

From the other hand in fig. 6 similar dependence is calculated for λ_1=3 cm and λ_2=10 cm which widely used in weather radar [2]. In this case the scattering is mostly in the Rayleigh region and therefore character of dependence is strongly changed. The limits of single-valued variations of differential radar reflectivity is only 3 dB that is too small taking into account the achievable accuracy of radar measurements (≈1÷2 dB). So couple of wavelengths λ_1=3 cm and λ_2=10 cm can not be used for double frequency method.

It is necessary to consider obtained results in average meaning because they are based on mean relation between parameters of gamma distribution and rain intensity similar to other results [1, 9]. Nevertheless the considered approach permits to measure not only rain intensity I mm/h (2), but also microphysical rain characteristics $\alpha(I)$, $\beta(I)$, drop concentration N_0 (m^{-3}) and water content W (g/m^3). So if dimension of β is mm, I – mm/h, D – mm and ρ_0 – g/m^3 then

$$N_0 = I\left\{(3{,}6\cdot 10^{-3})^{-1}\cdot\frac{\pi}{6}\cdot\frac{\Gamma(\alpha+4)}{\Gamma(\alpha+1)\beta^{\alpha+1}}\left[9{,}87\beta^{\alpha+4}-10{,}4\left(\frac{1}{\beta}+0{,}605\right)^{-\alpha-4}\right]\right\}^{-1},\ \mathrm{m}^{-3} \tag{4}$$

$$W = 10^9\cdot\frac{\pi}{6}\rho_0\, N_0\,\beta^3(\alpha+1)(\alpha+2)(\alpha+3),\ \mathrm{g/m}^3. \tag{5}$$

Finishing the present consideration it is necessary to note some items: attenuation of radiation in precipitation is not taken into account here; validity of obtained data is strongly depends on reliability of contact measurements of microphysical parameters of gamma distribution. So it will be coming to specify the contact data and extend their representation.

Conclusions

1. Differential radar reflectivity weakly depends on temperature and strongly depends on operating wavelength.
2. Comparison of calculations and measurements of differential radar reflectivity in 8 mm and 3,2 cm wave bands showed that instead of nonspherical shape of water drops the use of Mie theory is sell grounded and provides accuracy 3,5 %.
3. The double frequency method proposed provides measurement of rain intensity in the range 0,2 mm/h ≤ I ≤ 15÷20 mm/h.

References

1. *Abshaev M.T., Dadaly Yu. A.*, "About possibilities of micro-structure study of clouds and precipitation by radar methods", Trudy VGI, No. 5, pp. 124-132, 1966.
2. *Stepanenko V. D.*, "Radiolocation in meteorology", Gidrometeoizdat, Leningrad, 1973, p. 343.
3. *R. Knoechel, G. Khlopov, A. Teplyuk, K. Schuenemann, O. Voitovych, A Linkova.*, "Double frequency sounding of solid polydisperse aerosols". J. Radiophysics and Electronics, vol. 15, no. 1, 2010, pp. 51-61.
4. *R. Knoechel, G. Khlopov, A. Teplyuk, K. Schuenemann, O. Voitovych, A. Linkova*, "Double frequency sounding of volume scatterers", Proceedings of IRS 2009, Hamburg, Germany, September, 2009, pp 437-441.
5. *A. B. Shupyatskiy*, Radar measurement of intensity and some other parameters of precipitation, Leningrad, Hydrometeoizdat, 1960, pp. 118.
6. *H. C. Hulst*, "Light scattering by small particles", John Wiley & Sons, Inc., New York, 1957.
7. *I. V. Litvinov*, "Structure of atmosphere precipitation", Gidrometeoizdat, Leningrad, 1974, p. 153.
8. *G. M. Ayvazyan*, "Propagation of millimeter and sub-millimeter waves in clouds", Gidrometeoizdat, Leningrad, 1991, p. 478.
9. *S. Joseph Munchak*, "Retrieval of Raindrop Size Distribution from Simulated Dual-Frequency Radar Measurements", J. Appl. Meteor. and Climatology, vol. 47, January 2008, p. 223-239.
10. *Z. S. Haddad, S.L. Durden, E. Im.*, "Parameterizing the raindrop distribution", J. Appl. Meteor., vol. 35, 1996, p. 3-13.
11. *J. Goldhirsh, I. Katz*, "Estimation of raindrop size distribution using multiple wavelength radar systems", Radio Science, vol.9, 1974, p. 439-446.

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GENERALIZED MULTIPLICATIVE COEFFICIENT OF Z-R RELATIONSHIP DEDUCED UNDER THE ASSUMPTION OF MODIFIED GAMMA DSD AND IT'S USE WITHIN A WIDE RANGE OF WAVELENGTH AND TIME INTERVALS

This report is devoted to a discussion of an original technique of radar measurement interpretation based on calculating the generalized multiplicative coefficient of the Z-R relationship. This approach makes it possible to estimate vertical airflow velocity and rain microstructure using vertically pointing Doppler radar within a wide range of time-space scales and wavelengths.

Introduction

The accuracy of rain rate estimation by well-calibrated radar is limited by the lack of detailed knowledge of drop size distribution (DSD). Rain rate R is usually estimated from a radar reflectivity factor Z using a Z-R relation. It is well known that the Z-R relation changes from location to location and time to time depending on changes in the DSD. Therefore the empirical Z-R relation fixed for the whole observation period cannot provide accurate estimations for various types of rain because it cannot handle time and space variations in the DSD. The relation between Z and R is almost completely quantified only if the DSD is specified. Therefore accurate rainfall rate estimations based on the reflectivity factor requires detailed knowledge of rain DSD.

Doppler measurements in rain also require detailed knowledge of rain DSD, in order to separate the value of vertical airflow velocity from the gravitational velocity of raindrops [1]. For example, a set of curves for different σ – the width of the signal intensity spectrum (a spectrum of the signal received after it has passed through a square-law detector) is shown in Fig. 1. There are different spectra widths for the same value of Z/R ratio because of different rain DSD. The more accurate estimations of DSD, the more accurate the estimations of the average vertical airflow velocity w and the velocity of its turbulent pulsations can one get using the following expression:

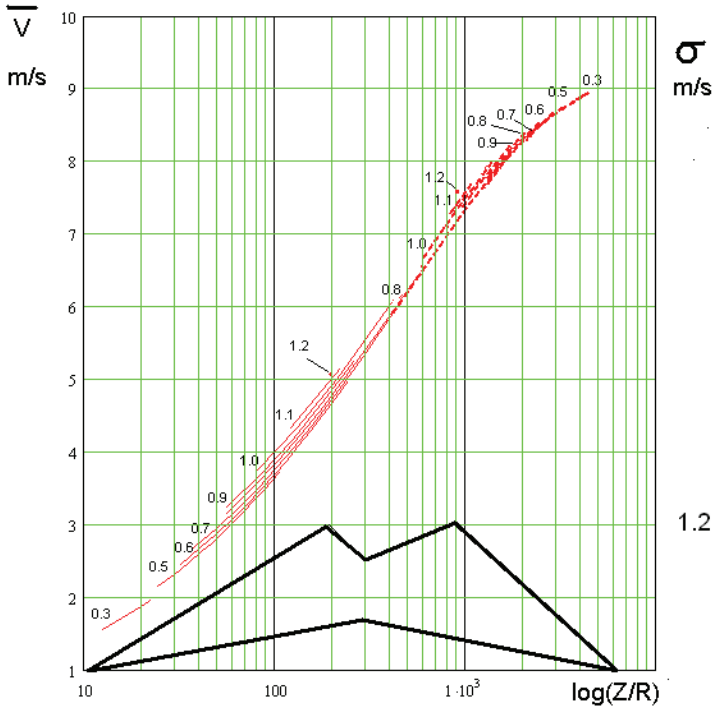

Fig. 1. The gravitational fall velocity of raindrops averaged over radar volume $\bar{v}$ and the width of power-spectrum of intensity of signal received σ against log(Z/R)

$$w = V(\overline{F_D}) - \bar{v}, \qquad (1)$$

where w - is a value of vertical airflows, $V(\overline{F_D})$ - is a value of velocity deduced from $\overline{F_D}$, the registered mean Doppler frequency, $\bar{v}$ - a value of the gravitational fall velocity averaged over the radar volume raindrops set.

First fit formula of rain DSD

The generally established way to approximate the relationship between the radar reflectivity factor Z and the rainfall rate R consist in using the following formula

$$Z = A \cdot R^b \qquad (2)$$

where: A is a multiplicative coefficient; b is an exponent and both A and b are free parameters of nonlinear regression which have to be implemented over radar data in order to get its exact value and depict the rain in question.
The first formula of DSD was offered by Marshall and Palmer (MPD) in the form of:

$$n(D)dD = N'\exp(-\Lambda D)dD \qquad (3)$$

where: N' – is an experimentally determined intercept parameter equal to about 0.08 cm^{-4}; Λ – is a slope parameter of the distribution (according to the original research of Marshall and Palmer this parameter is dependent upon rain rate only), n(D)dD is the number of drops per unit volume with diameters between D and D+dD.

MPD formed on the basis of long-term experimental data processing means that slope Λ is a simple function of R like $\Lambda(R) = 41R^{-0.21}$ or D_o (the median volume diameter) like $\Lambda(D_o) = 3.67/D_o$, because the rain rate is proportional to the 3.67-th moment that is close to the central moments. This relation between slope Λ and R, while the intercept parameter N' is a constant, made it clear that because Z and R are functions of the 6-th and roughly 4-th moment of the DSD, respectively, that the Z is related directly to R by a simple relation such as $Z=200R^{1.6}$. Logarithm of Z/R ratio is calculated very easy using MPD, but all attempts to use a width of the power-spectrum of signal intensity σ within this approach resulted in fail because of significant differences between the experimentally measured value of the width and that which was expected.

Modified Gamma as the best fit formula of rain DSD

Despite the fact that the superb correlation between Z and R follows from Marshall and Palmer's seminal work gave a tremendous impetus to many scientists around the world to use radar for rainfall measurements, it is an obvious and proven fact today that there are many relations like MPD in rains depending on rain type, the rain lifecycle period being observed, and duration of the sample interval. It was at shorter sample intervals that larger discrepancies with MPD were found, and it was impossible to classify them by clear-cut physical characteristics except in a gross manner. Therefore it looks as if we shall not use MPD for short-time sample intervals and even for long-time intervals we face some insurmountable obstacles even in classifying rains with confidence and especially in making correct radar data interpretations in terms of rain microphysics. Consequently, an accurate rain rate estimation based on the reflectivity factor, that requires detailed knowledge of instant drop size distribution, requires new approaches.

It is accepted now by most researchers that modified Gamma function (MGF) is the best candidate to approximate short-time DSD in rains. MGF can be written in the form of:

$$n(D)dD = N_0 D^m \exp(-\beta D)dD \qquad (4)$$

where: N_0 – is raindrop concentration per m^3, m and β are the shape and slope parameters, respectively.

Using it one can treat narrow and skewed DSD, and at the same time, while $\mu = 0$, approximate wide DSD, that are expected at longer sample intervals. Over the last fifty years lots of efforts have been made to develop methods of radar data interpretation based on MGF. It has to be emphasized, that for the first time using MGF and a more accurate fit formula of the relation between the drop equivalent diameter and the value of its gravitational fall velocity allowed to get

acceptable agreement between the experimentally measured width of the intensity spectrum and that which was expected [1]. But unfortunately to date no one has offered any acceptable expression for the multiplicative coefficient of the Z-R relation expressed in terms of MGF and nonlinear regression with two free parameters. This fact does not allow making remote estimations using radar data only. One of the possible ways of making such measurements without gauge data is to use the same MPD that, obviously, leads to a significant decrease in accuracy and reliability of the estimations, especially at short-time sample intervals. What is more, parameters of MGF are usually difficult to retrieve using contact instruments so there are very limited means available to verify remote estimations, not to mention the development of a robust and reliable technique.

Generalized multiplicative coefficient

Unreasonable complexity, one can face dealing with MGF and nonlinear regression with two free parameters, makes it necessary to think about the regression in new ways. One possible way out of the difficulty is to give the exponent b in (2) a constant value. Such an approach was employed in some TOGA COARE radar data processing projects [2]. As expected, the exponent was equal to 1.5 in most observations at long-time sample intervals. One can find in the literature the following form of Z-R relation which was proposed for conventional radars and then adapted for polarimetric radar measurements [3]:

$$Z = a(N^*)^{-0.5}R^{1.5} \qquad (5)$$

the normalized gamma distribution within this approach can be written as:

$$n(D) = N^* f(\mu)\left[\frac{D}{D_0}\right]^{\mu} \exp\left(-(3.67+\mu)\frac{D}{D_0}\right)dD \qquad (6)$$

where: $f(\mu) = \frac{6}{3.67^4}\frac{(3.67+\mu)^{\mu+4}}{\Gamma(\mu+4)}$, μ is the shape parameters, N^* – is a generalized intercept parameter in m^{-4} which can be evaluated using radar data for every sample interval.

The Z-R relation involves the estimation of N* from which the multiplicative coefficient of the $Z = aR^{1.5}$ relation can be determined 'in situ' from radar measurements [3]. The result of using a constant exponent surpasses all expectations in hydrology. However this approach is unlikely to be seen as foundation for a clear-cut analysis of the microphysical nature of the processes involved being developed on the basis of some kind formal results of statistical data processing of Z and R measurements,. Moreover, the potential of this method at short time sample intervals is unevaluated.

The author, working independently and sticking to physically explicit relationships between Z and R, has worked out an alternative approach which holds true both for short-time and long-time sample intervals.

It is obvious that at infinitesimal time intervals $Z = A_0R^2$. Taking integrals for Z and R expressed in terms of MGF over the semiinfinite interval of raindrop equivalent diameter, one could get an explicit relation for A_0. The main obstacle in this line of reasoning is that the fit formula of relation between the raindrop equivalent diameter and the value of its gravitational fall velocity (that must be used within the integral expression for R) has a limited approximation interval. Therefore either one should abandon the use of the semiinfinite interval required to take the integrals analytically, or there must be a good reason to think that the use of this interval results in acceptable errors. Detailed study of the question [4] in regard to well known fit expressions [1, 5] showed that – taking into account usual level of accuracy in contemporary meteorological radar estimations – we can use the semiinfinite intervals for the integrals of R with little or no regard to errors. The formula of generalized multiplicative coefficient A_0 is:

$$A_0 = \frac{1}{N_0}\frac{\Gamma(m+1)\Gamma(m+7)}{\Gamma(m+4)^2\left[K_2B\right]^2}\left[1 - F\frac{m+4}{\beta} - \left(\frac{\beta}{\beta+C}\right)^{m+4}\right]^{-2} \qquad (7)$$

or $$A_0 = \frac{1}{N_0} U(m) Y(m,\beta), \qquad (7')$$

where $Y(m,\beta) = \left[1 - F\frac{m+4}{\beta} - \left(\frac{\beta}{\beta + C}\right)^{m+4} \right]^{-2}$, $U(m) = \frac{\Gamma(m+1)\Gamma(m+7)}{\Gamma(m+4)^2 G}$, $G = 3.5 \times 10^{-2}$,

$F = 61.3$, $C = 0.318$, m and β are the shape and slope parameters of (3).

One can pass on to the following expression using formulae of the first and second statistical moments of MGF:

$$Y(\sigma, D_0) = \left[1 - F\frac{\left(\frac{D_0}{\sigma}\right)^2 + 3}{\frac{D_0}{\sigma^2} - 1} - \left(\frac{\frac{D_0}{\sigma^2}}{\left(\frac{D_0}{\sigma^2} + C\right)} \right)^{\left(\frac{D_0}{\sigma}\right)^2 + 3} \right]^{-2} \qquad (8)$$

The relation obtained implies that using time series of D_0 and σ (both of them can be easily deduced from Doppler radar data) allows calculating time series of A_0 and, as a consequence, evaluating the value of change of the exponent in (2) in comparison with b = 2 at any time intervals.

Conclusion

A sound theoretical foundation for the new technique of radar measurements interpretation based on calculating the generalized multiplicative coefficient of Z-R relationship developed to estimate vertical airflow velocity using vertically pointing Doppler radar in rains is presented.

Main aspects of the proposed technique and its use within a wide range of space-time scales and wavelengths are discussed and this might be of interest to those pursuing measurements in rains using Doppler techniques.

There is somewhat similar technique developed in hydrology to measure rain rate at long-time sample intervals. The existence of these two techniques implies the possibility of their results being compared for the same rain at long-time sample intervals at least. Such cross verification might provide valuable data for the further development of both.

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References

1. *A. G. Gorelik, V. F.Logunov, 1974*. Estimation of Vertical Airflow Velocity and Rain Microstructure using Doppler Spectrum and Intensity of Radioecho, Izvestiya Acad. Nauk USSR, Fizika atmosphery i okeana (Izvestiya, Atmospheric and Oceanic Physics - Engl. Transl.) , 10, N7.
2. *J. Testud, S. Oury, R. A. Black, P. Amayenc, and X. Dou, 2001*. The concept of "normalized" distributions to describe raindrop spectra: A tool for cloud physics and cloud remote sensing. J. Appl. Meteor., 40, 1118–1140
3. *V. Chandrasecar, V. N. Bringi, 2004*. Dual Polarization Radars Estimates of Rainfall: Recent Advances. Sixth International Symposium on Hydrological Applications of Weather Radar.
4. *S. F. Kolomiets, 2009*. Measurements of Parameters of Atmospheric Dynamics and Precipitation Microstructure in the Wide Range of Time-Space Scales in Rains Using Vertically Pointing Doppler Radar, Ph. Doctoral Thesis, Moscow Institute of Physics and Technology, Moscow.
5. *Atlas D., Srivastava R.C. and Sekhon R. S., 1973*, Doppler Radar Characteristics of Precipitation at Vertical Incidence, Rev. of Geophysics and Space Physics, Vol. 11 No. 1, pp. 1-35.

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THE STUDY OF DYNAMIC PROCESSES IN CLOUDS AND RAIN BY MEANS OF MULTIWAVELENGTH DOPPLER RADAR

This report is devoted to a discussion of multiwavelength Doppler techniques and corresponding mathematical ideas providing foundation for spectra interpretation at different wavelength.

Introduction

More than forty-year experience in meteorological radiolocation and the use of radar in atmospheric physics demonstrate that the potential of conventional radars is not enough for efficient research of atmospheric objects and processes involved. The using of conventional multwavelength radars does not change the situation significantly, either [1, 2].

Doppler techniques in line with polarimetric methods of signal receiving and processing open the door to a dramatic expansion of radar information potential by means of widening the set of parameters that could be measured directly by radar [3]. However, the potential of multiwavelength Doppler techniques is underestimated now and is not used in full measure, while there is a lack of directly measured parameters almost anywhere in remote sensing and especially in the atmospheric techniques. This results from unreasonable simplification of the present-day mathematical models providing foundation for radar data interpretation procedures. Apart from the pure scientific interest, more accurate models of Doppler signal formation by those particles scattered in the radar volume which could be implemented at different wavelengths and time-space scales are of importance for some critical applications.

One of the most complex problems of radar measurements in meteorology, which requires utilization of entire information potential of multiwavelength Doppler approach, is simultaneous measurements of precipitation microstructure parameters and parameters of atmospheric dynamic processes (airflow velocities, velocities of turbulent pulsations, etc.) attending the process of precipitations.

It has to be emphasized, that the multiwavelength Doppler approach almost always permits the use of different algorithm to estimate the same meteorological parameter. The possibility of cross verification between different remote estimations of the same parameter became of critical importance when robustness and reliability became of top priority and when there is no chance to repeat the measurements under the same environmental conditions. The selection of an exact set of wavelength, taking into account the different temporal and spatial features of scattering medium, as well as selection and justification of the exact set of signal parameters to be measured 'in situ' become of principal concern for applications.

Brief review of the historical background to the 'closed loop' Doppler measurements in precipitations that imply simultaneous measurements of precipitation microstructure and parameters of atmospheric dynamics attending the process of precipitations is presented in the report.

'Closed loop' Doppler measurements in rains

In the early 70-es the beginning ideas relating to 'closed loop' Doppler measurements in rains using a vertically pointing Doppler radar were published in [4, 5]. A value of scattered echo power, a width of the signal intensity spectrum (the spectrum of the signal received after it has passed through a square-law detector) and a value of the mean Doppler frequency were taken as information parameters of the technique published which allows evaluating vertical airflow velocity, rain microstructure and their temporal and spatial variations simultaneously.

It was supposed in [4, 5], that raindrop size distribution (DSD) can be fitted with modified Gamma function (MGF) within the entire interval of raindrop diameters. However research made later [6, 7, 8] favoured the view that the model of Doppler signal formation by particles scattered

among radar volume is more complex than anticipated at the beginning. The difference between the abstract model and that which actually existed might have resulted in unevaluated errors. Therefore the use of the fine structure of the Doppler spectrum was proposed, especially as all required relations had already been deduced in [5]. In the case of the monochromatic radar signal, the shape of the intensity spectrum of scattered signal repeats the distribution shape of differences of statistical pairs of raindrop velocity projection onto beam direction, taking into account reflectivity factor of individual raindrop in pairs. Within the same condition the Doppler spectrum shape repeats the distribution shape of drop velocity projection onto beam direction. The relations published in [5] opened the door to in-depth and extensive studies of rain microstructure dynamics using different radar wavelengths.

It was implied in [5] that the value of individual raindrop velocity is constant within the time interval of individual spectrum measurement. This qualification is fulfilled with great accuracy for inertial scatters at short cm-wavelengths. However, this is not true for light scatters at long cm- and decimeter wavelengths. On the one hand this fact makes it impossible to use the relations discussed in the conditions mentioned, on the other hand this is a way to retrieve some new information out of the radar volume.

Doppler spectra shape for different wavelengths

A great variety of models of scattering media can be depicted in terms of exponential-law correlation functions corresponding to the spatial and temporal features of scattering media. Therefore the power-density spectrum of the scattered field can be given in the form of $g(\omega) = \int_0^\infty e^{-F(s)} \cos \omega s ds$, where: $F(s) = 2k^2 \overline{\overline{(\Delta_s \xi_i)^2}}$, $\Delta_s \xi_i$ - a value of the shift of i-th scatter at the time period of total change of the received signal phase constitution $s = t' - t$. The double line stands for averaging over space and time.

The averaged quadratic shift of i-th scatter at time interval s is $\overline{(\Delta \xi_{ij})^2} = \overline{v^2} s^2$ and correlation function is $e^{-F(s^2)} = e^{-2k^2 \overline{v^2} s^2}$, where k – is a wavenumber, if velocities of particles *v* are invariable at s. In other words, the shape of power-density spectrum of scattered field intensity is close to the shape of the Gaussian curve. This model of scattered signal formation is restricted to heavy scatters and short waves: the shorter radar wavelength and more inertial particles, the more accurately this model represents the reality.

If the velocities of particles can not be represented as constant values at s (i.e. the particles are light and the radar wavelength is long), there is a need for additional averaging over the s-interval to obtain *v*, that is equal to the decrease of the exponent of s in the expression of the averaged quadratic shift of i-th scatter at time interval s written above. This decrease means that the shape of the power-density spectrum of intensity will take the shape of the resonance curve.

Measurement of turbulence using two Rayleigh wavelengths

The reasoning given above implies Rayleigh diffraction at both wavelengths. It is well known that the Gaussian spectrum has “steeper skirts of spectral skirt” in comparison with those of resonance curve. These differences of spectral shapes carry information about subscale turbulence. Besides, at decimeter wavelengths there is the Doppler spectrum mode located in the vicinity of zero Doppler velocities and formed by the scattering on refraction index fluctuations resulting from the same subscale turbulence and carrying, therefore, the same kind of information. Hence, the decimeter wavelength Doppler spectrum presents unique means of turbulent measurements and allows cross verifications both within the spectrum itself and between the spectra obtained either while particles velocities are constant or variable at s. But accurate interpretation of decimeter-wavelength spectra is still extra complicated. It has to be noted that one must use special indirect measurements implying radar volume changes and using the Kolmogorov-Obukhov law to retrieve information about subscale turbulence based on the spectra obtained while particles velocities are

constant at s. This kind of radar measurements is not convenient at all or even not feasible in some circumstances on account of the limited inertial interval of turbulence in the atmosphere in comparison with a scale of radar volume at a given distance as well as requirements of testing the Kolmogorov-Obukhov hypothesis itself in certain measurement conditions. Further, the calculations made in [6] point to the fact that even a slight local deviation of DSD (from that used for measurement results interpretation being given a priori) might lead to a significant overestimation (up to 300%) of turbulence intensity calculated indirectly based on a width of "Doppler spectrum of constant velocities". This effect is especially appropriate for peak (or pulse) type deviations and intensive turbulence as it is shown in Fig. 1b.

It is well known since the end of the 60-es that in clouds and liquid precipitations there are supergiant drops, formation reasons and conditions as well as concentration of them for different types of rain and clouds is not completely understood to date. However, experimental data available

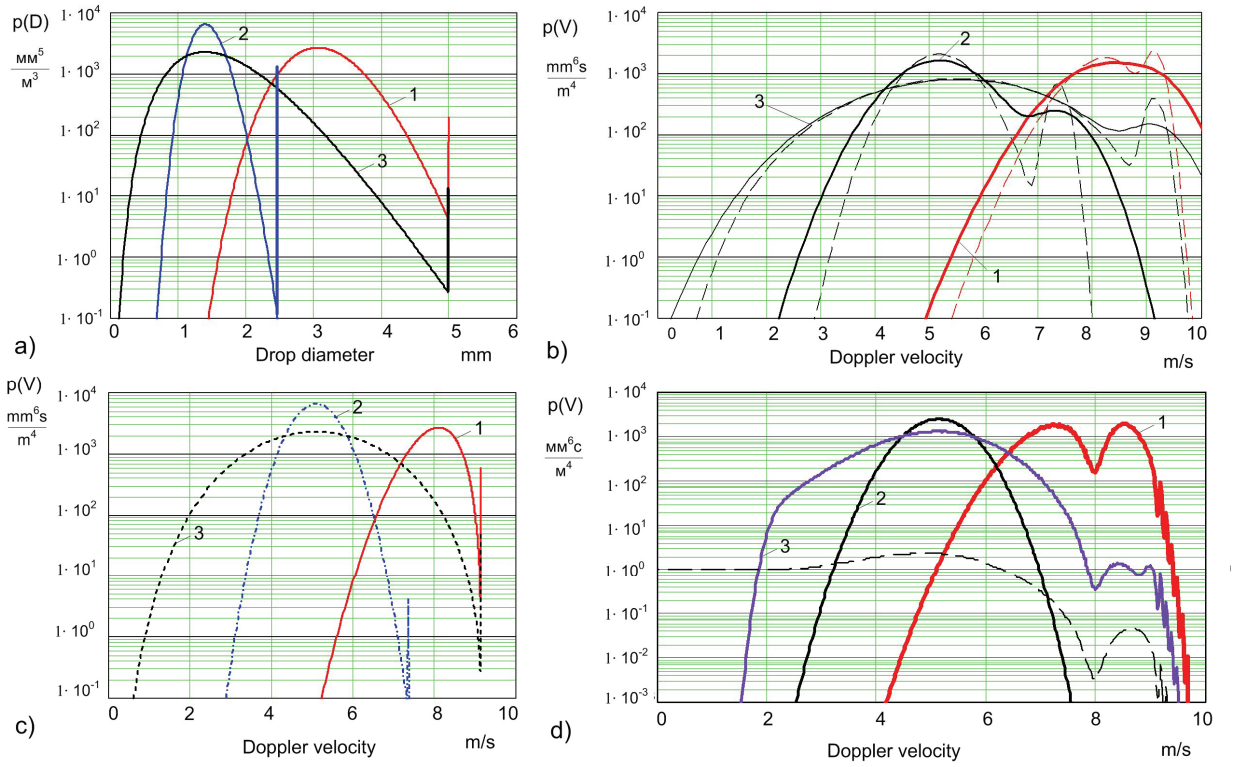

Fig. 1. Rayleigh and Mie velocity spectra shapes calculated for different DSD.

a) distinctive shapes of DSD with peaks (wide, narrow at the small drop side and at the large drop side)
b) velocity spectra for the same DSD in view of turbulence of different intensity (spectrum of the first rain looses its peak in the case of intensive turbulence and there is no means to detect whether it was)
c) velocity spectra for DSD showed in a)
d) Mie velocity spectra for the same DSD (λ = 5 мм)

in publications provide a good reason to suggest that the phenomenon of supergiant drops is not at all rare either for rains or clouds. Such drops in concentration equal to some drops per cubic meter (for drizzles and light rains) and some drops per radar volume (for heavy rains) can be seen as local peaks that may result in curious estimations of turbulence intensity even in case of moderate turbulence [6]. For example, unexpected strong turbulence detecting from time to time in stratiform precipitations might be due to precisely this phenomenon. Therefore "Doppler spectra of constant velocities" give fairly limited means for reliable estimations of subscale turbulence. But going back to short-wavelength Doppler spectra with correct and reliable estimations of turbulence obtained by means of two-wavelength Doppler technique (that allowing the evaluation of their reliability by

means of cross verification) one can have everything required to estimate microstructure and making more accurate estimations of large scale turbulence, respectively.

Measurement of turbulence and microstructure using Mie wavelength

The appearance of resonance scattering on raindrops as radar wavelengths became shorter allows defining spectrum distinctive points: resonance minimums and maximums located at certain positions along the frequency axis with a certain distance between them. Positional relationship of these points and their general representation in the spectrum permit estimating DSD (see Fig. 1d, 2c), evaluate the degree of turbulence anisotropy and homogeneity. As it was shown in [6], turbulent pulsations conforming to those requirements discussed in [10] doesn't change the distance between the distinctive points. Deviations of the statistics of turbulent pulsations observed from those relating to homogeneous and isotropic turbulence may cause certain changes in the positional relationship of the points and, consequently, changes in general spectrum representation. Value and character of the changes are indicators of conformity of the turbulence observed to homogeneous and isotropic turbulence. At Mie wavelength turbulence may influence the radar estimations and even mask (taking into consideration the performance characteristics of radar spectral equipment) distinctive points because of quite small differences between the magnitudes of resonance modes relating to the first and second resonance maxima and magnitude of the first minimum. Consequently, the main point of Mie wavelengths is an easy technique of DSD evaluation based on distinctive points of spectrum. Therefore it is useful to have an alternative turbulence estimation coupled with the measurement results obtained at this wavelength.

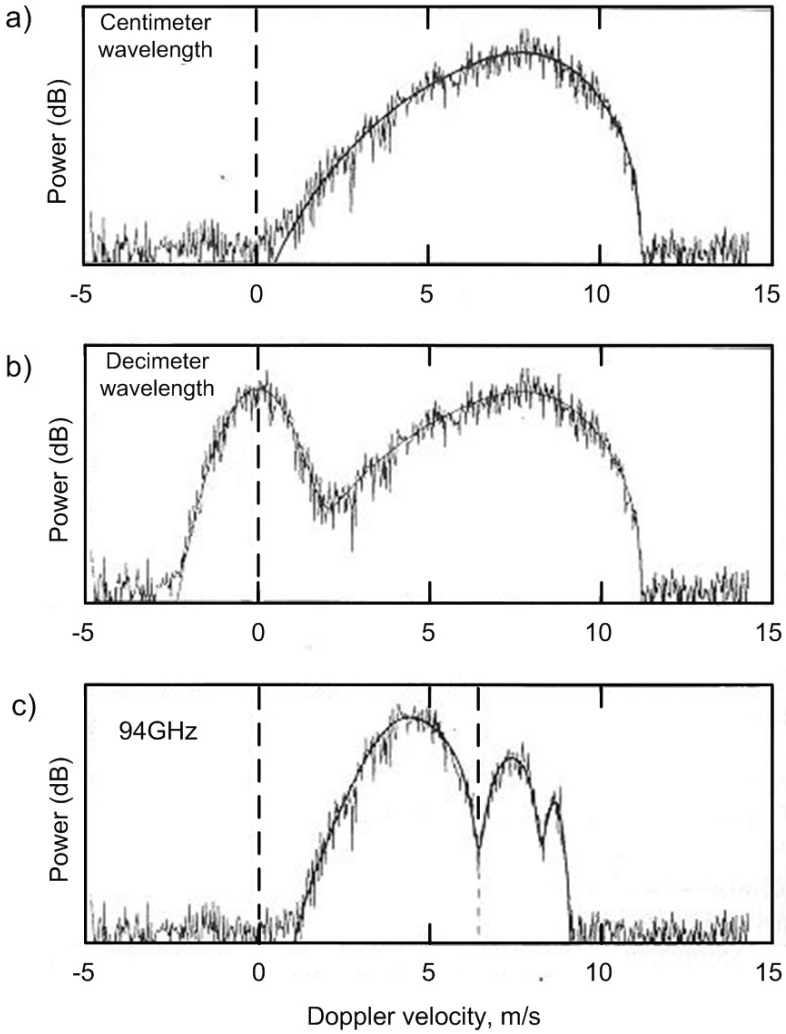

Fig. 2. Spectra shapes calculated for different wavelengths

Conclusion

Decimeter wavelength Doppler spectra can be seen as the most informative as they carry information both on microstructure and turbulence (Fig. 2) Interpretation techniques of such spectra may differ significantly from those for cm-wavelength and deserve special attention. In particular these spectra obtained in crystal-type precipitations and light rains may not in all cases be interpreted as cm-wavelength spectra. Yet this is common practice now. Neglect of the differences between models of Doppler spectra formation at different wavelengths tends to reduce information potential of interpretation techniques. Modification of the spectrum shape as wavelength became longer and particles became heavier makes it possible to use new ways to evaluate subscale turbulence. This permits avoiding the use of the Kolmogorov-Obukhov hypothesis as a priori grounds, and thereby opens the door to an in-depth study of its own applicability in different circumstances.

Adaptation of the techniques discussed to clear air and clouds may permit research into the clear air reflections and the processes of clouds formation and development from a new standpoint.

Two-wavelength and especially three-wavelength Doppler techniques allow using “closed loop measurements” with cross verification of results that of critical importance when there is no chance to repeat the measurement within the same environment.

Different spatial, temporal and dynamic features of scattering media make it necessary to be very careful with wavelengths selection in order to use efficiently the fine structure of Doppler spectra and thereby to utilize information potential of multiwavelength techniques fully.

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References

1. *C. A. Knight, L. J. Miller, 1998*. Early Radar Echoes from Small, Warm Cumulus: Bragg and Hydrometeor Scattering, J. Atmos. Sci., 55, 2974-2992.
2. *J. S. Erkelens, et all, 2001*. Coherent Scattering of Microwaves by Particles: Evidence from Clouds and Smoke, J. Atmos. Sci., 58, 1091-1102.
3. *Yanovsky F.J., Averyanova Yu.A*. New Concept of Multifunctional Weather Radar. Proceedings: International Radar Symposium, Hamburg, Germany, 2009. P.31-38.
4. *A. G. Gorelik, Y. V. Melnichuk, 1961*. To the Relation Between the Spectrum of Signal Fluctuations and Moving of Scatters of Meteorological Targets, Doklady Akad. Nauk USSR, 140, 3.
5. *A. G. Gorelik, V. F.Logunov, 1974*. Estimation of Vertical Airflow Velocity and Rain Microstructure using Doppler Spectrum and Intensity of Radioecho, Izvestiya Acad. Nauk USSR, Fizika atmosphery i okeana (Izvestiya, Atmospheric and Oceanic Physics - Engl. Transl.) , 10, N7.
6. *S. F. Kolomiets, 2009*. Measurements of Parameters of Atmospheric Dynamics and Precipitation Microstructure in the Wide Range of Time-Space Scales in Rains Using Vertically Pointing Doppler Radar, Ph. Doctoral Thesis, Moscow Institute of Physics and Technology, Moscow.
7. *A. V. Ryzhkov, J. M. Janish, T. J. Schuur, P. Zhan., and K. L. Elmore, 2003*. Dual-Polarization Radar as a tool for operational identification of different types of meteorological and non-meteorological targets. Cooperative Institute for Mesoscale Meteorological Studies, Norman, Oklahoma.
8. *J.Lavergnat, P.Gole, 1998.* A Stochastic Raindrop Time Distribution Model. J. Appl. Meteor., 37, 805-818.
9. *M. Schonhuber, 1998*. «About Interaction of precipitation and electromagnetic waves». Doctoral Thesis, Graz.
10. *G. K. Batchelor* The Theory of Homogeneous Turbulence. Cambridge University Press, 1953.

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DOPPLER-POLARIMETRIC RADAR METEOROLOGICAL APPLICATIONS

This paper is an overview of Doppler-polarimetric methods and means for remote sensing of atmosphere used for detecting and predicting dangerous weather phenomena zones along the route of the airplane. In addition to such traditional phenomena as turbulence, hail, icing-in-flight and thunderstorm, the approaches to distinguish areas of volcano dust is also included into consideration.

Introduction

Normally, weather radars are designed for monitoring the zones of intensive rains, turbulence, hailstones, windshear, probable icing-in-flight, and thunderstorms. In addition to such objects related with hydrometeor formations, wind behavior, and electricity of the atmosphere, the zones of volcano ash should be also considered as the object of observation.

Doppler and polarimetric radar has exclusive capability for detection, measurements and recognition of scatterer types as well as features of their motion. While the requirements to flight safety and regularity of flights are increasing gradually, new risks and additional phenomena that are the sources of hazard should be considered as the object of observation and monitoring. This paper presents an overview of radar methods that are used or can be used in the future for dangerous atmospheric phenomena detection, estimation, and prediction.

Radar detection of dangerous phenomena

Weather radar both ground-based [1] and airborne [2] is a powerful tool for meteorological phenomena detection. Rather effective methods for turbulence zone detection can be implemented even in non-coherent radars [3]. Developed algorithms for signal processing provide reliable detection of turbulent zones at SNR of about 10 dB taking into account both spectrum width and reflectivity factor.

Higher potential has Doppler radar [1], which is able to measure Doppler spectrum of scatterers within a resolution volume, and the motion of the scatterers is supposed to be caused by the turbulence. The developed models are suitable for signal processing including the calculation of the spectrum width (more exactly the variance) caused by droplets falling down with further subtracting it from the measured variance of the Doppler spectrum to improve the accuracy of turbulence intensity estimation.

However, in case of Doppler measurements of turbulence intensity, the influence of a scatterer inertia should be taken into account to achieve an accurate measurement of turbulence intensity The approach for accounting such influence was proposed by [4]. This approach was used in [5-8] where mathematical models and applied software have been developed, calculations done under the different conditions, as well as the results of Doppler-polarimetric method development and implementation have been presented.

These results include mathematical models and experimental researches which are in a good coordination. Particularly, the theory and implementation of spectral differential reflectivity application were discussed in [9, 10]. Another Doppler-polarimetric parameter related with both turbulence intensity and microstructure of the object is differential Doppler velocity [11] which is easier for measurement.

Polarimetric approach gives definite performance capabilities to detect zones of hailstones using parametrical and non-parametrical algorithms [12, 13] as well as probable icing-in-flight zone prediction [14, 15]. More generally, study of scattering on heterogeneous hydrometeor ensemble [16] is important for better understanding and development of hydrometeor type recognition algorithms [17-21]. Some outcomes of these works are presented in [22]. A new approach to study dynamic processes in precipitation based on polarimetry is developed in [28].

Work [23] discusses perspectives of UWB signal application in weather radar and sodar.

Experimental check was done by using sodar prototype, which has shown reasonable results and significant improvement of range resolution due to pulse compression.

New approach to relate polarimetric radar parameters with turbulence and other wind phenomena is proposed in [24]. This approach is based on the notion of polarization spectrum – reflected energy distribution over polarization components.

Methods and means of remote definition of electric structure of troposphere by using electrostatic or, more exactly, quasi-electrostatic measurements are described in [25]. This approach proposes a way to solve an ill-posed problem of finding the sources of charge by measuring electric field strength.

Another approach to remotely detect and passively locate zones of thunderstorms is proposed in [26]. It provides the passive range estimation from a single location. The results of modeling has shown that proposed method has advantages (in accuracy and maximum range) in comparison with known methods. There is also a different approach for pre-thunderstorm situation recognition by using a specific self-radiation of clouds that has been discovered and proposed to be used as the airborne and ground-based devices allowing to predict a lightning in 10-15 minutes.

Paper [27] is devoted to weather data accumulation and dissemination using automatic dependent surveillance ADS-B. This is really important task of obtaining the information and timely delivering the necessary data to aviation users. Separate consideration was devoted to detection of volcano dust [29].

Conclusions

The presented overview of the remote sensing means designed for flight safety under the conditions of dangerous weather as well as considered further perspectives of their modernization and development has shown that radar and lidar methods have strong potential for wide application in safety-related systems of both ground-based and airborne installation.

In this aspect, the data fusion of radar and lidar data has been proposed as a prospective way to increase information reliability. Fusion of satellite-based, ground-based, and airborne means can combine global coverage, high resolution and accuracy with data binding to every particular route and flight.

References

1. *R. Doviak, and D. Zrnic*, Doppler radar and weather observation. Academic Press Limited, London, 1993, 562 p.
2. *F. J. Yanovsky*, "Airborne Weather Radar as Instrument for Remote Sensing of the Atmosphere," Proceedings European Radar Conference, Manchester, 2006, pp. 162-165.
3. *F. J. Yanovsky, I. G. Prokopenko, and L. P. Ligthart*, "Radar turbulence detection: Statistical synthesis and experimental check of adaptive algorithms," Proceedings of SPIE - The International Society for Optical Engineering, 2006, 6159 I, art. no. 61591A, pp. 322-329.
4. *F. J. Yanovsky*, Simulation study of 10 GHz radar backscattering from clouds, and solution of the inverse problem of atmospheric turbulence measurements, IEE Conference Publication, 1996, (420), pp. 188-193.
5. *F. J. Yanovsky*, Doppler-polarimetric approach to microwave remote sensing of precipitation, MSMW'07 Symposium Proceedings - The 6th International Kharkov Symposium on Physics and Engineering of Microwaves, Millimeter and Submillimeter Waves and Workshop on Terahertz Technologies, 2007, 1, pp. 436-438.
6. *F. J. Yanovsky and L.P. Ligthart*, Microwave scattering on atmospheric particles, 6th International Conference on Antenna Theory and Techniques, ICATT'07, 2007, pp. 26-31.
7. *V. V. Marchuk, and F. J. Yanovsky*, Analysis of interconnection between doppler-polarimetric parameter and turbulence intensity in precipitation zone, Telecommunications and Radio Engineering, 2007, 66 (10), pp. 863-870.
8. *F. J. Yanovsky, C. M. H. Unal, H. W. J. Russchenberg, and , L. P. Ligthart*, "Doppler-polarimetric weather radar: Returns from wide spread precipitation," Telecommunications and Radio Engineering, 2007, 66 (8), pp. 715-727.

9. *F. J. Yanovsky, H. W. J. Russchenberg, C. M. H. Unal*, "Retrieval of information about turbulence in rain by using Doppler-polarimetric radar," IEEE Transactions on Microwave Theory and Techniques, 2005, 53 (2), pp. 444-449.
10. *V. V. Marchuk and F. J. Yanovsky*, "Use of spectral differential reflectivity at remote sensing of precipitation," Proceedings of Microwaves, Radar and Remote Sensing Symposium, MRRS 2008, pp. 182-185.
11. D. *N. Glushko and F. J. Yanovsky*, "DDV - Novel Doppler-polarimetric technique for remote sensing of precipitation," European Microwave Week 2009, EuMW 2009: Science, Progress and Quality at Radiofrequencies, Conference Proceedings - 6th European Radar Conference, EuRAD 2009, pp. 298-301.
12. *F. J. Yanovsky, R. B. Sinitsyn, and I. M. Braun*, "Reliability of detection of radar signals from hailstones by using parametric and non-parametric algorithms," EURAD 2005 Conference Proceedings - 2nd European Radar Conference 2005, pp. 137-140.
13. *Ya. P. Ostrovsky and F. J. Yanovsky*, "Precipitation and turbulence intensity classification based on the polarimetric doppler radar data analysis," Telecommunications and Radio Engineering, 2006, 65 (12), pp. 1077-1085.
14. *F. J. Yanovsky and A. A. Pitertsev,* "Advanced algorithm for radar detection of icing. Calculation of polarimetric observables," Telecommunications and Radio Engineering, 2007, 66 (16), pp. 1465-1471.
15. A. *A. Pitertsev and F. J. Yanovsky*, "Polarimetric approach to detection of probable aircraft icing zones. Icing detection algorithms," European Radar Conference, EURAD, 2007, pp. 271-274.
16. *F. J. Yanovsky, V. V. Marchuk, Ya. P. Ostrovsky, A. A. Pitertsev, and L. P. Ligthart*, "Inverse scattering and radar cross section of heterogeneous hydrometeor ensemble," IET Seminar Digest 2007 (11961), 5 p. http://dx.doi.org/10.1049/ic.2007.1157.
17. *A. A. Pitertsev and F. J. Yanovsky*, "Identification of the meteorological objects on doppler-polarimetric radar data by using fuzzy logic based algorithm," Mathematical Methods in Electromagnetic Theory, MMET, Conference Proceedings, 2006, pp. 344-346.
18. *A. A. Pitertsev, V. V. Marchuk, and F. J. Yanovsky,* "Identification of the dangerous meteorological objects on Doppler-polarimetric radar data using the neural network based algorithm. Part 1: Statistical modeling," 2nd Microwave and Radar Week in Poland - International Radar Symposium, IRS 2006, Proceedings, pp. 225-228.
19. *Ya. P. Ostrovsky, F. J. Yanovsky, and H. Rohling,* "Turbulence and precipitation classification based on doppler-polarimetric radar data," 2nd Microwave and Radar Week in Poland - International Radar Symposium, 2006, Proceedings, pp. 165-168.
20. *F. J. Yanovsky, Ya. P. Ostrovsky, and V. V. Marchuk,* "Algorithms for object recognition by weather radar," Proceedings International Radar Symposium, IRS , 2008, pp. 241-244.
21. *F. J. Yanovsky*, "Doppler-polarimetric radar system for recognition of distributed objects," IEEE International Conference on Microwaves, Communications, Antennas and Electronics Systems, COMCAS 2009, CD-1C3.4, pp. 1-4. (IEEE Xplore).
22. *F. J. Yanovsky*, "Recent researches in the field of weather radar at the National Aviation University," Proceedings of Microwaves, Radar and Remote Sensing Symposium, MRRS 2008, pp. 190-193.
23. *F. J. Yanovsky and R. B. Sinitsyn*, "Ultrawideband signal processing algorithms for radars and sodars," UWBUSIS 2006 - 3rd International Conference on Ultrawideband and Ultrashort Impulse Signals, Proceedings, pp. 66-71.
24. *Yu. A. Averyanova, A. A. Averyanov, and F. J. Yanovsky,* "The Estimate of Instantaneous Power of Polarization Spectrum Components in Polarmetric Weather Radar," Proceedings of Microwaves, Radar and Remote Sensing Symposium, MRRS 2008, pp. 179-181.
25. *F. J. Yanovsky*, "Methods and means of remote definition of clouds' electrical structure," Physics and Chemistry of the Earth, 1997, 22 (3-4), pp. 241-245.
26. *D. Glushko, A. Lawama, and F. J. Yanovsky*, "Retrieval of range information from singularities of electric components of lightning self-radiation," Telecommunications and Radio Engineering, 2008, 67 (6), pp. 559-566.
27. *F. J. Yanovsky*, "Automated dependent surveillance: Aircraft position and weather data," Tyrrhenian International Workshop on Digital Communications - Proceedings of Enhanced Surveillance of Aircraft and Vehicles, TIWDC/ESAV 2008, pp. 132-137.
28. *Yu. Averyanova, F. Yanovsky*, "Influence of Turbulence onto Depolarization of Signal Reflected from Hydrometeors", Proceedings International Radar Symposium, Vilnius, 2010, pp. 512-515- .
29. *F. J. Yanovsky*, "Specified for Air Safety, Monitoring Atmospheric Phenomena Including the Volcano Dust", Proceedings International Radar Symposium, Vilnius, 2010, pp. 2-6.

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RADAR WAVEFORMS WITH COMMUNICATION ABILITY

New scalable and flexible waveforms offer a great number of new opportunities for object- or environment-tailored signal processing. The paper addresses a particular class of such flexible waveforms, i.e. multiple carrier coded waveforms. These waveforms may for instance be used for the benefit of scalable resolution, fast unambiguous Doppler assessment and object-specific matched filtering. Also these waveforms support to use the same signal for both radar operation and message transfer. One of the properties of the OFDM-signal, i.e. the Peak-to-Average Power ratio is discussed, next to the data throughput capability of the waveform.

I. INTRODUCTION

The issue of how to detect targets by radar under complex environmental conditions is a topical subject to day. Traditionally the maximization of the signal-to-noise ratio (SNR) is the single most important criterion how to design the receiver. The focus is shifting however currently from the mere optimization of the SNR towards the topic how to distinguish between several detections that have a similar SNR, some of them being relevant to the user but not all. Optimization of the SNR in such cases is not always a sufficient condition for achieving the best performance from a user perspective. One should observe however, that the quality of the estimation of features of received echoes benefits from a high SNR. It would therefore be imprudent to consider the SNR as no longer of any importance. The cases where such a condition arises mostly concern the detection of objects in the context of surveillance radar against a background of clutter, more in particular for short range, high resolution radar. It is in such a condition, that extraction of the features of target echoes may assist in discriminating between various types of objects and it is in such a scenario that the paper proposes a contribution.

In public literature many publications have appeared already, mainly focused at ultra wideband waveforms. [1] Provides an excellent overview, in particular for non-cooperative target recognition. Under the denominator of waveform diversity, recently identified needs address dynamically adapted waveforms, multiple modes and sharing of data by communication. Early work on shaping the waveform such that specific properties of sought objects are highlighted is presented in [2], later followed by [3]. An overview of more methods can also be found in [4].

The quest for finding the best waveform for single radar given a specific application can be extended by considering how to choose a good waveform in a network of radars. In this context also the issue of communication is relevant. It is this combined capability of detecting objects while at the same time serving communication that is the main topic of this paper. The flexibility and coding opportunities offered by the rather specific class of Orthogonal Frequency Division Multiplexed (OFDM) modulation may serve this purpose of a dual use, i.e. radar and communication.

The structure of the paper is that Section II presents some of the relevant features that one may want to extract to distinguish certain classes of objects from other classes. Section III then focuses on the properties and some merits of the OFDM waveform. Section IV highlights the communication ability of OFDM waveforms. In order to be more specific, a benchmark case is discussed in Section V, where also conflicting requirements on the system eventually intended for dual use will be identified. Section VI concludes the paper.

II. OBJECT FEATURES

Many degrees of freedom are available when choosing a waveform. Always the issue is to know how the backscattering from the wanted objects is different from the unwanted ones. One may consider Doppler shift, the detailed Doppler spectrum, the shape of the object echoes, one may rely on the changes of the radar cross section over time given either a constant or an agile carrier frequency. Also in a number of specific applications (Doppler-)polarimetry proves useful in

privileging wanted objects from unwanted ones or in retrieving specific features of the objects. Many and very diverse features can be imagined. In any condition, whatever is the motivated choice made by the radar designer, the situation may present itself that the radar finds too many objects and that the radar engineer will have to find a way to retain the wanted and discard the unwanted ones. It is in this condition that the need for additional features arises, next to the SNR. Then the task of classification or even recognition adds to the task of detection. The features that are available and useful depend on the waveform and the properties of the wanted objects and their background. No concept exists that is always the best one in all conditions and applications and it takes a lot of field work to build a knowledge base to motivate the choices made in the actual design.

The major drawback of the majority of these features is that all objects must first be detected and tracked correctly before their features can be integrated over a number of observations. Moreover, sometimes the algorithm needs prior information, before a useful hypothesis can be accepted on their class. Also the quality of the features depends on the properties of the waveforms and the specificities of the objects. A universally applicable and useful method therefore is not available and the solutions in fielded systems depend strongly on the experience and lessons learned by the designers from real life experiments.

Apart from the features mentioned above, other methods have been proposed in the context of non-cooperative target recognition methods. We mention here in particular the concept of matched illumination and matched filter reception [2]. The technique basically enhances the contrast between wanted and unwanted objects by applying a filter that is tailored to the profile of the wanted objects. Such illumination is based on multiple frequencies, where the object response in each individual carrier frequency is measured and based on prior information on the object and/or the background the contrast between the sought specific object and the background can be maximized.

For the features to be of a high quality (in statistical terms) a few generalities can be concluded though: the waveform of the radar should offer:

- a wide bandwidth,
- a relatively long dwell time that unfortunately may compromise the narrow antenna beamwidth or the data refresh rate,

On top of this, the SNR should be as high as possible.

In the next sections we will discuss a waveform that has been proposed for radar recently and that offers an inherent flexibility supporting its use in systems where detection and classification are tied together.

III. OFDM SIGNALS

Multiple frequency waveforms have received considerable attention over time. Their generation and processing are now within the scope of the current technology. Some specific problems and opportunities are associated with multifrequency waveforms that will be addressed in this section. We have selected a few of them, but the opportunities extend to many more than can be discussed in a single paper. We will first define a specific class of multiple carrier waveforms, i.e. the OFDM waveform, and then address a few properties and new opportunities created by this waveform.

A. Definitions and signal model

Multiple carrier signals have met a renewed interest recently. The work by Levanon [5] shows a clear overview of the state-of-the-art.

Among the multicarrier signals, Orthogonal Frequency Division Multiplexing (OFDM) has seen a wide spread application in the domain of telecommunications, as it possesses the same spectral efficiency of a single carrier waveform, allows increased spectral flexibility, and can be easily processed with Fast Fourier Transforms (FFT).

The OFDM baseband elementary signal (chip) can be expressed as follows:

$$s(t) = \sum_{k=0}^{N_{sc}-1} c_k e^{j2\pi f_k t} rect\left(\frac{t}{T}\right) \quad (1)$$

where N_{sc} is the number of carriers, T is the OFDM chip duration, f_k is the *k-th* carrier centre frequency, c_k is the code symbol mapped on the *k-th* sub-carrier on the OFDM chip, $rect(t/T)$ is the rectangular window of duration T and unit amplitude. The particular property of OFDM that has made it so appealing consists in selecting the carrier spacing Δf equal to the inverse of the OFDM chip duration. Consequently the carriers are orthogonal.

Expressing the OFDM chip in (2) in discrete form, recalling that f_k is the product of k and Δf and sampling at the Nyquist frequency $f_s = N_{sc}/T$, leads to:

$$s(p) = \sum_{k=0}^{N_{sc}-1} c_k e^{j2\pi \frac{k\,p}{N_{sc}}},\ p = 0,\ldots,N_{sc}-1 \quad (2)$$

The encoded symbols $c_k, k = 1..N_{sc}$ may be used for various purposes, as will be discussed later.

A few properties of this waveform can be seen directly from this definition:

- The total bandwidth of each symbol is

$$B = N_{sc} \cdot \Delta f = N_{sc}/T \,.$$

- The time-bandwidth product is

$$BT = N_{sc} \cdot \Delta f \cdot T = N_{sc} \,.$$

Under the condition of no Dopplershift, all carriers can be retrieved individually, leaving many opportunities for tailoring the impulse response of the composite signal, specific benefits from coding, and scaling the bandwidth (by selecting a limited range of frequencies).

B. *Assessing the unambiguous radial velocity.*

In some applications the unambiguous radial speed is a feature of interest. To measure it, the pulse repetition frequency should be (very) high, depending on the objects' properties and the wavelength of the radar. Doppler unambiguous measurement as such is conflicting with range unambiguous measurement. By selecting an OFDM waveform with a narrow spacing between the carriers and orthogonal coding of the carriers, the unambiguous radial velocity can be measured with a different level of ambiguity.

The OFDM signal can be conveniently be generated through the Inverse Fourier Transform (IFFT), where the entries to the IFFT are the random codes c_k. On receive the inverse operation is applied to the received signal and the code can be recovered. The effect of Doppler can be devastating for the recovery of the code, as is a recognized issue in communications, and also it is causing significant losses in the process of pulse compression in the radar processing.

The processing scheme, as explained in [6], consists of compensating for the effects of Doppler on the received echo. The Doppler effect is modeled as a frequency shift, assuming a narrow-band condition. By comparison (through the pulse compression process) of the code of the shifted carriers of the OFDM signal with the code of the received carriers, the best matching shift can be found and thus the actual Dopplershift. The Doppler compensation thus shifts the recovered codes back to their original frequencies. The whole processing for one OFDM chip can be expressed in discrete form as

$$\chi(\tau,\varepsilon) = \frac{1}{N}\sum_{k=0}^{N-1}\sum_{n=0}^{N-1}\left(\begin{array}{l} s_{R,v}(n)\,exp\left\{-j2\pi\dfrac{(k+\varepsilon)n}{N}\right\}\cdot \\ \cdot exp\{-j\phi_k\}\,exp\left\{j2\pi\dfrac{k\tau}{N}\right\} \end{array}\right) \quad (3)$$

where $s_{R,v}(n)$ is the critically sampled received echo, R and v the object range and velocity, ε is the amount of the cyclic shift of the carriers to compensate for the Doppler shift and τ is the delay

associated with the range profile. The result is the range profile for one OFDM chip and for one specific carrier shift ε.

If the procedure is based on a single chip, the basic "Dopplerbin" is identical to the frequency spacing between the carriers. That may be too large a value to give either a useful resolution or a useful accuracy. If that is the case, on top of this cyclical shift of the c_k, a train of chips can be transmitted and the received train processed in a Doppler filterbank. The chips have the same understanding as a sweep of FMCW radar or the pulse of a pulse Doppler radar. The period of the "sweep" is $1/\Delta f$. This filterbank refines the interval of the chip repetition frequency and thus improves the Doppler resolution.

While the basic maximum unambiguous Dopplershift equals the PRF, using the principle of cyclically shifting the coded carriers, the maximum Dopplershift corresponds with the maximum bandwidth, which obviously is several orders of magnitude larger. This is a significant advantage of this type of waveform.

The complete processing scheme is illustrated in Fig.1, as provided in [6].

It should be commented that this procedure is based on the orthogonality of the codes of the carriers. Another comment concerns the dimensions of the parameters involved. For instance, when we propose a bandwidth of 300MHz, which is an advanced value for high resolution radar, and when we want to have a basic "Dopplerbin" as suggested before of $\Delta f = 1000Hz$, we would need $3 \cdot 10^5$ carriers. The time duration of each chip would be $1/\Delta f = 1m\,sec$. Thus such a waveform is basically a CW-waveform.

It should also be concluded that issues like the isolation between transmit and receive are a concern and that probably this waveform therefore hints at short range applications. Fig. 2 shows a timeline diagram of the transmission/reception schedule. Fig. 3 shows an example of the ambiguity function of a train of 14 pulses, using 1024 carriers at a mutual spacing of $\Delta f = 1000Hz$.

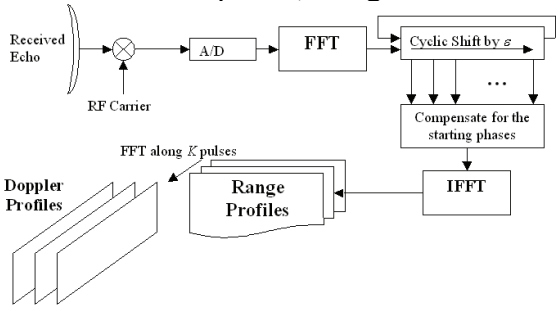

Fig. 1 The processing scheme block diagram

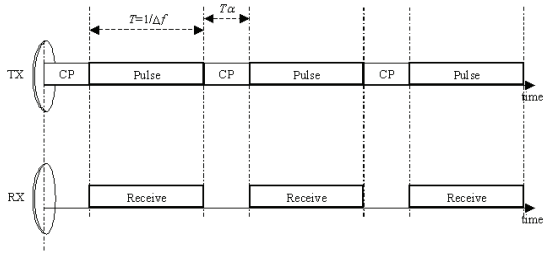

Fig 2. Timeline of transmission and reception.

Thus, using this technique, it seems to be possible to find the Dopplershift unambiguously up to a very high maximum value and hence the radial speed of the majority of real life objects.

C. *Object-Matched extended target filtering*

The matched filter was developed for point targets against a background of white Gaussian noise. In the case of high resolution radar, a large number, if not the majority, of objects can no longer be considered as a point. They extend over a number of range resolution intervals. In such a case, the OFDM offers a very flexible method of filtering, where the shape of the extended object is used to design an extended target filter. The basic processing steps might be:

- Transmit an OFDM waveform with uniform power spectral density.
- Correlate the received signal with the signal that would have been received for a sought object.

This very compact scheme can efficiently be implemented in the frequency domain, since there all carriers of the OFDM waveform can be assigned their own phase and power correction.

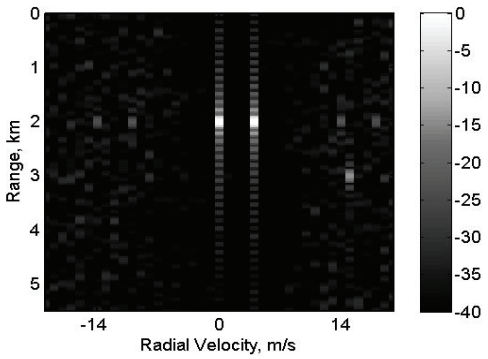

Fig. 3. Top view of ambiguity diagram for a scene with two objects at range R=2km, having a different speed, and a third object at range R=3km with a speed of 15 m/s (this is beyond the limit imposed by the PRF). The intensity is in dB.

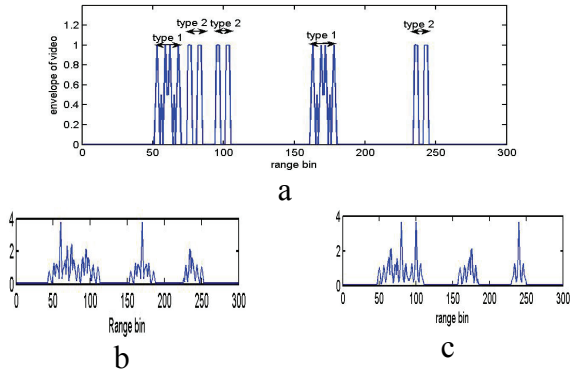

Fig.4 Object-Matched extended target filtering.
Subplot a shows the regular matched filter output. Subplots b and c show the result after filtering the received signal matched to the two different types of objects that are in the scene of subplot a.

An example result is presented in Fig.4. Fig.4a shows the regular matched filter receiver result. The scene consists of two types of objects, i.e. three of type 1 and two of type 2. They cannot be discriminated in this subplot. However, after using a filter based on the expected range profiles for these two types of objects, the respective results as shown in Figs 4b and 4c are obtained. This simple scheme would imply that as many filters should be implemented as there are types of objects. The computational cost of such an approach might be prohibitive. Then the alternative approach might be to use a filter that is reducing the background as much as possible, maybe adaptive to the local conditions.

IV. USING THE RADAR FOR COMMUNICATION

Once accepting a coding concept like in OFDM the question automatically arises whether or not radar based on such a concept could at the same time be radar and a node in a network of radars. A seminal paper [7] suggests that the signal might be useful for such application. The concept in that case includes that the radar signal is coded with a sequence of symbols, representing a message. We will now present an example of the analysis of the communication performance of the system.

A. Brief description of the system

The system parameters as a benchmark to be analyzed here are summarized in Table 1 and the antenna pattern is shown in Fig.4. It is the pattern of a typical high quality radar antenna, with low sidelobes. While the transmitting antenna is the radar antenna, the receiving antenna is an auxiliary omni directional one.

Table 1. System Parameters		
Antenna gain, (G_0)	30	[dBi]
Antenna beam width, (θ_{-3dB})	2.8	[°]
Antenna revolution time	4	[sec]
Carrier Frequency	10	[GHz]
Instantaneous bandwidth, B_r)	300	[MHz]
Average transmitted power, (P_T)	10	[W]
Gain of omni-directional receiver	4	[dBi]

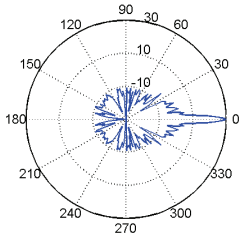

Fig. 5 Radar antenna diagram

B. *Bit Error Rate (BER)*

As a first performance characteristic let us analyze the bit Error Rate (BER) under Line-Of-Sight (LOS) single-path condition with Additive White Gaussian Noise. Including multi-path is less realistic in this case, because the carrier frequency is 10GHz, allowing only line-of-sight propagation. In the benchmark case, we assume that the system is rather sensitive to small deviations of the carrier frequencies, since the spacing between them is rather small, and also, given the bandwidth of the modulation, small misalignments in the sampling may have serious effects on the ability to retrieve the codes. Therefore extra algorithms are needed to correct for both the time- and frequency misalignment. Further in order to allow low SNR but maintain a useful decoding, forward error correction is deemed required. The effects of these various measures to mitigate the susceptibility to low SNR are shown in Fig.6. The figure shows the error rate for randomly coded QPSK, for the frequently implemented differential QPSK (DQPSK), for forward error correcting codes and for the processing scheme able of correcting small frequency and timing offsets, as they may occur in our wideband signal with closely spaced carrier frequencies [8]. For the sequel we assume that all the listed precautions have to be in place and thus that the solid line in Fig.6 applies. In order to maintain a $BER=10^{-4}$, a minimum $SNR=2.5dB$ then is required.

C. *Throughput Rate*

Another important performance descriptor is the throughput rate of the communication link. The throughput rate for the OFDM-signal is

$$R_{bt} = R_c \cdot log_2\left[1 + SNR\right] \cdot B \cdot \delta \tag{4}$$

In this expression, R_c is the coding rate, $R_c = 0.5$, in agreement with forward error correction coding and convolutional decoding, B is the signal bandwidth and δ is the duty cycle, here $\delta = 0.9$. Continuing on the benchmark case, when the distance between the transmitting and the receiving station is 3.5km and the SNR is computed accordingly, the data throughput found for the system then is as shown in Fig 7. The total average bit throughput rate is of the order of 70 Mbits/sec. At times, depending on the off bore sight angle, the received signal is quite low and the data throughput is low accordingly.

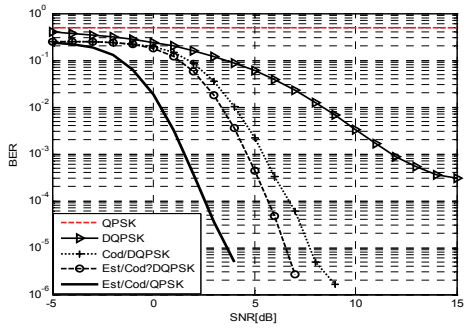

Fig. 6 Effect of various measures on the BER.

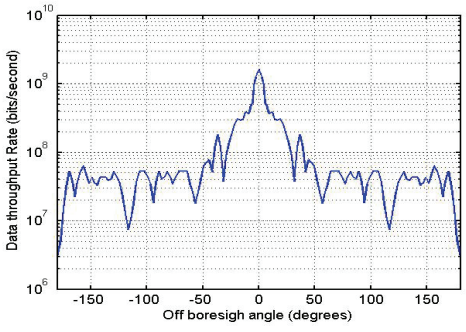

Fig. 7 Data throughput as a function of antenna pointing

V. DISCUSSION

The brief presentation of the properties of the opportunities offered by using the OFDM waveform might seem to neglect possible problems using the waveform. Indeed, using it includes that special attention has to be paid to a few consequences for the design of the radar. In this section we discuss the time domain properties of the waveform envelope, more in particular the Peak-to average power ratio (PAPR). Also we will discuss the issue of maintaining the datalink when the SNR is low.

D. *The Peak to Average Power Ratio*

The envelope of the OFDM waveform is actually the sum of harmonic components with frequencies that are separated by Δf. When a large number of such harmonic components are summed up, their phases might align to produce very high peaks. For an OFDM waveform where the carriers have random starting phases, the level of the peak power is also random with a certain cumulative distribution function (CDF). The varying envelope of this OFDM imposes a strict linearity requirement on the amplifiers, to prevent distortion of the signal. This requirement precludes using class C amplifiers in compression and results in low amplifier efficiency. The linearity requirement also necessitates a certain amount of back-off power and prevents the use of the amplifier at its maximum power level. While there is a multitude of techniques for controlling the PAPR, only those techniques that offer a significant reduction of the PAPR are of interest here due to the strict efficiency requirements for the amplifiers in the radar transmitters. A comprehensive overview that introduces various other techniques is provided in [9].

Golay complementary series have the property that the two complementary codes, when transmitted consecutively, yield sidelobes with opposite polarity that add up to zero when the range profiles from the two codes are summed up. In addition to this property, when the starting phases for the carriers of the OFDM are arranged to constitute a Golay phase code, the PAPR of the signal is strictly limited such that PAPR ≤ 2 [10]. However, the number of Golay phase codes is limited, reducing the throughput rate. The main reason for this reduction is not the limitation of the PAPR; the Golay phase codes comprise only a very small subset of all possible phase codes satisfying PAPR ≤ 2, which is demonstrated in [11].

When generating the OFDM signal through the IFFT operation, it is possible to have a spreading matrix before the IFFT to pre-code the communication symbols. The DFT is also a matrix operation with orthogonal column vectors. It can come before the IFFT stage of the OFDM modulation as a spreading matrix, implemented as an FFT. The result is the cancellation of the IFFT and FFT operations, practically resulting in a single-carrier signal [12]. Such signal is called *DFT-spread* OFDM or *single carrier*-OFDM (SC-OFDM), which is adopted for the up-link communication in the long-term evolution (LTE) radio interface, where the power efficiency is very important due to the limited available transmission power. This is one method that does not suffer from the reduced throughput rate; however the OFDM spectrum has to be broadened without increasing the data content to reduce further the time-domain fluctuations, effectively reducing the spectral efficiency of the OFDM signal without increasing the data content to reduce further the time-domain fluctuations, effectively reducing the spectral efficiency of the OFDM signal.

E. *Maintaining the data link*

As already commented in section IVB, a minimum SNR is required in order to maintain the bit error rate at an acceptable level. Using this as a criterion for maintaining the data link, an analysis was carried out as to what extent this condition is satisfied. Of course many system parameters are relevant in such an analysis and they can be chosen during the design phase of the radar.

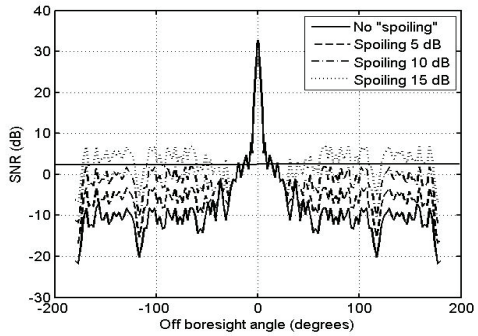

Fig. 8 SNR for the illustrative case. R=5km
The horizontal line at SNR=2.5dB is the minimum level in order for the BER to be acceptable.

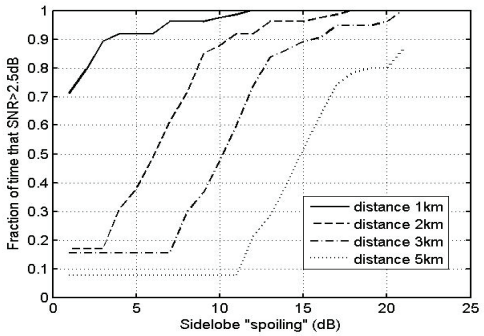

Fig. 9 Fraction of the time that the SNR>2.5dB

Therefore the analysis is presented here only for illustration of the effects. The parameters as used in the Table I were maintained. The radar antenna is a typical good antenna; it has low sidelobes. Since the antenna is pointing at the receiving antenna only during a very short interval of time, most of the communication is done via the sidelobes of the transmitting antenna to the auxiliary omni-directional antenna of the receiving station.

Depending on the distance and the direction of pointing of the transmitting antenna w.r.t. the line of sight between the two antennas, the SNR can be low. Higher sidelobes, so "spoiling" the radar antenna, will then support communication. Fig.8 shows the effect of the sidelobe level when the distance is 5km. It can be seen that in none of the presented cases, the SNR is always above the minimum level of 2.5dB. Of course, the shorter is the distance, the higher will be the SNR, and the more favorable is the outcome of the above exercise. For illustration purposes, the fraction of the time that the SNR>2.5dB is presented in Fig.9.

From this example it can be concluded that the total system design has to be tailored to the specific application.

VI. CONCLUSIONS

State-of-the-art technology allows the synthesis, transmission and reception of complicated waveforms. These waveforms support the extraction or enhancement of features of objects, such that a better distinction between wanted and unwanted objects is enabled. The paper discussed a few of these opportunities, but more can be found.

At the same time these complicated waveforms enable the radar signal to be used for message transfer in a communication link. The achievable data throughput depends on many system parameters and parameters of the network topology. At short ranges it can be high enough to be useful.

Using a radar system for communication doesn't fully go without compromises. They are in particular important in those applications and technologies where the transmitter is used in saturation, as is common in high power applications. As a consequence the main type of application is expected to be short range surveillance radar. Also, the common design of radar antennas to have as low sidelobes as possible may be in conflict with the need to respect a minimum SNR needed to keep the datalink synchronized. Active phased array technology, where beamshapes, including sidelobes, can be changed depending on the azimuth angle would certainly mitigate the impact of these compromises.

REFERENCES

[1] V.G. Nebabin, *Methods and Techniques of Radar Recognition*, Artech House, 1995, ISBN 0-89006-719-8

[2] D. Gjessing, J. Hjelmstad; T. Lund, "A multifrequency adaptive radar for detection and identification of objects: Results on preliminary experiments on aircraft against a sea-clutter background", IEEE Tr. On Antennas and Propagation, Vol. 30, Issue 3, May 1982, pp 351 – 365

[3] A. De Maio and G. Alfano, "Polarimetric adaptive detection in non-gaussian noise," Elsevier Signal Process., vol. 83, no. 2, pp. 297–306, 2003.

[4] P. van Genderen, "Recent Advances in Waveforms for Radar, Including Those with Communication Capability", Proc. of EuRAD2009, 30 Sep- 2 Oct 2009, Rome, Italy, pp 318 – 325

[5] N. Levanon, E. Mozeson, *Radar Signals*, John Wiley & Sons, Inc, 2004

[6] R. F. Tigrek, W. J. A. de Heij, P. van Genderen," Solving Doppler Ambiguity by Doppler Sensitive Pulse Compression Using Multi-Carrier Waveform", Proc. Of EuRAD2008, Sep 2008, Amsterdam

[7] P. van Genderen, H. Nikookar, "Radar Network Communication", Proc. Of Communications 2006, Bucharest Romania, 8-10 June 2006, pp313-316.

[8] T.M. Schmidl and D. C. Cox, "Robust Frequency and Timing Synchronization for OFDM", *IEEE Trans. Commun.,* vol. 45, pp. 1613-1621, Dec. 1997.

[9] S.H. Han, J.H. Lee, “An overview of peak-to-average power ratio reduction techniques for multicarrier transmission,” IEEE Wireless Commun., Vol. 12, No. 2, April 2005, pp. 56–65.

[10] J.A. Davis and J. Jedwab, “Peak-to-mean power control in OFDM, Golay complementary sequences, and Reed-Muller codes,” IEEE Trans. Inform. Theory, Vol. 45, Nov. 1999, pp. 2397–2417.

[11] R. F. Tigrek, W. J.A. de Heij, P. van Genderen, “A Golay code based approach to reduction of the PAPR and its consequence for the data throughput,” in Proc. 4th European Radar Conf., Munich/Germany, 10-12 October 2007, pp. 146–149.

[12] K. Bruninghaus, H. Rohling, “Multi-carrier spread spectrum and its relationship to single-carrier transmission,” in 48th IEEE Vehicular Technology Conference, Vol. 3, 18-21 May 1998, pp. 2329–2332.

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WIND TURBINES AND RADAR - SIMULATIONS OF EFFECTS AND CONDITIONS FOR COEXISTENCE

Summary— *Modern radio based systems, e.g. navigation, landing, radar and communication systems, rely on the physics of antennas and propagation. Their electrical performance is determined by the intended radiation and by the scattering of distorting objects. The scattering analysis is an integral part of the system simulations. The modeling of the antennas, the environment, the distorting objects and of the system itself are the basic steps of the simulation process. This paper describes the aspects of state-of-the art system simulations by evaluating actual examples and discusses radar related mitigation measures.*

I. INTRODUCTION

Wind turbines WT are constructed in increasing numbers as part of the renewable energy effort often relatively close distances to radar sites. The position of wind turbines is determined by several factors which do not allow the positioning of the turbines at arbitrary locations favorite for radar.

The effects of the wind turbines on the radar operation have to be determined in advance as part of the approval process.

Numerical system simulations are carried out today for the analysis of distortions on navigation or radar systems by scattering objects (Fig. 1, Fig. 2). The systems are quite different in terms of application, frequency and distortion mechanism, e.g.

- Navigation and Landing systems (e.g. NDB, ILS, DME, VOR/DVOR, GPS, MLS) ranging in frequency from long waves up to 6GHz,
- ATC Air Traffic Control radar system (2D primary PSR and secondary radar SSR/MSSR) at about 1GHz and 3GHz,
- Military Radar ADR covering a wide range of system types and frequency range (e.g. L-, S-, X-band),
- Marine MR and coastal radar and airport surface movement radar SMR often operating in the X-band,
- Weather radar systems operating mainly in the S- and C-band.

From Fig. 2 it can be nicely seen how crowded a typical industrialized country today is by scattered radar. Each radar is marked and surrounded by an assumed safeguarding circle of 35km as a typical example.

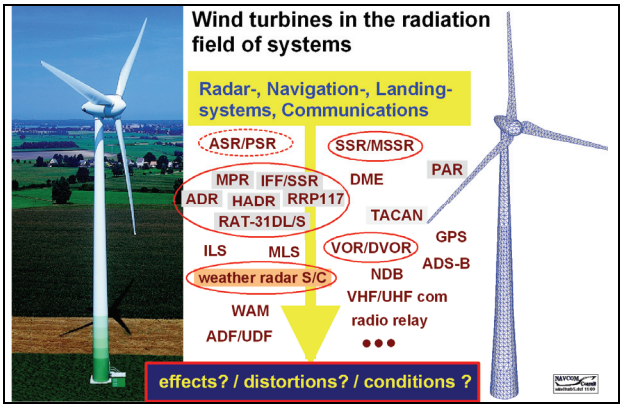

Fig. 1: Wind Turbines and Systems

The potentially distorted systems consist typically today of several basic functional parts to be modelled sufficiently and taken into account, by a

- transmitter and its associated antenna [1],
- environmental part and wave propagation
- distorting scattering object ([1] e.g. WT turbine)
- receiver and its associated antenna,
- signal and subsequent data processing,
- collocated radar and/or radar network .

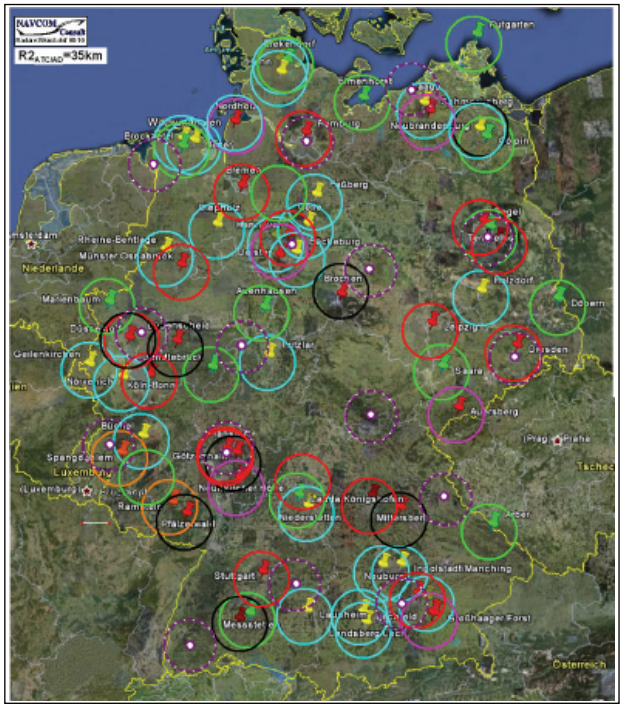

Fig. 2: Distribution of different radar in a country and "assumed safeguarding zones" around each radar

II. Simulation of Distortion of Systems – Principles of Distortions

Depending on the system it is often not clear and well defined what a "system distortion" really means. This is easy if a specification exists which includes the tolerable distortions, e.g. all the ICAO defined systems for aviation such as ILS, MLS. In the radar case, the definition of a distortion is often widely open and, by that, unfortunately often the same distorting scattering scenario is acceptable in one country and not acceptable in another. It should be kept in mind that a situation of "no distortion" at all is unrealistic and unphysical. The natural environment (e.g. ground, vegetation, rain, snow, ice) has more or less effects as well. If the effects by additional man-made objects is not larger or comparable to those from natural ones, they should be acceptable. Generally one can say that a distortion is not acceptable if ***the basic mission of that radar (-network) cannot be accomplished any more in the presence of these objects***. Of course the degree, to which the mission is affected, is crucial. Is 5% or 10% acceptable – or which percentage?

The simulations must take into account the systems operation and the potential distortions sufficiently. Common to all the radio based systems is that the "distorting scattering objects" are illuminated and radiate scattering signals according electromagnetic principles. This scattering can be analysed today by modern state of the art principles: 3D-modeling and application of adequate numerical methodology ([5 – 12]).

Some basic distortion principles and effects based on field effects can be listed relative to radar systems

- "Primary radar" ATC : shadowing, false targets by bi-static scattering, angle errors
- "Primary radar" AD (air defence) : shadowing, angle errors
- "Primary radar" marine/coastal, SMR : shadowing, false targets
- Secondary radar ATC MSSR: (shadowing), false targets/interrogations, monopulse angle errors

It should be pointed out that a radar "false target" is a ***real wanted target which is displaced*** in the radar data or screen [12] after all applied signal and data processing (Fig. 3).

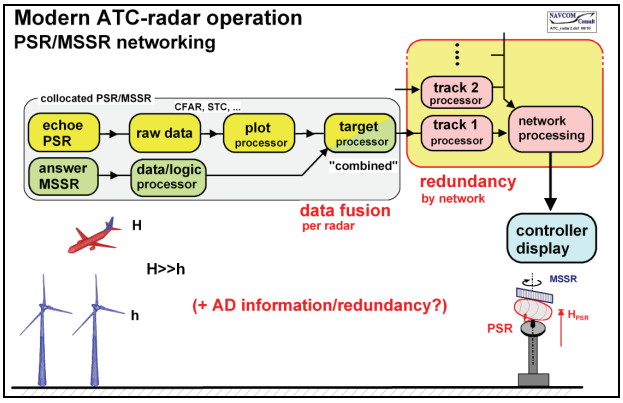

Fig. 3: Modern ATC-radar operation and wind turbines

By that a wind turbine can never be a "false target" although the radar signal and data processing may interpret the turbine wrongly as a "false target" according to the radar internal evaluation. If so, it must be treated as a deficiency of the radar which must cope anyhow other objects such as moving vehicles or boats/ships. The Probability of Detection PoD is connected with the maximum range and the minimum detectable RCS of an object (typically 1-2sqm) and the tolerated false alarm rate.

III. Wind Turbines: Scattering and System Relevant Characteristics

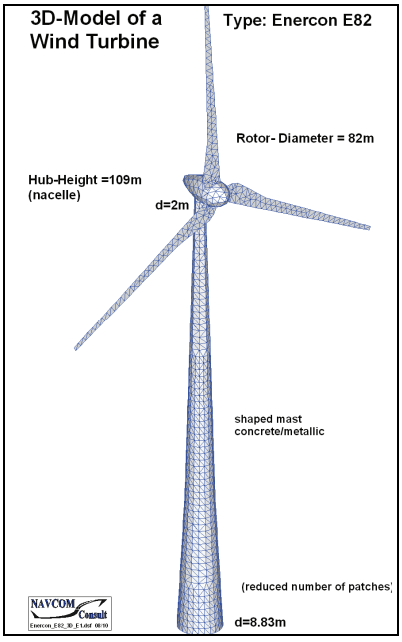

Fig. 4: 3D-model of a large WT

A wind turbine (Fig. 4) consists of 3 major parts in the context of scattering which are modelled by a large number of triangular patches

1. static and rotationally symmetric mast made of concrete and/or metal
2. quasi-static hub or nacelle made of glass-fibre or metal
3. rotating blades: rotation rate up to ca. 22rpm consisting of glass- or carbon-fibre and metal parts

The static parts scatter a standard mono-frequent radar signal. The rotating blades scatter a symmetric Doppler spectrum [11, 12] around the static spectral line. The spectral widths depend on the radar frequency and on the rotation rate [11, 12].

The scattering at the WT produces the shadowing by the forward scatter and the mono-static back scatter constitutes a potentially strong clutter for the radar depending on the type of the mast (Fig. 5). The bi-static scatter is responsible for the potential false targets. It has been shown [11] that it is practically impossible to generate real false targets for a primary ATC-radar by scattering at a WT in realistic scenarios.

IV. Simulation Examples and Results

A series of numerical simulations have been published by the authors

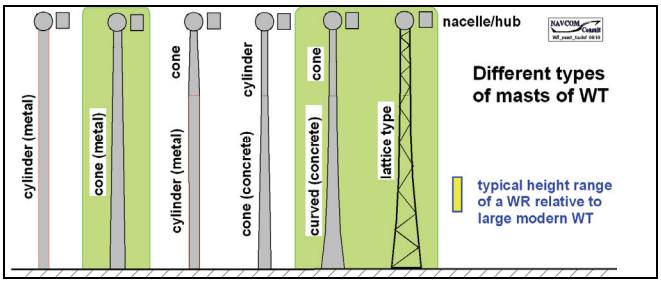

Fig. 5: Different types of masts in relation to radar

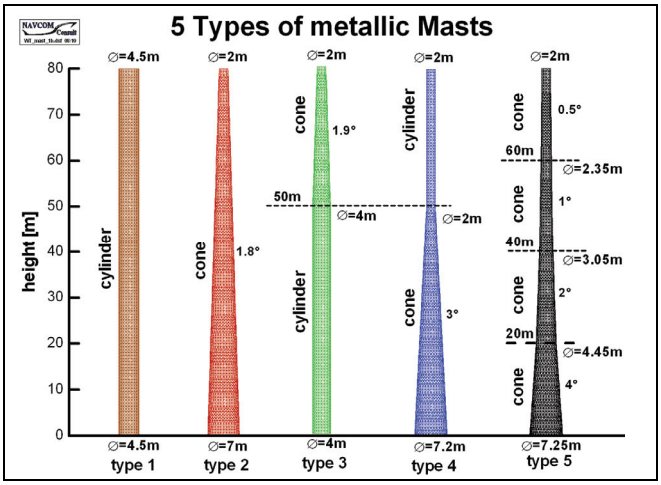

Fig. 6: 3D-models of 5 different types of masts

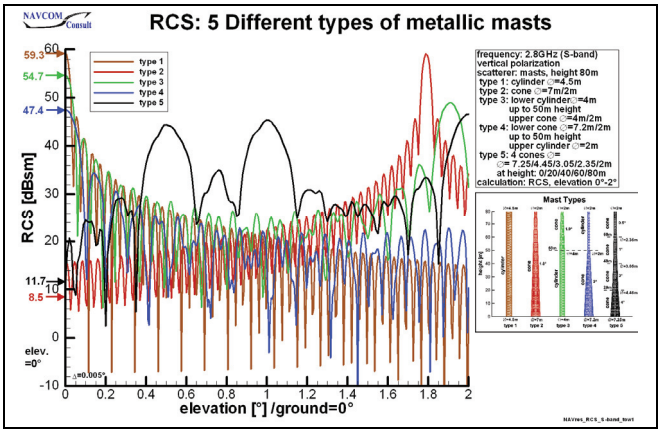

Fig. 7: RCS-results for 5 types of masts of WT from 0° to +2°

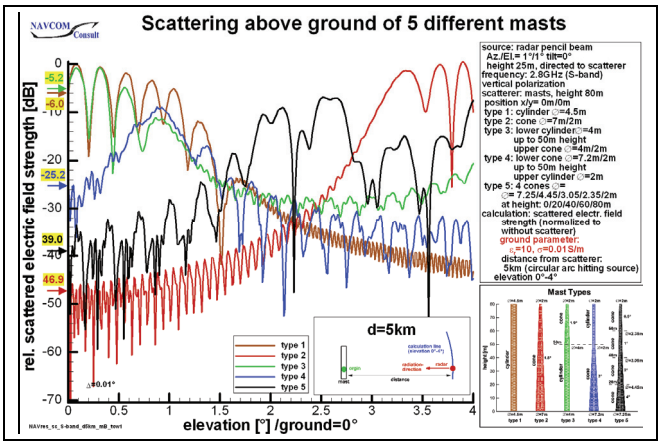

Fig. 8: Scattering-results for the 5 types of masts of WT excited; radar 25m above ground, distance of by WR to masts 5km; pencil beam 1°*1° pointing to 0°

for the of WT RCS under different radar aspects and different scenarios (e.g. [5 – 12]).

In this abstract the results are focussed to the back scattering and shadowing for different mast types. These results are in particular relevant for the weather radar where the shadowing may result in the raw data of the precipitation or the back scattering in increased clutter distortions or the aspect of the visibility for other primary radar (ATC, AD, MR).

Fig 5 shows schematically 6 different types of masts of WT. Fig. 6 shows the 3D-models of 5 different types of masts which can be found approximately in real wind farms. For comparison purposes they adjusted to each other, e.g. to have a comparable cross section. It has been extensively evaluated that the Radar Cross Section RCS is not applicable for objects on the ground [1 - 4, 5 – 12]. However for comparison purposes of the normalized scattering properties in free space, it is a restricted useful figure. Fig. 7 shows the RCS for all 5 masts in Fig. 6 in the vertical elevation angular range between 0° (horizon) and +2°. It can be clearly seen that the RCS at the operationally important angular range at the horizon is the largest one for the cylindrical mast. The very large span of the RCS can be seen and also that at the horizon the span between the masts is up to 50dB.

It is very obvious that the type of mast is a very effective measure to reduce the back scatter for primary radar. While the RCS is applicable only for plane waves without ground, Fig. 8 shows the back scattered results above ground for the same 5 masts in the finite near field distance of 5km.

Measured results for demonstrating the large threatening back scatter of WT could be probably referred to a cylindrical type of mast.

Skeleton types of masts do have favourite features for the back-scatter as well as for the forward scatter (i.e. the shadowing). Fig. 9 shows one single generic comparative numerical result for the shadowing effect of a cylinder and of a lattice type mast for a S-band radar. It can be clearly seen that the shadowing of the lattice type mast is decisively smaller than of a cylindrical mast as expected from electromagnetic principles. More systematic results will be shown on the conference itself. Further results for the statistical features, shadowing, time variant scattering and spectrum results will be re-iterated [5 – 12] and presented on the conference for completeness.

V. Consequences for Radar Systems; Mitigation Measures

The WT are installed at known locations having the principally known and described scattering and

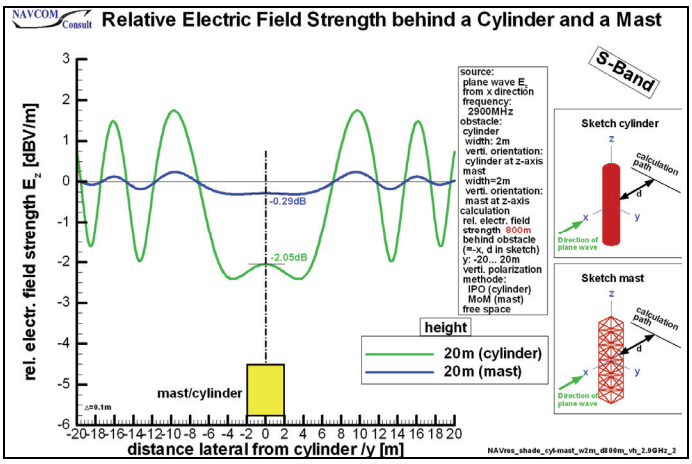

Fig. 9: Generic result of the shadowing in the back of a cylinder and of a lattice mast; plane wave, diameter=2m, h=40m, d=800m

spectral characteristics.

The different radar are faced with these features, but the potential impact is very much different. On top, the radar have its own characteristics and very much different technology on the RF level (Pattern, half power beam width, side lobe level) and also very much different characteristics on the system and radar signal and data processing level. Also the providers operate the radar very much differently and they try to enforce very much different safeguarding requirements. These operational differences range from dogmatic and unrealistically exaggerated preventive and, in contrast, also to modern and pragmatic radar operation which does not follow worst-worst case ideas and does not anticipate an unrealistic zero-risk and 100% safety radar operation.

E.g. for the ATC-radar: The situation may vary between single isolated analogue primary radar to a network of collocated 2D PSR and a 3D Mode S MSSR. The latter offers the modern plot and track processing on the local radar level as well as a multi redundancy processing on the network level. This procedure takes into account that the secondary radar is much more insensitive for the scattering at WT. The standard arguments of missing or malfunctioning transponders for SSR or intentionally switched off transponders by terrorists seems not accept that the air traffic has an accepted risk management already and the terror case cannot be solved reasonably by ATC radar at all, but by 3D ADR and adequate actions.

The progress in the radar technology is shifted from the RF frontend to the signal and data processing to data fusion, redundancy and networking.

Several basic priorities and mitigation measures shall be listed shortly and will be discussed :

- Define realistically the “distortions” and derived specifications according to the “mission of radar”,
- Use all radar inherent mitigation measures (modern technology, signal/data processing and fusion, adjustment and calibration (e.g. clutter maps, spectral processing),
- Simulate the effects of the WT realistically in 3D by adequate methodology - do not apply RCS,
- Compare and weigh the effects by the WT in relation to the environment and other objects.

VI. Summary and Conclusions

The effects of the WT have been analysed and discussed and mitigation measures on the side of the WT as well as basically on the radar side. More theoretical, radar system and numerical results will be presented on the conference. If all levels of measures are applied, the technical acceptance of WT for radar is improved.

VII. References

- Y .T: Lo, S. W. Lee., *Antenna Handbook*, Chapman & Hall, New York 1996, Vol. I
- SKOLNIK *Radar Handbook*, McGraw Hill, Boston 1990
- E.F. Knott et.al, *Radar Cross Section*, Artech House, London 1992
- IEEE STD 211-1997, Definition of terms
- G. Greving. *Numerical Simulations of Environmental Distortions by Scattering of Objects for the Radar - SSR and flat roofs, RCS and windturbines*, EURAD 2006, September 2006, Manchester/UK
- G. Greving, W.-D. Biermann, R. Mundt, *Wind Turbines and Radar - The Radar Cross Section RCS a Useful Figure for Safeguarding?,* IRS 2007, September 2007 Cologne/Germany
- G. Greving, W.-D. Biermann, *Application of the Radar Cross Section RCS for Objects on the Ground - Example of Wind Turbines,* IRS 2008, Wroclav/Poland, May 2008
- G. GREVING *Status of Advanced Scattering Distortion System Analysis for Navaids and Radar - Examples of A380 and Wind Turbines*; MRRS 2008, September Kyiv/Ukraine 2008
- G. Greving, M. Malkomes, *On the Concept of the Radar Cross Section RCS of Distorting Objects like Wind Turbines for the Weather Radar*; ERAD 2006, Barcelona/Spain
- G. Greving, M. Malkomes, *Weather Radar and Wind Turbines - Theoretical and Numerical Analysis of the Shadowing Effects and Mitigation Concepts*; ERAD 2008, Helsinki/Finland
- G. GREVING, W.-D. Biermann RCS - *Numerical, Methodological and Conceptional Aspects for the Analysis of Radar Distorting Objects*; IRS 2009 (International Radar Symposium), Hamburg September 2009
- **G. GREVING, W.-D. Biermann, R. Mundt** *Wind Turbines as Distorting Scattering Objects for Radar - Clutter Aspects and Visibility*; IRS 2010 (International Radar Symposium), Vilnius/Lithuania, June 2010

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COMPARATIVE DESIGN WITH IMPROVEMENT IN PERFORMANCE FACTOR THROUGH DELAY LINE CANCELLERS IN MTI RADAR

The target detected by radars have to deal with more than receiver noise due to received echoes from natural environment that is clutter which affects the reception and is strong issue to be considered. Conventionally it was achieved by simple Doppler filter but due to the limitation of the same delay-line cancellers replaced it. A cancelling technique revealed in this paper is basically a signal differencing which compare the signal train within a given scan cycle with that of the previous cycle by delaying the signals of said previous cycle in order to bring them into time coincidence in the canceller circuit.

Conventional clutter-lock cancellation techniques in airborne moving target indicator (MTI) radars become ineffective due to high satellite velocities and large spread in clutter doppler. Clutter scatterers are generally stationary except for a small internal motion; the Doppler shifts in frequency of the radar return signals can be utilized to discriminate the true or moving targets from the fixed objects or scatterers as in MTI radar. So delay-line cancellers are employed to meet the desired output, which function like a filter with a null response point or notch at DC or zero doppler frequency.

A pulse cancellation system, particularly adapted to moving target indicator (radar) stationary signal cancelling equipment. A block diagram of two pulse single DLC is shown below which basically employs impulse response function h (t) and input x (t) convolved.

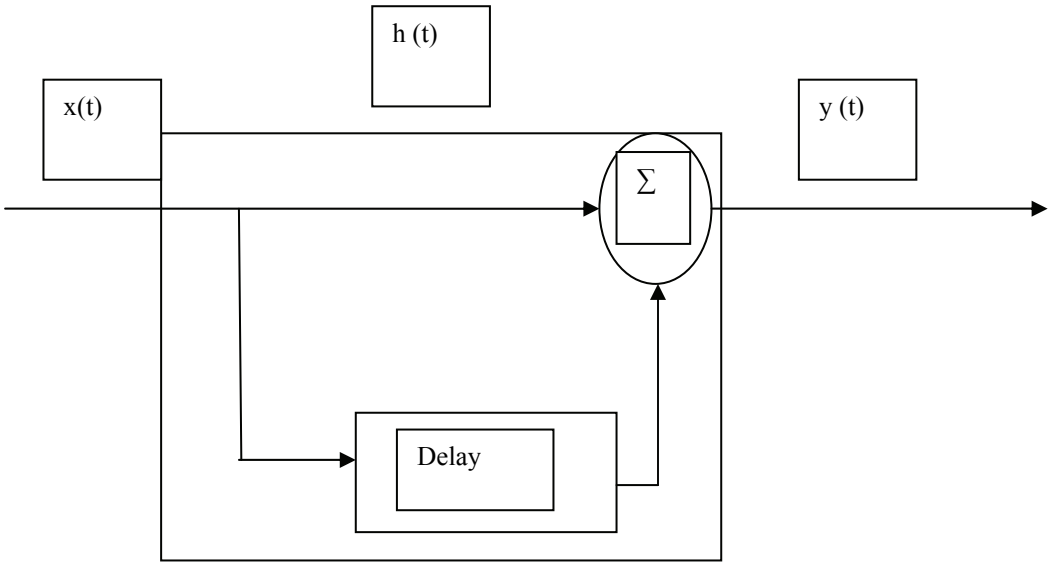

Fig. 1 Two Pulse Single delay line canceller

Wide notches in stop band in the frequency response of the single line canceller are not acceptable which provoked to use another approach. The cascading processes which increase the canceller in number improves the clutter attenuation factor and improvement factor. With the enhancement of the technology for the fine response of the signal received, the recursive technology is employed. The filter with only zeros does not have flexibility so filters with both poles and zeros are used which is achieved by feedback. The feedback loops producing recursive filter shapes the response.

This paper explores the comparative design with reverence to the different cancellers of a low prf radar with 0.8 kHz. The recursive filter will also analyzed to see the fineness in the frequency response curve with k = 0.1, 0.55, 0.96. By changing the different gain factors the analysis will be

carried out. It basically deals with improving the different factors such as clutter attenuation (CA) and improvement factor (If) taking wood hills as clutter. Results are purely formulated using MATLAB.Some results associated with single delay line canceller and double delay line cancellers are shown below:

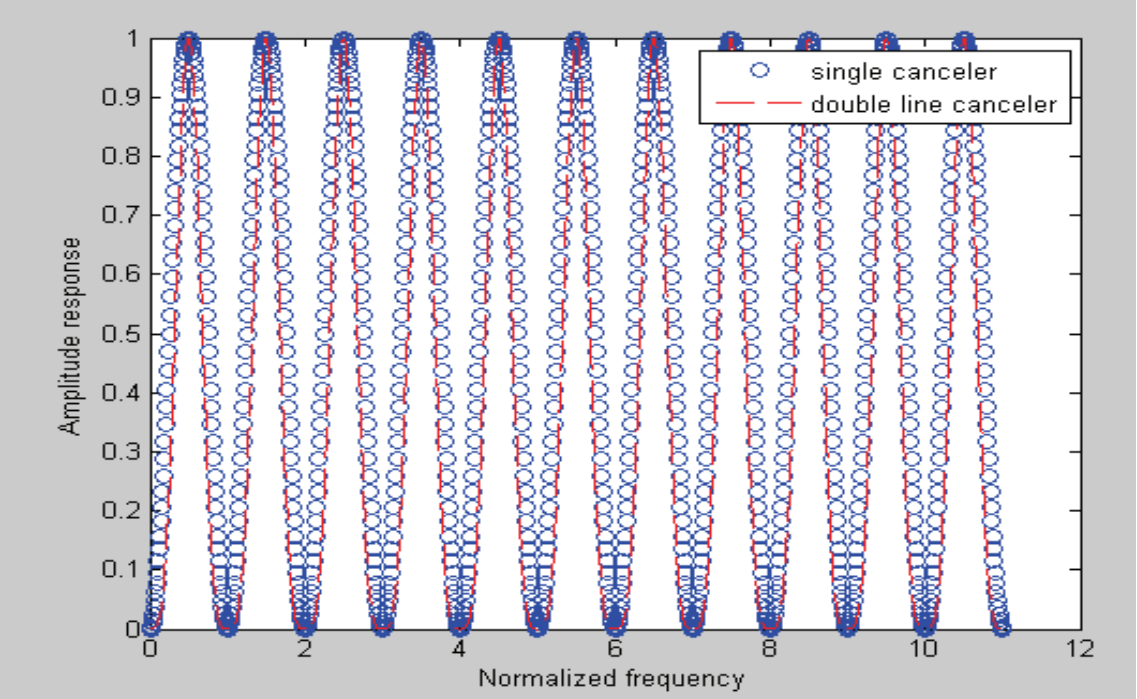

Fig.2 Results associated with single delay line canceller

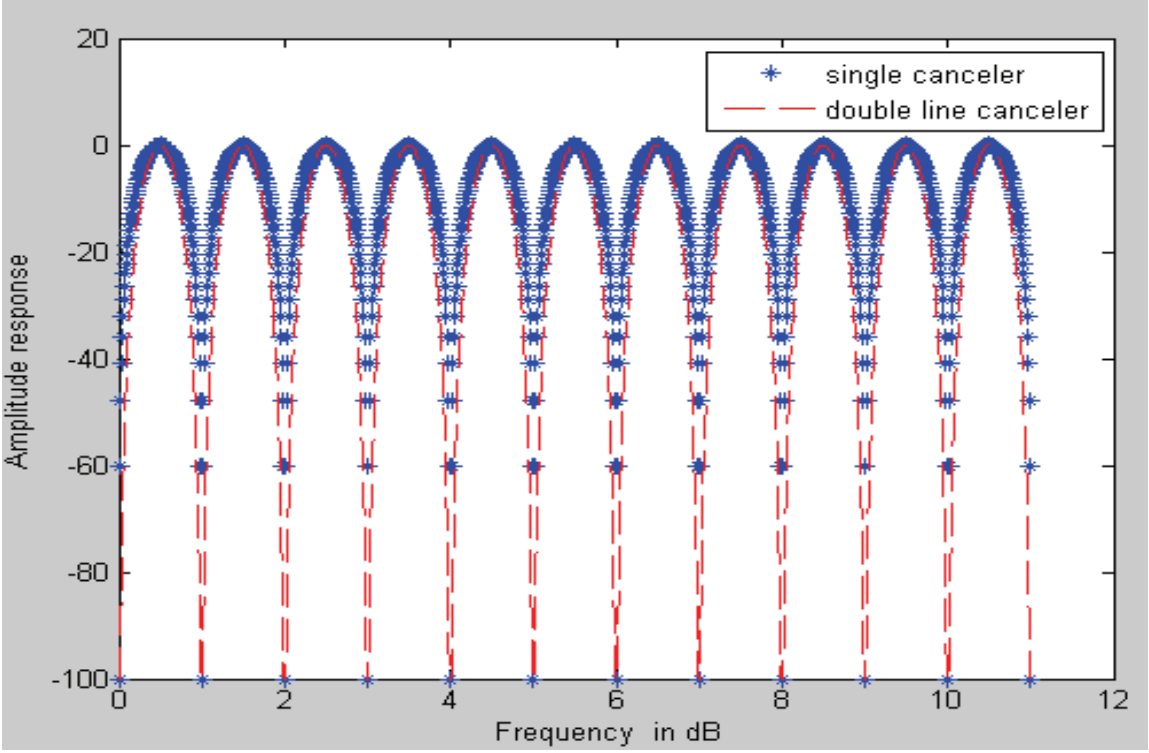

Fig. 3 Results associated with double delay line cancellers

Conclusion

With the exploit of cascading processes which improves the clutter attenuation factor and improvement factor but to achieve the fine response of the signal received, the recursive technology is employed. The feedback loops producing recursive filter shapes the response. But this is also limited by transient response which may subject to deliberate electronic countermeasures. The frequency response of Single DLC passes a portion of the clutter spectrum so a part of clutter appears but this is reduced in Double DLC so more clutter attenuation is achieved in Double DLC.There is enormous increase in the performance factor with DLC which may be around 80 % of the single DLC . Increasing the attenuation factor may eliminate the desired echo signal so other factor named Improvement factor which is basically ratio of signal to clutter is also considered.

References

1. *Shrader, W. W.*, "MTI Radar," in Radar Handbook, Chapter 17, Edited by M. I. Skolnik, McGraw-Hill Book Company, New York, 1970.
2. *Andrews, Jr., G. A* . , "Airborne Radar Motion Compensation Techniques -Evaluation of TACCAR," NRL Report 7407, Naval Research Laboratory,Washington.
3. *Barton, D. K.,* Radar System Analysis, Prentice-Hall, Inc., Englewood Cliffs, N.J. 1964.
4. *Staudaher, F. M.,* "Airborne MTI," in Radar Handbook, Chapter 18, Edited by M. I. Skolnik, McGraw-Hill Book Company, New York, 1970.
5. *Kelly, E. J.,* "Radar Surveillance from Space - Systems Concept and Radar Model," MIT Lincoln Laboratory Proj. Report SRT-7, December 1983.
6. *Tsandoulas, G. N.,* "Space Based Radar Frequency and Altitude Trade-offs," MIT Lincoln Laboratory Proj. Report SRT-23, October 1986.
7. *Miller, R. W.*, "Radar Requirements for DPCA Clutter Cancellation," MIT Lincoln Laboratory Proj. Report SRT-27, November 1987.
8. *Andrews, G. A.*, "Airborne Radar Motion Compensation Techniques - Evaluation of DPCA," NRL Report 7426, Naval Research Laboratory, Washington, DC, 20 July 1972.
9. *Wang, H. S. C.*, "Synthesis of Radiation Patterns of Planar Array Antennas," IEEE Aerospace Applications Conference Digest, Paper 11.3, February 1988.
10. *Rhodes, D. R.*, Introduction to Monopulse, Chapter 2, McGraw-Hill Book Company, Inc., New York, 1959.
11. *Rusch, W. V. T.*, "Computer Programs for Offset Parabolic Reflectors with Multiple Feeds," August 1980, unpublished.
12. *Rusch, W. V. T.*, et al., "Computation of the Radiation Characteristics of Axially Symmetric Near-Field and Classical Cassegrain and Gregorian Antennas with an Array Feed," November 1987, unpublished.
13. *Fitzgerald, W. D.*, "Limited Electronic Scanning with a Near-Field Cassegrainian System," MIT Lincoln Laboratory Tech. Report 484, 24 September 1971.
14. *WOODWARD, P.M.:* 'Probability, and information theory with applications to radar' (McGraw-Hill, New York, USA, (1953)
15. *RIHACZEK, A.W.*: 'Principles of high resolution radar' (McGraw-Hill, New York, 1969)
16. *COSTAS, J.P.:* 'A study of a class of detection waveforms having nearly ideal range-Doppler ambiguity properties', ***Proc.*** IEEE, 1984

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RADAR DETECTION VIA COMPRESSIVE SENSING USING PARTIAL FOURIER COEFFICIENTS

In this paper preliminary results are presented on detection performance of radar using Compressive Sensing (CS). CS is a recently developed theory which allows reconstruction of sparse signals with a number of measurements much lower than what is required by the Shannon sampling theorem. The results of CS reconstruction and detection will be compared to conventional Matched Filtering (MF) by means of Receiver Operating Curves (ROC).

Introduction

Increasing demands on radar systems in terms of resolution (bandwidth), and trends towards multi-channel radar systems, keep increasing the required sampling rates and amounts of data to be handled, up to the point where these become limiting factors on radar performance. In surveillance radar, as widely used in aviation and other application areas, the search volume, which is effectively divided into range and Doppler cells, typically contains a number of targets which is much smaller than the number of cells in the entire volume. This spatial sparseness can be exploited to reduce the requirements on sampling and data rates.

Compressive Sensing (CS) is a novel data acquisition/processing method which allows data reconstruction from incomplete measurements, based on the premise that the signal is sparse in some domain. Because of the wide range of applications, this topic has attracted the interest of many researchers in the last few years.

Although the field of CS has been developed only recently, the theory behind it is widely documented in literature, see [1]-[3] and references therein, and CS has been already successfully demonstrated in several fields of research, such as communications, optical and medical imaging, sensor networks, remote sensing and radar. Recent examples of Compressive Sensing in radar were provided in [7]-[8].

In radar applications the use of CS could bring significant improvement in terms of data acquisition time, lower sampling rates, or improved resolution with equal amount of measurements. However, while classical radar detection theory has since long been firmly established, detection properties of CS based approaches are not yet very well known or documented. This paper describes the analysis by simulation of CS-based radar detection, compared to conventional MF processing followed by detection.

Compressive Sensing framework

We want to observe a signal vector $\mathbf{x}$ of length N and assume that there exists a known basis $\mathbf{\Psi}$ in which the signal is K sparse, i.e. $\mathbf{x} = \mathbf{\Psi}\,\boldsymbol{\alpha}$ and only K coefficients in $\boldsymbol{\alpha}$ are non-zero[1]. If this condition is satisfied, then according to CS theory we can reconstruct the signal $\mathbf{x}$ from a number of measurements $M<<N$, where the measurements $\mathbf{y}$ are given by

$$\mathbf{y} = \mathbf{\Phi x} + \mathbf{n} = \mathbf{\Phi\Psi}\boldsymbol{\alpha} + \mathbf{n} \qquad (1)$$

where $\mathbf{\Phi}$ is the MxN sensing matrix and $\mathbf{n}$ is white Gaussian noise with variance σ^2.

Given the fact that $\mathbf{x}$ is sparse, the theory of CS proves that the original observation vector $\mathbf{x}$ can be reconstructed from a number of measurements M proportional to the sparsity of the signal and to the coherence $\mu(\mathbf{\Phi}, \mathbf{\Psi})$ between the sensing matrix $\mathbf{\Phi}$ and the sparsity basis $\mathbf{\Psi}$ (i.e. the largest correlation between all the possible pairs of columns of the two matrices). Examples of incoherent pairs are random sensing matrices with any sparsity matrix, and time/frequency (as in this paper).

[1] In stead of K-sparse, the signal may also be 'compressible', meaning that many coefficients are close to zero.

Since the number of measurements M is much smaller than the number of samples N that we wish to reconstruct, the problem is ill-posed. To be able to solve for the N unknowns, CS suggest to choose, amongst all possible solutions, the one with minimum l_1 norm which is in sufficient agreement with the measured data, i.e.

$$\hat{a} = \arg_{\alpha} \min \left\| \alpha \right\|_1 \text{ s.t.} \left\| \Phi \Psi \alpha - y \right\|_2 \le \delta \tag{2}$$

where δ is a threshold proportional to the noise variance.

Equation (2) is known as Basis Pursuit Denoising (BPDN), [3], it is a convex program and there exist several routines to solve it. In the results presented here the method proposed in [4] was used to solve equation (2). Several equivalent formulations of equation (2) exist, [3]-[6].

Signal Model using CS Stepped Frequency Waveform

In this paper we investigate the possibility of using CS for radar detection by looking at detection probability (P_d) and false alarm rate (FAR) of radar using CS reconstruction in the range domain. To perform CS in range we consider a transmitted waveform of discrete frequencies, as described in [7], so that after reception and demodulation each range bin maps to a phase which is proportional to the transmitted frequency. To apply Compressive Sensing, we reduce the number of discrete frequencies which are transmitted from N (which represents the Nyquist rate for unambiguous mapping of ranges to phases over the whole bandwidth) to M, with $M<<N$, where the selected M frequencies are chosen at random from the available N. This implies that our equivalent sensing matrix $\mathbf{\Phi}$ is an incomplete Fourier matrix of the form:

$$\mathbf{\Phi} = \frac{1}{\sqrt{M}} \begin{bmatrix} e^{-j2\pi k_1 n_1 / N} & \cdots & e^{-j2\pi k_1 n_N / N} \\ \vdots & \ddots & \vdots \\ e^{-j2\pi k_M n_1 / N} & \cdots & e^{-j2\pi k_M n_N / N} \end{bmatrix} \tag{3}$$

where k_i, i=1..,M is the wave number and n_l, l=1,…,N is the range bin index.

Please note that, since we are only transmitting M frequencies, the normalization factor is inversely proportional to the square root of M, so that the total power is independent of M. If in place of CS we use a conventional matched filter, then the sensing matrix is the complete Fourier matrix, of size NxN, with all N frequencies in the bandwidth and with a normalization factor proportional to N.

In our simulations $\mathbf{x}$ is a length N vector containing the complex T target amplitudes a_t, t=1,…,T, at indices corresponding to range bins where the targets are, i.e. $\mathbf{x}$ = [a_1, 0, 0, a_2…,0, a_T]. This implies that the sparsity domain $\mathbf{\Psi}$ is the target space (range); it is reasonable to assume that the scanned range will only contain targets at a few positions.

For comparison we also simulated the Decimated Matched Filter (DMF), which is obtained just like a conventional matched filter, but with the same number of non-zero samples as in CS. Thus DMF is a filter matched to the decimated set of samples.

Because we assume the transmitted signal is the sum of all selected frequencies, the actual noise power is also the sum of the noise power of each sample, therefore we define the input Signal-to-Noise Ratio (SNR) for each target respectively as

$$\begin{aligned} SNR_{in} &= \frac{|a_t|^2}{N\sigma^2} && \text{MF} \\ SNR_{in} &= \frac{|a_t|^2}{M\sigma^2} && \text{DMF, CS} \end{aligned} \tag{4}$$

Equation (4) defines an input SNR that depends on the value of N or M, because constant power is assumed. However, it is the output SNR that determines P_d and FAR, i.e. the input SNR to

the detector, and so for comparison it is appropriate to obtain an output SNR independent of M or N. With the above definition of input SNR, the output SNR for both MF and DMF is equal to[2]

$$SNR_{out} = \frac{|a_t|^2}{\sigma^2} \qquad \text{MF, DMF} \qquad (5)$$

Results

The performance of MF, DMF and CS are compared using ROC curves, i.e., detection probability versus false alarm rate. The latter is evaluated over all samples of the reconstructed vector. For each curve 10000 Monte Carlo simulations were performed with $N = 200$, $M = 66$. The results are compared on the basis of an equal MF output SNR. Figure 1 shows that, at low SNRs, CS does not perform much worse than MF or DMF, although, as seen in the P_d curve of figure 2, the detection probability of CS is bounded, for SNR = 0 dB, to a maximum of 0.68, no matter how low the threshold. This is because the reconstruction via l_1 norm forces a sparse solution, so that at low SNRs the reconstructed target amplitude is sometimes very close to zero (while the measured power is assigned to noise samples instead). On the other hand, at reasonable values of SNR, required for detection in any case, CS performs about as good as the DMF, and close to the optimum, which is given by the MF, as shown in figure 3. Moreover, as shown in figure 4, in the case of multiple targets, CS performs significantly better than the DMF, because the effect of decimation in the DMF creates high target sidelobes, thus generating more false alarms.

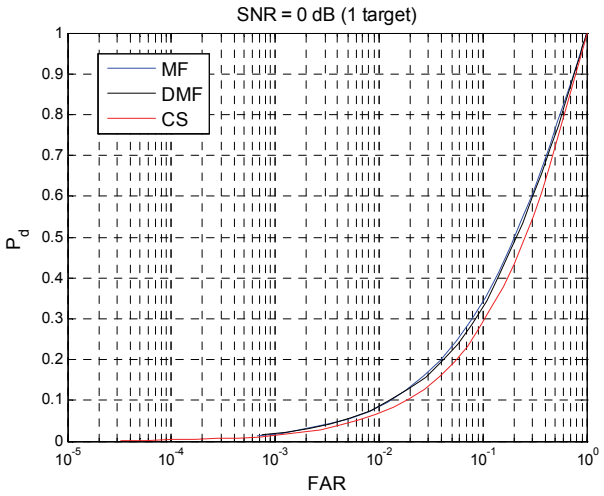

Fig. 1. ROC curve for MF, DMF, and CS with SNR_{out} = 0 dB and 1 target in the data

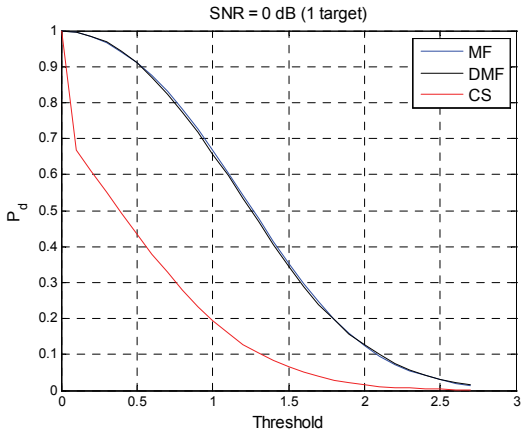

Fig. 2. Pd versus threshold for MF, DMF, and CS with SNR_{out} = 0 dB and 1 target in the data.

[2] For CS is not common to define an output SNR, since the CS solution is non-linear. However it was noted that at high SNR, the CS reconstruction behaves almost linearly.

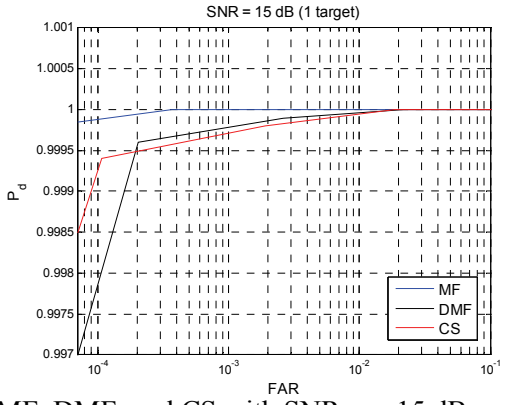

Fig. 3. ROC curve for MF, DMF, and CS with SNR_{out} = 15 dB and 1 target in the data.

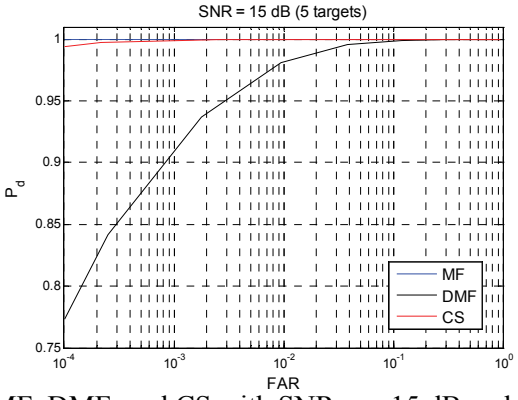

Fig. 4. ROC curve for MF, DMF, and CS with SNR_{out} = 15 dB and 5 targets in the data.

Conclusions

The simulations show that detection after CS reconstruction can closely approach classical detection performance, with much less frequency samples. CS is about as good as the DMF in medium (or high) SNR in terms of P_d. Moreover, CS does not produce target side lobes, which improves the FAR with respect to the DMF for a fixed threshold in a multiple targets scenario.

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References

1. *E. J. Candes, J. Romberg, and T. Tao*, "Robust uncertainty principles: Exact signal reconstruction from highly incomplete frequency information," IEEE Trans. Inf. Theory, vol. 52, no. 2, pp. 489–509, February 2006.
2. *D. L. Donoho*, "Compressed sensing," IEEE Trans. Inf. Theory, vol. 52, no. 4, pp. 1289–1306, April 2006.
3. *S.S. Chen, D.L. Donoho, and M.A. Saunders,* "Atomic decomposition by basis pursuit," SIAM J. Sci. Comput., vol. 20, no. 1, pp. 33–61, 1998.
4. *E. van den Berg and M. P. Friedlander*, "Probing the Pareto frontier for basis pursuit solutions," SIAM J. on Scientific Computing, vol. 31, no. 2, pp. 890-912, November 2008.
5. *E. Candès and T. Tao*, "The Dantzig selector: Statistical estimation when p is much larger than n," Ann. Statist., vol. 35, no. 6, pp. 2313-2351, 2007.
6. *R. Tibshirani*, "Regression shrinkage and selection via the lasso," J. Roy. Stat. Soc. Ser. B, vol. 58, no. 1, pp. 267-288, 1996.
7. *J. H. G. Ender*, "On compressive sensing applied to radar," Signal Process., vo. 90, no. 5, pp. 1402-1414, May 2010.
8. *R. G. Baraniuk, and T. P. H. Steeghs*, "Compressive Radar Imaging," IEEE Radar Conference, Waltham, MA, April 2007.

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ANALYSIS OF THE MULTIPLE ASSIGNMENT DETECTION METHOD IN RADAR TRACKING

In the paper a new approach to the problem of matching detections with tracks is presented. Due to limited radar resolution, two objects that fly close to each other can be detected as one object. In the proposed solution, one detecting can be matched with two tracks.

Introduction

In the classic tracking system, target tracking consist of an iteration process in the following cycle: prediction - matching - correction. Based on a model of motion, the place of the expected successive detection of the tracked object can be predicted. Due to the presence of the random errors and model imperfection, the prediction not always agrees with the real detection. Based on prediction, a new detections is selected; the one, which best corresponds to the tracked route (matching). To determine which detection is in the best correspondence with the prediction, one introduces the function of quality with arguments: prediction and detection, and the output value is a scalar of range 0 - 1. The value of the function of quality can be interpreted as the probability that the particular detection belongs to the particular track. After matching the detection with the track, any new detection is treated as a successive measurement of the tracked object location. On the basis of a new measurement, a correction of location of the tracked object is calculated. In the literature, a particular attention is focused on the effective estimation (prediction and correction). The process of matching is treated as less important. However, the process of matching detections with tracks is the most important part of the tracking system. Big errors of location estimation usually the result in errors of matching. If the procedure of decision, which detections matches errorlessly with tracks corresponding or the information about loss of a signal are known, the problem of determination of precise estimate of location would be not important. Usually, precisions of location, determined on he basis of several last measurements is sufficient. Estimation precision is necessary to perform accurate prediction of successive detection, which is necessary in the matching process.

In the proper matching, it is a reasonable assumption that one detection represents one track. However, due to limited radar resolution, two objects flying close to each other are detected as one echo. The ideal matching procedure should take this fact into account. As an alternative, a multiple matching of the same detection with several tracks can be allowed. However, such solution creates some new problems. They appear as so called permanent connection of the tracks. When trajectories of tracked objects diverge, both tracks follow just only one object. Detections of the second object create a new track.

In this paper the matching procedure is proposed. This procedure permits the matching the same detection with two tracks, omitting the problem of permanent connection together of the tracks. The essence of this idea is that the detection, which is for the second time matched to the track consist of artificially decreasing value of the quality function. In this way, in the case of a detection which matches the track, only this one is matched with the track, because value of its function of quality is not lowered. In this way, the matching twice the same detection with two tracks, is eliminated. Such solution considerably limits the possibility of the track connecting together.

Formulations of the problem

The process of matching consist in the association the plots to the tracks. The plot matched with the track is treated as a next measurement and on this base estimation and actualization of movement parameters is done. The matching process has fundamental significance in the tracking

process. The matching of the false plot provides the estimation of accidental parameters and false prediction. The possibility of matching the proper plot base on the accidental prediction is minute. Errors at the matching most frequently lead to loss of the track. For the operator the most important is that the loss of track does not occur. Usually, to the track which represents the tracking target, several important strategic information like friend/enemy, identification unit type, armament condition are attributed. When the brake in the tracking process occurs, all this information is lost. The phenomenon of track brake occurs when false plots are matching. It is the consequence of wrong matching. Usually, base on plots which origin come from real object, new track is initiated, but this track does not have all strategic attributes. These attributes are necessary to describe the new-created track. Very useful can be a service which remembers all recently broken tracks and their attributes. If the operator decides that the new initiated track is in fact the continuation of the old one (which has been broken) then he/she attaches to this new track a designation ID-attribute of the old one, together with all other attributes.

The formal the marching problem can be defined as follows. For the given set of plots $P:\langle p_1, p_2,..., p_n\rangle$ which recently enter to the system and for the given set of tracks $T:\langle t_1, t_2,...., t_m\rangle$ the problem of the matching process makes assigning of plots from the set P to tracks from the set T. To one track only one plot can be assigned and one plot can be assigned to one track.

The matching process is the most important part of tracking system. If there exists any method which permits matching new plots to the tracks faultlessly, the rest of the system will loose importance The main task of the system is target (track) tracking. The track which is represented as detection history normally is good enough for the operator.

Sometimes the velocity estimation is needed. It can be easily computed - base on several recent detections. Typically, the filter algorithms are most complicated part of the system. Filtration and estimation of motion parameters of the tracking target are only intermediate objective. Based on the estimated parameters, the prediction of the next detection is calculated. Based on this prediction the quality function is constructed and matching is achieved. The quality of prediction has the fundamental significance for this matching process.

Usually, only one wrong matching leads to loss of tracked track. Nevertheless, there exists a method which permits to reduce the consequences of the false matching. It makes tracking process much more robust. This method is known as MHT (Multiple Hypothesis Tracking). When to one track can be matched a few plots having similar values of quality function, it is not easy to decide which plot should be matched. It is also possible that the proper solution is the decision to loose of plot. The wrong matching leads to breaking the track. To assure that no proper matches are omitted, a clone of the track is created. With this clone one plot (or loss of the plot) is matched. In this case, the track represents in fact the tree of hypothesis which include different alternative of matching. By analyzing the successive matches we can easily decide which alternative is the proper one. The operator can see only one alternative. If in the future it would appear that it was false, the system automatically switches to another alternative which represents the proper stream of matches. The effective management of the hypotheses tree represents a big challenge. The branches which reflect false matches to which the plots confirm the trend did not come should be remove quickly. There is a large area for implementation of different heuristic techniques and artificial intelligence. While the effective management of hypotheses tree creates many problems, MHT permits to reduce effects of false matches (clone of track is matched properly) and drastically reduces number of broken tracks.

Classic solution

The matching problem can be presented as a mean to find the best matching of plots with tracks. To decide which matching is better, we must to have specific criterion. In the presented solution as follows below, to each track the quality function which permits to decide how certain plot fits to this track is attached. As the criterion of the best matching plots to the tracks we introduce the sum of quality functions for particular matches plots to tracks. The function of quality values is nonnegative. The zero value means that a particular plot does not belong to this track for

sure. Additionally, it is postulated that values of function of quality was in the limit <0,1>. In this case, we can interpret the value of quality function as measure of believe that a particular plot belongs to a particular track. Usually, it is assumed that the quality function for the plots, which is exact according to prediction, has value 1.0. For the distant plots the value of the quality function is smaller. Generally, the value of quality function of the choosing direction deceases when the distance between predicted position and the plot increase. It does not mean that the function of quality is only the function of distance between the plot and the predicted position. It is only in the simplest solutions. The distribution of prediction can be anisotropic (Fig.1). The plot (green) which is farther in direction which has big variance of error can be more proper matched then closer plot (red), which is in the direction which has small error variation.

The function of quality is connected to the idea of "gate of matching". Gate of matching is an area where the function of quality has non-zero value. The plot matched to a track must be inside the gate of matching. The reason of the using the gate of matching is putting the common sense limitations on matching plots with tracks.

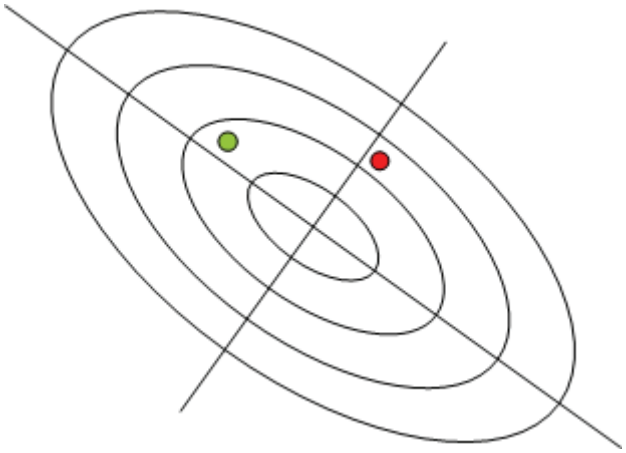

Figure 1 Distribution of prediction.

When the function of quality is defined the matching problem gets well defined. Let us take assumption that a particular plot can be matched with maximum one track. The plot is the position measurement of one object. Now we are looking for such set of matches between plots and tracks which will give maximum sum of quality function value for all matches.

Let us have:

- n number of tracks at prediction state with which a certain plot can be matched,
- m number of new plots, which enter to the system and can be matched with tracks
- table $Z(n*m)$. Element $z_{i,j}$ include the value of quality function of matching j-th plot to i-th track.

We have to find table of matches $S(n*m)$, which fulfills following conditions:

- $\forall_{i,j} s(i,j) \in \{0,1\}$
- $\forall_{i} \sum_{j} s(i,j) \le 1$
- $\forall_{j} \sum_{i} s(i,j) \le 1$

which maximalize the sum of quality matches value:

$$\max \sum_{i} \sum_{j} s(i,j) z(i,j) .$$

The first limitation determines binary character of matching. Plot j-th is matched (true - 1), or is not matched (false - 0) with i-th track. There is no another possibility. Second limitation determines (in the connection with first one) that in each row of the matched table S maximally

only single “1” occur, the rest elements are zero. In the other way, with selected track can be matched maximally one plot. Third limitation determines (in the connection with first one) that in each column at the matches table S maximally only single “1” occur, the rest elements are zero. In the other way, with any track can be matched maximally one plot. The aim function (the sum of values of quality function for all matched plots) must be maximalized. We are looking for such matching (represented by the matches table) which maximalizes aim function with limitations.

Simple-mined reasoning can lead us to the selfish scheduling algorithm which consist in that to each track we matched plot of the highest value of quality function. Unfortunately, the conflicts can occur. The selected plot can be the same one which has highest quality function for a few tracks. In view of above restrictions the plot can be matched only with one track. As well as choose to the matching track, which have value of quality function for selected plot is highest and it does not give us warranty that optimal solution would be find. The described problem is not trivial and so typical that has own name and methodology of solutions. Such formulated task is a classic “appointment problem”. It is a particular case of transport problem. In this case solving the corresponding transport problem, which is well-known in literature, is proposed as methodology to solve assignment problem. This methodology does not take into consideration the particular character of assignment problem. It is possible to design a more effective algorithm if this particular character of assignment problem would be taken into consideration. This more effective algorithm is known as Hungarian algorithm because it is based on the theory proofed by Hungarian mathematician Denes König enabling finding solution by an effective way.

Multiple assignment

In the base of the problem matching plots with tracks, which strict formulation leads to the assignment problem, there is assumption that a single plot is the results of measurement of position of a single target. The single plot can be matched only with one track. But reality is different. Radars have limited spatial resolution. When two targets are very close to each other they are frequently detected as one plot. It is called plot sticking. Quantities which can help to decide whether certain detection is in fact the result of several plots sticking, are physical parameters of echo, especially azimuth extension. Unfortunately, only a few types of radars provide this information in digital form together with other parameters of detection. Generally, this information is unavailable. Taking in to consideration the phenomenon of plot sticking and the fact that one (sticking) plot is a result of position measurements of several tracked targets, leads to rejection of limitation. Another effect of these limitation rejection is also radical simplification of matching problem. In this case selfish scheduling algorithm is optimal. For each track we have to match a plot for which the value of the quality function is highest. The same plot can be matched with several tracks. Unfortunately, a phenomenon of track sticking appears as the side effect of this solution. If certain plot has got the higher value of quality function for two (or more) tracks, it means that both predictions, based on which quality function is constructed, are similar. It is also possible that motion parameters of both tracking targets are similar. It is not unusual situation; for example the fighters which fly for military operations usually are in pairs. If to both tracks the same plot is matched then the effect of motion parameters estimation of both targets will appear closer. In the next iteration, based on closed motion parameters, the similar predictions will be obtained. The qualities functions are also similar because they are based on similar predictions. It is possible that once matching conflict occurs and the same plot will be best fit to both tracks. After several iterations when to both tracks the same plots matched, the tracks, in fact, will be the same (have the same motion parameters). Matching estimation and prediction will proceed in the same way. Always, the same plot will be the best fit for both tracks. In such case we are talking about track sticking phenomenon. This phenomenon is specially unfavorable. It leads to the situation when the same target can be tracked as several tracks.

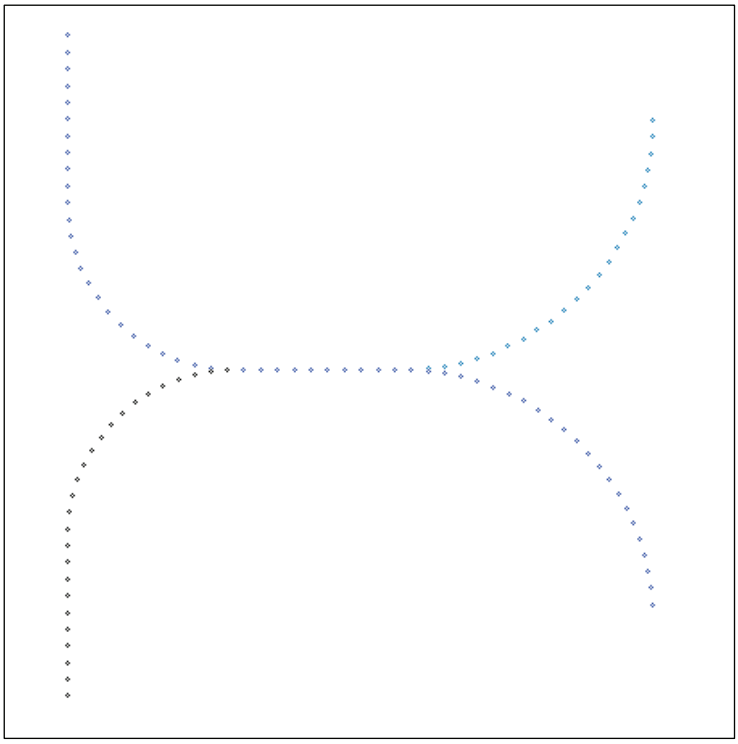

Fig.2. Track sticking

In the Figure 2 the result of simulation of the tracking two tracks which have common part is presented. On this common part we have plots sticking phenomenon. At the place when tracks are combined and the same plots are matched to them, the sticking of the tracks occurs. The grey track sticks to the blue one. It is invisible because the blue one covers them. Even when separation of both tracks is done, the tracking process is leading both tracks together. At the place where both tracks are separated and plots do not stick together, the new track (sky blue) has been initiated on the base of plots which consist of gray tracks. The gray track is permanently sticking to the blue one. The source of that it is matching with plot of particular tracks which is already matched with another track. Matching of the same plot to two tracks make sense only then, when in both it is only possible or really the best matching. If for particular tracks another plot exists, and the value of quality function for this plot is at least slightly smaller, they should be matched to this tracks. To show it better let us consider the example. We have three tracks at the prediction state (waited for plot matching) marked as Tr 1, Tr 2, Tr 3 and three new plots which entered to the system and marked as Pl1, Pl2, Pl3 can be matched to these tracks. The table of value of quality function is in table 1.

Table 1. Values of quality function

	Pl 1	Pl 2	Pl 3
Tr 1	0.56	0.0	0.0
Tr 2	0.0	0.65	0.89
Tr 3	0.0	0.52	0.71

If we use selfish scheduling algorithm and we permit to match the same plot to two tracks, we obtain matching table (tab. 2).

Table.2. Result of use selfish scheduling algorithm

	Pl 1	Pl 2	Pl 3
Tr 1	0.56	0.0	0.0
Tr 2	0.0	0.65	0.89
Tr 3	0.0	0.52	0.71

With track Tr 3 the same plot (Pl 3) has been matched. Plot Pl3 is matched to track Tr2 nevertheless for track Tr3 exists alternative matching (Pl 2) which value of quality function is over 50%. Such situation is typical during separation of the sticking tracks. The tracks have similar predictions and functions of quality. To both, with quite good value of quality function, we can match two different plots. By using selfish scheduling algorithm, to both tracks the same plot will be matched. Tracks remain stick. Most probably proper matching has a form (tab. 5.3).

Table 3. Proper solution

	Pl 1	Pl 2	Pl 3
Tr 1	0.56	0.0	0.0
Tr 2	0.0	0.65	0.89
Tr 3	0.0	0.52	0.71

The same result we will obtain using Hungarian algorithm. We should find such procedure which will block or make difficult to match the same plot to two tracks at the situations when are possible another, only slightly worse, matching. The author has developed the algorithm which permits matching of the same plot to two tracks only in the situation when in both cases it is only possible or really the best solution. The core of this idea is the modification of quality function value for the plot secondary matched. If the plot is secondary matched to the succeeding tracks, the value of quality function is decreased by half. If even the value of quality function decreased by half, and the plot best matches the track then this plot can be matched again to this track. In the opposite case, there is another plot with higher value of quality function then this plot will be matched to this track. Two tacks will not stick by matching of the same plot.

The algorithm consists of two steps. At the first step we are looking for all plots (columns in the table) which are the best matching for more then one track. For each of such plot, the second virtual plot is created, which represents possibility of repetitively matching of this plot to another track. The value of quality function for the virtual plot decreases by half compared to original. The second step it is finding the solution of such modified (increased by virtual plots) assignment problem using Hungarian algorithm. In the discussed case, it is only one plot which is the best matched for more than one track and make matching conflict. This is plot Pl 3. We are creating virtual plot Pl 3', which represents possibility to matching plot Pl 3 to another track. The value of quality function at the column Pl 3' less by half then the one in Pl 3. It gives us the following table of quality function:

Table 4. Values of quality function after adding virtual plot.

	Pl 1	Pl 2	Pl 3	Pl 3'
Tr 1	0.56	0.0	0.0	0.0
Tr 2	0.0	0.65	0.89	0.445
Tr 3	0.0	0.52	0.71	0.355

After solving the modified assignment problem (using Hungarian algorithm) we obtain results according to predictions. The plot Pl 3 is not matched again.

Table 5. Result of use proposed methodology

	Pl 1	Pl 2	Pl 3	Pl 3'
Tr 1	0.56	0.0	0.0	0.0
Tr 2	0.0	0.65	0.89	0.445
Tr 3	0.0	0.52	0.71	0.355

The plot Pl 3 will be matched again only when the alternative matching (Pl 2) has got drastically lower value of quality function, for example at situation described in table 5:

Table 6. In extreme situation the same plot can be matched again (as 3 and 3')

	Pl 1	Pl 2	Pl 3	Pl 3'
Tr 1	0.56	0.0	0.0	0.0
Tr 2	0.0	0.14	0.89	0.445
Tr 3	0.0	0.11	0.71	0.355

In this case, Pl 2 is probably the poor matching, which get into matched gate of both tracks (having similar predictions). The proper solution it is matching of two tracks with the same plot Pl 3, which occurs (as Pl 3 and repetitively as Plot 3').

In the presented solution one plot can be matched to maximum two tracks (one virtual columns representing repetitively matching is added). It is done intentionally. In this way, the number of sticking tracks is limited maximum to two. In reality, the sticking plots normally are created very seldom as result of connection more then two detections. This well corresponds with the presented solution. The simulation study has confirmed the effectiveness of proposed solution. The permanent stick of tracks does not occur. When trajectories of tracked target are separated, the sticking tracks are splitting according to our expectation. The presented solution represents total, design, implemented and tested by author. While presented solution drastically reduces probability of permanent sticking tracks however it does not give warranty that permanent sticking of the tracks does not occur. In such case it is necessary to design the system which detects sticking tracks and deletes one of them. This target is effectuated by module for tracks management. The decision problem, when two tracks are permanently sticking, opens the large area for implementation of heuristic techniques and artificial intelligence. There are also possible some modifications of matching method. For example, changing of reduction coefficient of quality value for the plot secondary matched.

Conclusions

Presented solution has a practical origin. During observations of the work of real tracking systems, sometimes a problem of matching detections with tracks appears. None of the classic solution works well for the full set of possible configurations. Proposed solution solves the problem. It fulfils the restriction, that single plot can be matched only with one track. In extreme situation when two targets fly very close each to the other and they are detected as one plot, the same plot can be matched with booth tracks. The advantage of presented solution is its simplicity. Only the table of quality function has to be modified. The algorithm of the assignation remains unchanged. Simulation and research proved that presented approach is more robust than others.

References

1. *Jacek Karwatka* Multiple Assignment as a Robust Method of Matching Detections with Tracks/ Proceedings of Signal Processing Symposium SPS-2009, 28-30 May 2009, Jachranka near Warsaw, Poland. (CD Publication)

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MONITORING OF BIOLOGICAL ORGANISMS IN ENVIRONMENT USING MODERN TECHNICAL MEANS

Some problems of construction of electronic network information systems (IS) with databases (DB) for biological organisms are described. Methods of radar registration of insect-pest quantities for the prevention of non- controlled increasing of their populations are suggested.

Introduction. During the last years we already have published the number of articles where the practice of IS construction for biology and medicine [1 – 3] is described. For successful construction of such IS it is necessary to take into account different sides of solved problems. 1 - biological (or medical) because the properties of biomedical objects define IS construction by itself. 1 – informational (as well as mathematic) because such IS has to process the information and may be described using mathematic rules. 3 - radiotechnical because such IS are formed on the base of complex of radiotechnical devices and may be explained and constructed basing on physical rules. In present work I would like to take into account all aspects of IS for biological and medical information.

Biomedical allocated DB with information from radars. Biomedical content of IS that we would like to observe includes great volume of the data about insects-pests. Such pests demonstrate great danger for national incomes for all countries with developed agriculture like Ukraine. Nowadays with the development of computer technique appears the tendency of collection of the data important for agriculture. The data about pests form enough important segments of such data. Into the DB have to be included following data: name of pest – specie and genus (using Cyrillic and Latin scripts), place and time of it's collection, name of collector, plants of feeding etc. In last years in such DB information from radars is also may be included (see below). Taking into account that million of insect species were registered for today, and each specie need few recordings one can imagine the volume of such DB. In terms of modern computer networks such DB the most reasonably have to be allocated DB because of collective contribution of numerical investigators and amateurs.

Radar information for IS with biomedical data. Radar information for IS with biomedical data is important due to different reasons. One of the most important is a possibility of specie recognition through analysis of some species characteristics. Some pest species in periods of propagation and migration form clouds that move in atmosphere. Each pest cloud may be characterized by frequency of wings vibration. With some approaches specific wing frequency vibration may characterize the specie of migrated pest. After the accumulation of such data into allocated DB frequency characteristics may be used for distant specie recognition by electronic system.

One of the most interesting examples of allocated electronic system for distant flying pest recognition using radar registration was done in Australia on 1999 [4]. This system is based on two remote radars used for insects monitoring - monitoring radars (MR). Computers are linked with node computer in central laboratory. Each MR is equipped by devices for meteorological monitoring under the control of personal computers (PC) for obtaining of meteorological data and their analysis. PC are connected with the central computer through modem and also linked with public telephone network. The channel PC – central computer is used for the transmission of data of monitoring. Engineers developed special automated system for analysis of meteorological information and the data of radars about insects – migrants. On the base of these data and analysis electronic system generates the daily statistical reports and represents radar information in graphical form. Farmers and other users may see in Internet useful for them information that is updated daily. In reports is represented information about intensity, amplitude, velocity and frequency of wings flapping as well as direction of insect cloud migration. Authors tested their system for such insects as *Chortoicetes terminifera* and *Helicoerpa punctigera*. Information about

the *Locust* migration is the most important in Australia because of it great danger for national incomes [4].

Domestic approaches. The same system step by step may be organized also in Ukraine because all elements of Australian system are present in Ukraine too [4]. Quality standards in Ukraine are also high for the obtaining of the same positive results. But for the construction of the same system necessary to take into account some peculiarities of our country. This peculiarity is the system of nature protection of high level that was developed during Soviet Union in Ukraine. This system of nature protection included numerical biological stations, preserves with respective scientific departments and staff. This staff with good biological education during decades collected biological data, results of biological monitoring of pests aimed on the defense of agriculture. Simultaneously during decades numerical results were collected by biological expeditions and amateurs. Obtained data were represented as paper versions in tables, reports, articles etc. All this complex system functioned successfully until 90-th years of XX century and in limited dimensions it functions today too. Achievements of this system – successes in agriculture in this period as well as successes in struggle with pests: Locust mass migrations from the delta of the Danube were blocked on early 60-th of XX century. Imperfections of this system from contemporary point of view were absence of data digitizing and standardizing, absence of computers and, respectively, impossibility of contemporary computer technologies use. Great volumes of the data registered during decades on XX century in Ukraine are at paper carriers still; their access and processing are difficult.

Conclusions. Analyzing the information given above necessary to emphasize following.

1. Radar electronic system for insect monitoring in Australia is a new step in control of ecological situation at great areas. This system has technically simple realization and may be constructed in Ukraine also.

2. Peculiarity of Ukraine is primary highly developed system of ecological monitoring with great volume of collected data at paper carriers; their access and processing are difficult.

So, basing on the developed networks of domestic biological stations it is possible to construct effective electronic system for ecological control. Sure, the presence of radar elements in this system is preferable. Probably, in contemporary domestic practice during the construction of such system the main emphasis has to be done on the system of PC at biological stations.

3. During the construction of electronic system for ecological monitoring in Ukraine (as opposed to described Australian variant [4]) necessary to realize one of the main principles of Internet systems: principle of decentralization. Decentralization is more natural for Ukraine with its great variety of computer network segments that were constructed spontaneously by different biological organizations and amateurs in different time.

References

1. *Ключко О.М.* Розробка електронних інформаційних систем для моніторингу фауни комах. – "Електроніка та системи управління". – №3(17). – 2008. – с. 57-63.

2. *Ключко О.М.* Створення екологічних баз даних як частини алгоритмів екологічного моніторингу. – "Електроніка та системи управління". – №2(16). – 2008. – с.42-50.

3. *Ключко З.Ф., Ключко О.М.* Про деякі особливості фауни совок (Lepidoptera, Noctuidae) Українських Карпат та Приельбрусся. – Известия Харьковского энтомологического общества. – Вип. 1-2. – 2007-2008. – С.165-167.

4. *Drake V. A., Wang H. K., Harman I. T.* Insect monitoring radar: remote and network operation. Computers and Electronics in Agriculture. - V. 35, Is. 2-3. – 2002. - P. 77-94.

5. Duan Y., Edwards J.S., Xu M.X. Web-based expert systems: benefits and challenges. - Information & Management. - V. 42, Is. 6. – 2005. - P. 799-811.

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A NOVEL RECONFIGURABLE DUAL BAND MICROSTRIP CIRCULAR PATCH ANTENNA USING COAXIAL FEED

A novel reconfigurable, dual band, coaxial feed microstrip circular patch antenna is presented in this paper.

Reconfigurable antennas have recently received much attention for their applications in wireless communications, Broadcast satellite systems, global positioning systems, with properties like high frequency selectivity, bandwidth, polarization and gain. [1]. Dual frequency reconfigurable microstrip antennas can offer advantages of frequency reuse for enhancing the system capability and polarization diversity with high efficiency for good performance of reception and transmission into one antenna [2]. The main advantage coaxial feeding scheme is that the feed can be placed at any desired location inside the patch to match input impedance and has low spurious radiation.

Design of circular patch antenna consists of a simple circular patch which is designed for resonant frequency of 7GHz. For dual band operation a stub is introduced with a length comparable to λ/4. The excited frequencies of dual band are tuned by changing the stub length. A pin diode controlled switching technique for reconfigurable dual frequency operation is used [3].

A coaxial type of feed is used. The inner conductor of the coaxial connector extends through the dielectric and is soldered to the radiation patch, while outer conductor is connected to the ground plane. The feed must be located in the design, where the input impedance is 50 ohms for the resonant frequency. For the different locations of the feed point, the return loss is compared and that feed point is selected where return loss is most negative.

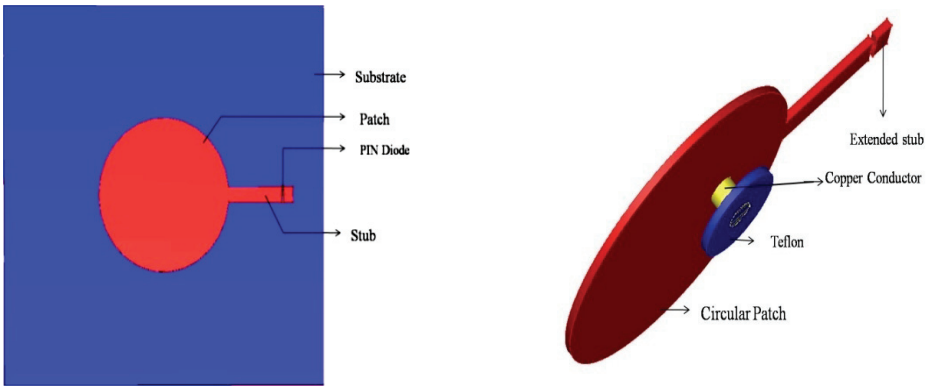

Fig. 1 Structure of circular patch antenna and coaxial feed

Stub length is varied to achieve good frequency matching for the four excited frequencies with high degree of return loss. Its parametric analysis is done using CST- Microstripes-2009[6]. Simulation results for the ON and OFF condition of PIN diode are reported.

The analysis of circular patch antenna is done using the cavity model. The cavity consists of two conductors one as a patch and another as a ground plane and a cylindrical magnetic conductor around the circular periphery of cavity. Electric and magnetic fields are determined by vector

potential approach. The figures of merit such as quality factor, bandwidth and efficiency are interrelated and are calculated to describe the performance of the antenna [5].

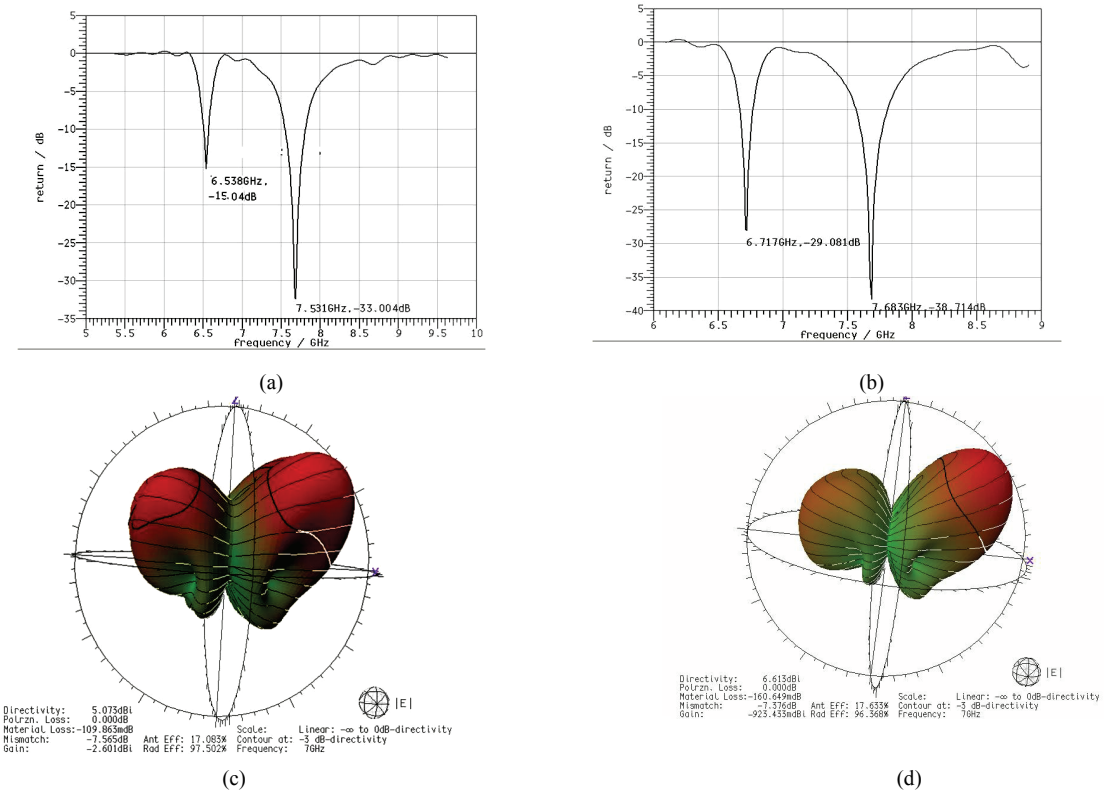

Fig. 2 (a) Response when PIN diode ON, (b) Response when PIN diode OFF
(c) Radiation pattern when PIN diode ON, (d) Radiation pattern when PIN diode OFF

When diode is in ON condition dual band frequencies of 6.53 GHz and 7.531 GHz is achieved with rejection levels of -15.04dB and -33dB respectively while in OFF condition of diode 6.71 GHz and 7.68 GHz is achieved with rejection levels of -29.08dB and -38.71dB respectively. Thus the proposed design presents reconfigurability of about 200 MHz with satisfactory level of return losses. The radiation efficiency is 97.5% in ON condition while 96.3% in the OFF condition of diode.

References

1. *Peroulis, D., K. Sarabandi, and P. B. K. Katehi,* "Design of reconfigurable slot antennas," IEEE Transactions on Antennas and Propagation, Vol. 53, 645–654, 2005.

2. *Shynu, S. V., G. Augustin, C. K. Aanandan, P. Mohanan, and K. Vasudevan*, "A reconfigurable dual frequency slot loaded microstrip antenna controlled by pin-diodes," Microwave and Optical Technology Letters, Vol. 44, 374–376, 2005.

3. *Shynu, S. V., G. Augustin, C. K. Aanandan, P. Mohanan, and K. Vasudevan,* "A compact electronically reconfigurable dual frequency microstrip antenna for L-band applications,"International Journal on Wireless and Optical Communications, Vol. 2, No. 2, 181–187, 2004.

4. *Shynu S . V, Gijo Augustin , C.K. Aanandan, P. Mohanan, and K.Vasudevan*, "A Reconfigurable Dual frequency Slot-Loaded Microstrip Antenna Controlled By Pin Diodes", 2005 Wiley Periodicals, Inc**.**

5. *Balanis, Constantini*. "Antenna Theory, Analysis & Design", Jonh Wisley & Sons, Inc., pp 752-764, 1982.

6. CST MICROSTRIPES - 2009

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SMALL SIZE AXIAL-SYMMETRICAL ANTENNAS FOR WiMAX APPLICATIONS

The cylindrical monopole antennas with the L-shape screen and an additional metal screen with the challenging performance for WiMAX applications are presented. The first antenna is the dual-band one with resonant frequencies f_1 = 7.2GHz and f_2 = 10.1GHz. And the second antenna is the broadband one with the resonant frequency f=8.87GHz and bandwidth Δf= 3GHz. The experimental results are in good agreement with simulations.

1. Introduction

The main goal of this paper is designing the small size cylindrical monopole antennas with a wide frequency band and omniderectional radiation pattern in the azimuth plane. In this respect, two types of antennas such as the antenna with the L-shape screen and the antenna with an additional screen are under test. We note that these antennas were investigated by us earlier with the aim to determine the main beamforming features of those. As a result, it has been shown that the radiation pattern can undergo fundamental modifications with changing the geometrical components [1-4]. Now we will very geometrical parameters to realize the antenna with characteristic noted above. We use the experimental set-up described in paper [8] in the frequency range 8 -11 GHz.

2. Beamforming of the antenna with the L-shape screen.

In this chapter we present the results of experimental and theoretical investigations of the radiation performance of antennas formed by the vertical monopole with the d_{r1} height as a central core of the coaxial cable and finite ground plane with the radius R. At that the monopole mount is located over the ground plane surface at the distance h (Fig. 1a**)**. The vertical part of the L-shape screen is formed by the coaxial cable armature. In our study the all aforementioned parameters were changed to determine the optimal ones.

a b

Fig.1. Antenna with the L-shape screen: general view (a) and prototype (b)

It has been determined that with the ground plane radius increase up to R=30mm one can see the resonant frequency shifting towards the lower frequencies for each fixed height of the vertical part h of the L-shape screen. The frequency dependences of the return loss coefficient for the antennas with parameter h changing within limits 7.5mm ≤ h ≤ 30mm (Fig. 2) show that the antenna with the minimal parameter h=7.5mm is ineffective (S_{11} > -10dB). The increase of this parameter up to h=15mm gives rise to the useful increase both the antenna bandwidth and antenna efficiency. It would be interesting to observe that with the subsequent parameter h increase up to h=22.5mm the given antenna becomes the dual-band one. At the same time the antenna becomes as the single-band antenna again when increasing the parameter h up to h=30mm.

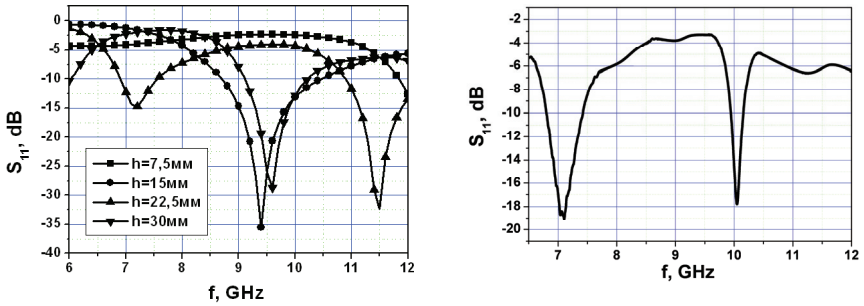

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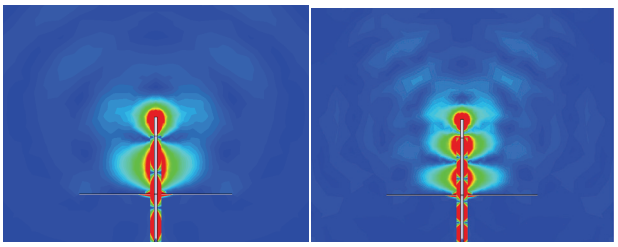
Fig. 2. Calculated (a) and measured (b) return loss coefficient of the antenna with the L-shape screen on the parameter h (d_{r1}=7.5mm, R=30mm)

A possibility of this antenna to operate in the double-band mode becomes evident when analyzing the near-field distributions (Fig. 3). In particular, by examining the E-component near-field distribution of the antenna with parameters d_{r1}=7.5mm, R=30mm and h=22.5mm we conclude that the vertical part of the L-shape screen can be considered as an additional resonance element of the given antenna design in which the resonance conditions are realized at the frequencies f=7.2GHz and f=11.5GHz. It is worth noting that the near-field distributions of antenna at these two frequencies differ essentially that will result in the radiation patterns changing.



a b

Fig. 3. The space-time near-field distributions for the L-shape screen antenna (d_{r1}=7.5mm, R=30mm and h=22.5mm) for the two resonant frequencies f_1 = 7.2GHz (a), and f_2 = 11.5GHz (b)

By analyzing the radiation patterns of the antenna at resonant frequencies noted above we can see the non-regular radiation pattern with the visible ripples at the frequency f=11.5GHz. Here, in contrast to the resonant frequency f=7.2GHz the main radiation maximum at the frequency f=11.5GHz is shifted towards zenith on $\theta=7^0$ (Fig. 4). But for both cases the high power radiation is oriented to the azimuth direction ($\theta=90^0$).

The antenna prototype with parameters d_{r1}=7.5mm, R=30mm, and h=22.5mm has been manufactured (Fig. 1b) and tested. This antenna is dual-band one with resonant frequencies f_1 = 7.2GHz and f_2 = 10.1GHz. The lower resonant frequency is in a good agreement with simulations. At the same time, the distinctions observed in the measured and simulated higher resonant frequency can be explained by the difference in both the armature type of the coaxial cable and top edge architecture of the vertical part of the L-shape screen in the physical model and in the prototype. From the near-field distributions we can conclude that the second resonance is exactly caused by the vertical part of the L-shape screen.

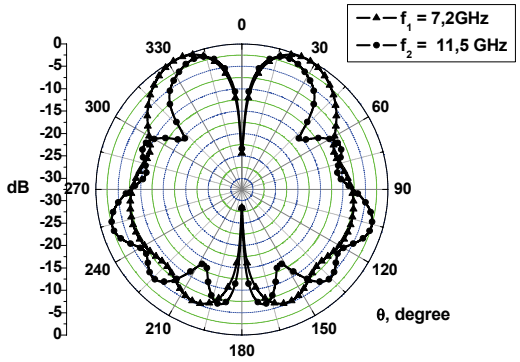


Fig. 4. The calculated radiation patterns of antenna with the L-shape screen (d_{r1}=7.5mm, R=30mm and h=22.5mm) for the two resonant frequencies: f_1 = 7.2GHz and f_2 = 11.5 GHz

3. Beamforming of the antenna with an additional screen.

The monopole antenna design under test includes the cylindrical monopole of d_{r1} height and the additional metal screen of R_1 radius. At that the monopole mount is located at the distance h over the stationary ground plane of R radius (Fig. 5a). As for the antenna with the L-shape screen, the all geometrical parameters of this antenna were changed in our investigations.

a b

Fig. 5. Antenna with an additional screen: general view (a) and prototype (b)

Taking into account the application aspect of presented investigations we shall consider the monopole antennas with an additional screen R_1=15mm and stationary ground planes with the following radii: R=7.5; 15; 22.5, and 30mm. In order to illustrate the visible changes in the radiation patterns of antennas we shall consider the most effective antenna (see Fig. 6) with following parameters: R_1=15mm, h=15mm, and R=30mm. It is worth noting that the antenna bandwidth exceeds 3GHz. Unlike the antennas with large stationary ground plane radii the antenna under test demonstrates the mono-beam radiation pattern (Fig. 7). Furthermore, the mono-beam radiation pattern remains virtually the same over the entire operational frequency band of antenna. The maximum radiation is shifted from zenith $\theta=27^0$ towards the azimuth plane $\theta=54^0$ with the frequency increase but the high power radiation is observed in the azimuth direction for all cases. The prototype with parameters noted above has been manufactured (Fig. 5b) and tested. The experimental results are in good agreement with simulations: the resonant frequencies are f_{ex}=8.87GHz and f_{sim}=8.73GHz; the antenna bandwidths are Δf_{ex}=3GHz and Δf_{sim}= 3GHz.

4. Conclussions

The broadband and dual band monopole antennas for WiMax applications with challenging radiation characteristics are presented. The EM field distributions in the near-field and far-field regions of cylindrical monopole antennas with the L-shape screen and additional metal screen allow one to formulate their main features, namely: (i) the vertical part of the L-shape screen is an additional

resonance element of the given antenna design realizing the dual band mode operation; (ii) the additional metal screen availability leads to the radiation focusing close to zenith.

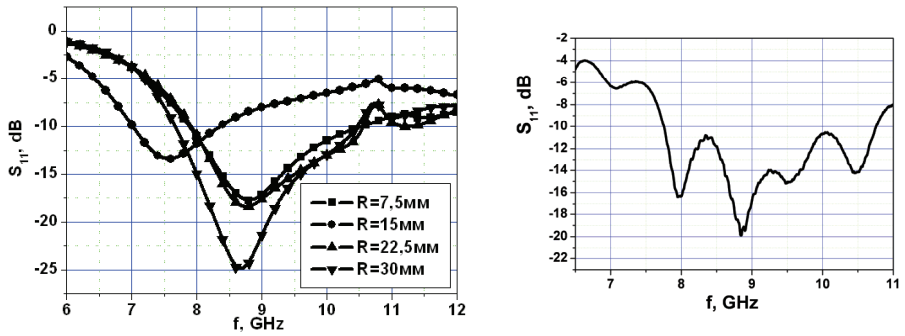


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Fig. 6. Calculated (a) and measured (b) return loss coefficient of antenna with an additional screen for different ground radii R (d_{r1}=7.5mm, R_1=15m, and h=15mm)

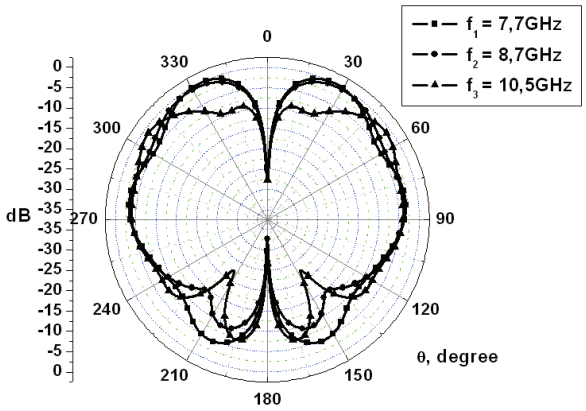

Fig. 7. The calculated radiation patterns of the antenna with an additional screen (d_{r1}=7.5mm, R_1=15mm, and h=15mm) for three frequencies inside the operational frequency band

References

1. *Ivanchenko I.V., Korolev A.M., Khruslov M.M., Pazynin V.L., Popenko N.A.,* The Features of Radiation Pattern Formation of the Monopole Antenna with Finite Screens // TELECOMMUNICATIONS AND RADIO ENGINEERING – vol. 65, 2006, No. 20, pp.1859-1869.

2. *Khruslov M.M., Pazynin V.* X-Band Coaxial Monopole Antenna With An Additional Screen // 16-th international conference on microwaves, radar and wireless communications MICON-2006, 22-26 May 2006, pp.756-758.

3. *Ivanchenko I.V., Korolev A.M., Khruslov M.M., Pazynin V.L., Popenko N.A.* Effect Of Finite Screen And Monopole's Height On Radiation Characteristics Of Monopole Antenna // 16-th international conference on microwaves, radar and wireless communications MICON-2006, 22-26 May 2006, pp. 729-731.

4. *Khruslov M.M., Pazynin V.* X-Band Coaxial Monopole Antenna With An Additional Metal Screen // JOURNAL OF TELECO9MMUNICATIONS AND INFORMATION TECHNOLOGY– 2007. No. 1, pp. 30-34.

5. *Andrenko A.S., Ivanchenko I.V., Ivanchenko D.I., Karelin S.Y., Korolev A.M., Laz'ko E.P., and Popenko N.A.*, Active Broad X-Band Circular Patch Antenna // *IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS,* vol. 5, 2006, pp. 529-533.

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BEAMFORMING REGULARITIES OF AXIAL-SYMMETRIC ANTENNAS FOR WiMAX APPLICATIONS

Regularities in changing characteristics of two types of antennas, cylindrical monopole antennas and dielectric disk antennas, as function of their geometrical parameters are determined and analyzed. The influence of edge effects on the beam shape is explained in terms of near-field phenomena emerging in the inductive region of the antenna. The availability of such information allows for optimizing the antenna parameters for each application. A number of original antenna designs with challenging characteristics for WiMAX applications is proposed and tested.

Introduction

Up-to-date communication systems exhibit a tremendous growth. In this respect, new requirements and new applications of these systems will get a great and permanent demand. In particular, the mobile terminals of wireless applications must be light, sufficiently small, low-cost, and efficient. However, taking into account the progress in electronic chip characteristics, the antennas have not experienced the same evolution from the development of smaller dimensions point of view. The main reason is that the size of the antenna is determined mainly by the laws of physics and not by technological innovations only. Therefore, the antenna should be optimized for each application to create reasonable compromise among geometrical dimensions, bandwidth, and efficiency. It is known that the monopole-type antenna performance is heavily dependent on ground plane effects [1-3] especially when miniaturized. It places severe restrictions on the lower frequency of operation and the bandwidth [4]. The results of these studies pointed out both in theory and experiments, some typical features in the antenna pattern when varying the ground plane size, namely: quasi-sinusoidal variations in the received power [5], ripples in the radiation pattern for co- and cross polarizations [4], strong oscillation in the peak directivity [6], shift in resonance frequency [7], etc.

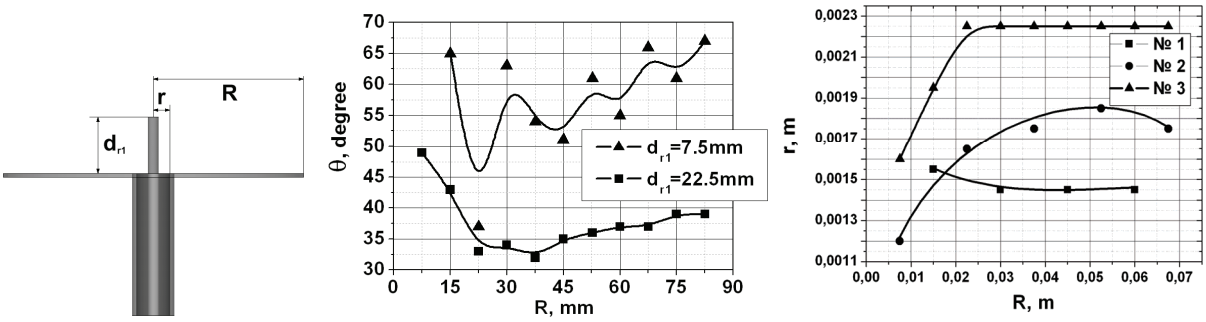
Main goal of this paper is to analyze in detail the role of edge effects on beamforming using axially symmetric antennas and to propose high efficient small-size antennas operating in the X-band range because just higher operational frequencies in mobile-communication systems give the possibility to use larger bandwidths requested by multimedia services or high-speed data transfer [8].

Result and discussion

A simple antenna producing the omnidirectional radiation pattern is the cylindrical monopole antenna (Fig. 1a). Simulations and measurements of the input reflection coefficient as well as the near- and far-field distributions have been performed for a number of antenna designs when varying the geometric and physical parameters of the antenna.

To our opinion for the first time we have explained the oscillating behavior of the maximum radiation angle and resonance frequency for the $\lambda/4$ monopole antenna when increasing the ground plane radius R (Fig. 1b). The variation is caused by a changing space field structure in the inductive region of the antenna, namely: for antennas with R equal to a multiple times $\lambda/2$ only two variations are observed along the ground plane radius whereas for antennas with R equal to an odd times $\lambda/4$ the number of such variations increases when increasing the ground plane size [9]. At the same time, a similar (but slower changing) dependence for the $3\lambda/4$ monopole is obtained and it possesses a minimum value $\theta \approx 32^0$ within the interval R=20-45mm (Fig. 1b). It is accompanied by a transformation from a mono-beam radiation pattern into a multi-beam one. For the $\lambda/4$ monopole

such modifications appear from R=30mm onwards whereas for the 3λ/4 monopole the number of beams also increases from R=30mm but unlike the λ/4 monopole we now observe an increased number of beams in the backward direction [9]. It is worth noting that the circular diaphragm for the coaxial output in the ground plane is the second diffraction element of the antenna. Our investigations have shown that one can choose an optimal circular diaphragm radius providing an essential improvement in the radiation characteristics especially for the antenna with a monopole height of λ/4 (Fig.1c).



a b c

Fig.1. Cylindrical monopole antenna: scheme drawing (a); the elevation angle of the peak directivity for d_{r1}=λ/4 and d_{r1}=3λ/4 (b); optimal circular diaphragm radius versus the ground plane radius for d_{r1}=λ/4 (curves 1 and 2) and d_{r1}=3λ/4 (curve 3) (c).

Based on the results noted above we propose some new antenna designs. One is a monopole antenna with characteristics L-shape screen (Fig.2a). From our study it has been shown that the antenna is the dual-band one in the wide frequency range 6GHz - 18GHz (Fig. 2b). The extension of the vertical part of the L-shape screen (parameter h) leads to a shift in the resonance frequency towards lower ones and decreasing the mutual distance between them. By analogy with the antenna reported in [10], the given antenna also combines two resonant elements. This is illustrated by the calculated near-field distribution (Fig. 2c). The measurements performed for the antenna prototype are in good agreement with simulations [11]. We also have shown that by using an additional metal screen the antenna becomes a single-band one with bandwidth of about 3GHz. Both antennas just mentioned provide stable monopole-like conical patterns across the full impedance bandwidth which is important for practical applications.

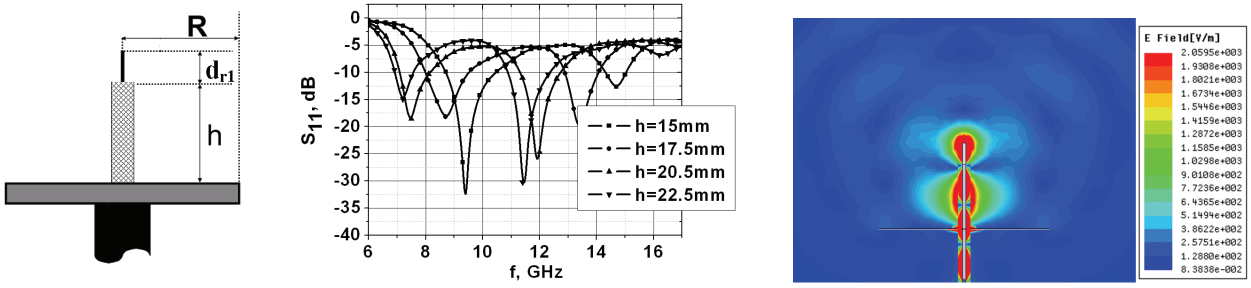


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Fig. 2. Cylindrical monopole antenna with the L-shape screen: scheme drawing (a); input reflection coefficient versus the parameter h (b); near-field distribution (c).

Vertical monopole antennas, partially or entirely buried in a grounded dielectric substrate, attract attention in connection with some applications such as a monopole submerged partially or entirely in soil or water and as a feed structure for microstrip antennas [12]. For these reasons we investigated the characteristics of the aforementioned antenna designs, which were placed into the dielectric, and we modified both geometric and physical antenna parameters. In particular, the characteristics of the cylindrical monopole antenna placed into different dielectric layers have been analyzed in detail and discussed in our previous paper [13]. As it follows from our study, the near-

field distributions in the inductive region of the cylindrical monopole antenna with ground plane radii R>30mm at each resonance frequency look like a spatial periodical lattice with a different number of field variations along the ground plane radius. At that, the amplitude of these oscillations decays to the antenna edge. Moreover, several resonance frequencies are exited in the frequency band under test. Here, the number of beams changes when passing from one resonant mode to another. Antennas with R≤15mm provide a mono-beam radiation pattern over the impedance bandwidth. In this case an increase in layer permittivity results in a resonance frequency shift of the antenna towards higher frequencies and in achieving a maximum gain and bandwidth for a relative permittivity 2.2<ε<4.4. The best antenna prototype demonstrates a beamwidth $\Delta\theta=77^0$, gain G=3.08, bandwidth Δf=2.04GHz at the resonance frequency f=8.49GHz.

The antenna design with L-screen embedded into a dielectric (Fig. 3a) could be used both as dual-band one and a wide-band antenna shaping the mono-beam radiation pattern [14]. For example, as learned from calculations the antenna prototype produces a mono-beam radiation pattern over a frequency band of more than 53% (Fig. 3 b, c).

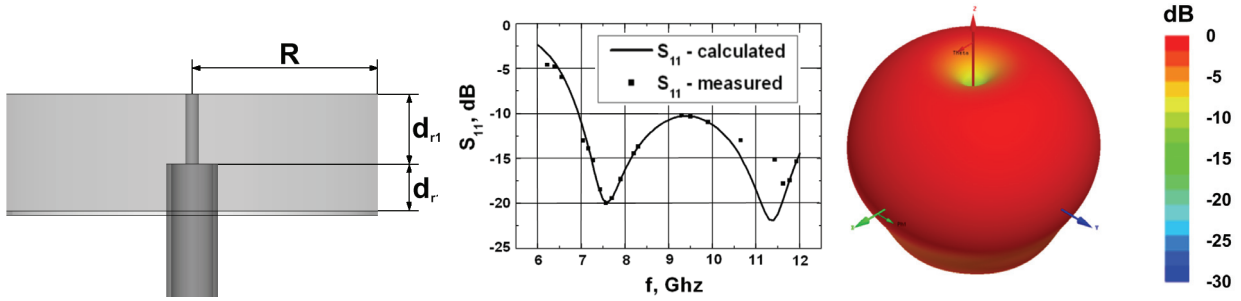


Fig. 3. Cylindrical monopole antenna with L-shape screen embedded into the dielectric (ε=2.5, R=30mm, d_r=2mm, and d_{r1}=4.9mm): scheme drawing (a); input reflection coefficient (b), radiation pattern at f=7.6GHz (c).

The edge effect in on beamforming of the dielectric disk antenna (Fig.4a) has been investigated in our previous papers [15 - 17]. It has been shown [15] that similar to monopole antennas in a dielectric layer, the near-field distribution in the inductive region of the disk dielectric resonance antenna has also a periodical structure. That is why such antennas can produce both the mono- and multi-beam radiation patterns depending on the relation between the relative permittivity of the substrate and the dielectric disk. For example, a wide band (bandwidth Δf=4.1GHz) (Fig.4b), mono-beam radiation pattern (Fig. 4c), and high gain was obtained for an antenna with the substrate radius R_s=15mm and for optimal disk radius [17].

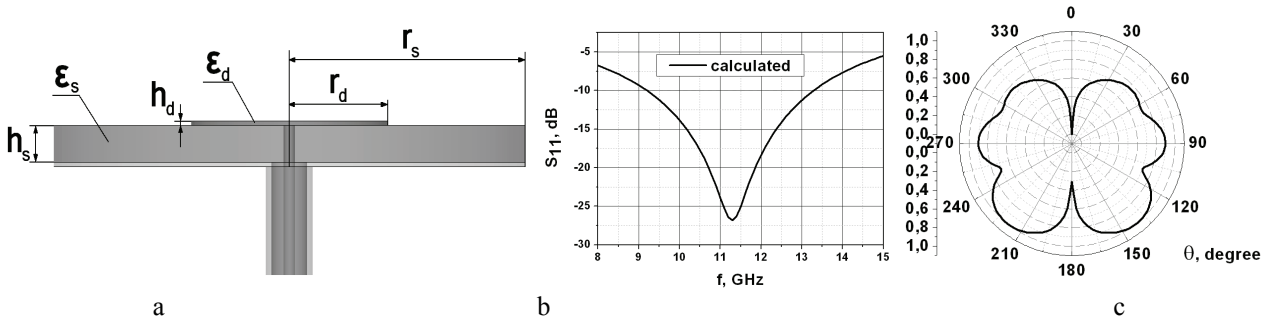
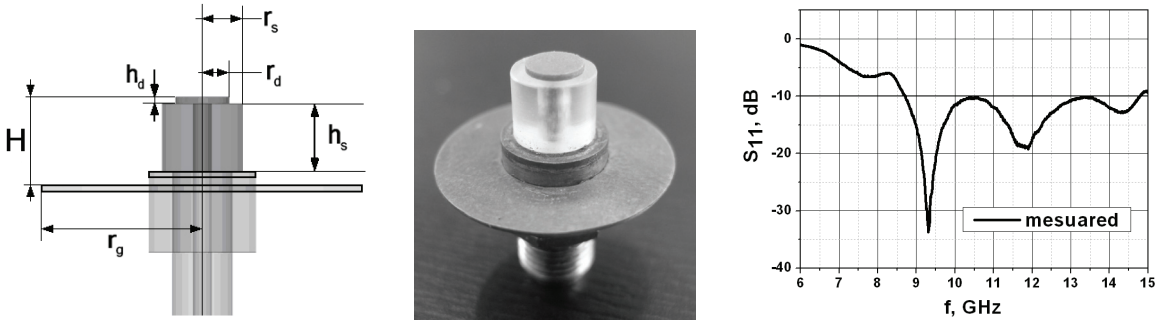


Fig. 4. Dielectric disk antenna: scheme drawing (a); input reflection coefficient (r_d =2mm, h_s=5mm, r_s=3mm) (b), and radiation pattern at f=11.3GHz (c).

We also have shown that the best characteristics appear for the antenna with the following parameters: r_d = 2mm, r_s=3mm, h_s=5mm, r_g=12mm, and H=8.5mm (Fig. 5a). The photo of the antenna prototype is shown in Fig. 5b. In this case the antenna has three resonance frequencies within the -10dB impedance bandwidth Δf=6.0GHz (Fig. 5c) and a mono-beam radiation pattern.



a b c

Fig. 5. Dielectric disk antenna (r_d =2mm, h_s=5mm, r_s=3mm): scheme drawing (a); antenna prototype (b); input reflection coefficient (c).

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Conclusions

By employing a near-field approach we have in our opinion for the first time clarified the role of edge effects on antenna beamforming. It allowed us to manipulate the antenna performance by means of (on purpose) enhancement or attenuation of these effects. Furthermore, there is a possibility to predict the antenna beam shape by using different elementary additions into the antenna structure allowing for the formation of a suitable near-field distribution. Different axially symmetric antenna designs with challenging characteristics for practical applications have been proposed and tested, namely:

- dual-band monopole antenna with L-shape screen in which resonance frequencies can be shifted by changing the height of the vertical part of the latter;
- broadband monopole antenna with an additional metal screen in which the bandwidth control is realized by changing the mutual distance between the two parallel-plate screens;
- small-size dielectric disk antenna (bandwidth Δf=4.1GHz);
- combined metal-dielectric disk antenna (bandwidth Δf=6.0GHz).

References

1. *A.T. Arkko,* "Effect of Ground Plane Size on the Free-Space Performance of a Mobile Handset PIFA Antenna," IEEE Int. Conf. Antennas & Propagat. (ICAP), (1), 316-319, 2003.
2. *E.Antonino-Daviu, C.A.Suarez-Fajardo, M.Cabedo-Fabrés, M.Ferrando-Bataller,* "Wideband Antenna for Mobile Terminals based on the Handset PCB Resonance," Microwave Opt. Technol. Lett, 48, (7), pp. 1408-1409, 2006.
3. *M.J.Ammann and M.John*, "Optimum Design of the Printed Strip Monopole," IEEE Antennas & Propagat. Mag,. Vol. 47, No. 6, pp. 59-61, 2005.
4. *M.J.Ammann and M.John.* SOME TECHNIQUES TO IMPROVE SMALL GROUNDPLANE PRINTED MONOPOLE PERFORMANCE, Antennas and Propagation Society International Symposium, 2007 IEEE , pp.2825-2828.
5. *Edward E. Altshuler, Terry H. O'Donnell,* "The Measurement of Antenna Gain with Transmitting and Receiving Antennas on a Finite Ground Plane," Antennas and Propagation Society International Symposium, 2007 IEEE, pp. 533-536.

6. Haruo Kawakami and Takashi Ohira, “Electricail Steerable assive Array Radiator (ESPAR) Antennas,” IEEE Antennas and Propagation Magazine, Vol. 47, No. 2, pp. 43-49, April 2005.

7. *Eric Lier and Kurt R. Jakobsen,* “Rectangular Microstrip Patch Antennas with Infinite and Finite Ground Plane Dimensions,” IEEE Trans. Antennas Propagat., vol. AP-31, No. 6, November 1983, pp. 978-984.

8. *A.K.Skrivervik, J.-F.Zurcher, 0.Staub and J.R.Mosig*, “PCS Antenna Design: The Challenge of Miniaturization,” IEEE Antennas and Propagation Magazine, Vol. 43, No. 4, August 2001, pp. 12-27.

9. *I.V.Ivanchenko, L.P.Ligthart, A.M.Korolev, V.L.Pazynin, N.A.Popenko, M.M.Khruslov*,” Size effect of the ground plane and axial coupling aperture on the monopole antenna performance,” The Seventh International Kharkov Symposium on Physics and Engineering of Microwaves, Millimeter and Submillimeter Waves (msmw'10) Kharkov, Ukraine, June 21-26, 2010.

10. *Dong-Uk Sim, Jung-Ick Moon, and Seong-Ook Park,* “A Wide band Monopole Antenna for PCS/IMT-2000/Bluetooth Applications,” IEEE ANTENNAS AND WIRELESS PROPAGATION LETTERS, VOL. 3, 2004, pp. 45-47.

11. *I.V.Ivanchenko, A.M.Korolev, V.L.Pazynin, N.A.Popenko, M.M.Khruslov,* “Effect of finite screen and monopole’s height on radiation characteristics of monopole antenna,” In: Proc. MICON-2006, 729-731.

12. *Zhongxiang Shen and Robert H. MacPhie,* “Modeling of a Monopole Partially Buried in a Grounded Dielectric Substrate by the Modal Expansion Method,” IEEE Trans. Antennas Propagat., vol. 44, No. 11, pp. 2-24, November 1996.

13. *I.V.Ivanchenko, N.A.Popenko, M.M.Khruslov, R.E.Chernobrovkin*, “Beamforming features of the grounded dielectric substrate based X-band monopole antenna,” RADIOELECTRONICS & INFORMATICS № 4 (43), October – December 2008, pp 4-10.

14. *I.Ivanchenko, N.Popenko, M.Khruslov*, “Compact X-band Coaxial Monopole Antenna,” 3rd European Conference on Antennas and Propagation, 23-27 March 2009, Berlin, Germany, pp. 442-444

15. *A.Andrenko, I.Ivanchenko, N.Popenko, M.Khruslov*, “Near-Field Characterization And Radiation Properties of Circular Dielectric Patch Antennas,” Proc. of 2-nd Intern. Conf. on Electromagnetic Near-Field Characterization & Imaging, Barcelona-Spain (8-th-10-th June, 2005), pp.174-179.

16. *A.Andrenko, N.Bliznyuk, I.Ivanchenko, N.Popenko, M.Khruslov*, “Theoretical and Experimental Study of Microwave Circular Dielectric Patch Antennas,” «JINA 2004», Nice, France, November 8-10, 2004, pp. 450-451.

17. *I.V.Ivanchenko, N.A.Popenko, M.M.Khruslov*,”Compact high performance dielectric disk antenna for wimax application,“ Microwave Opt. Technol. Lett, 52, (3), pp. 580-584, March 2010.

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THE DEVELOPMENT OF NORMS OF FREQUENCY AND DISTANCE SEPARATION OF DIGITAL BROADCASTING AND TELEVISION OF STANDARD T-DAB AND DVB-T WITH THIN-ROUTE RADIO RELAY STATIONS

The paper addresses the problem of electromagnetic compatibility of digital broadcasting and television, which is planned for the frequency bands 174-230 MHz and 470-862 MHz with existing radio relay stations (RRS) P-409 and P-419. Drafting standards of frequency and distance separation between the means of digital broadcasting and radio relay stations P-409, P-419 were developed with established software.

On November 26th 2008 the State program of digital broadcasting in Ukraine was approved by the Cabinet of Ministers of Ukraine. The aims of program are to implement the decisions adopted by Ukraine at the Regional Radiocommunication Conference of ITU-R in Geneva in 2006, which envisages the transition from analog to digital broadcasting by 2015.

The country must build an infrastructure for digital broadcasting with guaranteed coverage throughout the territory in the bands 174-230 MHz (third TV band), 470-862 MHz (fourth and fifth television band). The third range serves for audio broadcasting in standard T-DAB which is compatible with television standard DVB-T. In the fourth and fifth television bands there will be only digital television broadcasting.

An obligatory step in obtaining permission for broadcasting is positive decision relatively electromagnetic compatibility of digital broadcasting with other radio electronic equipment (REE), including radio relay stations (RRS) P-409M, P-419A. Efficient frequency planning tool is the norms of frequency and distance separation (FDS), which are considered in this work.

Standards DVB-T, DVB-H are based on the algorithm coding audio and video MPEG-2 or MPEG-4 [1] , [2].

Implementation of standards DVB-T, DVB-H stipulates construction single-frequency synchronous network SFN. In single-frequency network synchronization of operation should be provided with satellite transmitters or terrestrial channels. Radiated symbols have to be identical.

In the DVB standard modulation COFDM (OFDM with previous coding) is used. TV signal of 8, 7, 6 MHz bandwidth is formed using orthogonal carrier, the frequencies of which are defined as:

$$f_n(t) = \cos\left[2\pi\left(f_0 + n/\tau\right)t\right],$$

where: f_0 - the lower frequency of range; n - the number of sub-currier 1 до N; τ - time interval of transmission of one symbol.

During modulation packet data stream is divided by N parts, which modulate carriers with less speed. Carrier frequency offset

$$\Delta f_n = \frac{1}{\tau}.$$

To preserve orthogonality and prevent intersymbol interference that may arise as a result of multipath propagation, each symbol interval obtain protective value of $0{,}25\,\tau$.

In the 8 MHz bandwidth, used in Europe, the maximum carrier number $8 \times 1024 = 8192$ or $8K$. Each carrier is modulated by 4-position quadrature phase shift keying (QPSK) or 16- or 64-position quadrature amplitude modulation (QAM). Accordingly, one modulation symbol on carrier transfers from two to six bits.

Also according to the number of quadrature modulation levels the data stream is divided into: 2 sub-streams for QPSK, 4 sub-streams for 16- position QAM. So during demultiplexing the first bit appears in the first sub-stream etc. Sense of internal interleaving is permutation by definite individual rule in each sub-stream of bits by block with length 126 bits. In parallel outputs of the

internal interleaving block the modulation symbol is formed with two, four or six digits. One carrier transfers one symbol. Therefore, using $8K$ mode simultaneously is radiated 48 groups of 126 symbols, that corresponds to 6048 carriers with useful information, or 12×126=1512 carriers using $2K$ mode. QAM-symbols are divided into different sub-channel of OFDM interleaving, which allows to restore the information at a loss OFDM-symbol. Complex signal of OFDM-symbol [3] is written

$$S_n = \sum_{k=0}^{N-1} C_k(nT) e^{i2\pi knT/n}, \quad (1)$$

where: T - discrete time interval; n - reference number.

Expression (1) identical to the Fourier inversion at sampling interval equals to the ratio of duration of one transmission symbol to the carrier number.

Radiated DVB signal looks like noise-type with Gauss distribution. Spectrum of signal consists of a large number of partial spectral modulated carriers. Due to this spectrum is practically continuous.

Radio frequency masks of DVB-T radiation signal is presented at Fig. 1 [4].

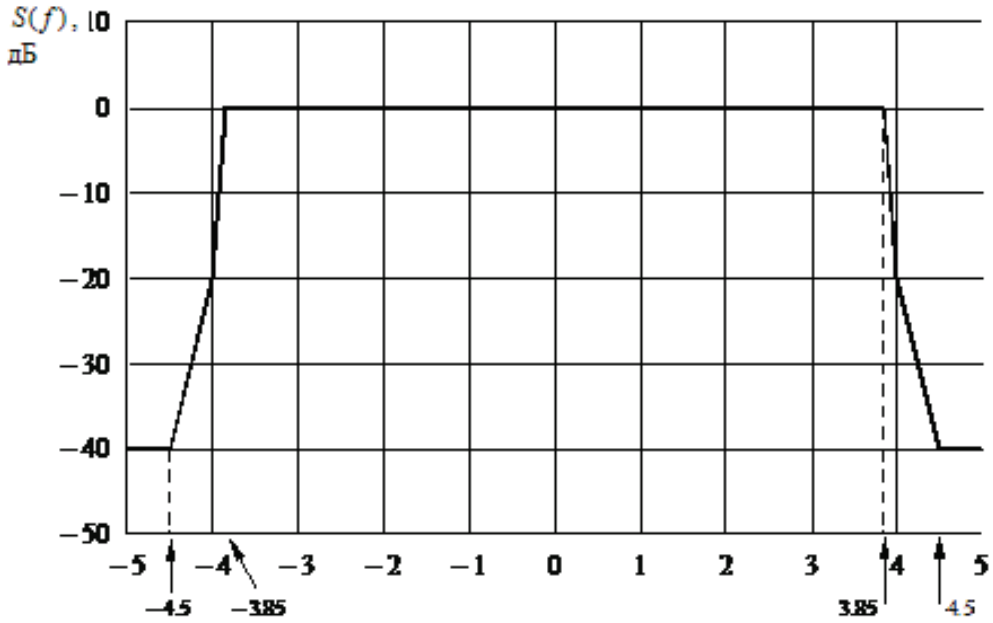

Fig. 1 Radio frequency mask of digital television with bandwidth of 8 MHz

Typical antenna system can be built on the basis of firm ELTI sectored antennas TVA 31/50 or TVA 24/50, which have a similar structure and different number of radiators (respectively 4 and 2). TVA 24/50 can radiate waves with horizontal or vertical polarization (depending on the spatial position) in a working range of 470-862 MHz, directivity factor 6.8 ... 9 dB (with respect to the dipole), bandwidth in E and H planes $2\theta_{0,5}^{E} = 56^{o}$, $2\theta_{0,5}^{H} = 49^{o}$.

At placing four antennas TVA 31/50 or TVA 24/50 in the horizontal plane radiation pattern can be considered isotropic. In order to obtain greater directivity in the vertical plane using antenna TVA 31/50 or TVA 24/50 these aerials form antenna arrays with number of racks from 1 to 16. Designs from one, two and three aerials in horizontal plane and antenna racks in vertical plane can provide radiation in azimuthal sectors $\varphi = 0...90^{0}$, $\varphi = 0...180^{o}$, $\varphi = 0...270^{o}$ correspondingly.

Parameters of antenna systems based on TVA 31/50 are given in the table 1.

Table 1

Parameters of antenna systems standard DBV-T / H with horizontally polarized aerials TVA 31/50

Parameter	Number of antenna racks in the vertical plane at non-directional radiation in the horizontal plane				
	1	2	4	6	8
Number of radiators TVA 31/50	4	8	16	24	32
Maximum input power, kW (analogue)	10	20	40	60	80
Maximum input power, kW (digital signal)	8	16	32	48	64
Gain at a frequency of 665 MHz with respect to the dipole, dB	4,87	7,88	10,89	12,65	13,9
SWR in a wide range	≤ 1.12	≤ 1.12	≤ 1.12	≤ 1.12	≤ 1.12
SWR in the working channel	≤ 1.05	≤ 1.05	≤ 1.05	≤ 1.05	≤ 1.05

RRS P-409, P-419 [5-9] belong to a thin-route stations, designed to build a radio relay lines, and perform some other functions. P-409 has three frequency bands, P-419 – four. The transition from one to another frequency band of P-409 is carried out by replacing the antenna and removable elements of transceiving path. RRS P-419 in the third and fourth frequency bands uses one antenna. In case of good matching antenna with the feeder the overlapping factor is equal two. Restrictive lines of directional diagrams (DD) antennas RRS P-409, P-419 were built. Equations of restrictive lines DD Z-shaped antenna with a screen in the E-plane is presented in the Table 2.

Table 2

Equations of restrictive lines DD Z-shaped antenna with a screen in the E-plane at a 180 MHz

Sector, degrees	Equation	Sector, degrees	Equation
0…15	$F(\theta) = 1$	0…-15	$F(\theta) = 1$
15…35	$F(\theta) = -0{,}0275\theta + 1{,}4125$	-15…-35	$F(\theta) = 0{,}0275\theta + 1{,}4125$
35…78	$F(\theta) = 0{,}45$	-35…-78	$F(\theta) = 0{,}45$
78…110	$F(\theta) = -0{,}00895\theta + 1{,}148$	-78…-110	$F(\theta) = 0{,}00895\theta + 1{,}148$
110…156	$F(\theta) = 0{,}11$	-110…-156	$F(\theta) = 0{,}11$
156…180	$F(\theta) = 0{,}01 + 1{,}45$	-156…-180	$F(\theta) = -0{,}01 + 1{,}45$

Detail description of procedures of EMC evaluation is considered in [10].

Software for calculation norms FDS was developed based on the above data. Norms of frequency and distance separation are intended for use in frequency planning of digital television broadcasting networks standards DVB-T, DVB-H and selection locations for transmitters in order to ensure their electromagnetic compatibility with radio relay stations P-409 and P-419.

Draft Norms of frequency and distance separation are presented as tables containing the data for different versions of electronic means applications. Tables corresponding to three cases of mutual orientation of broadcasting antennas and RRS aerials, namely:

- toward the peaks of both antenna directional diagrams (main to main);
- in the direction of maximum antenna pattern DVB-T - the maximum of the first side lobe of antenna pattern RRS (main to 1-st side);
- in the direction of maximum antenna pattern DVB-T - maximum of the back and side lobes of antenna pattern RRS (main to back side).

It is assumed that all power except feeder losses (accepted = -1.5 dB) is applied to the terminals of corresponding sector antenna in the direction of RRS.

During defining drafts FDS gain value of antenna DVB-T transmitter $G_0 =$ 10,89 dBi (against dipole) is used. Antenna gain is connected with the directivity factor D by aerial

efficiency η_A: $G = D\eta_A$. For dipole $D = 1{,}64$. In the considered band efficiency value can be assumed η_A=0,95. Then $G_{\lambda/2} \approx 1{,}6$. Example of drafts FDS is contained in Table 5.

Table 5

Draft norms of frequency and distance separation of RRS P-409M(MA) and digital broadcasting and television of standard T-DAB and DVB-T

Conditions of determination FDS norms	DVB-T transmitter output power, W											
	10		50		100		400		1200		5000	
Frequency of radiation f = 470-480MHz	$D^{1)}$, km	$\Delta f^{2)}$, MHz	$D^{1)}$, km	$\Delta f^{2)}$, MHz	$D^{1)}$, km	$\Delta f^{2)}$, MHz	$D^{1)}$, km	$\Delta f^{2)}$, MHz	$D^{1)}$, km	$\Delta f^{2)}$, MHz	$D^{1)}$, km	$\Delta f^{2)}$, MHz
Antenna orient-tation Rec.-Trans.: main to main	9,5	0	16,4	0	20,6	0	28,8	0	36,6	0	48,3	0
	9,5	3,7	16,4	3,7	20,5	3,7	28,8	3,7	36,6	3,7	48,3	3,7
	8,7	3,8	15,1	3,8	19,1	3,8	27,2	3,8	34,7	3,8	46,1	3,8
Hanging height of DVB-T antenna (Trans.): 250m	6,3	3,9	10,8	3,9	13,7	3,9	21,4	3,9	28,1	3,9	38,2	3,9
	3,2	4,0	5,5	4,0	7	4,0	11,1	4,0	16,2	4,0	24,5	4,0
	0,7	4,1	1,1	4,1	1,4	4,1	2,2	4,1	3,2	4,1	5,2	4,1
	0	4,2	0	4,2	0	4,2	0,6	4,2	0,9	4,2	1,5	4,2
Hanging height of RRS antenna (Rec.) : 19,5m	0	4,3	0	4,3	0	4,3	0	4,3	0,7	4,3	1,1	4,3
	0	4,4	0	4,4	0	4,4	0	4,4	0	4,4	0,7	4,4
	0	4,5	0	4,5	0	4,5	0	4,5	0	4,5	0	4,5
	0	4,6	0	4,6	0	4,6	0	4,6	0	4,6	0	4,6
	0	4,7	0	4,7	0	4,7	0	4,7	0	4,7	0	4,7

1) D - separation by distance
2) Δf - separation by frequency.

Frequency and distance separation norms simplify attainment of electromagnetic compatibility digital broadcasting and television with existing radio relay stations P-409 and P-419 in the bands 174-230 MHz and 470-862 MHz.

References

1. *Довідник* з радіомоніторингу / Під аг. Ред.. П.В. Слободянюка. – Ніжин: ТОВ «Видавництво Аспект-Поліграф», 2008. -588 с.

2. *ETSI TR101 190:* 2004 Digital Video Broadcasting (DVB); Implementation guidelines for DVB terrestrial services; Transmission aspects.

3. *Вишневский В.М., Ляхов А.И., Портной С.Л., Шахнович И.В.* Широкополосные беспроводные сети передачи информации. – М.: Техносфера, 2005. – 592 с.

4. *Recommendation* ITU-R BT.1206. Spectrum shaping limits for Digital Television Broadcasting.

5. *www*.interpolitex.rasu.ru/index.php.

6. *www*.radioscanner.ru/photo/antennas/relay.php

7. *vkmtuci*.edu.mhost.ru/texcba/rrlspravka.htm

8. *www*.omskindustry.ru/firm.asp?skl=7579

9. *www*.techtorg.ru/firm.asp?skl=7579

10. *Іванов В.О., Решетнік М.В., Бондаренко Д.П.* Алгоритм розрахунку норм частотно-територіального рознесення радіоелектронних засобів. – К.: Вісник ДУІКТ. – 2007. – Том5(3). – С.262 – 270.

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NOISE DETECTION CONDITIONS FOR BIOLOGIC ELECTRIC FIELD EFFECT: MATHEMATICAL MODELING

In the present paper the mathematical modelling of electric field effect, thickness of double layer and small surface electric potential (less than 25 mV) of the red blood cell membrane and capillary wall are provided. The capillary blood flow, pressure and shear stress tension as conditions of noise detection are examined.

Introduction

Blood flow in vessels and capillaries is accompanied by occurrence of acoustic noise. Characteristics of this noise are defined by blood properties and character of its flow (blood flow quantity per second, difference of pressure, stress tension), and external conditions. Such external conditions can be electric, magnetic and gravitation fields, thermodynamic parameters of environment, an emotional condition of the person etc.

In the papers [3, 4] an electrical charge presence of red blood cells (RBC) with potential $\tilde{\zeta}$ and capillary wall for calculation of hydrodynamic characteristics of a single RBC movement in capillaries was not taken into account. At the same time the influence of electrical forces on hydrodynamic flow of a conducting viscous liquid between two spheres, between parallel plates and in a cylindrical capillary is estimated in paper [1, 2, 7]. The additional drop pressure arising due to influence of electro-kinetic forces has the same order of value as hydrodynamic drop pressure value.

Method

Let's take the double layer (Fig.1), where $\bar{\varepsilon} = 1/\bar{\chi}$ – thickness of a double layer forms a negative charged surface with positive charged anions ($\bar{\chi}$ – Debye's shielding radius); $\bar{\varphi}_1$, $\bar{\varphi}_2$ – superficial potential of a cell and a capillary wall. $\bar{R}_0$ and $\bar{a}$ – capillary and inner cylinder radiuses.

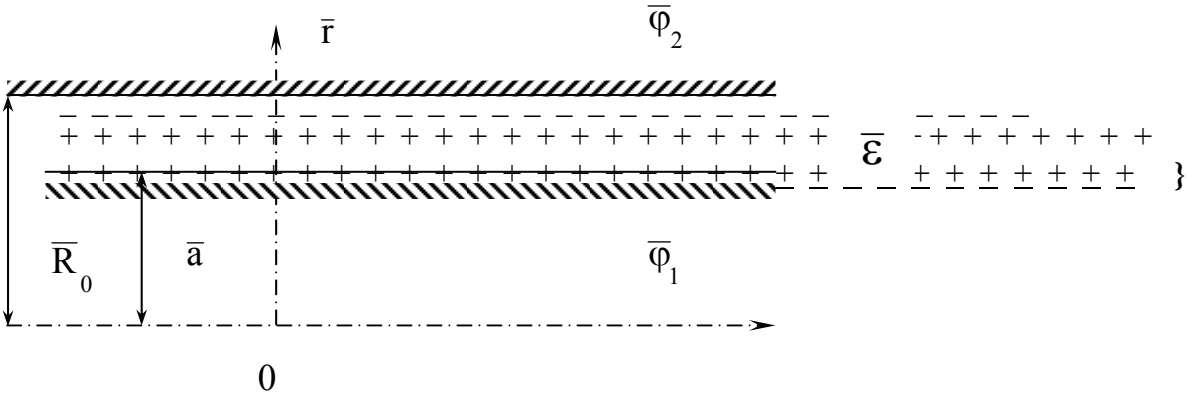

Fig. 1. Formation of double layers in an electro-viscous liquid flow at charged capillary and internal cylindrical wall

There is an electro-viscous liquid flow in a layer between internal and external cylinders is described by the Poisson-Boltzmann equation [1, 7] for dimensionless value – distribution function of an electric charge density $f(\mathrm{r}, \mathrm{z})$:

$$\frac{1}{\mathrm{r}}\frac{\partial}{\partial \mathrm{r}}\left(\mathrm{r}\frac{\partial f(\mathrm{r},\mathrm{z})}{\partial \mathrm{r}}\right) = \mathrm{Sh}\,(f(\mathrm{r},\mathrm{z})) \qquad (1)$$

The boundary conditions for equation (1) are:

$$f(\beta\chi, z) = \varphi_1 , \quad f(\chi , z) = \varphi_2 , \tag{2}$$

Where φ_1, φ_2 – dimensionless superficial potentials; r, z – dimensionless coordinates: $r = \bar{r}/\bar{a}$, $z = \bar{z}/\bar{R}_0$; $\chi = \bar{\chi}\bar{R}_0$; $\beta = \bar{a}/\bar{R}_0$, Sh – Struhal's number.

The boundary-value problem (1) and (2) may be decided only numerically [2, 5, 6]. But if we are limited by small superficial potentials (no more than 25 mV), then $|\varphi_1, \varphi_2| \le 1$ equation (1) becomes simpler:

$$\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial f(r)}{\partial r}\right) = f(r). \tag{3}$$

Equation (3) may be replaced by the equation

$$r f'' + f' - r f = 0 ,$$

which is related to Bessel's equation and has the exact solution

$$f(r,z) = C_1 W_1(r) + C_2 W_2(r).$$

Where W (x) = J(i x), W (x) = Y(i x); C_1, C_2 – constant values. Let's to deform a surface of an ellipsoid for modeling an erythrocyte motion in elementary cylinders (Fig.2)). The common decision of a boundary-value problem (1) and (2) for an ellipsoid moving in a narrow capillary under a constant drop pressure, with take into account a rotation around semi-axis $\bar{a}$ and $\bar{b}$, is:

$$f(r, z) = C_1(z, \varphi_1, \varphi_2) W_1(r) + C_2(z, \varphi_1, \varphi_2) W_2(r),$$

where C_1, C_2 depend on the form of cell surface $R_C(z)$ and value of superficial potentials:

$$C_2 = \frac{\varphi_1 W_1(\chi) - \varphi_2 W_2(\chi R_C(z))}{W_1(\chi) W_2(\chi R_C(z)) - W_1(\chi R_C(z)) W_2(\chi)} , \quad C_1 = \frac{\varphi_2 - C_2 W_2(\chi)}{W_1(\chi)}.$$

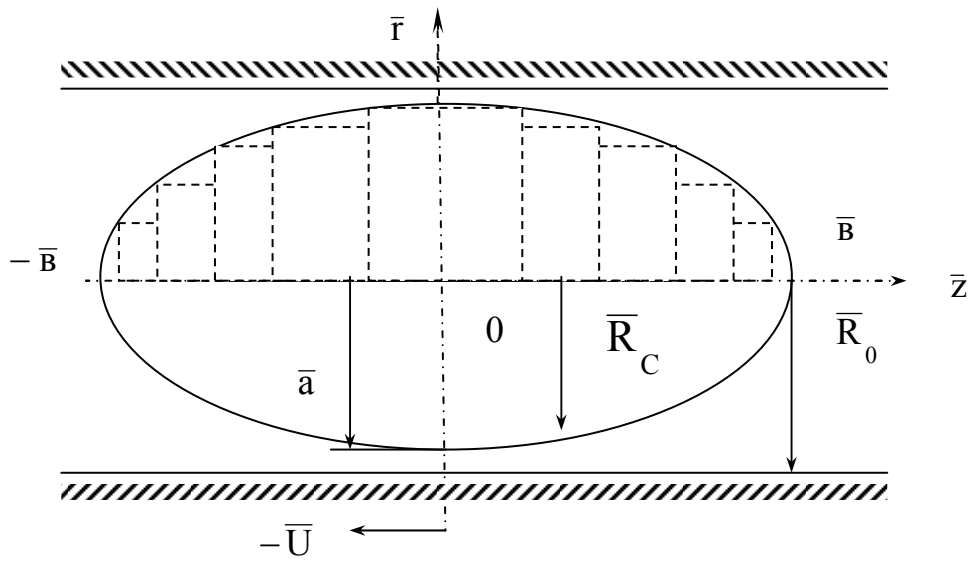

Fig.2. Basic coordinate system and RBC movement in a capillary scheme

At the presence of electro-kinetic forces, the equation of a liquid flow in a lubrication layer between capillary wall and cell surface in a projection to Oz axis (system of coordinates ORz is connected with cell (Fig. 2)) becomes:

$$\frac{\partial \bar{p}}{\partial \bar{z}} = \frac{\bar{\mu}}{\bar{R}}\frac{\partial}{\partial \bar{R}}\left(\frac{\partial \bar{v}_z(\bar{R}, \bar{z})}{\partial \bar{R}}\right) + \bar{F}_z , \tag{4}$$

Projection of external mass force density to axis Oz [4] is: $\overline{F}_z = -\overline{E}\,\overline{\Re}(\overline{R},\overline{z})$.

Where $\overline{\Re}(\overline{R},\overline{z})$ is the distribution of an electric charge density in lubrication layer between capillary wall and cell, $\overline{E}$ is an electric potential gradient is considered as a constant, $\overline{\mu}$ is dimensionless viscosity. The projection of the movement equation and the continuity equation on the Oz axis, in comparison with a cell movement equation in capillary without taking into account influence of an electric field [3, 4] are same:

$$\frac{\partial \overline{p}}{\partial \overline{R}} = 0, \quad \frac{\partial\left(\overline{R}\,\overline{v}_R(\overline{R},\overline{z})\right)}{\partial \overline{R}} + \frac{\partial\left(\overline{R}\,\overline{v}_z(\overline{R},\overline{z})\right)}{\partial \overline{z}} = 0,$$

where $\overline{v}_R(\overline{R},\overline{z})$, $\overline{v}_z(\overline{R},\overline{z})$ are the components of a velocity vector; $\overline{p}$ is pressure in a lubrication layer.

The boundary conditions of the problem are:

$$\overline{v}_R(\overline{R},\overline{z}) = 0,\ \overline{v}_z(\overline{R},\overline{z}) = 0 \text{ for } \overline{R} = \overline{R}_c(\overline{z});$$
$$\overline{v}_R(\overline{R},\overline{z}) = 0,\ \overline{v}_z(\overline{R},\overline{z}) = -\overline{U} \text{ for } \overline{R} = \overline{R}_0. \quad (5)$$

The pressure drop on the cell ends is denoted as: $\overline{p}(-\overline{b}) - \overline{p}(\overline{b}) = \Delta\overline{p}$. Here $\overline{U}$ – cell velocity at motionless coordinate system is connected with the capillary wall.

Equation for mass conservation is:

$$\int_{R_C(z)}^{R_0} \overline{R}\,\overline{v}_z(\overline{R},\overline{z})\,dR = -\overline{R}_0\,\overline{Q}_0. \quad (6)$$

Where $\overline{Q}_0$ is the unknown leak back of blood's plasma in the gap between cell and the wall of a capillary vessel is defined by the formula $\overline{Q}_0 = \overline{R}_0/2\ (\overline{U} - \overline{V}_0)$, where $\overline{V}_0$ is the average velocity of plasma in gap.

Taking into account that the pressure does not vary with z, it is integrating twice the equation (4) and using the boundary conditions (5) we have:

$$\overline{v}_z = \overline{v}_z(\overline{R},\overline{z},\overline{Q}_0,\overline{U},\overline{E},\overline{\Re}(\overline{R},\overline{z})). \quad (7)$$

Substituting expression (7) into equation (6) and integrating the results, one gets the Reynolds' equation.

The velocity expression (7) and Reynolds' equation contains unknown parameters cell velocity $\overline{U}$ and leak back of plasma in the gap $\overline{Q}_0$. To determinate $\overline{U}$ and $\overline{Q}_0$ we take equation of the cell motion and the result of equation (4) integration in the control volume of plasma including the cell bounded by the surface of the capillary vessel and two planes tangential to the cell at downstream direction [3]. After taking all of these terms in the correct order one get the "zero-drag" condition, used by H.Tozeren and R.Skalak [8]. The second equation is the result of a formal integration of pressure equation. As a result, we take two linear equation containing unknown dimensionless parameters – cell speed U_0, a dimensionless gradient of an external electric field E_0, dimensionless leak back of liquid C_0 and dimensionless pressure drop ΔP :

$$\begin{aligned} A_{11}C_0 + \Delta P &= A_{12}U_0 + A_{13}E_0, \\ A_{21}C_0 + \Delta P &= A_{22}U_0 + A_{23}E_0. \end{aligned} \quad (8)$$

where A_{ij} are dependent on the cell form only and are determined in [1], (i, j = 1,2).

Where $C_0 = \frac{2\bar{Q}_0}{\overline{R}_0 \overline{U}}$, $U_0 = \frac{\bar{U}}{\overline{U}_M}$, $\Delta P = \frac{\overline{\Delta p}\,\bar{a}}{\overline{\mu}\,\overline{U}_M}$, $E_0 = \tilde{\Re}\frac{\overline{E}\,\overline{R}_0\,\bar{a}}{\overline{\mu}\,\overline{U}_M}$; $\alpha = \frac{\bar{a}}{\bar{b}}$;

$\Re_1(R,z) = \frac{1}{R}\int R\,\Re(R,z)\,dR$; $\Re_2(R,z) = \int \Re_1(R,z)\,dR$; $\Re_3(z) = \int_{R_C(z)/\beta}^{1/\beta} R\,\Re_2(R,z)\,dR$. To prepare equations in dimensionless form we use two scales of length $\overline{R}_0$ and $\bar{a}$; scale of speed $\overline{U}_M$ – maximum value of velocity; scale of pressure and stress tension in liquids – $\frac{\overline{\mu}\,\overline{U}_M}{\bar{a}}$; scale of gradient of an electric field $\tilde{\Re}$.

Results and conclusions

Based on equations (7)-(8) we can research the blood flow in narrow capillary. The blood flow in capillary for $\chi \le 41.34$ is opposite: in the first case, if a cell ζ– potential φ_1 is smaller than capillary wall ζ– potential φ_2, and, in the second case, if $\varphi_1 \ge \varphi_2$. In the second case the general increasing of flow resistance (ΔP grows) takes place due to an additional braking gradient which is same as viscous forces. Flow resistance reduction (ΔP fall down) takes place due to the occurrence of an additional accelerating gradient. Situation for first case is opposite. That is, the flow resistance increases due to an additional accelerating gradient, and reduction of flow resistance is reduced due to a braking gradient. For $\chi > 41.34$, (the least thickness of a double layer) the quantity of current at $\varphi_1 < \varphi_2$ is same as quantity of current at $\varphi_1 \ge \varphi_2$.

References

1. *Honig B., and Nicholls A.* Classical electrostatics in biology and chemistry. *Science*. 268 (5214):1144-1149, 1995.

2. *Jerri A.J., and Herman R.L.* The solution of the Poisson-Boltzmann equation between two spheres. Modified iteractive methods. *J. Sci. Comp.* 11:127-153, 1996.

3. *Kalion V.* Mathematical models of blood cell and rolling movement in the capillaries. Ph.D. Thesis. Kiev: KGU Press, 1984.

4. *Kalion V., Shmakov Yu.* Mathematical model of RBC movement in capillaries. *Akad. Sci. of Ukraine*. A 4:7-12, 1989.

5. *Nicholls A., and Honig B.* A rapid finite difference algorithm. utilizing successive over-relaxation to solve the Poisson-Boltzmann equation. *J. Comp. Chem.* 12:435- 445, 1991.

6. *Rocchia W., Alexov E., and Honig B.* Extending the applicability of the non-linear Poisson-Boltzmann equation: Multiple Dielectric Constants and multivalent ions. *J.Phys. Chem*. B105 (28):6507-6514, 2001.

7. *Sigal V.* Electrohydrodynamic flow in a flat capillaries with porous walls. *Colloid magazine (Russia)*. 2:47-56, 1976.

8. *Tozeren H., and Skalak R.* The steady flow of closely fitting incompressible elastic spheres in a tube. *J. Flud Mech.* 87:1-16, 1978.

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THE TRICOMI THEORY OF CONFLUENT HYPERGEOMETRIC FUNCTIONS AND ITS APPLICATION TO WAVEGUIDE PROPAGATION

Abstract – the distinguishing features of the tricomi theory of confluent hypergeometric functions (the theory of the kummer and tricomi ones) are specified. a numerical study of the latter is performed in the complex plane for selected values of their parameters. the results are depicted in a graphical form. the computation of the differential phase shift, provided by the circular waveguide, containing an azimuthally magnetized remanent ferrite toroid and a dielectric cylinder for the normal TE_{01} mode, is presented as an example of the employment of the functions in question.

I. INTRODUCTION

The best way to comprehend which are the confluent hypergeometric functions and what is their significance, is to refer to the original works by the scientists who most of all contributed to the development of their theory: E. T. Whittaker [1], H. Buchholz [2] and F. G. Tricomi [3-5]. In view of the subject of this investigation, here the opinion of the last of them is cited only:

"*Each of these equations* (the Kummer and the Whittaker ones) *is called confluent hypergeometric equation and any of their solutions is called confluent hypergeometric function*; …" [3].

"*… all'infuori delle funzioni ellittiche … quasi tutte le funzioni speciali finora rivelatesi di effettivo interesse nelle Matematiche applicate sono funzioni ipergeometriche confluenti, …*" ([4], p. X). (… except the elliptic functions … almost all the special functions which until now revealed an effective interest in the applied mathematics, are confluent hypergeometric functions, ...)

"*Le principal intérêt que présente la théorie des fonctions hypergéométriques confluentes est de conduire à une vision d'ensemble de la plupart des fonctions spéciales qui présentent un intérêt pratique.* ([5], p. 51) (The principal interest which presents the theory of confluent hypergeometric functions is to conduct to a general vision of the greatest part of the special functions which are of practical interest.)

"*Invece le funzioni confluenti generali sono ancora relativamente poco conosciute ed usate,* …" ([4], p. X). (However the general confluent functions are still relatively little known and used, …)

Out of the two main theories of the functions, being an object of the debate: the Whittaker-Buchholz one [1,2] and that, elaborated by F. G. Tricomi [3-5], the second is treated in the present research. Its basic idea is expressed in the following way:

"*Nous prendrons, …, pour base de la théory, la fonction …* Φ *de Kummer … et une seconde solution* Ψ *de la même équation confluente* (de l'équation de Kummer) …" ([5], p. 5). (We take, …, as a base of the theory, the Kummer function Φ … and a second solution Ψ of the same confluent equation (of the Kummer equation) …)

In keeping with this, the definitions of both functions and the forms of the general integral of Kummer equation whose partial solutions they are, are adduced. Besides, a numerical analysis of the same is made in the complex area. The outcomes are illustrated graphically. The putting into practice of confluent functions in examining the properties of the normal TE_{0n} modes in the circular waveguide, comprising a ferrite toroid of azimuthal magnetization, is demonstrated.

II. SOME ELEMENTS OF THE TRICOMI THEORY OF CONFLUENT HYPERGEOMETRIC FUNCTIONS

The Kummer confluent hypergeometric function is determined by the infinite power series [3-5]:

$$\Phi(a,c;x)=\sum_{\nu=0}^{\infty}\frac{(a)_\nu}{(c)_\nu}\frac{x^\nu}{\nu!} \tag{1}$$

which is absolutely convergent for all real or complex values of a, c, x, except $c = 0,-1,-2,...$ $(a)_\nu = a(a+1)...(a+\nu-1)$, $(a)_0 = 1$, $(1)_\nu = \nu!$, $(\nu = 0,1,2,...)$ is the Pochhammer's symbol. $\Phi(a,c;x)$ is an entire analytic function in the whole complex x – plane. It is regular at $x = 0$ and single-valued, wherever it exists. For a fixed x, $\Phi(a,c;x)$ is an entire function of a and a meromorphic one of c with simple poles at the points $c = 0,-1,-2,...$

In case $c = l+1$ $(l = 0,1,2,...)$ – a positive integer, the Tricomi confluent hypergeometric function is given by the expression [3-5]:

$$\Psi(a,l+1;x) = \frac{(-1)^{l-1}}{l!\Gamma(a-l)}\left\{\Phi(a,l+1;x)\ln x + \sum_{\nu=0}^{\infty}\frac{(a)_\nu}{(l+1)_\nu}[\psi(a+\nu)-\psi(1+\nu)-\psi(1+\nu+l)]\frac{x^\nu}{\nu!}\right\} + \frac{(l-1)!}{\Gamma(a)}\sum_{\nu=0}^{l-1}\frac{(a-l)_\nu}{(1-l)_\nu}\frac{x^{\nu-l}}{\nu!} \tag{2}$$

in that $\Gamma(a)$ and $\psi(a) = \Gamma'(a)/\Gamma(a)$ are the Euler gamma function and its logarithmic derivative. In particular $-\psi(1) = C = 0.577215665...$ is the Euler-Mascheroni constant. The last term in formula (2) is omitted, if $l = 0$. $\Psi(a,c;x)$ is defined for all real or complex a, c, x, save for $x = 0$. In the vicinity of the latter it tends to infinity. $\Psi(a,c;x)$ is multiple-valued, with the zero as a branch point and a main branch, determined by the condition $-\pi < \arg x \le \pi$.

The Kummer confluent hypergeometric equation [3-5]:

$$x\frac{d^2y}{dx^2} + (c-x)\frac{dy}{dx} - a\,y = 0 \tag{3}$$

is a second order ordinary differential equation, possessing regular and irregular singularities at 0 and ∞, resp. It has eight partial integrals, resulting in six forms of its general solution, applicable, depending on the values of parameters a and c, and of the difference $c-a$ between them [3-5]:

$$y = A\Phi(a,c;x) + Bx^{1-c}\Phi(a-c+1,2-c;x), \qquad c \ne 0,\pm1,\pm2,... \tag{4}$$

$$y = A\Phi(a,c;x) + B\Psi(a,c;x), \qquad a \ne 0,-1,-2,... \tag{5}$$

$$y = A\Phi(a,c;x) + Be^x\Psi(c-a,c;-x), \qquad c-a \ne 0,-1,-2,... \tag{6}$$

$$y = Ax^{1-c}\Phi(a-c+1,2-c;x) + B\Psi(a,c;x), \qquad c-a \ne 1,2,3,... \tag{7}$$

$$y = Ax^{1-c}\Phi(a-c+1,2-c;x) + Be^x\Psi(c-a,c;-x), \qquad a \ne 1,2,3,... \tag{8}$$

$$y = A\Psi(a,c;x) + Be^x\Psi(c-a,c;-x). \tag{9}$$

There are no restrictions, concerning the workability of the form (9). (A, B are arbitrary constants.)

III. Numerical Study of the Kummer and Tricomi Functions in the Complex Plane

A numerical evaluation of the Kummer and Tricomi functions is done by means of the series (1) and (2), assuming $a = c/2 - jk$ – complex, k – real, $c = 2\mathrm{Re}\,a$ – restricted positive integer, $x = jz$, z – real, positive. The loci curves of $\Phi(0.5-jk,1;jz)$ in the complex plane are plotted in Figs. 1 a-d and those of $\Psi(0.5-jk,1;jz)$ – in Figs. 2 a, b for $k = +0.5$, 0 and –0.5 (solid, dotted and dashed lines, resp.) in different intervals of variation of z. The dotted straight lines (dotted curves) in the first (second) set of Figures show the influence of k on the behaviour of the functions, regarding z as parameter. The curve, portraying the change of $\Phi(0.5-jk,1;jz)$ between its two subsequent zeros and the relevant straight lines, connecting the origin of co-ordinates system (the

image of zeros) with it, are drawn by the same colour. The latter is altered for each of the pairs. Similar results for $\Phi(1.5-jk,3;jz)$ and $\Psi(1.5-jk,3;jz)$ have been obtained in Refs. [6], [7], resp.

IV. Application to Waveguide Propagation

The structure regarded is an infinitely long, perfectly conducting circular waveguide of radius r_0, loaded with a dielectric cylinder of radius r_1, surrounded by an azimuthally magnetized latching ferrite toroid of inner and outer radii r_1 and r_0, resp. The anisotropic medium is characterized by a Polder permeability tensor $\vec{\mu} = \mu_0[\mu_{ij}]$, i, $j = 1, 2, 3$, with nonzero components $\mu_{ii} = 1$ and $\mu_{13} = -\mu_{31} = -j\alpha$, $\alpha = \gamma M_r / \omega$, γ – gyromagnetic ratio, M_r – ferrite remanent magnetization, ω – angular frequency of the wave and a scalar permittivity $\varepsilon = \varepsilon_0 \varepsilon_r$. The isotropic filling has a scalar permittivity and permeability $\varepsilon^d = \varepsilon_0 \varepsilon_d$ and $\mu^d = \mu_0 \mu_d$, resp. It is accepted that $\varepsilon_d = \varepsilon_r$. The propagation of normal TE_{0n} modes in the configuration described is governed by the equation [8]:

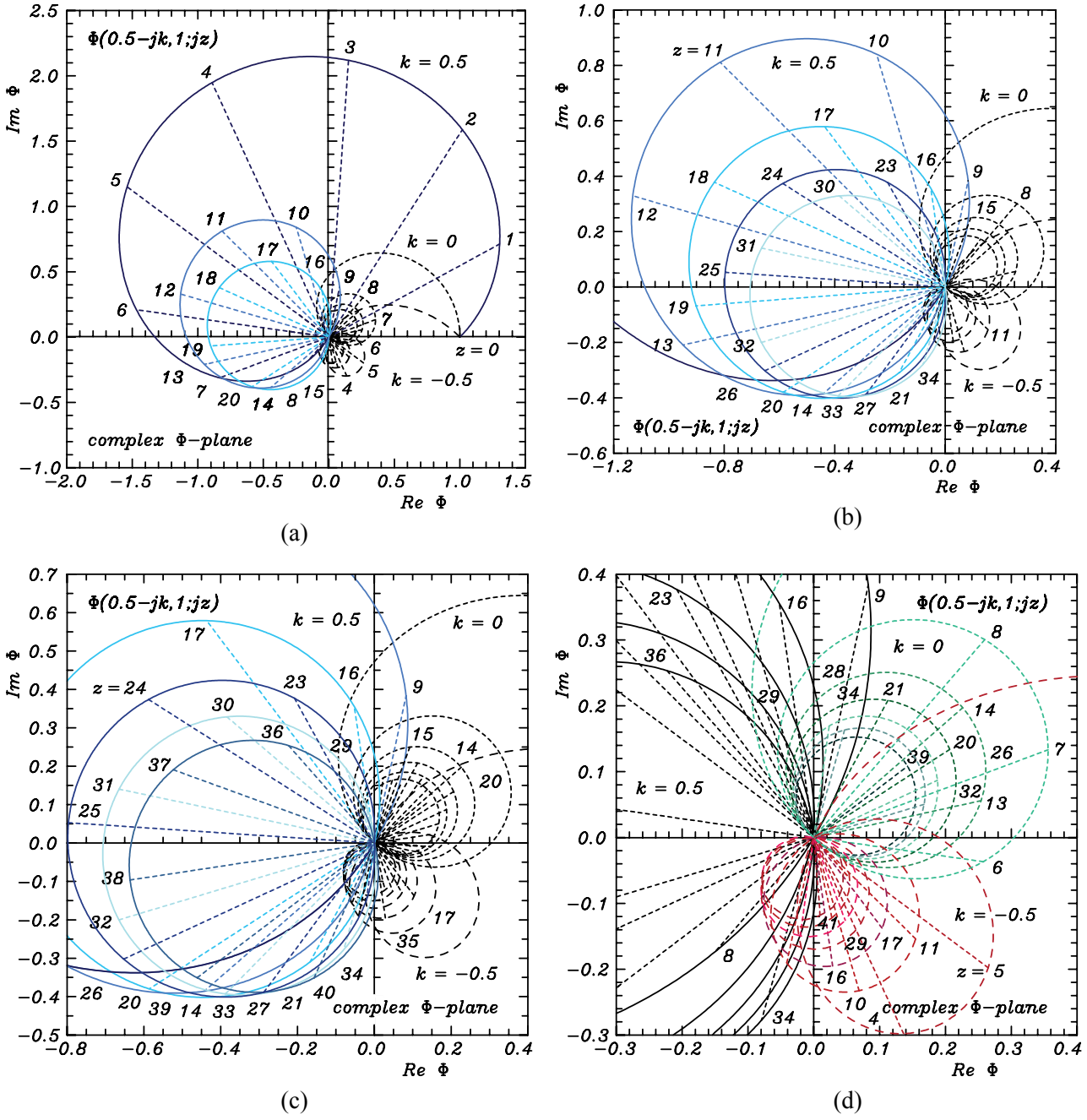

Figure 1: *Loci curves of* $\Phi(0.5-jk,1;jz)$ *in the complex plane for* $k = +0.5$, 0 *and* –0.5, *and* z, *varying in the interval*: *a)* $z = \langle 0 \div 20 \rangle$; *b)* $z = \langle 8 \div 34 \rangle$; *c)* $z = \langle 14 \div 40 \rangle$ *and d)* $z = \langle 4 \div 41 \rangle$.

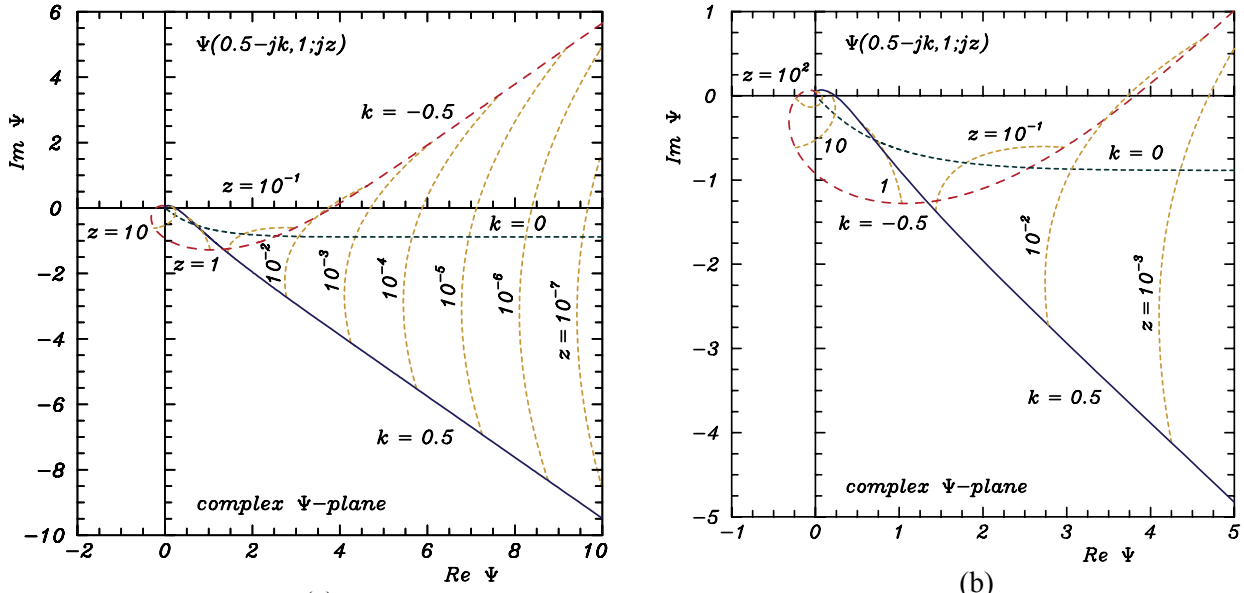

Figure 2: *Loci curves of* $\Psi(0.5-jk,1;jz)$ *in the complex plane for* k = +0.5, 0 *and* –0.5, *and* z, *varying in the interval*: *a)* $z=\langle 10^{-7}\div 10\rangle$ *and b)* $z=\langle 10^{-3}\div 10^{2}\rangle$.

$$\left(1-\alpha^2\right)\left[\Phi(a,c;\rho x_0)\Psi(a,c;x_0)-\Phi(a,c;x_0)\Psi(a,c;\rho x_0)\right]/2=\left[\Phi(a-1,c-2;\rho x_0)\Psi(a,c;x_0)+(a-1)^{*}\Phi(a,c;x_0)\Psi(a-1,c-2;\rho x_0)/2\right]J_1(y_0)/\left[y_0J_0(y_0)\right], \tag{10}$$

written through the Kummer and Tricomi functions $\Phi(a,c;x)$ and $\Psi(a,c;x)$, and the zeroth and first order Bessel ones $J_0(y)$ and $J_1(y)$. In eqn. (10) $a=c/2-jk$, , , $x_0=jz_0$, $k=\alpha\overline{\beta}/(2\overline{\beta}_2)$, $z_0=2\overline{\beta}_2\overline{r}_0$, $y_0=\rho q z_0$, $\rho=\overline{r}_1/\overline{r}_0$, $0<\rho<1$, $q=0.5\{(\varepsilon_d/\varepsilon_r)\left[1+(2k/\alpha)^2\right]/(1-\alpha^2)-(2k/\alpha)^2\}^{1/2}$, $\overline{\beta}=\beta/(\beta_0\sqrt{\varepsilon_r})$, $\overline{\beta}_2=\beta_2/(\beta_0\sqrt{\varepsilon_r})$, $\overline{r}_0=\beta_0 r_0\sqrt{\varepsilon_r}$, $\overline{r}_1=\beta_0 r_1\sqrt{\varepsilon_r}$, $\beta_0=\omega\sqrt{\varepsilon_0\mu_0}$, β – phase constant, $\beta_2=\left[\omega^2\varepsilon_0\mu_0\varepsilon_r(1-\alpha^2)-\beta^2\right]^{1/2}$ – radial wavenumber, $-1<\alpha<1$. The asterisk * (bar) denotes complex conjugate (normalized) quantity. Since $a\neq 0,-1,-2,\ldots$, the form (5) of the general integral of Kummer equation is utilized in deriving eqn. (10). Further, $\Phi(a,c;x)$ is expressed by the series (1). Among the various representations for $\Psi(a,c;x)$ [3-5] formula (2) is employed, as c is a positive integer. If $\eta_{k,n}^{(c)}(\varepsilon_d,\varepsilon_r,\rho,\alpha)$ stands for the nth positive purely imaginary root of eqn. (10) ($n=1,2,3,\ldots$), the latter holds, provided $\overline{\beta}_2=\eta_{k,n}^{(c)}(\varepsilon_d,\varepsilon_r,\rho,\alpha)/(2\overline{r}_0)$, giving the eigenvalue spectrum of the fields examined.

Under certain conditions the geometries, comprising ferrite, magnetized azimuthally in a positive ($\alpha>0$, $k>0$) or negative ($\alpha<0$, $k<0$) direction, may sustain normal TE_{0n} waves with different phase constants $\overline{\beta}_+$ and $\overline{\beta}_-$ [6-10]. Thus, they may provide differential phase shift $\Delta\overline{\beta}=$

Table 1: *Numerical equivalents of the normalized differential phase shift* $\Delta\overline{\beta}$ *for normal* TE_{01} *mode as a function of the parameters* $\overline{r}_0$ *and* $|\alpha|$ *in case* $\rho=0.2$ *and* $\varepsilon_d/\varepsilon_r=1$.

$\overline{r}_0$ \ $\lvert\alpha\rvert$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
4.0	0.0407 1309	0.0809 5639	0.1201 2686						
4.5	0.0361 8832	0.0719 5186	0.1067 4401	0.1397 1496	0.1693 6381				
5.0	0.0325 6839	0.0647 4723	0.0960 3379	0.1256 4333	0.1521 8480	0.1729 3571	0.1819 8406		
5.5	0.0296 0652	0.0588 5160	0.0872 6724	0.1141 1954	0.1381 0209	0.1566 5116	0.1641 9967	0.1467 9972	
6.0	0.0271 3819	0.0539 3772	0.0799 5839	0.1045 0632	0.1263 4045	0.1430 1760	0.1492 3265	0.1317 6344	

$\overline{\beta}_- - \overline{\beta}_+$ (possess potentialities of nonreciprocal digital phase shifters) [6-10]. A sample of the results from its numerical study is presented in Table 1 for TE_{01} mode. The values of $\Delta\overline{\beta}$ are counted, adapting to the specific configuration the iterative approach, developed recently and applied to several transmission lines of the kind considered [7,9-11].

V. CONCLUSION

Some points of the theory of Kummer and Tricomi confluent hypergeometric functions (the Tricomi one) are threshed out. Original thoughts by F. G. Tricomi are quoted which reveal certain of its basic characteristics. Graphs, based on a numerical investigation are displayed, visualizing the conduct of functions in the complex plane for specially picked out parameters. The application of the theory in the solution of a problem for waveguide propagation is manifested.

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REFERENCES

1. *Whittaker, E. T. and Watson, G. N.*, *A Course of Modern Analysis,* Cambridge, UK, Cambridge Univ. Press, 1965.
2. *Buchholz, H.*, *Die Konfluente Hypergeometrische Funktion mit Besonderer Berücksichtigung Ihrer Anwendungen,* Berlin, Göttingen, Heidelberg, Germany, Springer-Verlag, 1953.
3. *Erdélyi, A., Magnus, W., Oberhettinger, F. and Tricomi, F. G.*, *Higher Transcendental Functions,* Bateman project. vol. I, New York, Toronto, London, McGraw-Hill, 1953.
4. *Tricomi, F. G.*, *Funzioni Ipergeometriche Confluenti,* Rome, Italy, Edizioni Cremonese, 1954.
5. *Tricomi, F. G.*, *Fonctions Hypergéométriques Confluentes,* Paris, France, Gauthier-Villars, 1960.
6. *Georgiev, G. N. and Georgieva-Grosse, M. N.*, "A new property of the complex Kummer function and its application to waveguide propagation," *IEEE Antennas Wireless Propagat. Lett.*, vol. 2, pp. 306–309, Dec. 2003.
7. *Georgiev, G. N. and Georgieva-Grosse, M. N.*, "An application of the complex Tricomi function," in *Proc. Eleventh Int. Conf. Electromagn. Adv. Applicat. ICEAA'09*, Turin, Italy, Sept. 14-18, 2009, pp. 819-822, in CDROM.
8. *Georgiev, G. N. and Georgieva-Grosse, M. N.*, "Effect of the dielectric filling on the phase behaviour of the circular waveguide with azimuthally magnetized ferrite toroid and dielectric cylinder," in *Proc. Asia-Pacific Microwave Conf. APMC-2009*, Singapore, Dec. 7-10, 2009, pp. 870-873, in CDROM.
9. *Georgiev, G. N. and Georgieva-Grosse, M. N.*, "Iterative method for differential phase shift computation in the azimuthally magnetized circular ferrite waveguide," in *Proc. 27th Progr. In Electromagn. Res. Symp. PIERS 2010*, Xi'an, China, Mar. 22-26, 2010, p. 186, in Abstracts, pp. 274-278; *PIERS Online*, vol. 6, no. 4, pp. 365-369, 2010.
10. *Georgieva-Grosse, M. N and Georgiev, G. N.*, "Advanced studies of the differential phase shift in the azimuthally magnetized circular ferrite waveguide," in *Proc. 28th Progr. In Electromagn. Res. Symp. PIERS 2010*, Cambridge, MA, USA, July 5-8, 2010, p. 505, in Abstracts, pp. 841-845.
11. *Georgiev, G. N. and Georgieva-Grosse, M. N.*, "Analysis of the differential phase shift in the circular ferrite-dielectric waveguide with azimuthal magnetization," in *Proc. 2010 IEEE Int. Symp. Antennas Propagat. & CNC-USNC/URSI Radio Science Meeting AP-S 2010*, Toronto, ON, Canada, July 11-17, 2010, paper 330.9, in CDROM.

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MULTIBAND RESONANCE GENERATION BY FEED MANIPULATION IN MICROSTRIP ANTENNA

Microstrip antennas have been in vogue since almost two decades and their popularity is still increasing with progress in manufacturing of miniature communication equipment. In the field of antenna design, a major area of interest has been to design antennas which can simultaneously operate on multiple frequencies to facilitate the operation of a device based on different communication modes. In this paper, a new technique is being presented which helps in achievement of the multi-band characteristics in regular patch antennas by manipulating the feed point location on the patch. The presented approach reveals that variation in number of resonating bands for an antenna can be observed by altering the feed location on the patch. The analysis and research has been carried out to obtain the resonating band outcomes and it endorses the findings presented this research. The focus has been to implement the desired solution by exploiting the tolerance levels of device peculiarities, consistently tracking the needs of area of application and standards of the network under consideration.

Introduction

Microstrip antennas are very popular for low profile applications and are being used to minimize the dimensional constraints in manufacturing of communication equipments [1]. The world is converging towards the era of unified communications and the future holds the implementation of heterogeneous networks to realize the concept of seamless interoperability. In order for a wireless communication equipment to operate with multiple communicating interfaces, it must employ an antenna capable of supporting more than one frequencies of operation [2]. Such antennas are termed under the category of multiband antennas.

Microstrip antennas are preferred for most of the user-end applications because of the ease of operation offered by them. These antennas operate on low-power and offer very low fabrication costs as they are itched over a dielectric substrate on top of a conducting ground plane [1].

Multiband behavior in antennas has been achieved using several complex techniques like slots [3], notched edges [4] and antenna arrays [5] etcetera; however, a different approach is presented in this paper to demonstrate the effect of varying the feed point location from the centre edge-fed patch on either side. Although sophisticated multiband antennas are popularly placed in the category of log-periodic antenna, also termed as fractal antennas; the associated design and manufacturing complexity is, nonetheless, quite high and needs reduction based on the tolerance offered by the application environment. Generally, the application of multiband antennas can be found in networks operating at dual bands for example a Wi-Fi based LAN operating on 2.4 GHz and 5.45 GHz simultaneous switched access, or a GSM network operating on 900/1800 MHz dual band. Moreover, for interoperability of Wi-Fi hotspots in an IEEE 802.16 network, multiband antennas are employed in the enabled equipment to support the communications at all the three available frequency bands i.e. 2.4 GHz and 5.45 GHz for Wi-Fi and 3.4 GHz for the 802.16 based Metropolitan Area Network (MAN) configurations.

The conventional techniques for stimulating the dual band or multiband characteristics in microstrip antennas involve placement of slits in the patch which are of measured length and width and are highly sensitive to the frequency of operation [6]. This sensitivity in the placement of the slots induces complexity in fabrication and a modest variation occurring during the manufacturing of the prototypes causes a serious shift in the operating frequency or the number of operating bands. Contrary to this, the research presented in this paper demonstrates that dual band or multiband characteristics can be inducted in an antenna with a comparatively much simpler methods, although, compromising the performance characteristics compared to their predecessor methods. Moreover,

the desired number of operating bands can also be adjusted as single, dual or multiband by careful variation of the feed location.

Rest of the paper is organized as follows: Section II presents the background requirements and review of recent works in the area of focus while Section III describes the developed hypothesis and structural approach. Section IV describes the feed variation approach and in Section V, the simulation results and analysis are presented. Section VI concludes the paper while Section VII describes the future work.

Background & Literature

In [7], [8] and [9], some of the most significant achievements have been addressed, emphasizing the need to have dynamic resonance arrays. Multiband arrays are used to analyze and build phased directionality in wireless networks [10], which can in turn prove to be of extreme interest for Quality of Service (QoS) enhancements in communication equipments. In all scenarios involving systematic designs, cost and benefit relationship is an aspect to be considered at the utmost priority in order to maximize the provision of services to masses along with stranding to the standardization constraints. MIMO systems also employ multiband features which are achieved by using highly sophisticated design methods presented in [11] and [12], but in turn, with the torment of high cost and complexity associated with it; thus, planting a hindrance in rapid and low-cost deployment of the designed functionality of equipments.

Ongoing research on multiband antennas further generates interests in the area of reconfiguration of resonating structures in real-time, allowing for variable polarization and system in-concentric operation. These techniques have been discussed deeply in [13], [14] and recommendations clearly suggest a boost in costs and complexity to design such resonating structures. This fact, on the contrary, imparts a not so visible, but long lasting limitation on the developed design, in terms of deployment of this technology and high-cost service provisioning.

Furthermore, excavating into the knowledge base of recent researches regarding multiband resonance, we can surely not ignore heterogeneous network support, which is essential in present day devices [15]. The current focus is not just limited to the design of antennas with operational capabilities as discussed in the preamble, but also to achieve them in such a way that reduces the design and manufacturing complexity along with satisfying the cost optimization constraints [16]. Thereby, allowing a carefully controlled tradeoff among design complexity, performance precision; heterogeneity support and associated implementation costs.

Rationale & Structure

Tailoring the achievement of multiband resonance employing the scissors of facts presented in section II, the aim of this experimental research is to achieve a method which creates a descent in both cost and design complexity. Moreover we wish to exploit the tradeoff relationship between operational accuracy and design complexity. Considering that the applied resonator works in a network which is not exposed to extreme fading for example, indoor communication networks, small wireless LANs or local peer-to-peer Access Point nodes, then slight variations in operational characteristics may be tolerated if they offer shear reduction in development complexity. The extent of acceptance of these tolerances, allow us to design multiband resonators in less sophisticated ways, still fulfilling the constraints of performance characteristics demanded by system peculiarities.

Thus, the major focus of this work is placed on the study of the variation in antenna characteristics by altering the feed locations. In order to develop a hypothesis, we exploit the fundamental properties of antenna design regarding antenna dimensions and feed locations [17], suggesting that a pattern of variations can be detected to occur periodically, with cyclic and controlled shifting of feed. Apparently, the detection of such patterns can help us to predict and to obtain, desired multiple frequencies of operation, and make necessary parametric adjustments. Hence, a simple rectangular patch was chosen to test the hypothesis, presented in [18]. A major reason to choose such a design was its low implementation cost and particularly, strong

performance characteristics, as demonstrated in [18]. The geometrical specifications of the employed patch antenna are demonstrated by Table I whereas Table II presents the properties of the substrate employed in the simulation environments.

TABLE I. TEST ANTENNA SPECIFICATION [18]

Components	Dimensions	
	Length (mm)	*Width (mm)*
Ground Plane	80.0	50.0
Radiating Patch	27.5	40.0
Transmission Line	26.25	4.0

TABLE II. SIMULATION ENVIRONMENT SPECIFICATIONS [18]

Layer	*Type*	*Loss Tangent*	*Thickness (mm)*	*Permittivity*
1	Air	0	32	1
2	FR-4 (lossy)	0.019	1.5	4.9

To support the argument, software analysis and simulations were carried out using evaluation versions of AWR Microwave Office (MWO-228, VSS-100) and High Frequency Structure Simulator (HFSS). These software package is quite user friendly and provides highly accurate visualizations of micro strip patch antennas. It must be emphasized here that software analysis has been carried out using two simulators to ensure accuracy of results and endorse the correctness of deductions from the generated outputs.

Feed Manipulation Technique

Initially, the patch antenna was fed using a 50 ohms transmission line attached at the central bottom edge of the patch. Let us refer to this initial location as point (0,0) expressed in units of (x,y) millimeters. Figure 1 shows the trend of shifting and varying the feed points across the feeding edge of the patch.

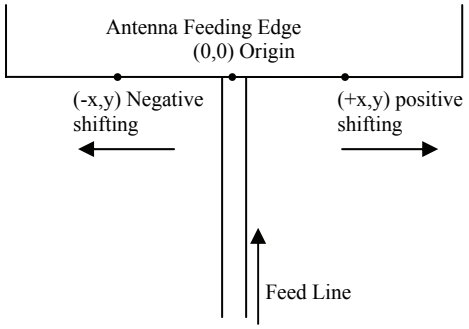

Fig. 1. Manipulation trend followed for analysis (deviations in mm)

At this point, the antenna exhibited normal behavior with a single operating band at 2.4 GHz having a fractional bandwidth of 140 MHz. After this, the feed location was given a positive shift of 1 mm, rendering the feed point to be (1, 0). This resulted in a dual band behavior with the first resonant band centered at 2.09 GHz and the second one at 2.64 GHz. These two bands possessed an average bandwidth of 85 MHz/each and demonstrated return losses below -20 dB. This trend continues with an increase in the distance of the feed location from the origin with the number of resonant bands fixed at two, depicting minute variations in the return loss.

TABLE 3 - DUAL BAND CHARACTERISTICS WITH FEED VARIATION

		Feed Points Reference to Centre (0,0) (mm)						
		Left Shift			*Centre*	*Right Shift*		
		-3	-2	-1	0	1	2	3
	No. of Bands	1	2	2	1	2	2	2
Band I	Frequency (GHz)	2.61	2.08	2.04	2.4	2.0	2.10	2.1
	Return Loss (dB)	-13	-22	-18	-34.5	-23	-24	-24
	Bandwidth (MHz)	50	80	70	150	80	80	90
	%age bandwidth	1.92	3.85	3.43	6.25	3.8	3.98	4.2
Band II	Frequency (GHz)	-	2.63	2.59	-	2.6	2.66	2.6
	Return Loss (dB)	-	-24	-25	-	-21	-20	-17
	Bandwidth (MHz)	-	110	107	-	90	88	90
	%age bandwidth	-	4.18	4.13	-	3.4	3.31	3.3

Table III summarizes an overview of the dual band resonance characteristics of the antenna based on shifted feed points. It was further observed that when the feed location reached 15 mm from the origin, at point (15,0), the antenna started to exhibit tri-band behaviors. The resonant bands were found to be at 2.1 GHz, 2.55 GHz and 3.05 GHz with an average return loss of -14 dB. The varying placement of the transmission line feeding the patch from the centre of patch towards the far right-end illustrates a regular recurrence in the surfacing of resonating bands. Gradually varying the feed points makes the antenna to resonate, firstly at a single frequency band, then, it demonstrates a dual band behavior which is maintained for some feed locations and finally, as the placement of feed becomes greater than 10 units from centre, tri-band characteristics are exhibited.

Thus the simulation scenario is based over placement of the feed location across various points on the feeding edge of the patch and observing the outcomes based on the number of resonant bands achieved in context to the figures of merit like return loss, fractional bandwidth, and voltage standing wave ratio (VSWR).

Simulation Results

Employing on the approach prescribed in Section IV, the simulations were performed to extract a general conclusive behavior from the test setup. The results obtained by the simulations carried out during this project are presented in this section. In these graphical results, the abscissa represents the frequency of operation in GHz whereas the ordinate represents return loss in decibels (dB).

Single Band Resonance

The basic idea is to shift the feeding point from the center point of the radiating patch towards the left and right edges. The graph in Figure 2 shows the results of the antenna resonance when transmission line feed was placed at the centre point, be it (0,0), as in Figure 1.

The results shown in figure 2 are on the operating frequency at which the antenna was designed. The resonance is quite clear with a return loss of -34.59 dB at 2.4 GHz. The fractional bandwidth, as measured by the software simulation result, is approximately 150 MHz as calculated at VSWR value of 2.0.

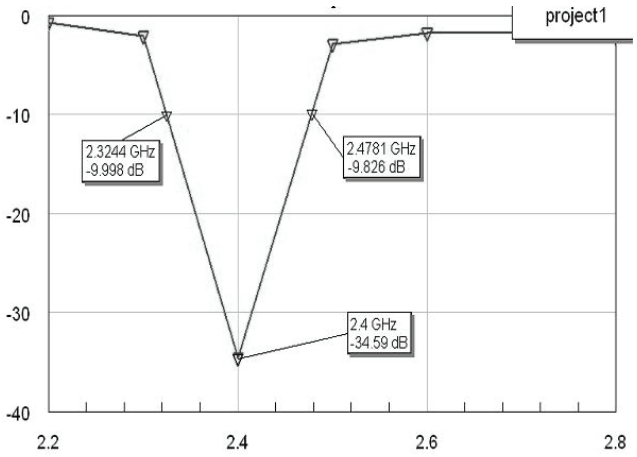

Fig. 2. Magnified snapshot of result at feed location (0,0)

Dual Band Resonance:

In the figures below, the points at which dual band behavior is found are plotted against return loss. The feed location has been varied on the left and right of the central feed point and the results are presented here. Figure 3 shows the dual band behavior of antenna when location of the feed is given a positive shift of 1 mm.

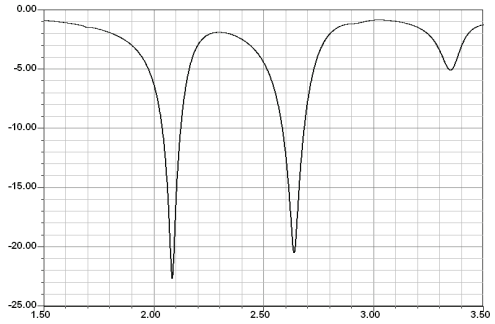

Fig. 3. Shifted feed location results at (1,0)

Note the existence of a third band on the right side of the dual bands which, at present, is not providing acceptable return loss. The dual band average return loss is -22 dB. Figure 4, 5 6 and 7 demonstrate the result of behavioral simulations to observe dual bands by giving positive and negative shifts of 1 mm, 3 mm and 6 mm to the feed.

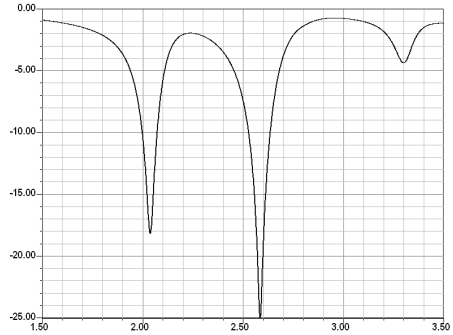

Fig. 4. Shifted feed location results at (-1,0)

Variations can be seen in the return loss with shifting of the feed locations. Hence, a tradeoff relationship is explicitly observed between multiband resonance and fractional bandwidth. It is highly dependent on the application for which the design is to be employed, the level of toleration to be accommodated regarding the observed inverse relation.

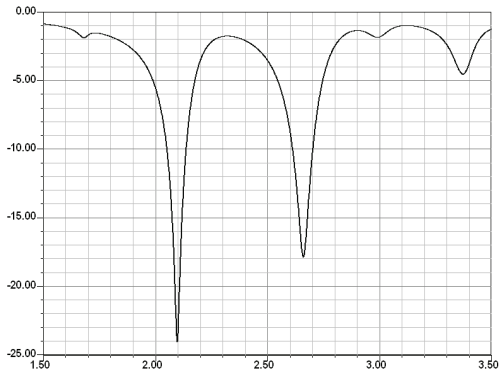

Fig. 5. Shifted feed location at (3,0)

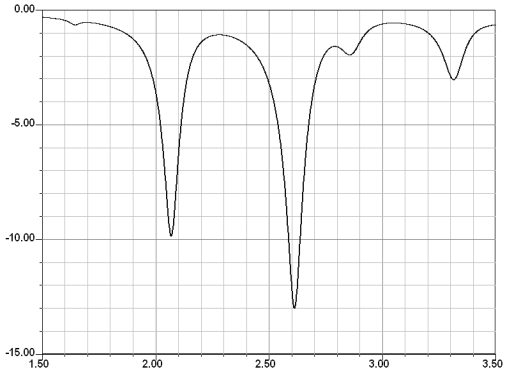

Fig. 6. Shifted feed location at (-3,0)

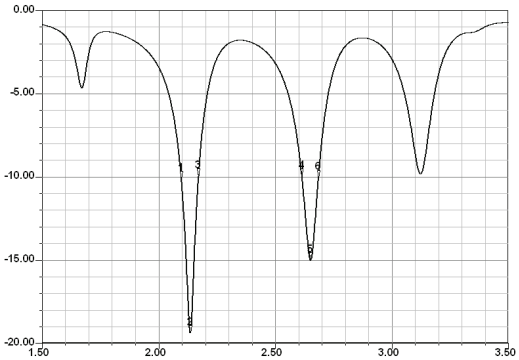

Fig. 7. Shifted feed location at (6,0)

Tri-Band Resonance

As the feed point is moved further to right or left of the central feed location, the return loss and VSWR of the resonating bands attains the acceptable threshold needed to overcome operational merits. The results in the following figures show the behavior of the bands to be converging towards tri-band characteristics. Figure 8 and 9 show 3 bands with an average return loss of -13 dB and -12 dB respectively. However, after a certain units of further shifting, the tri-band behavior starts to diminish as the bands move close to -10 dB at certain feed points above 12 mm from centre.

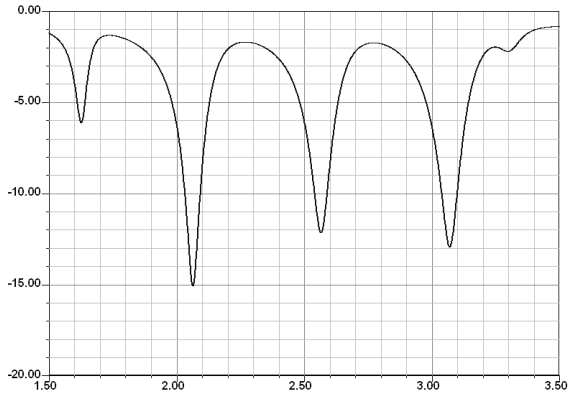

Fig. 8. Shifted feed location at (-12,0)

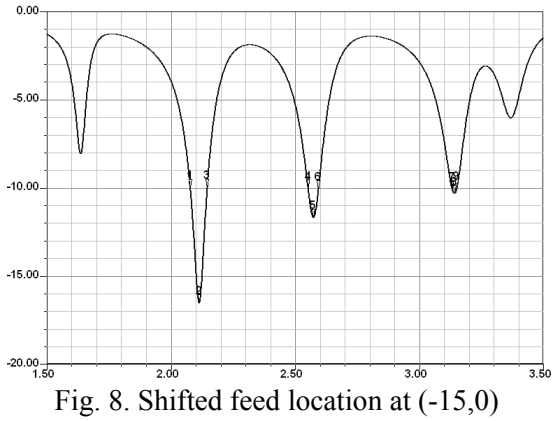

Fig. 8. Shifted feed location at (-15,0)

Multiband Resonance

Investigating the trend described above, the frequency sweep was carried out on a large scale and it was observed that the antenna starts to show multiband behavior after the feed location is approximately an order of 10 or more units shifted from the feed point origin.

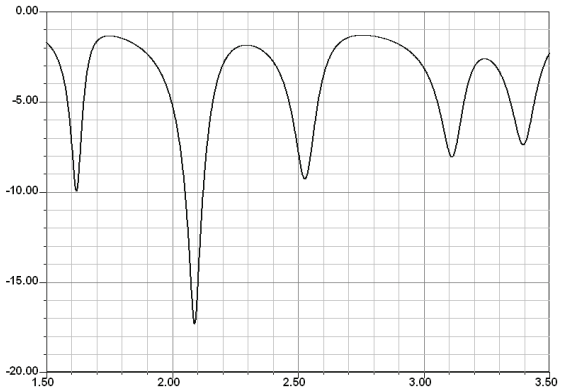

Fig. 10. Shifted feed location at (-18,0)

There is inconsistent variation in the return losses after a shift of -15 units which results either in a multiband behavior at some points, or a shear single band resonance. Figure 10, 11 and 12 show the results of the extended frequency sweep using the same parametric figures. The multiband behavior is clearly exhibited in these figures.

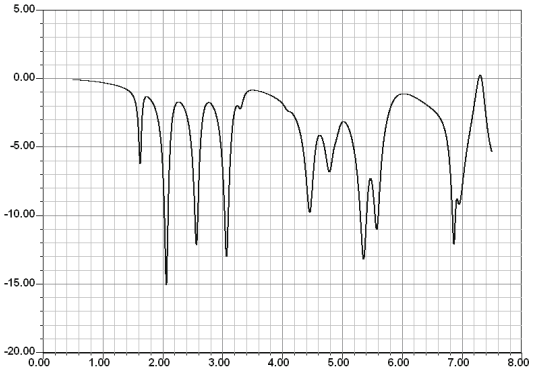

Fig. 11. Extended frequency sweep with feed at (-15,0)

The simulation results suggest that the hypothesis regarding the sweeping of feed over the edges of the patch to get multiple resonance bands has been successful. Based on the results, we suggest that a complex resonating structure which is supplied with multiple input feed lines can be used as a reconfigurable radiating patch with ability to radiate the signals in more than one spectrum, adjusting according to the communication network characteristics and the environmental conditions. The need to perform this switching may depend on the variation levels of experienced fading, monitored SNRs, vertical handoff capability integration or any other system dependent property. Of course, this spectrum switching is performed and adjusted by implementing back-end support as the radiator itself is only a passive structure acting as the front-end. This argument suggests that the approach may also be further extended to make the radiators exhibit radiations over a series of available polarizations, using feed-line switching across its length and width simultaneously. Figure 12 shows a final extended frequency sweep generating approximately 5 operational bands, measured over RL of -10. In case the application is to be made in an environment which is relatively more consistent, the bands below RL value of -5 may be considered appropriate; thus allowing for a much wider range of operational frequencies with suitably large bandwidths.

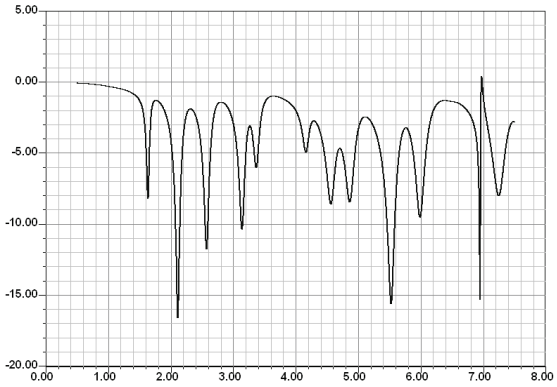

Fig. 12. Extended frequency sweep with feed at (-12,0)

Conclusion

In the paper, a new empirical technique of achieving multiband characteristics in microstrip patch antennas by manipulating the feed location has been presented. The results, after careful interpretation and analysis, suggest that the proposition proved to be successful. Manipulation of feed location in patch antennas does produce a single, dual or multiband resonance in the antenna structure the extent of which is dependent on point of feed, displaced from the central feed location. Hence, an easy to implement technique for tuning the antenna to work on more than one frequency has been introduced. Moreover, the relationship observed between the performance characteristics and the number of resonating bands suggests that there is a tradeoff between the number of resonating bands and the offered return loss and VSWR by the antenna. The greater the number of bands for an antenna, tuned using the feed manipulation method, the more the deviation if return loss and VSWR from their ideally desired values.

Future Work

The trend observed in feed point manipulation suggests that more work is required to explore this area of feed adjustable microstrip antennas. The future work regarding this research includes the behavioral analysis of microstrip antennas fed using angular transmission lines and their shifted versions. Also, the effects of feed manipulation on radiation characteristics of antennas have to be investigated.

References

1. *Constantine A. Balanis,* "Antenna Theory: Analysis & Design", Chapter 1,3rd Edition, Jhon Wiley & Sons Inc. USA, 2003.
2. *I. S. Jacobs and C. P. Bean*, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
3. *C. Y. Huang, J. Y. Wu, and K. L. Wong*, "Slot-coupled microstrip antenna for broadband circular polarization", Electronic Letter 34, pp 835-836, 1998.
4. *M. C. Pan, K. L. Wong*, "A broadband slot-loaded trapezoid microstrip antenna", Microwave Optical Technology Letters No. 24, pp 16-19, 2000.
5. *Jhon D. Kraus, Ronald J. Marhefka, Ahmed S. Khan*,"Antenna for all applications", 3rd Edition, pp 246-247, p 584, McGraw Companies, 2002.
6. *Kin-Lu Wong*, "Compact and broadband microstrip antennas", Texas A&M University, Jhon Wiley Inc., USA. 2002.
7. *Allen Miu, Hari Balakrishnan, Can Emre Koksal*, "Multi-radio diversity in wireless networks", Wireless Networks Journal, Vol. 13-6, June 2007.

8. *Allen Miu, Hari Balakrishnan, Can Emre Koksal*, "Improving loss resilience with multi-radio diversity in wireless networks", Proceedings of the 11th annual international conference on Mobile computing and networking, August 2005.

9. *Sandeep Kakumanu, Raghupathy Sivakumar*, "Glia: a practical solution for effective high datarate wifi-arrays", Proceedings of the 15th annual international conference on Mobile computing and networking, September 2009.

10. *Micheal Buettner, et. a*l., 'A phased array antenna testbed to evaluate directionality in wireless networks', Proceedings of 1st International Workshop on System Evaluation of Mobile Platforms, ACM, June 2007.

11. *Xi Liu, et. al*., "DIRC: increasing indoor wireless capacity using directional antennas", Proceedings of the ACM SIGCOMM'09, August 2009.

12. *Griffiths, L.A. Furse, C. You Chung Chung*, "Broadband and Multiband Antenna Design Using the Genetic Algorithm to Create Amorphous Shapes Using Ellipses", IEEE Transactions on Antenna & Propagation, Vol. 54-10, October 2006.

13. *Mak, A.C.K. Rowell, C.R. Murch, R.D. Chi-Lun Mak*, "Reconfigurable Multiband Antenna Designs for Wireless Communication Devices", IEEE Transactions on Antenna & Propagation, Vol 55-7, July 2009.

14. *Zhang Hu Guobin Wan Changjie Sun Huiling Zhao*, "Design of modified Sierpinski fractal antenna for multiband application", IEEE 3rd International Symposium on Microwave, Antenna, Propagation and EMC Technologies for Wireless Communications, December 2009.

15. *Hsuan-Wei Hsieh Yi-Chieh Lee Kwong-Kau Tiong Jwo-Shiun Sun*, "Design of a Multiband Antenna for Mobile Handset Operations", IEEE Antenna & Wireless Propagation Letters, Vol. 8, April 2009.

16. *Dongho Kim Seokjin Hong Jaehoon Choi*, "Design of a multiband antenna for GSM900/DCS1900/WiMax wireless communication application", Proceedings of IEEE Asia-Pacific Microwave Conference, January 2010.

17. *Jhon D. Kraus, Ronald J. Marhefka*, "Antennas for all applications", Chapter 16: Antennas for Special Applications – Feeding Considerations, 3rd Edition, McGraw Hill, 1997.

18. *Raheel M. Hashmi, Arooj M. Siddiqui, M. Jabeen, K. Shehzad, S. Muzahir Abbas, K. S. Alimgeer*, " Design and experimental analysis of high performance microstrip antenna for wireless broadband communication", International Journal of Computer & Network Security, Vol. 3-1, pp. 50-53, December 2009.

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COSECANT-SQUARED PARABOLIC REFLECTOR ANTENNA DESIGN FOR AIR AND COASTAL SURVEILLANCE RADARS

This paper deals with the analysis and proper design of parabolic reflector antennas to obtain pencil beam, cosecant-squared and inverse cosecant-squared radiation patterns for air and coastal surveillance radars. The analytical regularization method (ARM) is used to solve the problem of E-polarized wave diffraction by parabolic shaped perfectly electrical conductive (PEC) cylindrical reflector with finite thickness.

1. Introduction

The parabolic reflectors are one of the most popular antennas commonly used in microwave radar, power transmission, satellite and point-to-point communication systems [1-3]. They have generally large physical dimensions with respect to the wavelength. Thus, high frequency electromagnetic wave scattering techniques such as geometrical optics (GO), physical optics (PO), aperture integration (AI) and geometrical theory of diffraction (GTD) are mostly used for determining the far field antenna characteristics [4]. Some direct numerical techniques; i.e. method of moments (MoM), finite element method (FEM) and finite difference methods, can be employed especially for non-canonical structures [5]. However, in many cases, the complexity of some cavity or aperture geometries creates hard numerical convergence problems because of the computational instabilities. The origin of these problems is related to the nature of the direct numerical methods, which reduce a diffraction boundary value problem (BVP) to the functional equation of the first kind. A typical first kind algebraic equation system frequently has a singular kernel and a very big condition number value that can cause unstable numerical process. Thus, minimizing the computational error by increasing the truncation number of the algebraic equation set cannot be guaranteed [6-7].

To obtain pencil beam and cosecant-squared radiation patterns, the reflector geometry is cut and bended partially, and the effects on the radiation characteristics are analyzed parametrically. Analytical regularization method (ARM), which is implemented for solving the 2D problem of E-polarized wave diffraction by arbitrary shaped, smooth and perfectly conductive cylindrical obstacles, is applied to obtain fast, accurate and reliable results for the parabolic reflector structure (see Fig. 2). The ARM equivalently reduces the original diffraction BVP to the algebraic system of the second kind of the form $(I+H)x=b,\ x,b\in l_2$, where I and H are correspondently identical and compact operators in space l_2 of summable sequences [8]. Therefore, the numerical stability of solving process is guaranteed for arbitrary big truncated matrix to enable us to reach the solution of original BVP with any required accuracy [9].

In this study, new studies on switching different beam types (pencil, cosec^2, inverse cosec^2) are also introduced just by changing flare angles of the feed horn. It is shown that such major pattern switching can be reached by using asymmetric illumination. By this way, same reflector structure can be used for both air and coastal surveillance radars.

2. ARM Formulation

Scalar diffraction problem of an infinitely long, smooth, longitudinally homogeneous and perfectly conducting cylindrical obstacle corresponds to the Dirichlet boundary condition for E-polarized incident wave. Consider its XOY plane cross section is denoted by the closed contour *S*, the incident and scattered scalar wave functions ($u^i(p)$ and $u^s(p)$) must satisfy the following Helmholtz equation given in Eq. (1) and the Dirichlet boundary condition in Eq.(2), also with the Sommerfeld radiation condition.

$$\left(\Delta + k^2\right) u^s(p) = 0, \quad p \in R^2 \backslash S \tag{1}$$

$$u^{s(+)}(p) = u^{s(-)}(p) = -u^i(p), \quad p \in S \tag{2}$$

where, *S* smooth contour of the domain *D* in 2D space R^2 that belongs to the smoothness class C^2. $u^{s(+)}(p)$ and $u^{s(-)}(p)$ are limiting values of $u^s(p)$ in the inner and the outer sides of *S*, respectively. The solution of the BVP is written in Eq. (3) using Green's formula and the boundary condition in Eq. (2).

$$-\frac{i}{4}\int_S \left[H_0^{(1)}(k|q-p|)Z(p)\right] dl_p = -u^i(q), \quad q, p \in S \tag{3}$$

where, $Z(p) = \dfrac{\partial u^{s(-)}(p)}{\partial n} - \dfrac{\partial u^{s(+)}(p)}{\partial n}$, $p \in S$; n is the unit outward with respect to *S* normal of the point *p*. The unknown function *Z(p)* is constructed by solving Eq. (3), and using parameterization of the *S* contour specified by the function $\eta(\theta)=(x(\theta),y(\theta))$ that smoothly parameterizes the contour *S* by the points of $\theta \in [-\pi, \pi]$. The integral equation representation of the first kind in Eq. (3) can be equivalently rewritten by means of the $\eta(\theta)$ parameterization as follows:

$$\frac{1}{2\pi}\int_{-\pi}^{\pi}\left\{\ln\left|2\sin\frac{\theta-\tau}{2}\right| + K(\theta,\tau)\right\} Z_D(\tau)\,d\tau = g(\theta), \quad \theta \in [-\pi, \pi] \tag{4}$$

with the unknown function $Z_D(\tau)$ and the given function $g(\theta)$, where

$$Z_D(\theta) = l(\theta)Z(\eta(\theta)), \quad g(\theta) = -u^i(\eta(\theta)); \quad \theta \in [-\pi, \pi] \tag{5}$$

$$l(\theta) = \left([x'(\theta)]^2 + [y'(\theta)]^2\right)^{1/2} > 0, \quad x(\theta), y(\theta) \in C^{\infty}\left(Q^1\right) \tag{6}$$

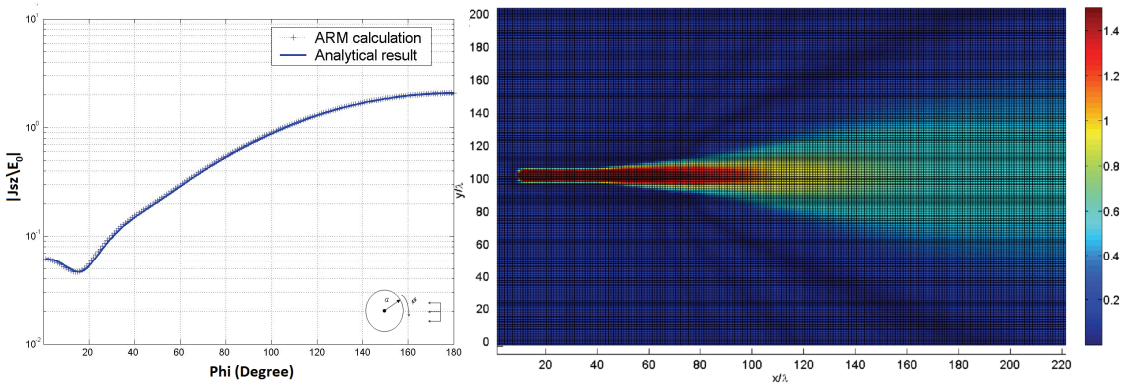
Here $K(\theta,\tau)$ function is rather smooth section of the Green's function in comparison with $\ln|2\sin\frac{\theta-\tau}{2}|$ part that represents the main singularity of the Eq. (4) [9]. The functions in Eq. (4) are represented by their Fourier series expansions with $k_{s,m}$, z_m, g_m coefficients. Subsequently, one can obtain an infinite system of the linear algebraic equations of the second kind:

$$\mathfrak{z}_s + \sum_{m=-\infty}^{\infty} \mathfrak{k}_{s,m}\mathfrak{z}_m = \mathfrak{g}_s, \quad s = \pm 1, \pm 2, .. \tag{7}$$

where, $\mathfrak{k}_{s,m} = -2\tau_s\tau_m\left[k_{s,-m} + \frac{1}{2}\delta_{s,0}\delta_{m,0}\right]$, $\mathfrak{z}_n = \tau_n^{-1} z_n$, $\mathfrak{g}_s = -2\tau_s g_s$, $\tau_n = \max(1, |n|^{1/2})$, $n = 0, \pm 1, \pm 2, ..$ (8)

and $\delta_{s,0}$ is the Kronecker delta function. Finally, the scattered field $u^s(q)$ for $q \in R^2$ are obtained by the integral equation representation of the Eq. (4) with any required accuracy by the truncation method.

3. Geometrical Design and Numerical Results



(a) (b)

Figure 1. Comparisons of the ARM calculations with analytical results

a) Uniform plane wave illumination, circular cylinder, normalized radius (*ka*)=3.1

b) Near field analysis of the feed horn antenna

c)

The ARM procedure is verified by the analytical solution for induced current density distribution function of the infinitely long circular cylinder for the oblique incident plane (see Fig. 1a) and also by the analytical solution of radiation from open-ended waveguide [10-11]. The near field analysis of the feed horn model with 3λ flare length is presented in Fig. 1b.

The 2D configuration of the parabolic reflector and its feed horn antenna are shown in Fig. 2. To obtain pencil beam, the parabolic reflector antenna indicated with dashed line is used. To obtain cosecant-squared radiation pattern, the bottom side of the reflector antenna is partially cut and bended by 5, 10, 15 and 20 degrees, respectively. The performance results of pencil beam and cosecant-squared radiation patterns are given in Fig. 3.

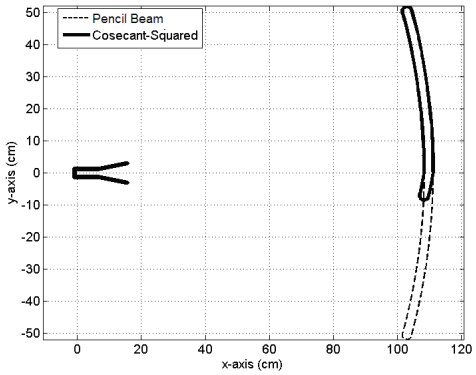


Figure 2. XOY-plane cross-section geometry of parabolic reflector and feed horn

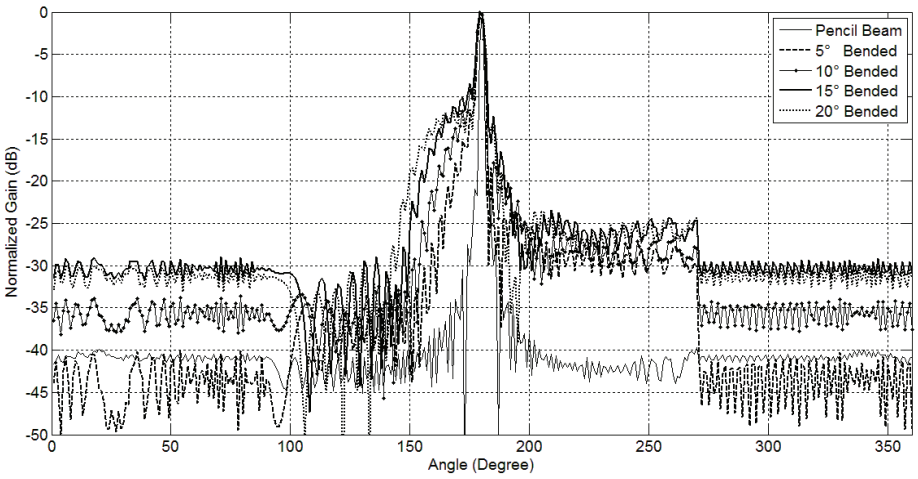


Figure 3. Far-field symmetric and cosecant-squared radiation patterns

4. Conclusion

This paper has presented the geometric analysis of the radiation characteristics of parabolic reflector antenna illuminated by H-plane horn feeder. The analytical regularization method is used to perform 2-D analysis of E-polarized electromagnetic wave scattering problem as a fast, accurate and stable numerical technique. The ARM algorithm is firstly compared with analytical data for verification. The results of different geometrical configurations such as, symmetric, offset cut, and bended reflector shapes are demonstrated on the radiation patterns to attain pencil and fan beams, which are required for microwave radar systems used for air and coastal surveillance.

References

1. *Skolnik*, M., "M.I: Radar Handbook", *McGraw-Hill,*1970.

2. *Uno*, T.; Adachi, S., "Optimization of Aperture Illumination for Radio Wave Power Transmission.", *IEEE Trans. Antennas and Propagation, 32 (1984), 628-632.*

3. *Hagen*, J.B., "Backscatter Gain of Aperture Antennas*", Radio Science 31 (1996), 693-699.*

4. *Suedan*, G.A., *Jull*, E.V., "Beam Diffraction by Planar and Parabolic Reflectors", *IEEE Trans. Antennas and Propagation 39 (1991), 521-527.*

5. *Umashanka*r, K., *Taflove*, A., "Computational Electromagnetics", *Artech House*, 1993.

6. *Wilkinson*, J.H., "The Algebraic Eigenvalue Problem.", *Clarendon Press*, Oxford, 1965.

7. *Fletcher*, C.A.J., "Computational Galerkin Method.", *Springer- Verlag*, Berlin, 1984.

8. *Tuchkin*, Y.A., "Wave Scattering By An Open Cylindrical Screen Of Arbitrary Profile With Dirichlet Boundary Value Condition", *Soviet Physics Doclady 30 (1985), 1027-1030.*

9. Y. A. *Tuchkin*, E. Karacuha, A. S. Turk, "Analytical Regularization Method for E-Polarized Electromagnetic Wave Diffraction by Arbitrary Shaped Cylindrical Obstacles", *7th Int. Conference on Mathematical Methods in Electromagnetic Theory (MMET 1998)*, 733-735, Kharkov, Ukraine, (1998)

10. A. S. *Turk*, "Analysis of Aperture Illumination and Edge Rolling Effects for Parabolic Reflector Antenna Design", *International Journal of Electronics and Comm. (AEÜE)*, 60, 257-266. (2006).

11. A. S. *Turk*, O. M. Yucedag, O. Yurduseven, "Parametric Analysis of H-Plane Horn Antenna Radiation", *Proc. 7th International Kharkov Symposium on Physics and Engineering of Microwaves, Millimeter and Sub-millimeter Waves (MSMW'10)*, IEEE press, Kharkov, Ukraine, (2010).

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TEM HORN FED PARABOLIC REFLECTOR ANTENNA DESIGN FOR HYPER WIDE BAND IMPULSE RADAR SYSTEMS

This paper deals with the design of partially dielectric loaded TEM horn fed parabolic reflector antenna to reach hyper-wide band radiation performance from 200 MHz up to 30 GHz for impulse radiation. The partially loaded transmission line and analytical regularization methods are used to calculate the antenna characteristics.

1. Introduction

Ultra-wide band (UWB) impulse technologies are being used increasingly for RF wireless networks, high-speed communication, high power RF jamming, and high-resolution impulse radar systems [1-2]. Due to short-time impulse signal radiation and reception principles, operational frequency bands of the impulse radar systems can be very broad starting from a few hundred MHz up to 30 GHz. The wide band operation provides critical advantages, such as improved detection, ranging and target resolution performances. Furthermore, the radar power consumption is highly reduced on account of the low average power of impulse generator; also the radar operation achieves immunity against jammers.

Ground-penetrating impulse radar (GPR) is one of the popular technologies used for detection, identification and subsurface imaging of buried objects [3]. The frequency band of the transmitted impulse signal is the key factor for the system performance. Higher frequencies are needed for better range and angular resolution to determine small size objects. However, lower frequency bands are usually preferred for longer detection ranges. Thus, ultra-wide band short time pulse signal is used to benefit from both low and high frequencies. The impulse waveform is generally Gaussian shaped mono-cycle type in time with the application-oriented pulse durations from a few nanoseconds to a few hundred picoseconds corresponding to a broad frequency spectrum from VHF up to millimetre wave bands. Thus, the radar performance rigorously depends on the proper design of the UWB antennas, which must have flat and high directive gain, narrow beam, low side and back lobes over the operational frequency band to attain the uniformly shaped impulse radiation [4]. On this scope, TEM horn antenna is an appropriate structure as a result of its wider band, higher gain and narrower beam width characteristics [5]. Dielectric loading techniques can be applied to improve the gain pattern increasing the antenna electrical size [6]. For instance, the partial dielectric loaded TEM (called PDTEM) horn and its Vivaldi shaped versions (called PDVA) have been introduced by Turk, as UWB impulse radiators over 20:1 frequency band [4,7]. An array combination of PDTEM horn antennas has also been designed by Turk to obtain wider band characteristics from 150 MHz to 10 GHz for multi-band impulse GPR operation [8].

This paper proposes use of PDTEM horn (and PDVA) antennas as feed horn of the parabolic reflectors to obtain hyper-wide band antenna characteristics from 200 MHz up to 30 GHz for proper impulse radiation. The partially loaded transmission line antenna method (PLTLM) is used to calculate fast the near field distribution of PDTEM horn feeder, which is considered as incident field for the reflector. The analytical regularization method (ARM) is applied to obtain fast, accurate and reliable results for the parabolic reflector structure shown at Fig. 1 [9]. The boundary value problem (BVP) is formulated with respect to z-component of electric field satisfying Helmholtz's equation with Dirichlet boundary condition and the original diffraction BVP is reduced to the algebraic system of the second kind of the form $(I+H)x=b,\ x,b\in l_2$, to guarantee the numerical stability. The ARM validity tests have been demonstrated in [10-11].

2. PLTLM Procedure for Feeder Antenna

TEM horn is a kind of travelling wave antenna. Therefore, its structure can be considered as combination of discrete antennas each composed of a number of transmission line segments which are characterized by their local geometrical and constitutional structure parameters. The staircase modelling is used for the analysis. 3D antenna geometry is firstly divided into *N* number of elementary cells which are chosen locally homogeneous and sufficiently small in wavelength. Then, the structure is reduced to the equivalent one-dimensional (1-D) transmission line with corresponding characteristic impedance (Z_0^n), propagation constant (β_n), segment length (l_n), segment width (w_n), segment height (d_n) and total arm length (*L*) definitions. The input impedance of each line segment and its characteristic impedance are expressed as [12]:

$$Z_{in}^n = Z_0^n \frac{Z_{in}^{n+1} + jZ_0^n \tan\beta_n l_n}{Z_0^n + jZ_{in}^{n+1} \tan\beta_n l_n} \quad ; \; n = 1,2,...,N \tag{1}$$

$$Z_0^n = 138\sqrt{\frac{\mu_r^n}{\varepsilon_r^n}} \log\frac{8}{\left(w_n/d_n\right)} \quad ; \text{for } \left(w_n/d_n\right) \le 1 \tag{2}$$

where, $\beta_n = \frac{2\pi f}{c}\sqrt{\mu_r^n \varepsilon_r^n}$ and Z_{in}^{N+1} is the equivalent antenna line output impedance. The input and local reflection coefficients of the n*th* segment line are given by

$$\Gamma_{in}^n = \frac{Z_{in}^n - Z_0^{n-1}}{Z_{in}^n + Z_0^{n-1}} \quad ; \; n = 1,2,...,N \tag{3}$$

$$\Gamma^n(z) = \Gamma_{in}^{n+1} e^{-j2\beta_n(l_{n+1}-z)} \quad ; \; z \in l_n; 0 \le z \le L \tag{4}$$

Using the Eq. (4), the discrete voltage and current distribution functions over the antenna line are determined rapidly by Eq. (5). V_{0+}^n and I_{0+}^n coefficients are calculated iteratively using the initial values [12]. The integral equation techniques are used for near field calculation [7-8].

$$V^n(z) = V_{0+}^n e^{-j\beta_n z}\left[1+\Gamma^n(z)\right] \quad ; \; I^n(z) = I_{0+}^n e^{-j\beta_n z}\left[1-\Gamma^n(z)\right] \quad ; z \in l_n; n = 1,2,...,N \tag{5}$$

3. ARM Formulation for Reflector Antenna

Scalar diffraction problem of an infinitely long, smooth, longitudinally homogeneous and perfectly conducting cylindrical obstacle corresponds to the Dirichlet boundary condition for E-polarized incident wave. Consider its XOY plane cross section is denoted by the closed contour *S*, the incident and scattered scalar wave functions ($u^i(p)$ and $u^s(p)$) must satisfy the following Helmholtz equation given in Eq. (6) and the Dirichlet boundary condition in Eq. (7), also with the Sommerfeld radiation conditions [9].

$$\left(\Delta + k^2\right)u^s(p) = 0, \quad p \in R^2 \backslash S \tag{6}$$

$$u^{s(+)}(p) = u^{s(-)}(p) = -u^i(p), \quad p \in S \tag{7}$$

where, *S* smooth contour of the domain *D* in 2D space R^2 [9]. $u^{s(+)}(p)$ and $u^{s(-)}(p)$ are limiting values of $u^s(p)$ in the inner and the outer sides of *S*, respectively. The solution of the BVP is written in Eq. (8) using Green's formula and the boundary condition in Eq. (7).

$$-\frac{i}{4}\int_S \left[H_0^{(1)}(k|q-p|)Z(p)\right]dl_p = -u^i(q), \quad q,p \in S \tag{8}$$

The unknown function $Z(p)$ is constructed by solving Eq. (8), and using parameterization of the S contour specified by the function $\eta(\theta)=(x(\theta),y(\theta))$ that smoothly parameterizes the contour S by the points of $\theta\in[-\pi,\pi]$. The integral equation representation of the first kind in Eq. (8) can be equivalently rewritten by means of the $\eta(\theta)$ parameterization as follows:

$$\frac{1}{2\pi}\int_{-\pi}^{\pi}\left\{\ln\left|2\sin\frac{\theta-\tau}{2}\right|+K(\theta,\tau)\right\}Z_D(\tau)d\tau=g(\theta),\quad \theta\in[-\pi,\pi] \tag{9}$$

with the unknown function $Z_D(\tau)$ and the given function $g(\theta)$, where

$$Z_D(\theta)=l(\theta)Z(\eta(\theta)),\quad g(\theta)=-u^i(\eta(\theta));\quad \theta\in[-\pi,\pi] \tag{10}$$

$$l(\theta)=\left([x'(\theta)]^2+[y'(\theta)]^2\right)^{1/2}>0,\quad x(\theta),y(\theta)\in C^{\infty}\left(Q^1\right) \tag{11}$$

$K(\theta,\tau)$ function is smooth section of the Green's function [10]. The functions in Eq. (9) are represented by their Fourier series expansions with $k_{s,m}$, z_m, g_m coefficients. Finally, one can obtain an infinite system of the linear algebraic equations of the second kind in Eq. (12) and the scattered field $u^s(q)$ for $q\in R^2$ are obtained by the integral equation representation.

$$\text{€}_s+\sum_{m=-\infty}^{\infty}\text{€}_{s,m}\text{€}_m=\text{€}_s,\quad s=\pm1,\pm2,.. \tag{12}$$

$$\text{where, }\text{€}_{s,m}=-2\tau_s\tau_m\left[k_{s,-m}+\frac{1}{2}\delta_{s,0}\delta_{m,0}\right],\quad \text{€}_n=\tau_n^{-1}z_n,\quad \text{€}=-2\tau_s g_s,\quad \tau_n=\max(1,|n|^{1/2}),\quad n=0,\pm1,\pm2,.. \tag{13}$$

4. Design and Numerical Results

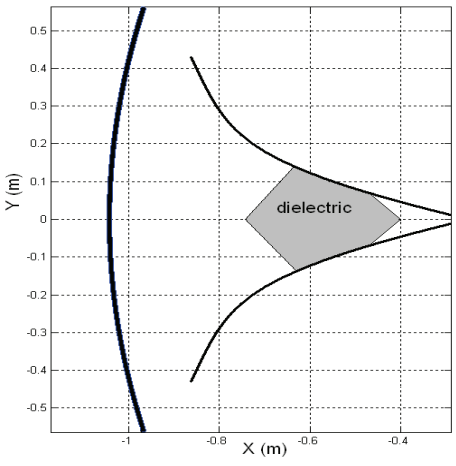


Figure 1. Geometry of the antenna

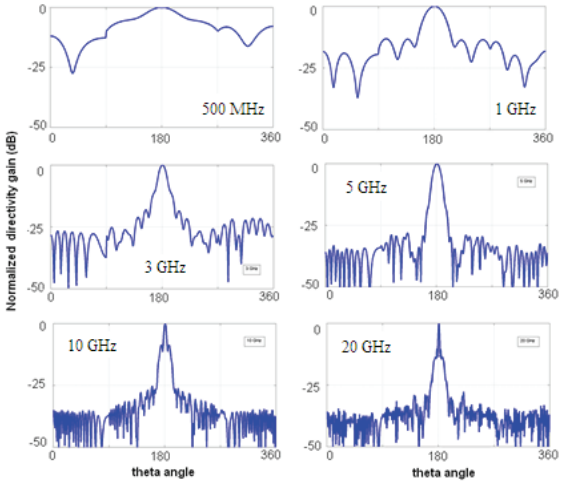
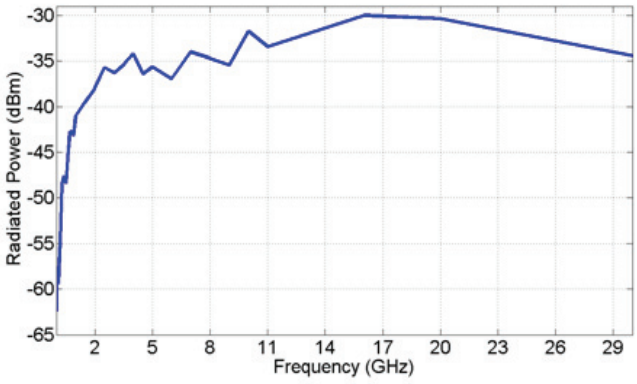
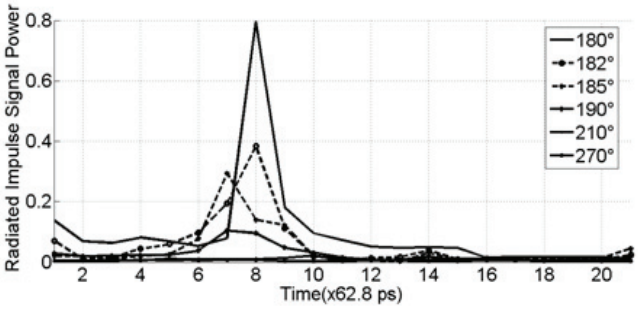


Figure 2. Normalized radiation patterns



(a)



(b)

Figure 3. Antenna radiation response; (a) Frequency domain (b) 20 GHz impulse radiation (at angles)

4. Conclusion

This paper has presented the ultra-wide band design and radiation characteristics of the parabolic reflector antenna illuminated by PDTEM horn feeder.

References

1. *M. I. Skolnik*, Radar handbook, McGraw-Hill, 1970.

2. *R. J. Fontana*, "Recent system applications of short-pulse ultra-wide band technology", IEEE Trans. Microwave Theory Tech., Vol. 52, No. 9, Sept. 2004.

3. *A. S. Turk, A. K. Hocaoglu,* "Buried Object Detection", Encyclopedia of RF and Microwave Engineering, vol. 1, pp. 540-559, Wiley-Interscience, New Jersey, 2005.

4. *A.S. Turk, D. A. Sahinkaya*, "Partial Dielectric Loaded TEM Horn Design for Ultra-Wideband Ground Penetrating Impulse Radar Systems", Ultra-Wideband Short-Pulse Electromagnetics Series 7, chapter 34, Springer, Berlin, 2007.

5. *B. Scheers, M. Acheroy, A. V. Vorst*, "Time-domain simulation and characterization of TEM horns using a normalized impulse response", IEE Proc. Microwave Antennas Prop., 147, 6, 463-468, 2000

6. *A. G. Yarovoy, A. D. Schukin, I. V. Kaploun, L. P. Ligthart*, "The dielectric wedge antenna", IEEE Trans. on Antennas and Propagation, vol. 50, no. 10, 1460-1472, 2002.

7. *A. S. Turk*, "Ultra-wideband Vivaldi antenna design for multi-sensor adaptive ground-penetrating impulse radar", Microwave and Optical Technology Letters, 48, (5), 834-839, 2006

8. *A. S. Turk*, "Hyper-wide band TEM horn array design for multi band ground-penetrating impulse radar", Microwave and Optical Technology Letters, 50 (1), 76-81, 2008

9. *Y. A. Tuchkin, E. Karacuha, A. S. Turk,* "Analytical regularization method for E-polarized electromagnetic wave diffraction by arbitrary shaped cylindrical obstacles", 7th Int. Conference on Mathematical Methods in Electromagnetic Theory (MMET 1998), 733-735, Kharkov-Ukraine, 1998.

10. *E. Karacuha, A. S. Turk*, "E-polarized scalar wave diffraction by perfectly conductive arbitrary shaped cylindrical obstacles with finite thickness", Int. J. Infrared and Millimeter Waves, 22, 1531-1546, 2001

11. *A. S. Turk*, "Analysis of aperture illumination and edge rolling effects for parabolic reflector antenna design", International Journal of Electronics and Communications (AEÜE), 60, 257-266, 2006.

12. *D. M. Pozar*, Microwave Engineering 2nd edition, John Wiley and Sons Inc., New York, 1998.

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POLARIZATION SELECTIVE ANTENNAS FOR RADAR APPLICATION

In this paper the possibilities of modern polarization selective antenna systems to solve problems of obtaining versatile information about hazardous weather phenomena is presented and discussed.

Introduction

The operative obtaining information about hazardous for aviation weather phenomena is the question of great importance to provide safe, regular and economical flights. Since the development of radars the aviation services succeeded noticeably. Nowadays the non-coherent radar systems as well as coherent Doppler radars are in wide use throughout the world. The antenna or antenna system measures the reflected signal power in case of non-coherent radar or frequency and power of reflected signal in case of coherent Doppler radar. Then the received signal is usually processed as a function of time. The transmitted wave when interacting with medium (atmosphere) undergoes the change of amplitude, phase, frequency, propagation direction and polarization as well. Therefore in case of only temporal processing reflected signal power or frequency the important part of information about state of atmosphere and processes in it can be lost. Consequently we cannot obtain the full information about structure, state and dynamics of atmosphere.

During the last decades the development and researches of combined Doppler and polarimetric radar systems that were made in different states and have shown their greater potentials for atmospheric studies [1]. Some of these systems use one antenna that can be switched by turns to receive signals with polarization coordinated with transmitted signal polarization (main polarization) and to receive orthogonally polarized signals. There are Doppler and polarimetric radars that have two antennas for simultaneous receiving signals with principal and orthogonal polarizations. There were also considered systems with three antennas [2] where polarization parameters of the wave were measured in series with one antenna with switched polarization. The atmosphere is the subject of constant change. To obtain the profound and deep information about its state it is interesting to obtain information parameters simultaneously. In case of systems with two orthogonal antennas with possibilities of simultaneous measurement the received signal parameters with orthogonal polarization usually is too low for further successful processing. Moreover the measured polarization parameters are mostly used for retrieving information about microstructure of atmospheric formation. In [3] the possible use of polarimetry for determination of dangerous weather phenomena connected with wind is reviewed.

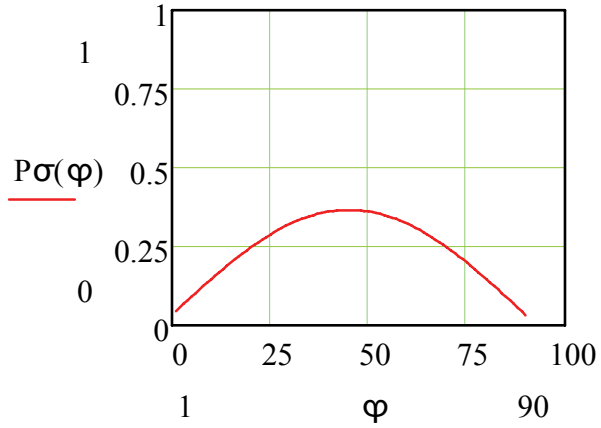
In this paper the possibilities of modern polarization selective antenna systems to solve questions of obtaining versatile information about hazardous weather phenomena is presented and discussed.

Multi antenna polarimetric system

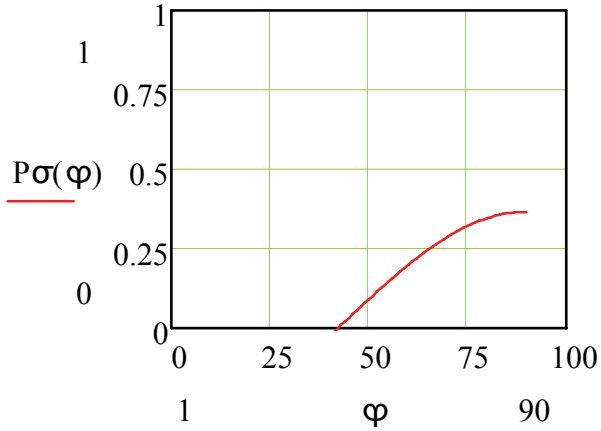
In work [4] the polarization selective system that receives simultaneously reflected waves with main polarization (polarization of the sounding waveform), polarization that differs from main, and polarization that is orthogonal to the main polarization is proposed and considered. This system gives possibility to obtain simultaneously and to analyze polarization spectra of electromagnetic waves reflected from hydrometeors [5]. The approach to estimate the atmospheric turbulence with such systems is presented in [5]. It is based on the transmitting into the atmosphere the sounding waveform with the fixed polarization and receiving reflected signals by the set of antennas or a multi-input antenna. Each antenna in the antenna set or different antenna inputs are adjusted to receive electromagnetic waves of certain polarization. In real situation the most of the wind phenomena can cause the change of polarization angle in the limits of about 15 degrees. Therefore to receive waves with changed polarization at accepted for further signal processing and parameter

calculation level the intermediate antenna is used. This antenna is adjusted to receive waves in the limits of polarization angle change up to 45 degrees

In Fig.1(a,b) the levels of useful signal power variation in the receiving antennas that is set up to receive reflected electromagnetic waves with different polarization relative to the polarization of the sounding waveform are shown. Sounding waveform is horizontally polarized. To obtain the useful signal the additive noise power was taken at 0.3 from the total received power. The angle of polarization change is put along *x* axis in Fig. 1(a,b) The normalized value of useful antenna current relative to its maximum value is put along *y* axis.



a)



b)

Fig.1 (a,b) Useful current variation in the receiving antenna coordinated to receive electromagnetic waves with polarization angle 45° (a) and in the receiving antenna coordinated to receive vertically polarized electromagnetic waves (b). Sounding waveform is vertically polarized.

From figure 1 one can see that effective reception of waves with changed polarization angle is possible when angle of polarization change is less than 45 deg. The energy level of received waves in cross-polarized antenna (horizontally polarized waves) will appear to be less than power of noise in case of small angles of polarization change (Fig.1b). From figure 1a one can see that almost all power of the electromagnetic field can be received with the antenna coordinated to receive electromagnetic waves with angle of polarization change of 45°. This is important for real situations connected with atmospheric dynamics.

The use of such antenna system for radar weather application allows to obtain the significantly higher level of signal with changed polarization than in the case of antenna with orthogonal polarization with respect to the sounding wave polarization. Moreover, it –provides

higher signal-to-noise ratio for better polarization parameter calculation. But in this case the additional requirements concerning the polarimetric antennas specification should be developed. Antenna requirements should cover such points as polarization antenna pattern and polarization antenna beamwidth. Polarization antenna pattern implies the perception of signal energy depending on polarization angle. Polarization antenna beamwidth is characterized by the relative sensitivity of the antenna for the receiving signals with certain polarization in the given direction. In this case it is necessary to make clear that antenna should receive not only the electromagnetic waves with coordinated polarization but momentary spectrum of the signals of the same frequency with different polarization angles. We named it as polarization spectrum [3]. Therefore traditional antenna beamwidth should be corrected taking into account receiving waves of different polarization angles.

Polarimetric system with single unipolarized antenna

The possibility to use single antenna with definite polarization properties for atmospheric study is explained in [6]. There it was shown that degree of polarization angle change of reflected signal as informative parameter is changed according to the directional cosines and leads to the receiving energy fluctuation in the antenna. The fluctuations appear because the maximum value of receiving antenna energy corresponds to the reception of the reflected from weather target wave with polarization that coincides with sounding wave polarization. In case of changing polarization of the reflected from weather target wave, the receiving antenna current is defined as the projection on its beamwidth main axis. Taking into account the fact that fluctuation of antenna current can be caused by many factors we need to decide how to discern the useful fluctuation. For this purpose the physics of atmospheric phenomena are studied and frequency characteristics of amplitude fluctuations due to different factors are taken into account. In [7] the frequency characteristics of turbulence were analyzed and used to demonstrate the possibility of radar system with single unipolarized antenna. The modelling results obtained with the proposed system are shown in Fig.2 . The method gave the integrated probability of error is of 0.1 order when dangerous turbulence detection.

The integrated probability of the error in case of application of the proposed approach with single antenna of definite polarization properties has the same order as the results obtained using other methods [8], for example when Doppler spectrum width is used for turbulence intensity estimate.

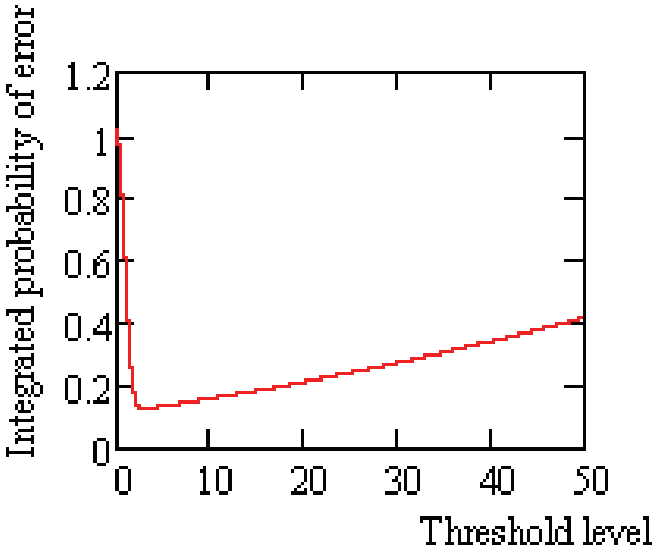


Fig.2 Modelling results of integrated probability of error as a threshold function

Conclusion

The polarization selective antennas considered in the paper can be used in the modern non-coherent and coherent radar systems for deeper and versatile studying the radar targets. It allows to provide the conventional detection of hazardous weather phenomena as well as to use polarimetry directly for wind related phenomena estimate.

References

1. *F.J Yanovsky, C.M.H. Unal, H.W.J. Russchenberg*, "Doppler-Polarimetric Radar Observations of Turbulence in Rain" *Report: IRCTR-S-006-03* (September 2002 – March 2003), TU-Delft, The Netherlands, 2003, 102 pp.
2. *B.L. Kashcheev, E.G. Proshkin, M. F. Laguti,* "Remote methods and means for study of processes in the Earth Atmosphere", Kharkov: National University of Radioelectronics of Kharkov; Bussiness Inform, 2002, 426 p. (In Russian)
3. *Yu. A. Averyanova,* **"**The possibility to use polarimetric radar for atmospheric turbulence intensity estimate"*,* Bulletin of the National Aviation University, No 3, 2006, pp.46-48
4. *Yu. Averyanova, A. A. Averyanov, F.J. Yanovsky*, "Polarimetric Radar", Invention patent of Ukraine № u200804248, April 2008. (in Ukrainian)
5. *Yu. Averyanova, A. Averyanov, F.J. Yanovsky*, "Polarization signal components estimate in weather radar", Proceedings of 12th International Conference on Mathematical methods in electromagnetic theory, Odesa, Ukraine, 2008, pp. 360-362.
6. *Yu. A. Averyanova, A. A. Averyanov, F.J. Yanovsky*, "Influence of Turbulence onto Depolarization of Signal Reflected from Hydrometeor," Proc. Of International Radar Symposium (IRS 2010), Vilnius, 2010, pp. 501-504.
7. *Yu. Averyanova, A. Averyanov, F.J. Yanovsky*, "Statistical Estimation of Polarimetric Method Potential for Dangerous Turbulence Detection in Rain" Proc. Of International Conference on Mathematical Methods in Electromagnetic Theory, Kiev, Ukraine, 2010.
8. *F.J. Yanovsky*, Meteorological-navigation Radar systems of Air Vehicle*,* - Kiev, Publishing House of NAU, 2003, 304 pp. (In Ukrainian).

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PASSIVE RADAR FOR ATC

Modern air traffic control systems (ATC) consist of the net of active primary and secondary radars. While the primary radars usually do not have full coverage, it is necessary to improve coverage using other technology. The good coverage of secondary radars do not solve the problem, while many small aircrafts are not equipped with transponders. One of possible solutions is the application of passive radars used as the gap-filler and primary radars at small airfields.

1. Introduction

The main goal of the modern air traffic control systems (ATC) is to provide the recognized radar picture (RAP) – the current position, velocity and identification of all airborne objects in the surveillance airspace. All available information are then used for flight control and collision avoidance. The modern ATC net consists nowadays of netted active primary radars giving position information of all detected objects and secondary radars providing position and classification information of all cooperating targets. Secondary radars are better suited for ATC, but they are "blind" in case of failure or switching off on-board transponders, and cannot track targets not equipped with transponders, like small private airplanes. So good coverage of primary radars is the important feature. This has become even more obvious after September 11 (2001) suicide terrorist attack, when it was difficult to track hijacked aircraft, having only partial coverage of primary radars.

The secondary radars are nowadays in wide usage, having much better coverage than primary radars. This situation is caused by the high price of the primary radars, and the limitation of their use due to relatively high transmitting power. Many local society protests again installation of new active radars in the urban environment due to high radiating power which may cause health hazards and generate interferences in communication and TV receivers.

The ATC active radars have detection range from 100 to 350 km. Typically they are dislocated in such way that the radar coverage overlaps on the 10 000 m flight level are small. This produces relatively high blind zones at lower flight levels, so there is a very low coverage of active radars below 3 000 m. Many small airports used for local private communication and training, are not tracked either by active not passive radars, so their air operations are based on procedural approach rather than instrumental one. This situation may be improved by installing short range radars (10-50 km instrumental range) playing gap-filling role and helping air traffic controllers to provide better service for collision avoidance. The modern alternative to the active surveillance radars are passive radar, which are now in the phase of active research.

2. Passive radar fundamentals

Passive radars do not transmit electromagnetic wave toward potential target but use the transmitters of opportunity in the vicinity to illuminate targets. The concept of passive radar is not new, while in 1935 A. Wilkins demonstrated in England the detection of a Heyford bomber at a distance of 12 km [1] using a short wave BBC commercial radio transmitter as the illuminator. One problem that had to be solved was how to distinguish between the strong direct signal and the weak target echo, having only simple analogue circuits for disposal. He solved the problem using two receiving antennas and compensated the direct signals using a concept similar to Wheatstone bridge. The appearance of the aircraft echo caused the unbalance of the bridge that was detected on the scope screen.

The passive radar technology development has been stopped for more than 50 years, while the analogue circuit was not well suited to this technology. The development of digital technology enabled rediscovery of passive radar technology. This technology has now different names: Passive covert radars (PCR), bistatic passive radar (BPR) and Passive Coherent Localization radar (PCL) [2, 3, 4, 6, 7]. This technology is based on the correlation of the signal reflected from the moving

target with the direct illumination signal. The direct signal is attenuated in the surveillance channel using adaptive filters [9]. During the last decade a lot of papers on passive radars have been published worldwide. The researchers have tried to investigate the possibility to exploit different transmitters of opportunity for target illumination. Due to the high transmitter power, a lot of works have been devoted to the analogue TV broadcasting and FM radio [2, 4]. The satellite TV, as well as GPS signals were also under intensive investigation. Nowadays more efforts are placed on digital broadcasting [5] such as digital radio (DAB), digital television (DBVT) and cellular phone (GSM, UMTS) transmissions.

The passive radar (PCL) instead of emitting its own energy, exploits the energy originating from the emitters of opportunity. The target detection is performed in a completely passive way, while the target is illuminated by the existing net of transmitters, used for communication or radio and TV broadcasting. A classical PCR scenario is presented in Fig. 1.

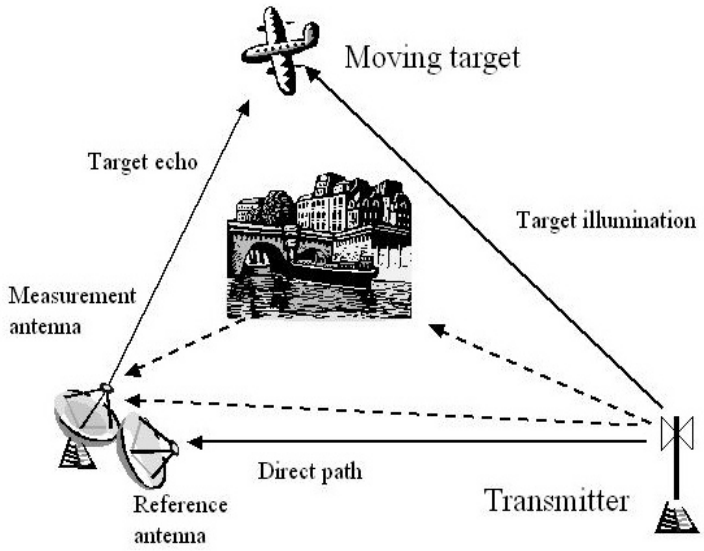


Fig. 1. The scenario of the PCL technology

The transmitter illuminates the target and the reference antenna [4] directed towards it. The surveillance (measurement) antenna is directed towards the target. It receives the target echo but also the direct illumination signal (via antenna sidelobes) and echoes originated from other objects, including ground, buildings, tree etc, what caused the serious problems of target to interferences ratio, often in the range -50 to -100 dB.

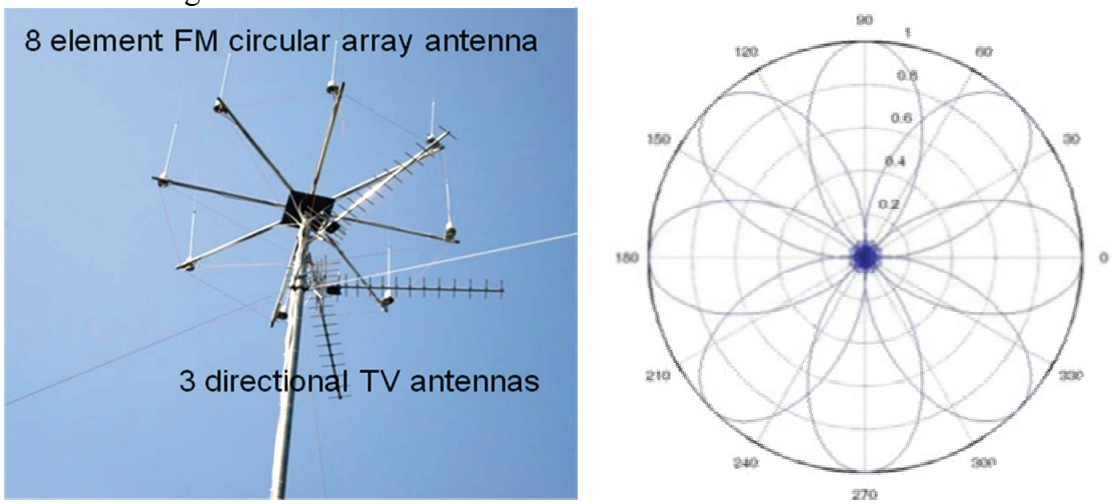


Fig. 2.The PCL multibeam circular array antenna (left) ant antenna beam-pattern (right)

To obtain the large surveillance volume, the number of surveillance antenna are in use. The alternative is the use of multibeam antenna array [6, 7, 8]. The multibeam circular antenna, used in

PaRaDe – passive radar demonstrator constructed in Warsaw University of Technology, is presented in Fig. 2. It consists of the 8 dipole FM antennas placed on the circle. Below it is possible to see 3 additional sector antennas for DBV-T passive radar. The passive radar using one single location receiver and one single location transmitter can calculate only the bistatic range and bistatic velocity. To locate the target in the 3D Cartesian coordinates several (minimum 3) bistatic ranges are needed, so the typical location scenario, presented in Fig.3 is based on the calculation of ellipsoid cross-section. For that it is necessary to exploit minimum 3 transmitters placed in 3 different locations. In many European countries these conditions are not fulfilled while usually all local transmitters are placed on a single transmitter rower, and the next transmitter is located at large distance. Instead of applying single receiver exploiting several transmitters, it also possible to use several receivers and single illuminator.

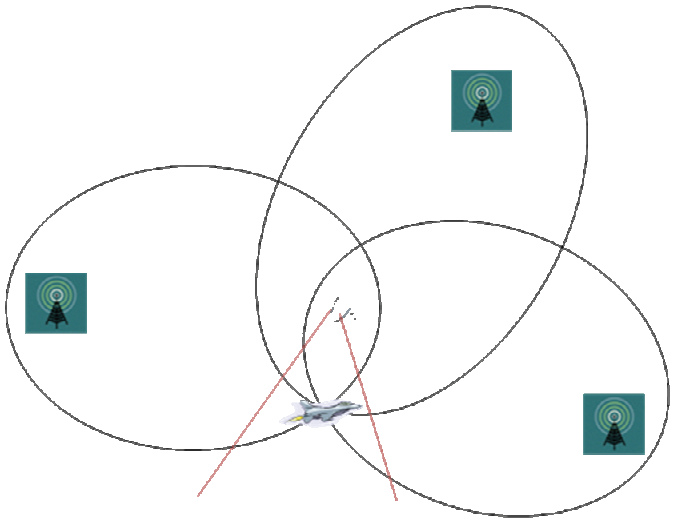
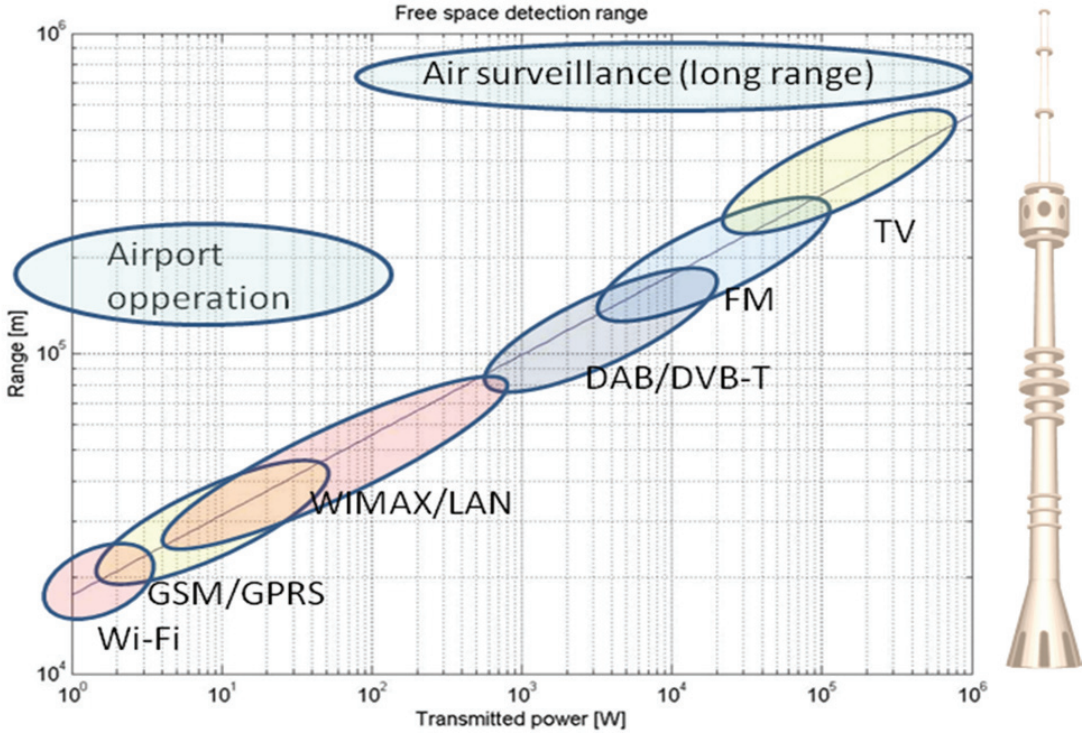


Fig. 3.The localisation of targets using single receiver and 3 illuminating transmitters

3. The concept of ATC passive radar network

The different illuminator can be used for passive technology. All of them differ in carrier frequency, bandwidth, and transmitting power. As the result, the passive radars exploiting them will have different detection range, different range and velocity cells and different tracking accuracy. The predicted detection range for most common transmitters of opportunity (versus transmitted power) is presented in Fig 4. The Analogue TV has the higher power (up to 500 kW), and relatively high bandwidth (6 MHz) but due to signal structure it is not a good candidate for illuminator. The most promising are the FM radio with transmitting power 1-100 kW. The signal bandwidth depends on the signal contents, and varies from 20 to 100 kHz. The range cell is thus in range 1.5-4 km, but it is possible to obtain tracking accuracy 200-600 m, sufficient for medium range surveillance. The PaRaDe demonstrator shows 150 km detection range for large aircrafts, 300 m (position) and 1 m/s (velocity) tracking accuracy [10]. The DBV-T has the same bandwidth as TV, but much better signal structure (almost like noise) giving small range cell (30 m) and very good tracking accuracy (3 m, 1 m/s). The transmitted power is 1-100 kW, and detection range is 50-150 km. Similar properties has DAB signal, but the bandwidth is smaller – 1.5 MHz (100 m range cell). There are also many of data transmitters such as GSM, GPRS, UMTS, EDGE, 3G, HSDPA, HSUPA, WiFI, WiMax and others, but they have lower power and worse signal structure (from PCL point of view). The proposed PCL system for ATC application, specially dedicated for the small airports, is a multiband one, working with FM, DBV-T and DAB signals. In the areas, where several (minimum 3) transmitters are present (at different locations), the single receiving system can be used (placed e.g. on the top of the airport control tower). In the location where less transmitters are visible, two or three receivers should be used, placed in the different locations (e.g. at the corners of airport or surrounding buildings).

The refresher rate of such system can be 1 second, and the tracking accuracy 1-10 m. Such systems can be used both for area surveillance (in the range 50-150 km) and the airport surveillance.



4. Conclusions

The paper presents the idea of using passive radars to support air traffic control systems. While PCL technology is still in development, there are no commercially available PCL radars for ATC. The situation probably will be changed soon, while it is possible to construct low price PCL radars.

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References

1. *N.J. Willis*, "Bistatic Radar", Artech House, 1991.
2. *P. E. Howland*, "A Passive Metric Radar Using the Transmitters of Opportunity", Int. Conf.on Radar, Paris, France May 1994, pp251-256.
3. *H. D. Griffiths, C. J. Baker, H. Ghaleb, R. Ramakrishnan, E. Willman,* "Measurement and analysis of ambiguity functions of off-air signals for passive coherent localisation", Electronics Letters, Vol. 39, No 13, June 2003, pp 1005-1007.
4. *P. E. Howland*, "Target Tracking Using Television-Based Bistatic Radar", IEE proc Radar, Sonar Navig, vol 146, no 3, June 1999, pp 166-174.
5. *A. Gunner, M.A. Temple, R.J Claypoole, Jr,* "Direct-path filtering of DAB waveform from PCL receiver target channel", Electronics Letters, Vol. 39, No 1, Jan. 2003, pp 1005-1007.
6. *B.D. Nordwall*, "'Silent Sentry' A new type of radar", Aviation Week & Space Technology, no 30, 1998, pp 70-71.
7. *J. Baniak, G. Baker, A.M. Cunningham, L. Martin*, "Silent Sentry passive surveillance", Aviation Week & Space Technology, no 7, June 1999.
8. *N. Fourikis*, "Phased array-based systems and applications" N. York: John Wiley and Sons, 1997
9. *K. Kulpa, Z. Czekała*, "Short distance clutter masking effects in noise radars", Proc. of the Int. Conf. on the Noise Radar Technology. Kharkiv, Ukraine, 21-23 October 2003.
10. *M.Malanowski, K.Kulpa, R.Suchozebrski*: Two-stage Tracking Algorithm for Passive Radar, Proc.12th International Conference of Information Fusion 2009, 2009. pp. 1-7; CD.

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ACTIVE MICROWAVE AND MILLIMETERWAVE ISAR IMAGINE AND MILLIMETERWAVE PASSIVE RADAR RECEIVER DESIGN

In the paper, two different topics are investigated. Firstly, to see advantages which millimeter wave length brings, measurements of the object at microwave and millimeter wave regions are performed in a newly constructed measurement chamber and then their ISAR images are reconstructed using filtered back projection method. In the another work, to use the advantages of passive millimeter wave receiver such as revealing explosive object without being detectable, the design of millimeter wave passive radar receiver is studied. In the part of Theorical Formulation, filtered back projection method is explained for ISAR imaging at microwave and millimeter wave ranges. In the part of Experimental Setup, Applications, and Results, both works are openly introduced. As a result, conclusions for both studies are shown and explained in Conclusion part.

Introduction

Due to the properties of electromagnetic wave at millimeter-wave length range such as penetrating into dielectric objects, bringing high resolution, imaging at that range is a great interest. So, active and passive millimeter-wave imaging has found various applications in security purposes. For these reasons, there have recently been many infrastructure investments in TUBITAK-MRC.

In the paper, two different topics are investigated. Firstly, to see advantages which millimeter-wave length brings, measurements of the object, F16 fighter of scaled model target, at microwave and millimeter-wave regions are performed in a newly constructed measurement chamber operating from 1 GHz to 100 GHz and then their ISAR images are reconstructed using filtered back projection method. In the part of Theorical Formulation, the method for calculating ISAR images is briefly explained. Then, in the part of Experimental Setups, Applications, and Results measurement setup (antenna system, Network analyzer, vs.), the measurement chamber, and their results are openly introduced. Additionally, measurement process is represented in details.

Secondly, to use the advantages of passive millimeter wave receiver such as revealing hidden explosive objects, the design of millimeter wave passive radar receiver is studied. In the part of Experimental Setups, Applications, and Results, components of the millimeter-wave passive receiver such as scanners (the scanner of radiometer receiver and a reflector located on turn table), radiometer receiver, dielectric lens, and computer on which measurement software and scanner control software are installed are introduced. In addition to it, measurement process is openly explained in the same part.

Finally, conclusions for both studies are shown and explained in Conclusion part.

Theoretical formulation

In the study of ISAR imaging at microwave and millimeter wave length range, filtered back projection method [1] is used to obtain ISAR images. Filtered back projection method is following

$$g(x,y)=\int_0^{\pi}\left[\int_0^{\infty}G(f,\theta)e^{j2\pi ft}|f|df\right]d\theta \quad (1)$$

where $G(f,\theta)$ is measured data, f is relevant frequency, θ is measurement angle and $g(x,y)$ is object function.

EXPERIMENTAL SETUP, APPLICATIONS and RESULTS

Measurement setup (see

Figure **1**.a), used in the study of bi-static ISAR imaging at microwave and millimeter-wave length range, consists of a newly constructed measurement chamber operating from 1GHz to 100

GHz, Elmika network analyzer (ELMIKA S4403), antennas (WR-10 Circular Antennas) and turn table on which target is located.

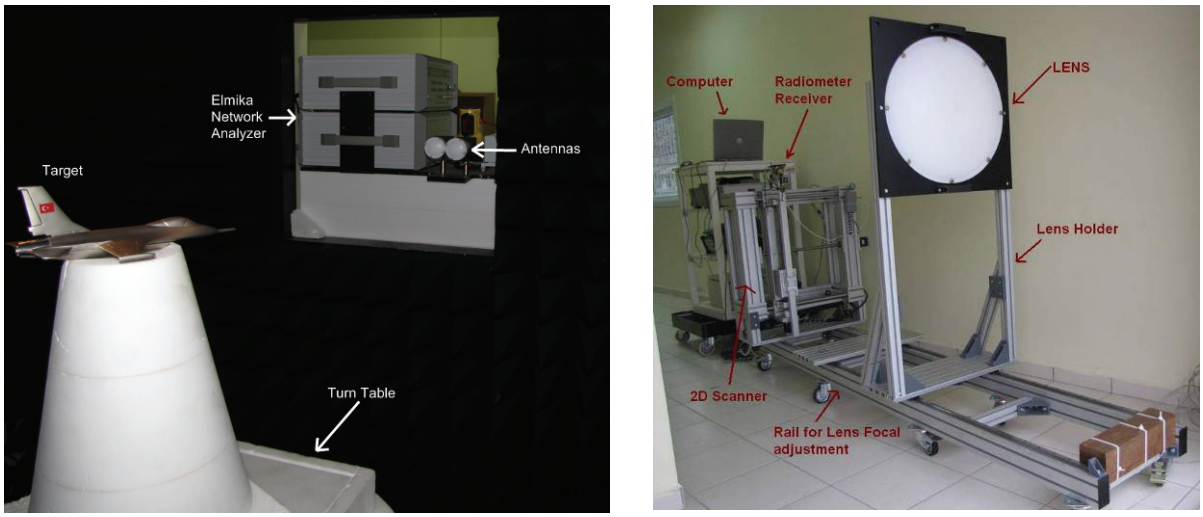


Figure 1. (a) Measurement setup for bi-static ISAR imaging in the measurement chamber, (b) the system of millimeter wave passive radar receiver

For active microwave and millimeter-wave radar imaging, F16 fighter of scaled model is used as a target. In this study two different measurements are performed. Relevant measurement parameters can be seen on Table 1.

Table 1. Measurement Parameters

	Frequency Band	**Frequency Number**	**Measurement Distance**	**Angle**	**Angle Step Size**
Microwave Range	12GHz-15GHz	32	1 meter	360 degree	1 degree
Millimeter wave Range	95GHz-105GHz	32	1 meter	360 degree	0.25 degree

In the study of design of millimeter-wave passive radar receiver, a radiometer system (see Figure **1**.b) consists of four main parts, scanner system, radiometer receiver, dielectric lens and computer on which computer measurement software and scanner control software are installed. For scanning in the image plane of the lens, the 2-D Cartesian scanner based on a raster mechanical scanning architecture is utilized. The reproducing of a radiometric image, corresponding to the brightness temperature of the target, in the plane of scanning is achieved by the long-focus HDPE (high density poly ethylene) or Teflon lens object. The radiometric receiver module (see Figure 4**),** operating in frequency range 98GHz-101GHz, includes conical horn with aperture size 40mm and direct detection receiver.

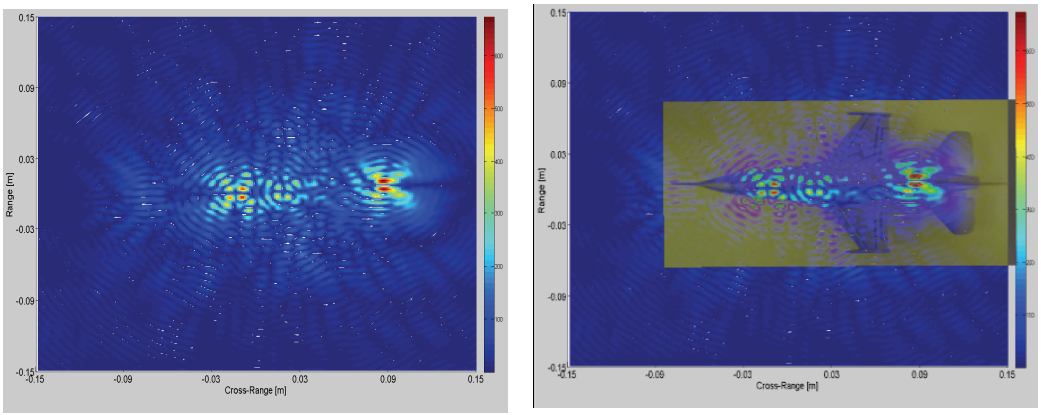
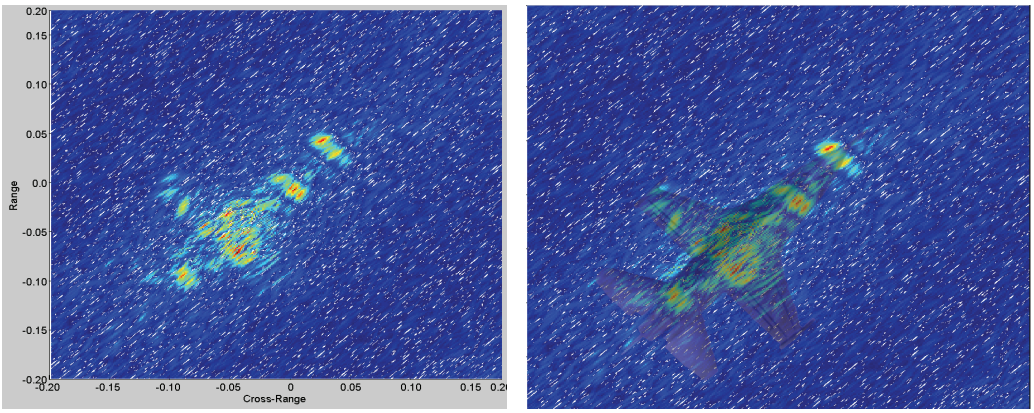


Figure 2. (a) the ISAR images of the scaled fighter, (b) optic and ISAR images of the scaled fighter are shown together for the measurement at the bandwidth of 12 GHz - 15 GHz.



(a) (b)

Figure 3. (a) The ISAR image of the scaled fighter at millimeter wave range, (b) optic and ISAR image of the scaled fighter are shown together for the measurement at the bandwidth of 95 GHz - 105 GHz

The receiver amplifier stage involves three matched cascades of the low noise amplifiers. The output signal was converted for subsequent imaging processing by the detector with sensitivity 200mV/mW. The maximum amplification factor achieved is about 45dB. Additionally, a reflector (see Figure 5) located on turn table is used. The reflector moves between ± 4.5 degree. By using the reflector system, scan time is reduced, remarkably.

For applications of millimeter-wave passive radar receiver, two different objects are investigated. Firstly, the real gun hanged on an artificial person (see Figure 6) is investigated. In this study the real gun is covered by a coat. Secondly, the real gun is hanged on a real person (see Figure 5) and then the gun is covered by a warm coat.

For both measurements of millimeter wave passive radar receiver, a distance between target and reflector is 370 cm.

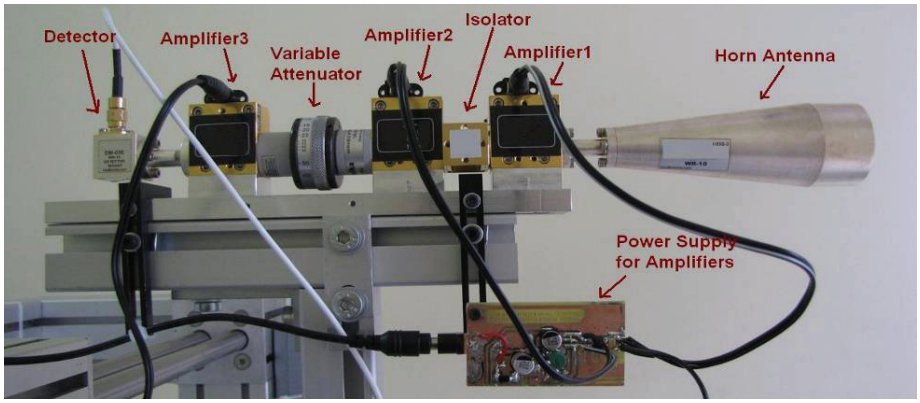


Figure 4. Millimeter wave radiometer receiver

Figure 5. The appearance of Millimeter wave passive Radar receiver during a measurement

(a) (b)

Figure 6. (a) the real weapon hanged on an artificial person, (b) the real weapon under the coat during the measurement

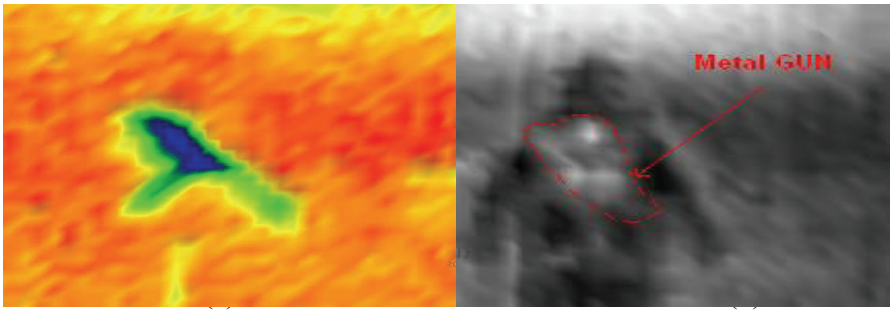


Figure 7. (a) The brightness temperature distribution of the concealed weapon on the artificial person and (b) the brightness temperature distribution of the concealed weapon on the real person.

Conclusions

As seen in Figure 2 and Figure 3, the resolution of the ISAR image of the target measured at millimeter wave range is better than that of the ISAR image of target measured at microwave range. Due to the result, it is clear that resolution is higher as wave length is decreased.

Our radiometric system exploits the one channel design for scanning [2] in the focal plane of the dielectric lens. In applications of the design of millimeter wave passive radar receiver, for both measurements performed with the real gun hanged on the artificial person and the real person, the concealed gun can be detected (see Figure 7). It is known that millimeter wave imaging technologies focus mainly on applications of security surveillance and nondestructive inspections (NDI) [3]. The results for millimeterwave passive radar receiver are most promising to disclosure of dangerous objects (weapons, explosives, drugs, etc.) concealed under persons' clothing, without revealing itself. Our following work will focus on improving the imagine resolution by applying signal processing method.

References

1. *Mensa D. L.,* High Resolution Radar Cross-section Imaging, Arthech House Inc., Normood Massachusetts, 1991

2. *Vertiy, A. A., Gavrilov, S. P., Aksoy, S., Voynovskyy, I. V., Kudelya, A. M., & V. N. Stepanyuk.* "Reconstruction of microwave images of the subsurface objects by diffraction tomography and stepped-frequency radar methods," Zarubejnaya Radioelektronika. Uspehi Sovremennoy Radioelektroniki. 7, 17-52, 2001.

3. *Oka S., Togo H., Kukutsu N., Nagatsuma T.*, Latest Trends in Millimeter Wave Imaging Technology, PIERS, vol. 1, pp. 197-204, 2008

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MULTIFREQUENCY MEASUREMENTS IN MILLIMETER WAVE RANGE AS A TOOL OF ARTIFICIAL STRUCTURES RESEARCH

The measurements in free space were carried out by the apparatus using measuring unites of scalar reflectometer of series R2 in the frequency range of 38-52 GHz. Synthesized time-domain signals have been obtained on base of holographic principle. The techniques of microwave measurements combining multifrequency measurements and transversal scanning for structures formed by water drops and objects located behind dielectric layer are presented.

INTRODUCTION

Implementation of multifrequency method [1] for measuring microwave reflectivity in the free space allowed testing different dielectric structures, objects located behind dielectric layer and other structures having one-dimensional irregularity along the axis of system's probe, with the purpose of estimating their parameters such as distance to object, thicknesses and dielectric constants of the layers. Scanner of system allow detecting an object embedded into non-homogeneous dielectric medium, estimating the object's position and sizes in transversal and longitudinal directions [2]. The purpose of the paper is development the previous results [2] to objects located behind dielectric layer and water-drop structures.

CONSTRUCTION OF MEASURING SYSTEM

The multifrequency measuring system usually includes only one probe for both irradiation of a structure under test and receiving the reflected signal (Fig.1). Both signals are detected and processed to get absolute insertion reflectivity values on the discrete grid of frequencies, and then time and spatial (after the appropriate recalculation of an abscissa axis scale) echoing characteristics are calculated that contain amplitude and, as well, phase information owing to presence of probe's (typically the pyramidal horn antenna) reflection. The system measures scalar values, and storing of the phase information is achieved due to using the principle of Fourier-holography with reflection from dominant irradiating system's discontinuity as a reference signal. For the measurements themselves the waveguide reflectometric circuit is used. It consists of two directional couplers (for extraction of signals proportional to incident and reflected wave signals) to which the diode detectors are attached.

Electronic frequency tuning of sweep-generator and using VSWR indicator device provide real-time operating of the system. The system allows using instruments of related types for engaging any arbitrary microwave frequency range. Frequency setting and data reading from indicator device is performed by general-purpose ADC/DAC module. These decisions involve advantages of electronic frequency tuning, automatic microwave power control and immediate measurement of incident and reflected wave signal ratio and also high performance of digital/analog block.

The measurements are carried out in the following way. The DAC controlled by a personal computer sets a frequency by outputting appropriate voltage to the oscillator control input. After some time delay depending on concrete "oscillator-indicator" system inertance the value from the indicator output is read with the help of the ADC. This value corresponds with the logarithm of incident and reflected wave ratio. From that value the absolute value of a reflectivity at given frequency measured in the waveguide tract is calculated. Then follows frequency tuning, and the process is iterated. Thus all the reflectivity values in the given frequency grid are measured.

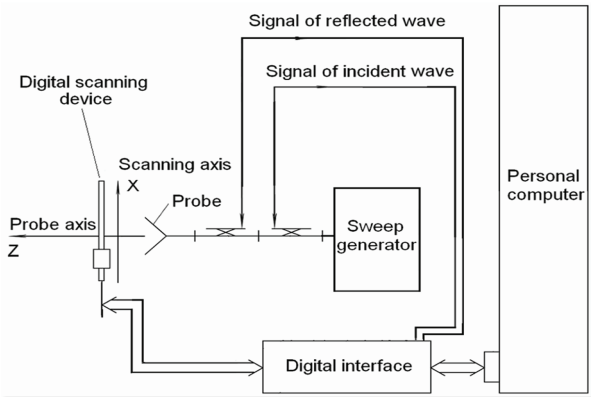


Fig. 1 Scheme of scanning. Scanning device ensures repositioning of structure under test along the OX axis

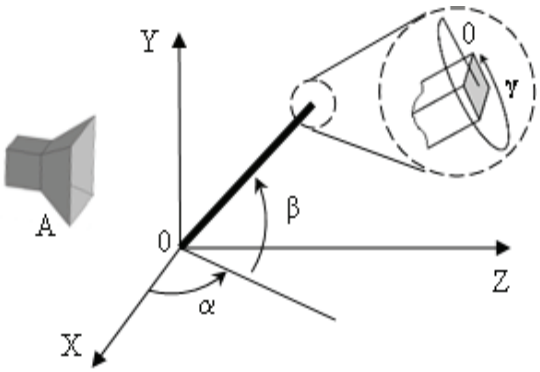


Fig. 2 Position testing of objects and probe A in the free space is presented

Acquired data is passed down for processing and the frequency reset to the beginning of given range, and then the new measurement cycle starts. Cycles are iterated until interrupted by the user. Data processing and all other operations are performed by the same PC involving parallel streams of execution. In particular, the system excludes abnormal values, then inverse Fourier-transforms the frequency response, obtaining time response that is echo of tested structure to a pulse signal.

The measuring system applies median averaging to series of sequentially measured characteristics. The averaging is performed only on obtaining completely all characteristics, of which values are averaged. This provides a comparable time interval between the moments of reflectivity value measurement, thus preserving both sense and utility of averaging. During median averaging there are several values of an echoing characteristic on each frequency, sorted by amplitude. The value having average index in sorted group serves as resulting average. Median averaging is preferred to arithmetic and others owing to elimination of fatal influence of outliers in frequency domain on synthesised time signal, when a considerable surge on one frequency gives strong distortion in all the domain of Fourier transform.

Scanning is done by the means of digitally controlled system with step motor. Speed of scanning on measuring 3 echoing characteristics per position and positioning step of 1.5 mm is about 22.5 mm per minute. Scanning transversally to the axis OZ of probe (Fig. 2) gives a set of echoing characteristics that can be conveniently represented as digital raster graphic image where properly normalized reflectivity amplitude is represented by pixel's brightness, and horizontal and vertical axes of the image correspond to probe and scanning axes (OZ and OX respectively). Applying color gradient map to the image allows showing areas of equal reflectivity (in particular, isolines) (Fig. 5, 7).

EXPERIMENTAL RESULTS

A horn with length of 118 mm and aperture size 46×46 mm and a waveguide with cross-section 5.2×2.6 mm were used. Evidently the border of the horn far-field zone is equal to 540 and 740 mm for longest and shortest wavelengths of range of measurements. The measurements of reflection from metal plate situated at distance of 660 mm have been carried out. The gain of the horn has been estimated by comparison of the peak amplitude for reflection from metal plate for using of radiation from the open-ended waveguide and the horn under consideration. As the gain of the open-ended waveguide is 6 dB so the gain estimates for the horn is 27 dB.

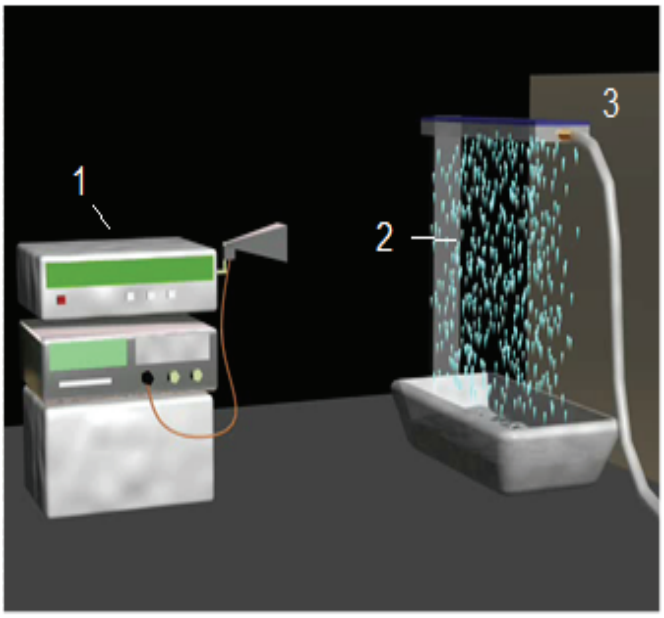


Fig. 3 Scheme of experiment: 1 – sweep-generator with electronic frequency tuning and VSWR indicator device, 2 – the water-drops structure, 3 – metal plate

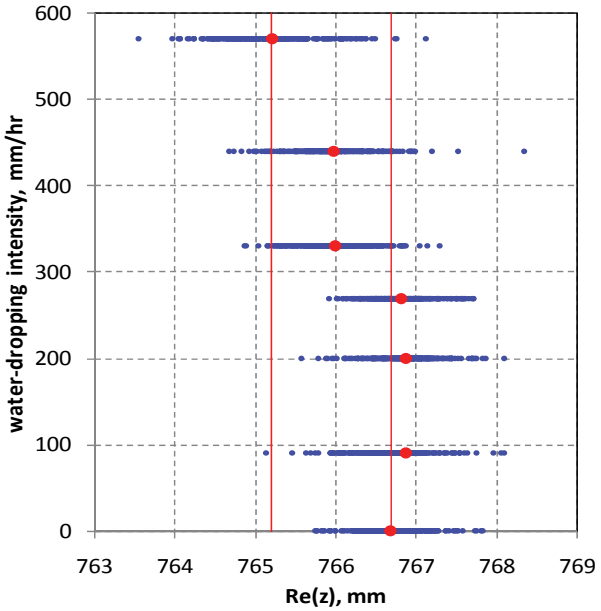
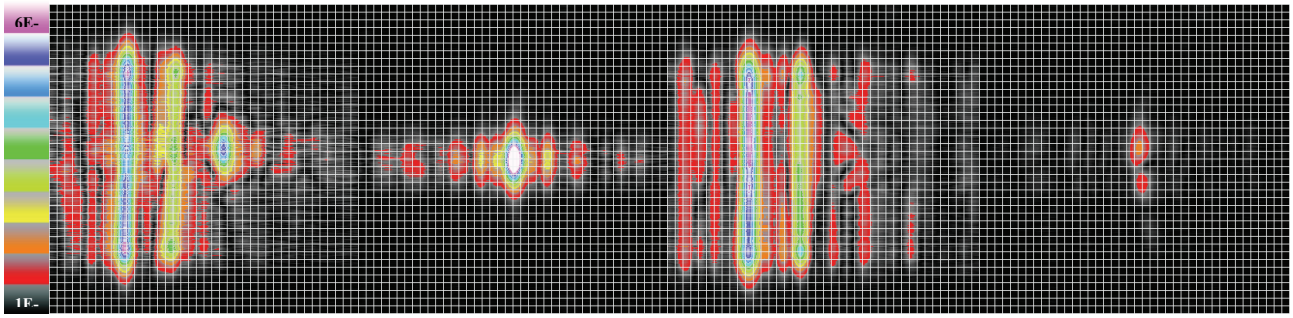


Fig. 4 The peak maximum position of reflection from metal plate as function of water-dropping intensity

Measurements were carried out in frequency range of 38-52 GHz. The time of sweeping of the whole frequency range was 0.08 s. To diminish the influence of noise median averaging for successfully obtained data was used. The number of successfully measured data can be changed from 1 to 11. Thus the time of obtaining result of synthesized time-domain signal was less than 1 s. Measurements were carried on in logarithmic regime. Three calibration levels were used. In time domain synthesized pulse had width of peak at 3 dB level equal to ~70 ps, i.e. the space width was ~20 mm. The fluctuation of amplitude of peak was less 2 % thus effects could be detected correctly.

The measurements were carried out for the structures formed by water drops with diameters 5-6 mm. These structures were produced by special equipment (Fig. 3). It is consists of drop-former plexiglass cavity with holes of 0.4 mm diameter. The holes were positioned in chess order with step of 8 mm. The thickness of the structure was approximately 80 mm. The positions of peak maximum corresponding to reflection from metal plate behind the SUT as function of water-dropping intensity are presented in Fig. 4. It is clear that for the intensity more 300 mm/hr there is the effect of

negative group delay. For water drops with diameter of 2-3 mm the effect was absent thus it indicates of resonance nature of the phenomenon.



a b c d

Fig. 5 2-D image of metal direct parallelepiped 110×25×25 mm (height×size of the basis) at position α=0°, β=90° located: a) on 60 mm behind dielectric layer, γ = 0°, b) without layer, γ = 0°, c) on 60 mm behind dielectric layer, γ = 15°, d) without layer, γ = 15° (the size of the cell is 10 mm)

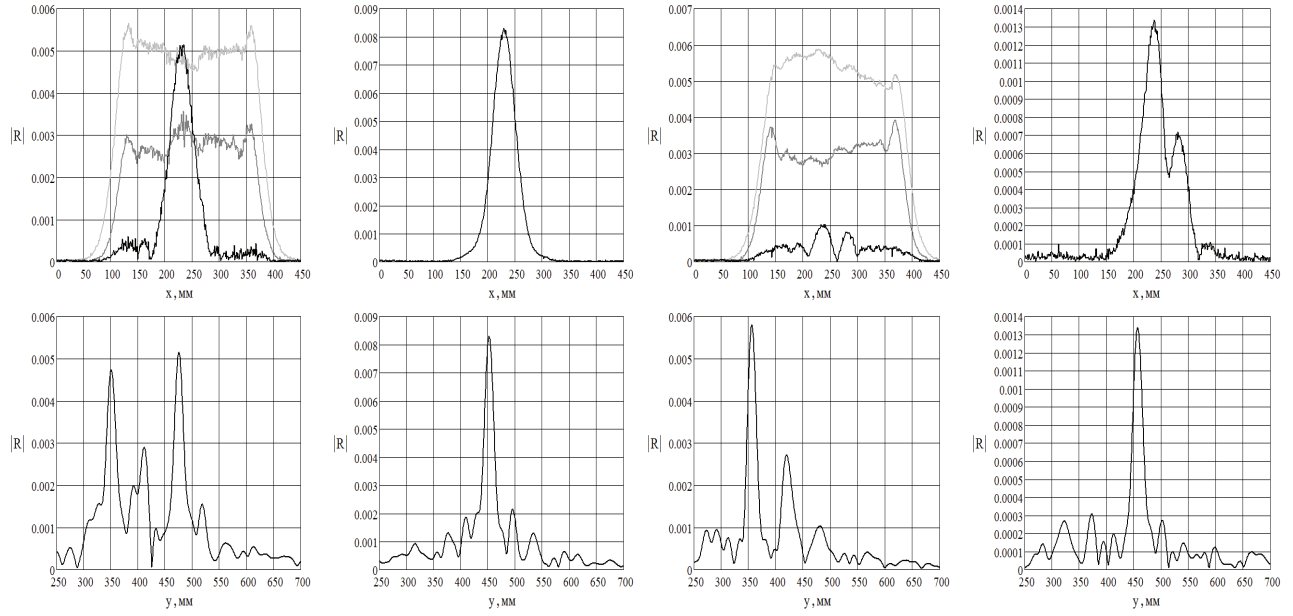


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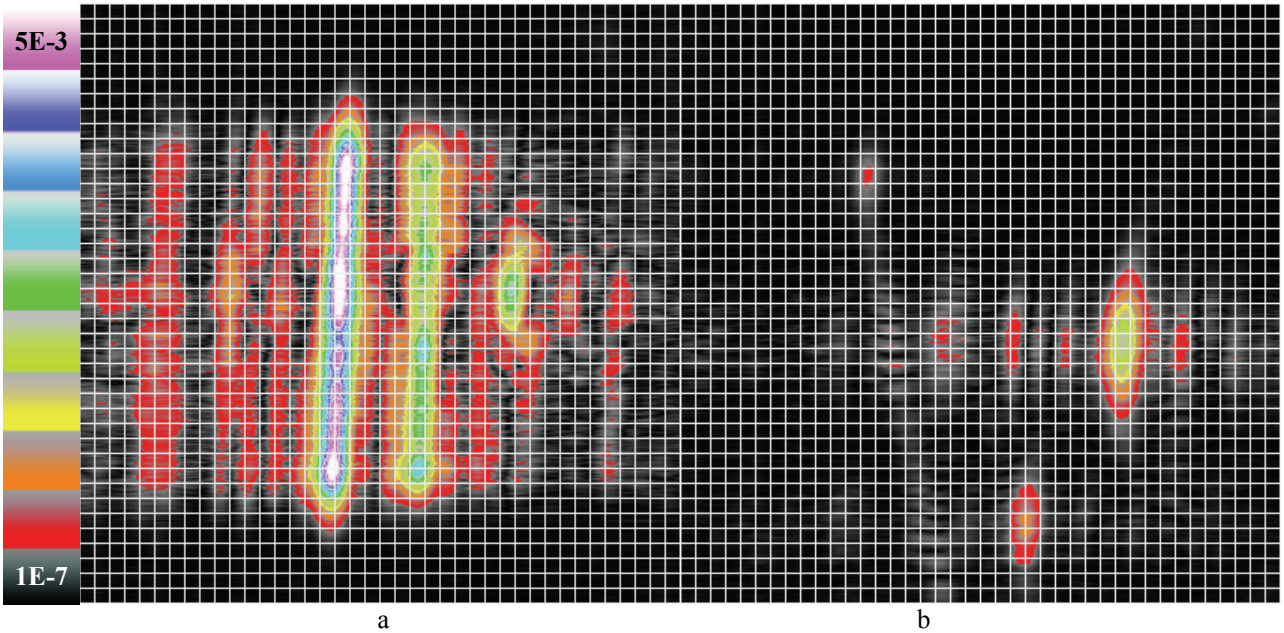
Fig. 6 1-D images the reflection of metal direct parallelepiped 110×25×25 mm along scanning (x) and probe (y) axes at position α=0°, β=90° located: a) on 60 mm behind dielectric layer, γ = 0°, b) without layer, γ = 0°, c) on 60 mm behind dielectric layer, γ = 15°, d) without layer, γ = 15°

The character of the data is different for probe and scanning axes: along the former the structure only can be recognized as the sources of discontinuity, while along the latter we can see their stretch. Analyzing 2D-images as expands application of multifrequency method for simple structures (allowing clear qualitative discrimination of signal peaks including in general as informative, so parasitic peaks, artifacts, combinatory signals and superposing echoing characteristics), so applies it for complex objects.

Resolution of 2D imaging method is different for scanning and probe axes: for the former it is determined by average wavelength, for the latter, as always, it is limited by the frequency bandwidth, for probe axis spatial reflectivity dependency is, in general, the synthesized time signal. We scanned using 6 mm wavelength generators having bandwidths 14 GHz. Also we can give quite accurate estimations for discontinuity position: along the scanning axis it depends only upon scanner repositioning precision (which in our experiments was 0.075 mm), and along the probe axis

it depends on SNR and phase error on the different distances probe-discontinuity, yielding 0.2-1.8 mm for the distance range 100-800 mm.



a b

Fig. 7 2-D image of metal cylinder 96×75 mm (height×diameter of the basis) at position α=0°, β=90° located behind dielectric layer, which is rotated by an angle: a) γ = 0°, b) γ = 15°
(the size of the cell is 10 mm)

CONCLUSIONS

The investigations of water-drop structures showed that effect of negative group delay was observed under resonance drop diameters of 5-6 mm. Diminish of drop diameters to 2-3 mm involved disappearance of the effect. Some radar portrets of simple objects such as cylinders and direct parallelepiped obtained by the microwave reflectometer synthesizing in real time the distance dependencies of reflectivity using data of multifrequency measurements and transversal scan are presented.

REFERENCES

1. *V.V. Alekseev, O. O. Drobakhin, Ye. V. Kondrat'yev, and D. Yu. Saltykov,* "Microwave introscopy using multifrequency measurements and transversal scan", *IEEE Aerospace and Electronic Systems Magazine*, vol. 21, no. 2, pp. 24-26, 2006.

2. *V.V. Alekseev, O. O. Drobakhin, and A. I. Chekh,* "Microwave multifrequency radar images of electrodynamic objects", Proceedings of 2008 Microwaves, Radar and Remote Sensing Symposium, Kiev, Ukraine, September 22-24, 2008, pp.212-217.

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COMPARISON OF USING SAR PROCESSING AND HOUGH TRANSFORM AS A METHODS FOR GPR RADAR IMAGE CREATION

The paper describes the simulation results for a ground penetrating radar. As a simulation model of SAR and Hough transform system, the pulse radar with LFM (Linear Frequency Modulation) signal has been applied. The aim of the experiment is to obtain fully focused image of the underground targets. For this purpose the comparison of SAR (Synthetic Aperture Radar) method to non-coherent Hough transform has been made. Simulation results presented in the paper show that better resolution of focused image is achieved in the SAR method.

I. Introduction

Main attention of digital signal processing algorithms for signal received by radar is devoted to various techniques to obtain the best resolution. In the case of the radar GPR (Ground Penetrating Radar) it can be distinguished two basic methods – coherent (SAR) and non-coherent (Hough transform). The majority of the publications related to GPR use Hough transform for underground imaging [1],[11] while better results are obtained using SAR. In the literature there can be found some experiments of use of coherent radars with SAR processing applied for underground targets imaging [8].

To create SAR image, platform with antennas in motion versus scene under observation is needed[4],[7]. Most SAR techniques are used for earth surface imaging from airborne platforms (e.g. UAV, aircrafts, satellites, etc) [1],[3],[9],[10].

II. Radar LFM Pulse

A typical pulse radar which uses simple waveform without any frequency modulation has range resolution [9]:

$$\Delta r_o = \frac{c\tau}{2}, \tag{2.1}$$

where: c - $3 \cdot 10^8 \left[\frac{m}{s}\right]$,

τ - pulse duration.

Commonly used method to improve range profile resolution is a pulse radar with linear frequency modulation (LFM). LFM signal with the signal peak power given by $P_n(t)$, initial phase φ_o and frequency bandwidth B is presented in the following form [2],[5],[6]:

$$S_n(t) = \sqrt{P_n(t)} \cdot rect\left(\frac{t}{\tau}\right) \exp\left\{j\left(\varphi_o + \frac{\pi B t^2}{\tau}\right)\right\}. \tag{2.2}$$

Chirp echo received from the object that reaches the radar after a time τ_o is presented in the following form:

$$S_o(t) = \sqrt{P_o(t-t_o)} \cdot rect\left(\frac{t-t_o}{\tau}\right) \exp\left\{j\left(\varphi_o + \frac{\pi B (t-t_o)^2}{\tau}\right)\right\}. \tag{2.3}$$

In the typical radar processing to obtain good range resolution, matched filter given by the following equation is used [4],[5]:

$$h(t) = rect\left(\frac{t}{\tau}\right) \exp\left\{-j\frac{\pi B t^2}{\tau}\right\}. \tag{2.4}$$

The range compressed image takes the following form [4],[9]:

$$S_{out}(t) = S_o(t) \otimes h(t) \cong \exp\left(-j\omega\frac{2r(t)}{c}\right) sinc\left(\frac{\pi}{\Delta r \cdot \tau}(t-t_o)\right), \tag{2.5}$$

where: Δr - normalized effective range dimension of the target image $\Delta r = \frac{c}{2B\sqrt{\varepsilon_r}}$.

Compression ratio of LFM pulse can be calculated as follows [2],[6]:

$$C_r = \frac{\tau}{1/B} = B\tau. \tag{2.6}$$

The shape of the chirp signal after range compression for B= 2 GHz, τ = 5ns is presented below:

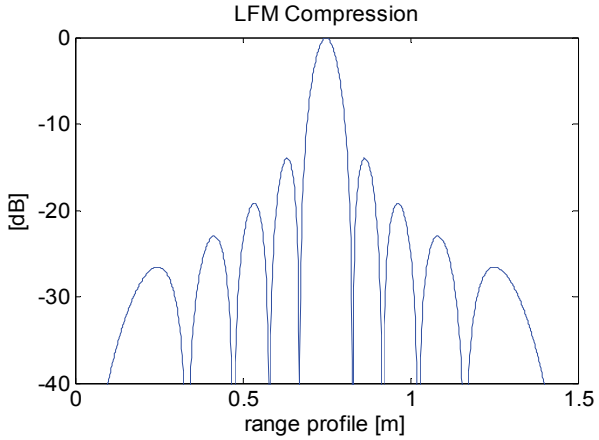


Fig. 2.1 LFM after compression

In order to achieve better azimuth resolution SAR and Hough transform algorithms was used. This article describes a different way of SAR azimuth compression for GPR radar. In the simulation and measurement two-dimensional filters were introduced.

III. Geometry for GPR radar

Appearance of buried objects change electromagnetic and mechanical properties of the earth. Fig. 3.1 presents two cases of wave propagation in the earth - with and without buried object.

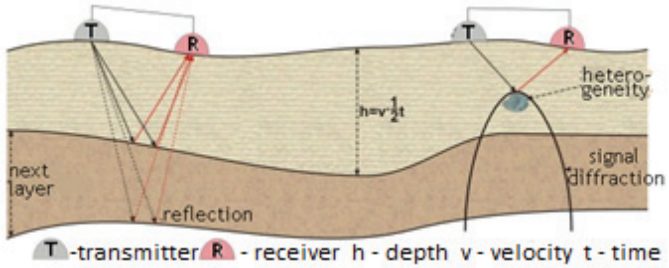


Fig. 3.1 Two-layered soil

The transition from one layer to another is associated with the loss of power. Moreover, an electromagnetic wave changes direction and velocity of propagation v_o:

$$v_o = \frac{1}{\sqrt{\varepsilon\mu}} = \frac{1}{\sqrt{\varepsilon_0\varepsilon_r\mu_0\mu_r}} = \frac{c}{\sqrt{\varepsilon_r\mu_r}} = \frac{c}{n}, \tag{3.1}$$

where: ε - dielectric permittivity,
n- refraction coefficient.

When an electromagnetic wave with power P_p falls on the border of two mediums, refraction and reflection phenomena are present in Fig. 3.2:

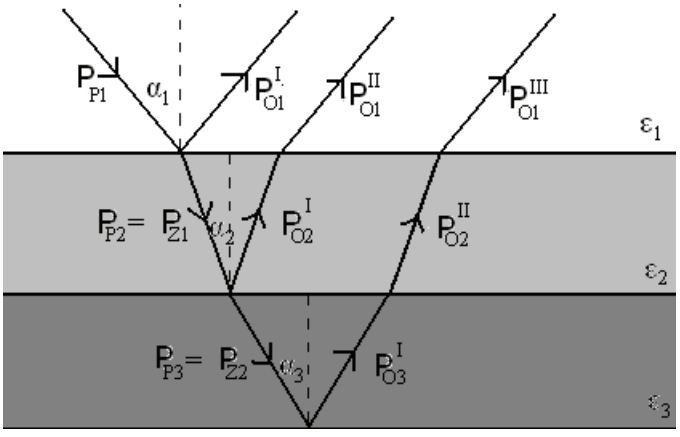


Fig. 3.2 Reflection from the medium boundary

Concerning the relationship between the reflected P_o, transmitted P_p and refracted P_z wave powers one may use reflection coefficients ρ [3],[4]:

$$\rho = \frac{n_{(i+1)} - n_i}{n_{(i+1)} + n_i} = \frac{\sqrt{\varepsilon_{r(i+1)}} - \sqrt{\varepsilon_{ri}}}{\sqrt{\varepsilon_{r(i+1)}} + \sqrt{\varepsilon_{ri}}}, \tag{3.2}$$

where: i - number of layer.

Reflection coefficient determines the amplitude ratio of reflected electromagnetic wave to transmitted wave. Coefficient (3.2) in second power defines the ratio of transmitted power to reflected power :

$$P_z = P_p(1 - \rho^2). \tag{3.3}$$

Taking into account formula (3.2) for the reflection coefficient in the above relation, the power of refracted wave takes the form:

$$P_{Zi} = P_{Pi}\left(\frac{4\sqrt{\varepsilon_{ri}}\cdot\sqrt{\varepsilon_{r(i+1)}}}{\left(\sqrt{\varepsilon_{ri}}+\sqrt{\varepsilon_{r(i+1)}}\right)^2}\right). \tag{3.4}$$

The angle at which the incident wave is reflected from i – layer is given by formula:

$$sin(\alpha_i) = \frac{\sqrt{\varepsilon_1}}{\sqrt{\varepsilon_i}}\sin(\alpha_1). \tag{3.5}$$

Refraction coefficients n of electromagnetic waves depend not only on the layer, but also on the wavelength. In the case of a wave with several frequency components each of them is refracted at different angle [13],[14]:

$$n^2(\lambda) = 1 + \sum_i \frac{A_i\lambda^2}{\lambda^2 - B_i}, \tag{3.6}$$

where: A_i, B_i - coefficients corresponding to the i – layer.

There are many GPR solutions for the homogeneous ground, where it is easier to determine the location of the object. Dealing with heterogeneous force to seeking for new solutions to determine position and permittivity coefficient of individual layers.

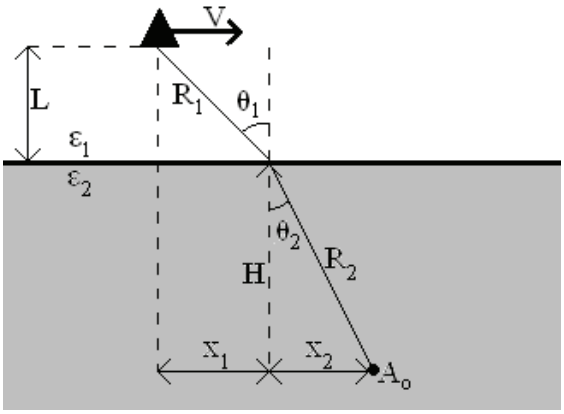


Fig. 3.3 Radar scenario

The picture 3.3 shows a situation where the radar is moving at a constant speed V. This scenario has been used for further simulations.

The distance traveled by the wave between the transmitting antenna to the object is expressed as follows:

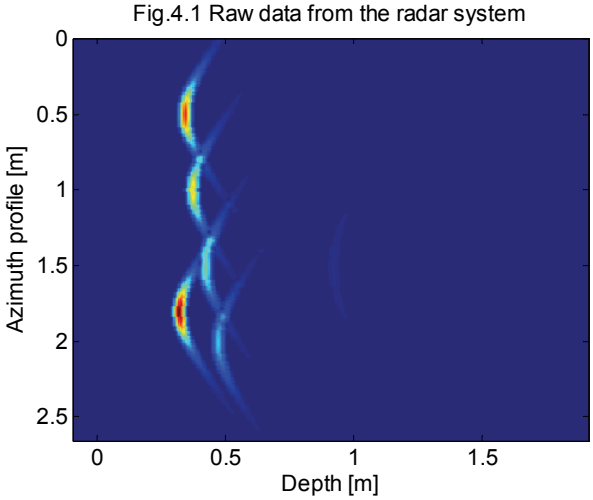
$$r(x) = \sqrt{L^2 + (x_1)^2} + \sqrt{H^2 + (x_2)^2}. \tag{3.7}$$

IV. Simulation Results

The simulation has been performed based on the geometry illustrated in Fig. 3.3. For the experiment a radar with f_{PRF} = 400 Hz, $V = 2m/s$ has been used. The dielectric permittivity of ground has been assumed for simulation as (ε_r=6).

The general objective of signal processing as applied to surface-penetrating radar is either to present an image that can readily be interpreted by operator. The image of a buried target generated by a GPR does not correspond to its geometrical representation. GPR image from one point object is similar to the curve, it is shown in Fig.4.1.

Fig.4.1 Raw data from the radar system



The simulation which was presented above has been carried out for range compressed data from single prominent points. There are six objects present at this picture, the deepest buried object is barely visible. Targets can be found at the following depths 0.35, 0.37, 0.4, 0.45, 0.5, 0.95 [m]. To improve azimuth resolution the focused SAR and Hough transform algorithms has been used.

Fig. 4.1 Raw radar data - shape of signal from single point.

SAR technique uses filter matched to the depth of the object as well as the dielectric permittivity coefficient. The shape of the curve depends on these two factors. Two-dimensional convolution of compressed data S(u,v) and matched filter F(n,m) can be calculated [6][7]:

$$S_{out}(n,m) = S_o(u,v) \otimes h(n,m) = \sum_{u=-\infty}^{\infty} \sum_{v=-\infty}^{\infty} S_o(u,v) \cdot h(n-u, m-v). \quad (4.1)$$

To achieve well-focused SAR image received signal is first divided into blocks according to the scheme (Fig. 4.2):

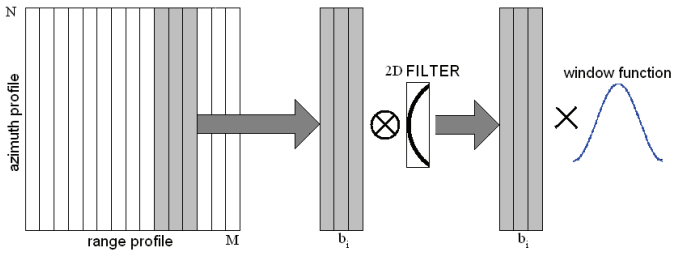


Fig. 4.2 2D SAR filtration.

At each step of filtering algorithm, matched filter corresponding to a given block b_i is calculated. Filter is characterized by two size – permittivity of the medium and depth of the object. These two factors have an influence on the shape of the curve of filter. Filtered block is then multiplied by Hamming window [1],[3]:

$$w(n) = 0.5 - 0.5 \cdot cos\left(\frac{2\pi n}{2 \cdot N_{BL}}\right), \quad (4.2)$$

where: n = 0,1,2,… $3 \cdot N_{BL}$ -1

The appearance of focused SAR image after applying filtration for raw data presented in Fig.4.1 is visible in Fig. 4.3

Simulations show that the correlation of raw data after range compression with the filter gives the desired resolution in the different variants of dielectric permittivity coefficient and depth of the object. For this reason, permittivity coefficient need to be provisionally estimated for tested soil.

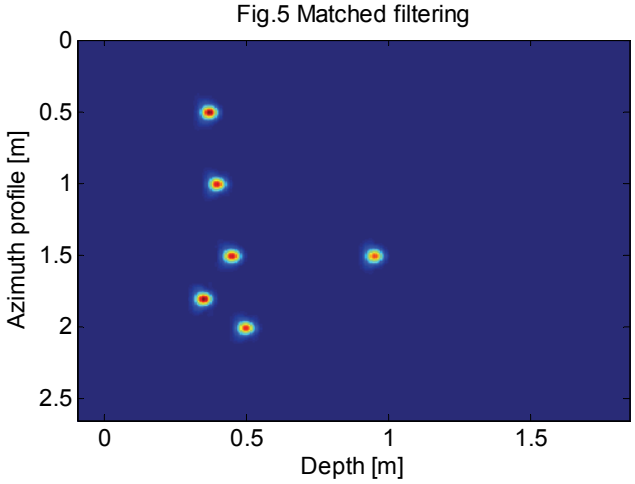


Fig. 4.3 Focused SAR image.

Hough transform is used to detect specific shapes in the analyzed image. The initial version of this technique is suitable for the detection of the line, but soon it was used in GPR. For this purpose, the mathematical description of the analyzed shapes was changed to adjust it to the shape of hyperbolic received from the object. Dependence on the position of an object in the soil for Hough transform is given by[11]:

$$H = \sqrt{\left(R(x) - \sqrt{h^2 + x_i^2}\right)^2 - \varepsilon_0 x_i^2} \quad (4.3)$$

where: ε_o – is called 'conditional' value of permittivity that depends on the real value of permittivity by formula[11],[12]:

$$\varepsilon_o = \frac{4 x_r y_{max}^2 S_r^2}{c^2 T_{ob}^2 x_{max}^2}, \quad (4.4)$$

where: T_{ob} - time interval of observation,
S_r - the route length,

x_{max},y_{max} - the maximal values of conditional coordinates, which correspond to T_{ob} and S_r ,

c - the velocity of electromagnetic wave in vacuum.

Display of localized object using the Hough transform is the sum of hyperbolas plotted in the Hough space for three estimated parameters: $x = x_1 + x_2$, H,ε_r.

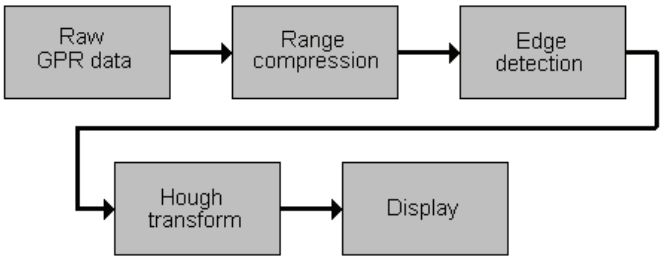


Image processing algorithm for Hough transform is presented in Figure 4.4. Initially, raw data are range compressed, then a filtering, which allows detection of the edge analyzed image, is performed. That image can be finally processed by Hough transform to obtain compressed result.

Fig. 4.4 Schema of Hough transformation.

The results of edge detection for range compressed image given by Fig. 4.1 is shown in Fig.4.5.

Hough transform for example presented above shows a set of multiple lines of hyperbolic. Presented curves intersect at points that determine the estimated location of the objects (Fig. 4.6).

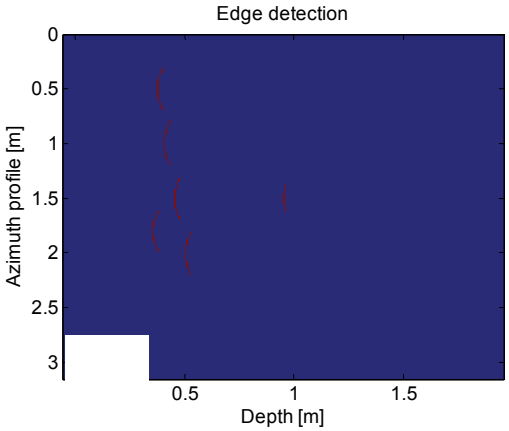


Fig. 4.5 Edge detection

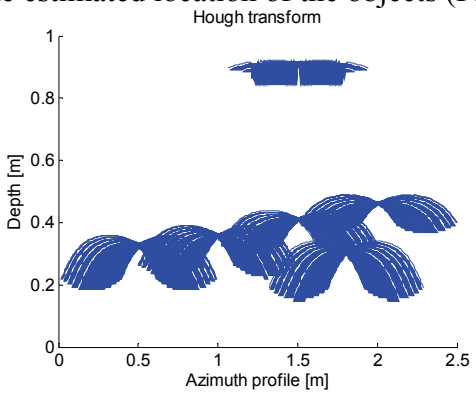
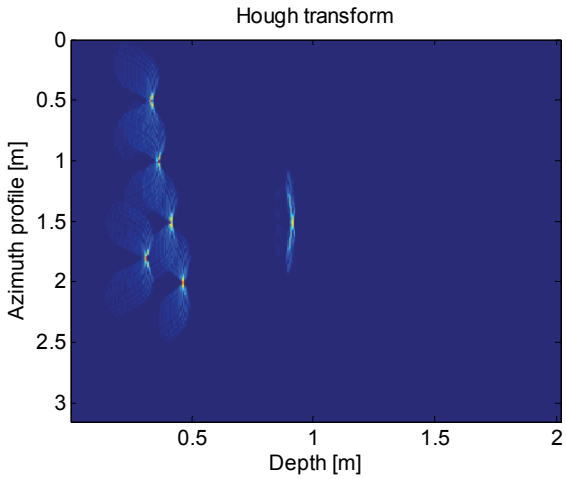


Fig. 4.6 Image after Hough transformation

Counting the multiplicity of the curve at a point in the image, the result of transformation can be illustrated more clearly.



In the case of ε_r parameter mismatch, the final image is worse focused and the detected object is fuzzy. To study this phenomenon some histograms for different permittivity are showed (Fig. 4.8 – 4.13). The best focused image is obtained for the correct value of the permittivity $\varepsilon_r=6$. Computational complexity of Hough transform algorithm is not large, which allows to use this transform in real-time systems. Resolution obtained using this technique is worse then theoretical focused SAR. Three - dimensional imaging of the Hough transform is presented in Figure 4.7.

Fig. 4.6 Focused image after Hough transformation

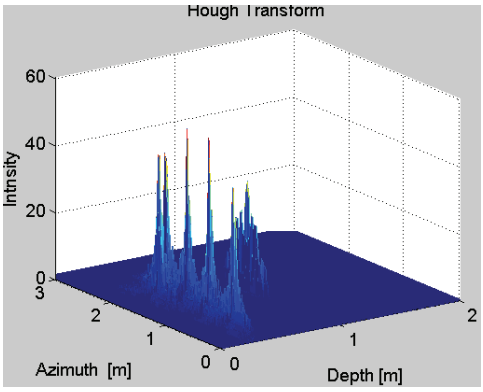
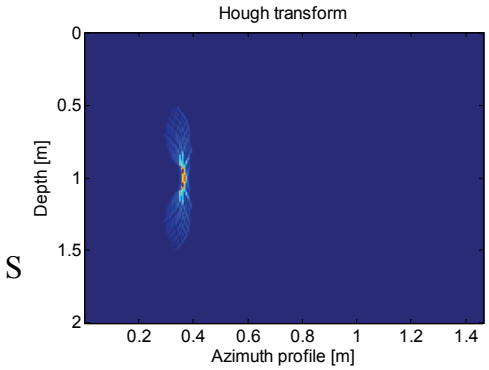


Fig. 4.7 3D image of Hough transform



S

Fig. 4.8. Focused image for permittivity ε_r=2

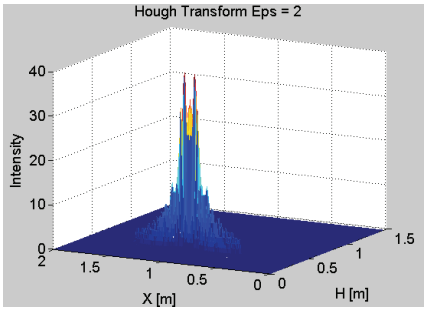


Fig. 4.9. 3D image for permittivity ε_r=2

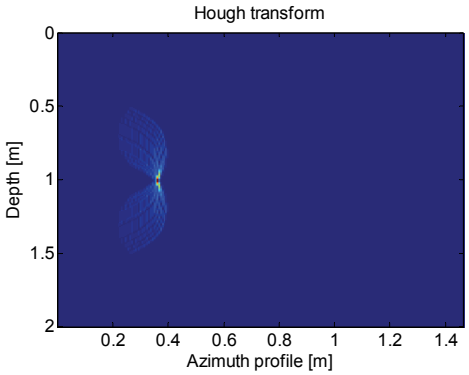


Fig. 4.10 Focused image for permittivity ε_r=6

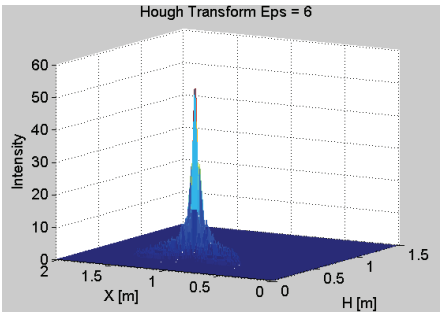


Fig. 4.11 3D image for permittivity ε_r=6

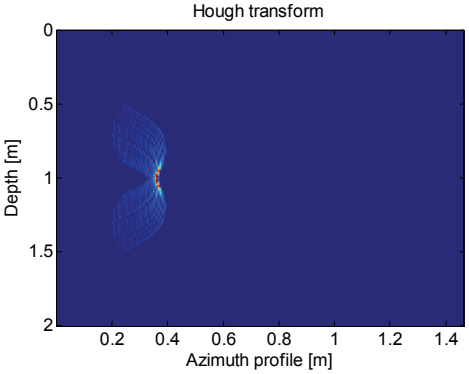


Fig. 4.12 Focused image for permittivity ε_r=10

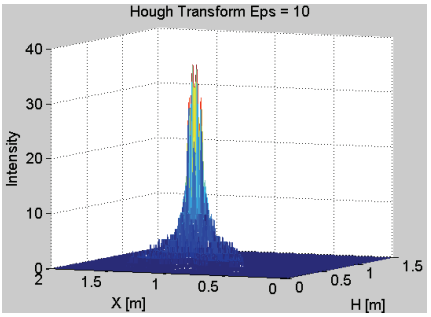


Fig. 4.13 3D image for permittivity ε_r=10

Better azimuth resolution is obtained for SAR, moreover Hough transform has a high level of side lobes.

V. Conclusions

- Simulation results for GPR imaging presented in the paper shows that it is possible to use SAR Hough transform processing for underground targets imaging.
- Focused image obtained with coherent SAR method has better resolution than using Hough transform, nevertheless Hough transform has less computational complexity.
- Presented ground penetrating radar could be used to investigate the soil structure, unless the permittivity coefficients is correctly determined.

References

1. *D. J. Daniels,* Ground penetrating radar 2nd edition, The Institution of Engineering and Technology, London 2007.
2. *Z. Czekała*, Parada radarów, Dom Wydawniczy Bellona, Warszawa 1999 r.
3. M. I. Skolnik, Introduction to radar systems 2nd edition, McGraw-Hill, Inc. 1981
4. *J. C. Curlander, R. N. McDonough*, Synthetic aperture radar, Systems and Signal Processing, John Wiley & Sons Inc., Canada 1991.
5. *W. G. Carrara, R. S. Goodman, R. M. Majewski*, Spotligth Synthetic Aperture Radar – Signal Processing Algorithms, Artech House Inc., London 1995.
6. *G. Franceschetti, R. Lanari,* Synthetic Aperture Radar Rrocessing, CRC Press, Boca Raton 1999.
7. *I. G. Cumming, F. H. Wong*, Digital Processing of Synthetic Aperture Radar Data, Artech House Inc., London 2002.
8. *I. Nicolaescu, P. van Genderen*, Procedures to Improve the Performances Used for Landmine Detection, MRRS-2008 Symposium Proceedings. Kiev, Ukraine, September 22-24, 2008
9. *P. Samczyński, G. Pietrzyk, A. Gorzelanczyk*, „Performance analysis of non-coherent methods of autofocusing images in strip mode SAR", Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments IV – Proc. of SPIE, Vol. 6159 (SPIE, Bellingham, WA, 2006), ss. 6159M–1–7.
10. *C. Oliver, S. Quegan*, "Understanding Synthetic Aperture Radar Images", 1999, Artech House, INC.
11. *A. Simi, S. Bracciali*, G. Manacorda, Hough transform based automatic pipe detection for array GPR: algorithm development and on-site tests
12. *M. M. Golovko*, The Automatic Determination of Soil Permittivity Using the Response From a Subsurface Local Object, Ultrawideband and Ultrashort Impulse Signals, 19-22 September, 2004, Sevastopol, Ukraine
13. *S. Khedim, A. Chiali, B. Benyoucef*, Calculation of refractive index of some materials, Revue des Energies Renouvelables ICRESD-07 Tlemcen 2007
15. *Abd El-Naser A. Mohammed, Ahmed Nabih Zaki Rashed, Abd El-Fattah A. Saad*, Spectral sensitivity coefficients (SSCs) of the based materials for photonic devices under optical wavelength and temperature sensing variations in modern optical access networks, International Journal of Library and Information Science Vol. 1(4) pp. 043-054 September 2009.

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THE RADIO SOURCES COORDINATES ESTIMATION BY THE RANGE-DIFFERENCE METHOD USING LOW-ORBIT CONSTELLATION OF SMALL SATELLITES

We proposed an iterative algorithm for radio sources coordinates estimating by the range-difference method using the multiposition passive satellite system. We simulated the coordinates estimating algorithm. We defined requirements to the satellite orbit altitude and to the distance between the satellites for the small satellites group. We estimated time of arrival estimation accuracy, which is necessary to achieve the required coordinates estimation accuracy.

Introduction

Radio reconnaissance is characterized by the next problem: it is necessary to estimate coordinates of the radio emission source (for example, radar, satellite phone, the jam source, etc.). This problem is solved, for example, in satellite communication systems for the detection of the transmitter that unauthorized uses satellite [1, 2], to control the movement of a missile [3].

To estimate the radio source coordinates there are three main methods: range-difference [4, 6], direction-finding [5] and Doppler method. Each of these methods can solve the coordinates estimating problem coordinates subject to certain requirements.

To implement passive space-based multiposition radar [4], we chose range-difference method, because it requires only the exact binding of the time scales and the satellite coordinates, which can be provided by the Global Orbital Navigation Satellite System (GLONASS).

Method for the Coordinates Estimation

Since the implementation of a range-difference method does not require a large number of board equipment, multichannel receivers, complex antenna systems, the satellite constellation should consist of small satellites. Its advantages are: low cost, the pipeline production, small cost of placing into orbit, calibration and positioning.

Range-difference or time-difference method is based on measuring the distances difference between the source and several satellites. To determine the difference between the distances it is necessary to measure a delay between the time of arrival of the source signal to each small satellite. For the coordinates estimation it is necessary to calculate three differences $\Delta R_{ij} = R_i - R_j$ between the four measured distances, so we should measure four time delays.

To measure the time delays we can use the base-correlation method, and it is not necessary to measure the distance to each satellite. The source coordinates estimation is carried out by the time of arrival differences at each satellite, and these differences are determined by the position of cross-correlation function maximum [7].

Fig. 1 shows an example of the range-difference system on the plane. On Fig. 1, the numbers 0, 1, 2 mark receiving stations, Source - a radio emission source, *d1* and *d2* the distance between the receiving stations, ψ - the angle at which lines of constant distances difference cross.

The expression relating the source coordinates, the receiving points and the distances difference is the following:

$$\Delta R_{ij} = R_i - R_j = \sqrt{\left[(x_i - x_S)^2 + (y_i - y_S)^2 + (z_i - z_S)^2\right]} - \\ -\sqrt{\left[(x_j - x_S)^2 + (y_j - y_S)^2 + (z_j - z_S)^2\right]} = c \cdot \Delta\tau_{ij} \quad (1)$$

where x_S, y_S, z_S – the source coordinates, x_i, y_i, z_i – coordinates of the *i*-th receiving point, x_j, y_j, z_j – coordinates of the *j*-th receiving point, $\Delta\tau_{ij}$ – delay between the time of arrival of the source signal to *i*-th and *j*-th small satellites.

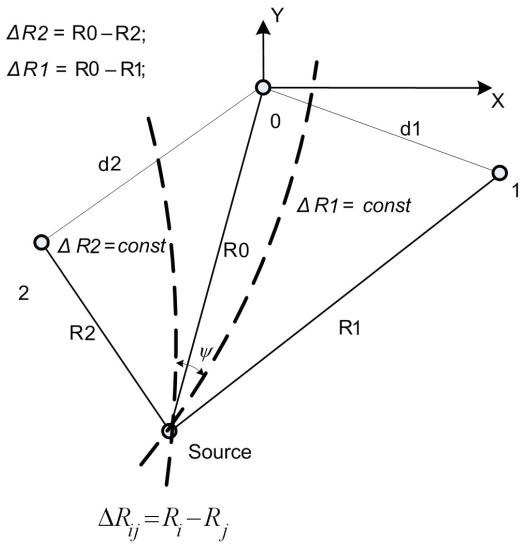

Figure1. Range-difference system on the plane

Time of arrival differences are usually calculated relatively one of the receiving points called central. We assumed that the index of the central point is equal to zero and omit it, introducing distance differences as ΔR_i.

The locus of points corresponding to one value of the informative parameter is called the position line (indicated in Fig. 1 by dotted lines). The intersection of two lines indicates the object location. Thus, to obtain the source coordinates estimation on the plane the range-difference system should consist of at least three receiving points, and to obtain the source location in the space – at least of four points. By a minimum number of receiving points and a single measurement of distances difference the source location can be found by solving nonlinear equations systems (1).

To solve the nonlinear equations (1) we can use iterative methods. Using the iterative method of least squares [4] makes it possible to estimate the source coordinates by a single measurement of time of arrival differences.

The sequence of actions describing the algorithm for the coordinates estimating by range-difference method is given below:

The distance between the i-th receiving point and the signal source is calculated by the specified coordinates of the receiver x_i, y_i, z_i and the initial source coordinates estimation $\hat{x}_{s(0)}, \hat{y}_{s(0)}, \hat{z}_{s(0)}$*:*

$$R_i = \sqrt{\left[(x_i - \hat{x}_{S(0)})^2 + (y_i - \hat{y}_{S(0)})^2 + (z_i - \hat{z}_{S(0)})^2\right]}$$

where $\hat{x}_{s(0)}, \hat{y}_{s(0)}, \hat{z}_{s(0)}$ – initial source coordinates estimation, x_i, y_i, z_i – coordinates of the *i*-th receiving point.

The vector of prediction errors C is calculated at the x - th iteration:

$$C_{i(x)} = R_{i(x-1)} - R_{x-1} - (T_i - T)c$$

where $R_{i(x-1)}$, R_{x-1} - the distances from the *i*-th and *0* - th receiving points to the point with coordinates estimation $\hat{x}_{s(x-1)}, \hat{y}_{s(x-1)}, \hat{z}_{s(x-1)}$ calculated at previous iteration, $T_i - T$ – time of arrival differences at the *i*-th and *0*-th receiving points, obtained by using the correlation processing algorithm, $C_{i(x)}$ – elements of the prediction errors vector for the *i*-th measurement base, calculated at the *x*-th iteration, *c* – wave propagation velocity.

Then it is calculated the matrix of partial derivatives A_x*:*

$$A_{i1(x)} = \frac{\partial \Delta R_i(x_S, y_S, z_S)}{\partial x_S},\ A_{i2(x)} = \frac{\partial \Delta R_i(x_S, y_S, z_S)}{\partial y_S},\ A_{i3(x)} = \frac{\partial \Delta R_i(x_S, y_S, z_S)}{\partial z_S}$$

Corrections ξ_x *is calculated for the x-th step by the results of the previous step:*

$$\xi_x = \left(\left(\mathbf{A}_{x-1}\right)^T \mathbf{B}_{\Delta\tau}^{-1} \mathbf{A}_{x-1}\right)^{-1} \left(\mathbf{A}_{x-1}\right)^T \mathbf{B}_{\Delta\tau}^{-1} \mathbf{C}$$

where $\mathbf{B}_{\Delta\tau}^{-1}$ – mutual covariance matrix of measurement errors.

We calculate the corrected coordinates:

$$\widehat{a}_x = \left\lfloor \widehat{x}_{s(x)}, \widehat{y}_{s(x)}, \widehat{z}_{s(x)} \right\rfloor = \left\lfloor \widehat{x}_{s(x-1)}, \widehat{y}_{s(x-1)}, \widehat{z}_{s(x-1)} \right\rfloor + \xi_x$$

Then we compare the maximum value in vector ξ_x with the preset threshold level. If the correction is less than the threshold, then for the final coordinates estimation is taken $\widehat{a}_x$.

Computer Simulation Results

To estimate accuracy provided by the algorithm we carried out the computer simulation in MATLAB. A similar simulation has been already held by team of the Military Space Academy named after A.F. Mozhaiskiy [7]. The error was defined as the second initial moment of the error modulus distribution:

$$\overline{\delta R} = \sqrt{\overline{\delta x^2} + \overline{\delta y^2} + \overline{\delta z^2}}$$

where $\overline{\delta x^2}$, $\overline{\delta y^2}$, $\overline{\delta z^2}$ – the mean square of the deviations from the true source coordinates in an arbitrarily chosen coordinate system.

In order to compare results, in this paper the coordinates error was estimated similarly.

The first step is the initial data selection: an orbit altitude, a base dimension, a time of arrival error. To determine the space system parameters we should obtain the dependences of the coordinates estimation accuracy on these parameters. An orbit altitude was chosen in the range from 700 km to 2000 km because of radiation belts presence. A base dimensions are determined by the number of satellites and the multiplicity of covering. To estimate coordinates it is necessary to provide fourfold covering of the area. The maximum base dimension is 3000 km, and we took 200 km as minimum dimension. A time of arrival error is determined by the receiver. Modern receivers provide error in the range from 30 to 100 ns. In the simulation we assumed that the time of arrival error has a normal distribution, propagation channel "Earth - Satellite" is a single-beam, and a basic error in the time of arrival estimation causes by different noises. We have obtained the dependences of the coordinates estimation accuracy on the orbit altitude and base dimensions for three time of arrival errors 25 ns, 50 ns and 100 ns (Fig. 2, 3 and 4).

For example, it's necessary to choose orbit altitude equal to 1500 km to provide estimation accuracy about 100 meters. Then we chose initial data for the algorithm: orbit altitude is 1500 km, base dimension is 2000 km, time of arrival error is 30 ns, satellite coordinates estimation error is 30 m, tests quantity is 5000. We simulated the coordinates estimating process and obtained the coordinates estimation field (Fig. 5). The error was about 90 meters.

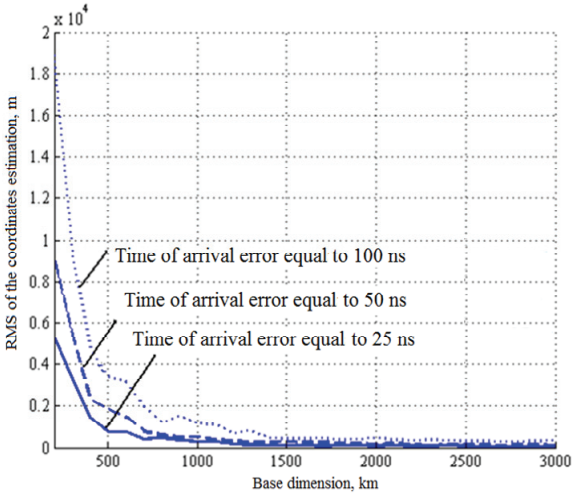

Figure 2. The coordinates estimation accuracy vs. base dimension.

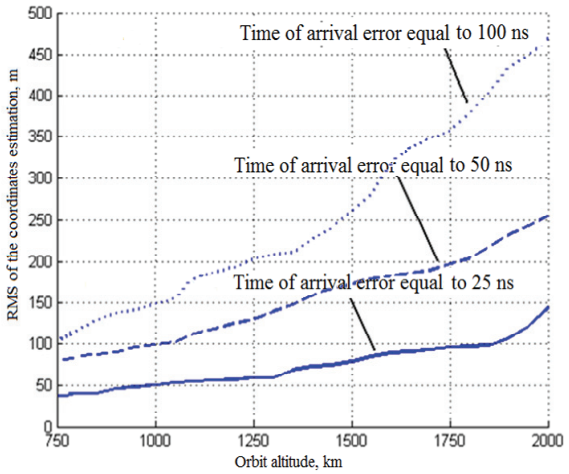

Figure 3. The coordinates estimation accuracy vs. orbit altitude.

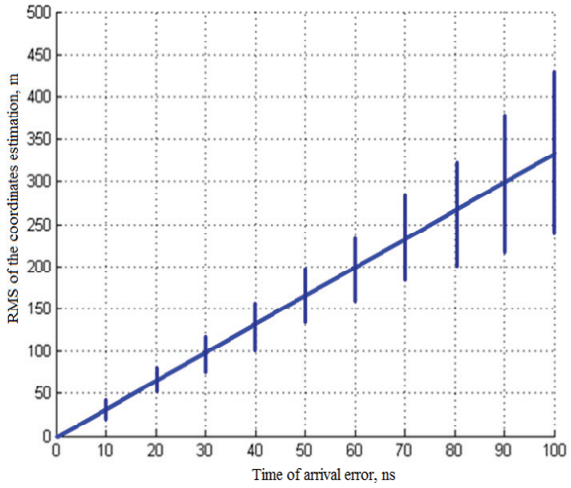

Figure 4. The coordinates estimation accuracy vs. time of arrival error

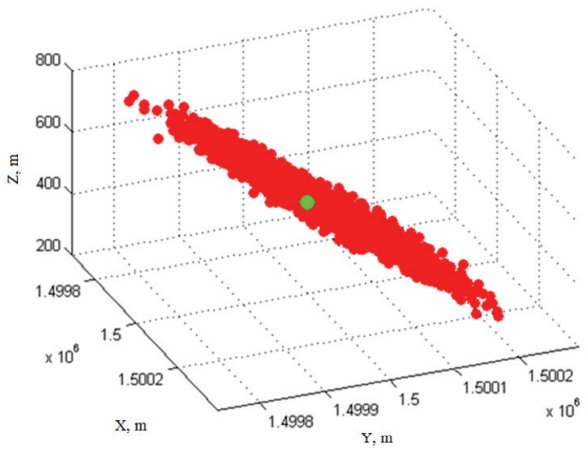

Figure 5. The coordinates estimation field

Conslusions

As a result we can formulate the following conclusions:

- The use of low-orbit satellites constellation preferably over high-orbit, since the accuracy of the coordinates estimation is higher due to the fact that the lines intersect at a less sharp corners and due to energy.
- Satellite orbit altitude should be selected in the range from 750 to 1500 km because of the radiation belts.
- Base dimension increasing leads to estimation accuracy increasing and appropriate to the value of 2000 km, a further base increasing will lead to a slight accuracy increasing.
- To estimate the source coordinates with an accuracy of 100 meters it is necessary to provide a time of arrival error equal to 25-30 ns and a satellite coordinates estimation accuracy equal to 30 m.
- One of the reserves for accuracy increasing is the increasing of satellites number.

References

1. Pat. 6 417 799 US, Int. Cl. H 04 D 7/19. Method of locating an interfering transmitter for a satellite telecommunications system / *A. Aubain (US), B. Lobert (US)*. – 9.07.2002, – 5 pp.

2. Pat. 5 594 452 US, Int. Cl. H 04 B 7/185. Method and System for Locating an Unknown Transmitter Using Calibrated Oscillator Phases / *J.C. Webber (US), C. A. Knight (US)*. – 14.01.1997, – 12 pp.

3. Pat. 6 839 017, Int. Cl. G 01 S 7/36. Method and apparatus for using anti-jam technology to determine the location of an electromagnetic radiation source / *D.J. Dillman (US)*. – 4.01.2005, – 9 pp.

4. *V.S. Chernyak*, The multiposition radar. M.: Radio and Svyaz, 1993.

5. *V.P. Denisov and D.V. Dubinin*, Phase direction-finders, Tomsk: Tomsk state University of Control Systems and Radio Electronics, 2001.

6. *V.P. Denisov and B.P. Dudko*, Radio Engineering Systems, Tomsk: Tomsk state University of Control Systems and Radio Electronics, 2006.

7. *В.В. Вознюк и С.А. Зайцев*, Космическая система радиотехнического мониторинга на основе группировки низкоорбитальных малогабаритных космических аппаратов, Изв. вузов. Приборостроение, Т. 48, № 6, С. 26–31, 2005.

SYMPOSIUM 3

INTERNATIONAL INTEGRATIVE PROCESS IN AIRSPACE AND AVIATION

UDC 330.101.541 (477)

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CONTEMPORARY MACROECONOMIC POLICY IN UKRAINE

The problems of modern economic position of Ukraine, the features and efficiency of operating fiscal and monetary policy on an exit from a crisis and transition to the stable economy growing are examined in the article.

The business surrounding of any country is very important for the development of its economy. The industrial structure and especially the development of aircraft and aerospace industries much depend on the economic incentives delivered by the proper instruments and measures of fiscal and monetary policy in the country. That's why the influence of economic surroundings upon the resource and demand conditions of production must be concerned thoroughly. The financial stimuli like government subsidies or tax credits are observed by the entrepreneurs as the good economic chance for the growth and competitiveness increase. The means of fiscal and monetary policies permit the industry to survive under the shocks of economic crisis. They provide the eligible conditions of costs' reduction and maintenance of constant market share for the national producer.

Economic conditions in Ukraine have deteriorated sharply from the end of 2008, affected by the global credit crunch, collapsing world trade and commodity prices, especially those of oil and metals. Ukraine has signed stand-by arrangements with IMF in order to support its currency from collapsing and to mitigate the balance-of-payments deficit. Now risks for a prolonged slump remain if there is no global recovery. Rising social unrest and political turmoil have added to the already substantial degree of economic uncertainty.

The Ukrainian economy suffered massive setbacks, owing to shrinking exports, lower foreign direct investment, and portfolio capital inflows, declining remittance inflows, slowing domestic credit growth, and the higher cost of external financing. The economic policy of Ukraine ,including monetary, financial and fiscal measures to stabilize financial markets and revive economic growth, needs greater efforts on coordination and larger financial transfers to the export-oriented industries. The next important task is to protect population and align the response with long-run sustainable the development goals.

The economic situation in Ukraine is now being steadily improved on the background of some positive changes in export trends. Real GDP in Ukraine growth was estimated at around 5% in 1Q 2010. On April 27th 2010, the parliament approved the 2010 state budget law with a targeted deficit of 5.3% of GDP. But there is a risk the broad fiscal deficit may be approximately 8-10% of GDP by the end of the year.

The Ukrainian government declared its willingness to introduce a number of structural reforms. For these purposes, a number of reform committees were created.

Being a very open economy, Ukraine has benefited from the ongoing recovery of the world economy. Driven by export-oriented industries and their related sectors (cargo transportation and wholesale trade), real GDP was estimated to increase by about 5% in 1Q 2010. On the back of slow domestic demand strengthening and delays in natural gas tariff adjustment, Ukraine's consumer price inflation decelerated to 11% in March.

The improving economic and political situation in Ukraine and resuming risk appetite of foreign investors allowed Ukrainian banks and companies to re-open foreign capital markets. This, in turn, contributed to the easing of Ukraine's external financing needs and may stimulate a faster recovery.

Despite a stronger recovery, budget revenues performance was rather weak. As fiscal austerity measures during presidential elections looked problematic and there was a need to realize some pre-election promises after the elections, budget expenditures grew at a robust pace.

The consolidated budget deficit amounted to 2% of GDP in 1Q 2010. However, the official deficit did not include Pension Fund and Naftogaz imbalances as well as bank recapitalization spending; hence, the broad fiscal deficit was estimated at about 7-8% of GDP. The deficit was primarily financed by new domestic borrowing. The lion's share of government T-bills was purchased by the NBU, implying indirect monetization of the budget deficit.

The parliament approved the 2010 state budget law with a deficit of 5.3% of forecasted GDP. The budget was developed based on a realistic macroeconomic forecast and included a realistic Pension Fund deficit.

Real sector data shows that the economic recovery in Ukraine has been gaining strength. Moreover, stronger-than-expected growth in the global economy, driven primarily by emerging Asia and Latin America, larger social transfers to the population approved in the 2010 budget law and a lower price for imported natural gas (renegotiated with Russia in mid-April) led to upgrade the 2010 macroeconomic forecast for Ukraine.

On a positive note, the slump in domestic demand brought an abrupt retrenchment of imports, while Hryvnia depreciation helped to restore competitiveness of the Ukrainian exports.

The recovery was concentrated in export-oriented industries, favored by strong demand from vigorously recovering emerging markets (particularly in Asia and Latin America).

A strong commodity price upswing benefited Ukraine's chemical production, metallurgy and closely linked extraction and coke products industries. Output in the respective industries was up by about 26%, 18%, 24% and 13% over January-March 2010.

The continuing strong rebound in the Russian Federation, the principal market for Ukraine's machinery exports, including avia- and aerocosmic aquipment, underpinned a 26% increase in Ukrainian machine-building. Generally speaking, the period saw an 11% increase in industrial production.

The growth in industrial production and foreign trade propelled the rise in service sector activity. Cargo transportation turnover went up by a solid 16% in January-March 2010.

But the fragile domestic demand helped to keep import growth subdued. All in all, taking advantage of favorable external conditions and low statistical base, real GDP was estimated to grow by about 5% in 1Q 2010. The commercial banks' weaknesses will continue to restrain consumption and investment growth, we have revised upwards Ukraine's real GDP growth forecast to 4.5% in 2010.

On the back of foreign investors' resuming risk appetite and the improving economic and political situation in Ukraine, Ukraine seems to be regaining access to foreign capital markets.

Following the successful debut of state-owned Ukreksimbank and energy company DTEK in issuing Eurobonds in mid-April, with foreign investors' demand exceeding supply by about 8 and 3 times respectively, a number of other companies announced their plans to resume foreign borrowing. Thus, new external borrowing arrangements may bring about $4 billion to Ukraine in 2010.

Despite the ongoing recovery, Ukrainian public finances remain under significant pressure. Even this modest increase was achieved on the back of further accumulation of VAT refund arrears, a low base effect and the NBU transfer of part of its profits received in 2009 to state coffers.

Ukraine collected UAH 22.3 billion ($2.8 billion) of VAT proceeds to the consolidated budget over January-March 2010, which was 4% lower than in 1Q 2009.

A high 2009 fiscal deficit and modest budget revenue growth in the first months of 2010 signaled an urgent need for fiscal consolidation measures.

Spending on public sector wages and social transfers to the population went up by about 15%. At the same time, to prevent the deficit going out of control, the government has cut capital expenditures by a nominal 22% over the period. Given the disparity in budget revenue and expenditure growth, the consolidated budget gap was reported at UAH 4.4 billion or about 2% of estimated period GDP for January-March 2010.

The broad fiscal deficit was more sizable due to ongoing deterioration of Ukraine's Pension Fund performance, the difficult financial stance of state-owned gas monopoly Naftogaz and bank recapitalization needs.

Hence, the overall fiscal deficit was estimated at around 7% of GDP in 1Q 2010 and was covered by new domestic borrowings.

Although foreign investors' interest in Ukraine's domestic T-bills has notably increased this year on the back of ongoing world economic recovery and improving economic and political situation in Ukraine, the NBU remained the principal purchaser of domestic debt securities.

As a result, Ukraine's domestic public and publicly guaranteed (PPG) debt grew by about 17% from January to March 2010.

Foreign investors' revived interest in Ukraine resulted in the foreign currency supply exceeding demand in March 2010. This pressured the Hryvnia exchange rate to appreciate with respect to the US Dollar to UAH 7.93 per USD.

But the NBU did not allow the exchange rate to appreciate further by buying out the surplus of foreign currency. For the first time since August 2008, net NBU foreign exchange interventions were positive and reached almost $1 billion in March 2010. This allowed the NBU to replenish its gross international reserves to $25.1 billion.

The liquidity stance of the Ukrainian banking system has notably improved in recent months.

Although increasing government cash balances, sizable NBU sterilization operations and limited refinancing of commercial banks contained the growth of monetary aggregates, it notably accelerated in February-March 2010.

The monetary base and money supply grew by 12.5% and 6.6% in March, compared to a 4.4% growth and a 5.5% decline in December 2009 respectively. Amid the acceleration of monetary aggregates growth, the continuing sizeable, though indirect, monetization of the fiscal deficit may further worsen inflation developments and threaten foreign exchange stability.

The stock of commercial banks' loans to the economy of Ukraine keeps declining and was almost 3% lower in March 2010. The decline was led by an almost 14% drop in retail lending.

Weak credit activity is attributed to the ongoing process of commercial banks' cleaning of their balance sheets and crowding-out with large domestic government borrowing.

However, faster-than-expected world economic growth, changes in price-setting mechanism for iron ore trade in March 2010, which are forecasted to pressure world steel prices upwards, and a 30% discount on natural gas imports negotiated in April, prompted us to upgrade our current account balance forecast to a surplus of about 2% of GDP in 2010.

Since the intensification of the financial crisis in September 2008, Governments world-wide have made available massive public funding to recapitalize banks, taking partial or full Government ownership of ailing financial assets. Further, recognizing that monetary and financial measure will not be enough to stave of a recession, many countries like Ukraine have also adopted fiscal stimulus plans to be spent over 2009-2011.

Ukraine needs to concentrate its attention on such four major areas:

1) To restore the financial health of banks is a very important action.

2) There must be coordination of the fiscal measures being undertaken by Ukrainian Government. Without adequate coordination, the stimulus measures may fall short of what is needed. Failure to coordinate the size and timing will limit the multiplier effects of the stimuli, thus reducing the impact on economic growth and employment.

Most counter-cyclical efforts should in-deed originate in Ukraine, but this does not ensure adequate rebalancing of its economy. Except that many of the stimulus packages imply (often unintentionally) unfair trading practices by providing subsides and incentives to domestic firms.

And of course, policy coordination needs to be accompanied by monitoring mechanisms to ensure accountability and credibility for the concerted efforts.

3) Fundamental reforms of the international financial system are needed to overcome the systemic flaws which caused this crisis in the first place and in order to guard against future crises.

Without elaborating in detail here, such reforms should first deal with the major weaknesses in the regulation and supervision of the international financial system. A macroprudential regulatory system needs to be created, based on counter-cyclical capital provisioning, to develop institutions for the supervision of all financial market segments in which systemic risk is concentrated, including hedge funds and cross-border flows.

Strengthened international tax cooperation should form a critical element of a more effective global system of financial regulation. Such cooperation should help to reduce tax evasion, which is often linked with money-laundering, corruption, financing of terrorism, and drug trafficking. As tax evasion is pervasive, improved tax coordination to combat it should also help to boost the fiscal capacity of Governments worldwide, which in turn would enhance financing available for recovery and development. Beyond this immediate need for action, an orderly sovereign debt workout mechanism and an improved framework for handling cross-border bankruptcies are needed.

It means that soon a new global reserve system which no longer relies on national or regional currencies as the major reserve currency must be created. A new system which allows for better pooling of reserves at the regional and international levels and which is not based on a single, or even multiple, national currency needs to be developed. It should permit the emission of international liquidity (special drawing rights or some equivalent thereof), so as to create a more stable global financial system.

4) A new framework for global economic governance in line with early twenty-first century realities needs to be created it means that fundamental reform of the governance structure of the Bretton Woods institutions is needed. Such a reform must be comprehensive so that they can more adequately reflect changing economic weights in the world economy, be more responsive to current and future challenges and strengthen the legitimacy and effectiveness of those institutions. These reforms should also lead to the establishment of a credible and legitimate mechanism for improved international coordination of macroeconomic policies. Institutionalized macroeconomic policy coordination should be embedded in a more representative multilateral framework. IMF could provide such a platform following adequate reform of its governance structure and revision strengthening its mandates for surveillance and policy coordination.

Broader global economic governance reforms must also be considered to ensure coherence in the global governance of the international financial architecture, the multilateral trading system, the framework for addressing climate change, the development agenda, and peace and security. Such coordination could take place through a new global economic council that is part of the United Nations system. Whatever the mechanism, it is essential that a body be created that can provide coordination and oversight of responses to the broader range of global challenges and set the world on a new but sustainable development path.

Conclusion

Now Ukraine looks to further ties with Russia and fresh IMF cash. Ukraine like other European countries needs science, technology and entrepreneurship to fuel innovation and green growth in perspective, which is the key step to competitiveness in a new post-crisis world. Ukraine needs new innovation resulting in production for export. Ukraine has enough potential to transform itself into a steady effective economy driven by innovations and new technologies.

References

1. The Financial Development Report 2009 // http://www.weforum.org/en/initiatives/gcp/FinancialDevelopmentReport/index.htm

2. United Nations Conference on Trade and Development, Assessing the impact of the current financial and economic crisis on global FDI flows (UNCTAD/DIAE/IA/2009/3).

3. World Economic Situation and Prospects 2009 (United Nations publications) // http://www.un.org/esa/policy/wess/wesp.html

UDC 1:316.4

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INFORMATIONAL SOVEREIGNTY OF THE STATE: THEORY-METHODICAL ANALYSIS

The report deals with the appearance and development problem of informational sovereignty of the state in terms of informational society. There are also described the main causes which produce the realization of informational sovereignty.

21st century can be described by means of the world economical and political processes globalization and the main component of which is the intensive use of modern technologies. Information is the most important global resource in the modern world. The economical potential of society is determined by the number of informational resources and level of informational infrastructure development. Information is getting always complicated, the number of its sources and users is increasing. But at the same time, the unreliable and sometimes even harmful information can cause the increase of modern informational society vulnerability. This information often comes not on time and can be connected with the industrial spying and computer crime. That's why the informational security system is very important within the global informational society.

The mass informatization of all the life spheres including the security of the personal security, security of the society, economy and finance, national infrastructure is arising the problem of informational security system. [1, p.10].

Nowadays the problem of information security plays the most important role. The protection of the informational sovereignty has a very close connection with the term of informational security.

The category of "informational security" is a variation to the term of "state security" and "national security". That is why it includes the range of conceptions which are common for all these terms. Moreover the term of "informational security" has a specific meaning because the word "informational" in this very sphere of social relations is connected not only with the term "information" but also with the sphere of information.

Speaking about the term "state informational security" it is impossible not to mention the category of "informational sovereignty" which is a variant of the term "informational security". In Ukraine the informational sovereignty as a category is legally accepted in the national legislation. But we think that it is requiring some further theoretical grounding and some work on its definition. First time we come across with this category in article 53, 54 Ukrainian legislation "About information" the year 1992. Here is determined the material background of the informational sovereignty and the guarantee of the informational sovereignty of Ukraine. [2, p. 53-54]. Soon after there were placed for consideration of Ukrainian Verkhovna Rada two legislations "About the informational sovereignty and informational security" from July7 1998 and April 15 1999. According to the legislation from April 15 1999 created by Ukrainian deputy Chyzh Ivan the informational sovereignty of Ukraine is described as a vital human right, as a right of the state, society in order to take part in the forming and development of the national policy according to the constitution and Ukrainian legislation, international law in the national informational space of Ukraine. [3]

The sovereignty is the same age as a state and its constant companion. Starting from the 16th century where there was concluded an Augsburg treatment between the Roman emperor Carl V and the German Lutheran prince about the keeping privacy in the spiritual life of monarchs – neighbors [4]. The principle of sovereignty reached the political consciousness west European. The first who defined the term of sovereignty was Jean Bodin in the 16th century. He offered the conception of the authority it on the basis of sovereignty. According to Jean Bodin sovereignty is a constant and absolute the highest level of authority which is carried out within and out of the country. Jean Bodin admitted the sovereignty representative the monarch but not

the state. Such an approach was determined by the socio-economic and political realia which were in time of formation centralized absolute state. Then after the idea of the sovereignty was developed by the representatives of natural right school, the most famous was Hugo Grotius. He made a difference between the term of sovereignty and its representative. Hugo Grotius considered sovereignty not as a state authority but as its special feature.

The analysis of the political-legal theory shows that the idea of the sovereignty was changing its meaning according to the peculiarities of the concrete period of time. In the second part of the 18th century was formed the conception of the national sovereignty. The most appropriate idea was formed by the French Jean-Jacques Rousseau who determined the nation as subject and a main carrier of the sovereign authority.

Rousseau denied the compatibility of the principle of the national sovereignty and democracy. He believed that direct expression of the general authority or the authority of the nation is impossible.

The ideas of Rousseau about the incompatibility of the national sovereignty and representative democracy principle had their opponents in times of French revolution in the 18th century. The most famous of them were Charles Montesquieu and Emmanuel Siess. They accepted the idea of the national sovereignty but with their own vision of it. Charles Montesquieu wrote that the nation is incompetent in terms of executive power. Siess believed that the great number of people cannot estimate the content of the legislations because they are not well-educated enough for this.

The constant element to the further development of the foreigner political-legal theory was the comparison of the representative and the democracy itself according to the principle of the national sovereignty. The dominant are still remaining the view according to which there appropriate theory and practice of the representative and also direct (pure) democracy. But at the same time the principle of the national sovereignty sometimes is concerned as a mask of the state – legal realia. According to this some scientists see the danger in the creating of the premises for the parliamentary despotism. They believe that such results could be only if in the representative organ there will be formed the random majority which will be ground on the national trust but unfortunately there doesn't exist such [28, c. 37]. The sovereignty belongs to the nation who is carrying out it in all its forms and within the constitution.

According to the constitutional principles the term popular sovereignty is replaced by the national sovereignty. In the Article 1. Constitution of Spain it is mentioned that the "national sovereignty" belongs to the nation of Spain which explains the state authority. The similar text can be found in the Article 3. Constitution of France. Such a replacement of terms happened not by chance. It explains the connection of the terms "national", "popular" and "state" sovereignty.

The usage of the term "national sovereignty" reflected the process of national states forming in the 17 -19th centuries. The nations which were already formed at the period of time were gaining the state features. So, no wonder, that the term "national sovereignty" was considered to be as a fundament principle of the state sovereignty.

In science term "state sovereignty" is explained as a domination of state on the whole territory and independence in the international relations. State domination shows the effect of the only one public authority within its territory. This public authority determines powers of the public bodies and officials and also subordination of the people in the country. State independency in the international relations is its being not under the authority of any foreign power, power of other states.

Sovereignty is an important political – law characteristic of a state. The meaning of the word sovereignty reflects attributive characteristics of a state. But at the same time is connected with the characteristics of a state authority, in other words, sovereignty displays the real nature of authority. The connection between the state and popular sovereignty is often described by means of the nation who is the only one source of authority which is carried out by the state and its bodies.

The end of the 20th century is the period informational society forming which is connected with informational systems development, globalization of informational processes. Under existing

conditions the great attention is paid to the problems of solving the problem of informational security and providing the informational sovereignty of some other countries.

Many scientists believe that the informational sovereignty comes from state sovereignty but is not equal to the last one. One should be careful with the term "informational sovereignty" because the sovereignty itself is a supreme authority in the domestic affairs and independency in the foreign affairs. One should take into account that informational sovereignty has a dual character. On one side it is an exceptional right of the state, and on the other side those are the main tasks of the state activity.

We think that informational sovereignty is a unique right of these states according to the constitution, legislation and standards of international law. They can carry out the domestic and geopolitical national interests, domestic and foreign informational policy, use its own informational recourses, form national informational space infrastructure, creating the conditions for its (informational sovereignty) into the world informational space and guarantee the informational security of the state.

The providing of the informational sovereignty by the government determines the following:

- realization of the informational sovereignty is possible only within the presence of the full right for the information by all the subjects of the informational social relations;
- realization of the informational sovereignty by the government includes providing is informational security;
- realization of the informational sovereignty should be based on the informational freedom and equal rights of parts in the informational legal relationship.

Conclusions

1. State sovereignty is supremacy of the state within its whole territory which means the effect within its borders of the only one public authority which determines the authorization of all states bodies and officials and also of being under this authority all the population; also its independence in the foreign affairs which provides its insubordination to any foreign authority.

2. Informational sovereignty has a dual character. On one side it is an exceptional right of the state, and on the other side those are the main tasks of the state activity.

3. Foreign affairs in the sphere of information fall under the regulative measures determined by the international law principles which are defined by means of international documentation of the different legal effect.

References

1. *Федоров В. А.* Глобализация: тенденции и перспективы // Вестник Российского университета дружбы народов. – 2001 – №3 . – С. 10-19.
2. Про інформацію: Закон України від 02.10.1992 р. № 2657-XII // Відомості Верховної Ради України. – 1992 - № 48. – Ст. 650.
3. Про інформаційний суверенітет та інформаційну безпеку України [Електронний ресурс]: Проект Закону України: [від 15.04.1999 р.] – режим доступу: www.zakon.rada.gov.ua/cgi-bin/laws/main/cgi?nreg=56
4. *Кузнецова Е.* Западные концепции государственного суверенитета. – режим доступу: www.intertrends.ru/eleventh/007htm

UDC 72.01

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SCANDINAVIAN ETHNODESIGNER SEARCH FOR A COMFORTABLE SURROUNDING

The article defines the peculiar features of the "northern design" created by the designer schools in all 4 Scandinavian countries. Also it examines the pecularities of all designer schools. The greatest attention is payed to the Finnish one.

Each national design, including Scandinavian, has its pecularities. Unlike to artistic Italian, populism American or aggressive Japanese, the design of the northern countries is distinguished with the help of its functionality, conservatism, remembrance of handicraft traditions and faithfulness to the ideas of modernism. Scandinavian art wears good fame all over the world. Especially, it is famous for goods made of glass, ceramics, metal, textile and wood.

In the 70s mankind became interested in Scandinavian design. Danish, Fin, Norwegian and Swede desigers definitely fulfilled not only moral but also financial aspect of their business [7]. After the northern concord, the traditional position of art and industrial design became also popular in the "Art Association in Denmark", "Fin Association of Handicraft and Design", "Norwegian Association of Handicraft and Design" and "Swede Association of Industrial Design". The concord held different exhibitions in Stocholm and Hottenburg and also performed conferences dedicated to some designer topics, concerning theory and practice.

The famous all over the world above mentioned northern style, disclosed after a modest exhibition in China town, London. The exposition was titled "Scandinavia at a table". It showed the indivisibility of the 3 countries: Denmark, Sweden and Norway in comparison with 3 meals a person takes per day. It should be reasonable to mention that the success was brought with the help of Danish designer – Erik Chechiov, who made the exposition in a creative way despite the small space.

Perambulating exhibitions in the USA were the second step to acknowledge the Scandinavian design. The projects of the perambulating exhibition halls were the basic fundamentals for the elaboration of Northern Travel Agency. The Northern Association had also practical problems concerning culture and their own information system. American designers spoke well about the elegance and refinement of the goods made by the designers of the Northern Concord. All four Scandinavian countries did their best in order to implement their project perfectly. They made attempts and mistakes in order to make it perfect for the public announcement. The designer ideas wide spread also on electronic and mechanical industry and adjusted in the inner surrounding, where the aim was not to surprise the person's imagination but to please the client with high quality.

The fort of the Scandinavian design is the ability to combine new object with the existing context, whether it is a complicated system design of a city, building or natural landscape. The attention on integrity is payed to that space which is created with the help of design or monumental-ornamental art and it doesn't matter whether it is an urban complex or interior [4].

Under the circumstances of modern structures, which exclude using permanent space limitations and traditional ornamental material, open approaches are used maximally in combination with colourful systems that determine the main emotional feature of the interior.

By the way, what concerns the colourful system, an interesting experiment was made in Sweden. Swedish Natural Colour System was established by Edward Henrich on the basis of studying and using the natural colour structure. Colourful rows are based on 6 main coloures: red, yellow, green, blue, black and white. A colourful circle is made of 4 chromatic coloures that link with achromatic ones. On the whole, the Standart System numbers 66 coloures. Designers can also use the atlas of coloures where 40 colourful and 5 grey tints are proposed. In case you combine one of these 5 grey tints with colourful ones you'll get yellowish, redish, bluish and greenish tones.

Exactly these coloures are the most often used in Scandinavia. In the process of making the inner space the same methods as in the process of making the stage space are used. Revetment, that is very effective for a not long but carefully measured period of time; mirror and grass sufraces and also sheets of polished steel that help to percieve the objects in the easiest possible way. In this case, a traditional closed size is substituted with the so called "building-window".

"The systematization of data concerning the designer processes showed that the Scandinavian design, especially Finnish, had shown the most recognizable national designer's originality in the whole Europe" [3]. While taking this into consideration, it should be reasonable to mention that among all the Scandinavian countries the Finnish design excites the most.

Finland is one of the northern coutries. Approximately one third of the country (from North to South) is situated behind the Polar Circle. The most populated South has a climate that is very similar to maritime, that's why the plastic arts and colourful saturation of the outer architectural and designer compositions are estimated to perceive them in scattered light and opposition to harmful air, humidity or wind effect. Stone boulders and rocky mountains represent the typical Finnish landscape. Finish design has got some differenciative features that distinguish it from the Europen, perhaps because the Scandinavian countries weren't under the influence of Roman Empire and succeeded in preserving the family order and primitive paganism.

The aim of the method that is used at the Finnish school is to establish the relation to architecture and design as to the main components of the complex surrounding, where the landscape, that is filled with different objects forms one single unit. The aim of the Finnish school is to bring the person and nature together with the help of architecture and design [5]. In the process of projecting, the symbolics of national romanticism and regional lanscape pecularities are taken into consideration.

One of the manifestations of this school was the new way of using wood and natural material. The laconism of the forms corresponds to the character of the country and its inhabitants, who always say: "Everything should be as simple as possible".

So the foundation of the Finnish design is the combination of pure forms and technological perfection. The main watchwords of the object complexes are: simplicity, functionality and technological effectiveness. According to it, chairs, telephones, vases and other stuff should be of high quality and handy in usage.

Finnish school created its own principles:

- right angle is a value of reducing the volumetrically-planning elements to big simple forms – parallelogrames, spheres, cylinders and etc.;
- the usage of natural materials;
- externalization of the buildings;
- intuition and an emotional start;
- fixing up the natural and artificial illumination.

The poetics of illumination together with the works of artists and architects reflect the northern people's attitude to the sun. Long northern nights bring sadness, that's why designers and artists try to compensate it with natural light. Natural illumination plays a great role in the northern world. A great contrast between the day light and night gloom evokes thoughts about the contrasting illumination in winter and summer.

One colour interiors and magnetism of the dosed illumination show the poverty of the northern nature. They create the mood of the northern atmosphere. The light forms the metaphysical phenomenon of the dwelling space.

At the beginning of the 21st century, the rapid development of the light design infringed on Finnish designer's interests, who began to get interested in light artificial climate. This is certified by a famous Finnish designer Hanu Tyka, who points out that the future of the light design consists in the usage of the multicoloured illuminators where the light transfuses, because such tendency is prearranged exclusively by the technological process. An interesting fact in creating "the Finnish radiance" is the innovatory search made by the designer group "Valvomo". They make luminaires by the means of "immuring" them into the ballons. So when you turn on the light, the bullon starts

to “breath” inhaling and exhaling with the help of the special valves. The mysticism of the northern radiance penetrates into the architecture and design. Mainly bleached tones and light strains of wood are used. Because of the cuts situated nearer the ceiling and because of the usage of the upper illumination, windows sometimes remind us of space illuminators and big plates sized from the floor to the ceiling.

Alvar Aalto is one of the brightest traditionalists and innovators in the sphere of interior in the Finnish design.

Aalto was of the opinion that among three types of art (architecture, pictorial art and sculpture) profound relations should exist. He examined the architecture as a “biodynamic process”, where it occupies the role of a tegument for the interior and all other stuff that together form the domestic comfort. And the linking chain is the material. All kinds of art get out of the material, they are characterized by their externalization. The dependence on material opens great opportunities for the harmonic art synthesis [1].

Constitutional forms were immanent to Aalto’s developments and the author strongly pointed out that the design should be combined with humanity. He rejected such artificial materials as metal pipes for the furniture which don’t correspond with person’s condition. Aalto thought that the designer should take into consideration not only the satisfaction of functional needs, but also the person’s psychological condition. In this case it would be reasonable to use natural materials, especially wood, which is, as he emphasizes, “a deeply human material”. Wood is a natural material which is very “close” to the person and can solve a chain of not only engineering tasks but also biological and psychological problems. That’s why it isn’t worthy of rejecting and using the atrificial materials instead.

Together with his wife Aino Marsio, he conducted experiments with wood concerning its bending. These experiments led to revolutionary projects made with wood furniture. Special interest was provoked on the furniture made for the health resort in Paymio especially on the plywood chairs which consisted of wooden frame that looked like a thin stripe with a curved plywood seat. Later on Aalto became interested in foliated wood and plywood and created technically perfect chairs with model sets # 31 and 41. These models started the new tendency of material usage, especially plywood, for the furniture production. Aalto considered that his great contribution to the furniture design was the solution of the old problem concerning the connection of vertical and horizontal elements. His construction, that was made from the curved wood called “the younger sister of the architectular pillar” is able to carry a seat independently. On the basis of this technical development the following set of chairs was produced: with L-shaped and Y-shaped legs (1946-1947) and with fan-shaped one in 1954.

He also thought that the most complicated problem consists not in finding the forms that correspond with the modern life, but in finding the forms based on the veritable human values. It is a well-known fact that highly qualitative artistically-industrial products can be made only in the handicraft-individual way. He spoke about being against the standartization of integral objects and at the same time supported the idea about the standartization of components refering to the nature as to the best “standartization committee” where there are no stereotypes. What concerns furniture, the problem is out of the question – it should be made according to the standarts and series [2].

Alvar Aalto created the symbol of modern gorgeous design. Aalto’s huge contribution in design consists in the ability to combine native elements with up-to-date technological processes and also in his good skills in modern artistic means of expressiveness.

Up-to-date Finnish designers are working in the direction of modern design’s evolution.

The most prominent figure is Yuha Leyviskya who bases himself upon Alvar Aalto’s and Blomsted’s creative works. He creates something average between architecture and music and in this case the designer occupies the role of the composer, who writes the symphony. According to Finnish architecture, the process of movement in this “musical work” is the sequence in development of the architectural space, where pauses, modulations and diminuendo should exist [6].

Yuha Leyviskya’s skills in the ablity to use the light and forms are shown in the parish church in Finland. The designer’s approach in this construction lies in the connection of inner and

outer surrounding. A suurounding is regarded as a material with the reflection capability made from light. The components of the surrounding (walls, ceiling, body) create one unit. Objective filling is subdued by the general idea, where a person studies the surrounding through in the light of the objects. By the way, Yuha Leyviskya got an international Carleberg prize for his project of the church Yohanessa in Myanysto.

Designer developments made at the end of the 20th century fascinate with their chaste forms which correspond with the present demands. Stephan Lindfors, Petri Weynio, Album-Max Mulius and other young designers are close to sculpture while creating the domestic things. Their works are characterized by a chaste form and material contrast. All these are coordinated with the changes in modern life and weather.

In 2005 a state programme «Design 2005» was worked out in Finland and now it undergoes the process of implementation. The strategic aim of this programme is to advance the Finnish design into the world leaders in order to strengthen the Finnish products on the domestic and foreign markets, because the design can increase their competitiveness.

The growth in competitiveness is solved with the help of the folllowing methods:

1. the development of the designer's education;
2. the development of the interdisciplinary searches, to which the representatives of the industrial enterprises, specialists in proximate design, teachers and students of the designer schools must be involved.
3. The development of the designer's infrastructure; stimulus in its usage by the Finnish companies in the spheres of small and medium business. A great amount of innovative centres are going to be opened, the aim of which is to choose partners for cooperation;
4. the integration of design into the national system of innovations.

Nowadays, the Scandinavian design is characterized by the collective creativity. Finns are very talented in design. They are known world-wide thanks to their consummate democratic designer works that fill in the space between the handicragt and industrial enterprise.

Yero Saarinen's, Yute Cacappuro's, Simo Heykilya's, Yevy Coconen's creative works, and not only theirs, serve as an examples for their collegues – they are the examples of the style cleanness, the undeniable filling of measure and functional perfection. On one hand, Finnish people are characterized by the stable interest in handicraft, the usage of the national traditions in everyday life and on the other – in search for new functional solutions.

And the result is a new design for a modern period of time that gets an inspiration from the ancient times. Chaste lines, calm tones, real materials, functionality and ergonomicity – this is the foundation of updated Finnish ethnodesign.

W.Ya. Danylenko states that "Finnish design is an interaction of traditions and innovations. The innovations don't deny the traditions as it is usually seen in post industrial countries of Western Europe and Northern America but cultivates the innovative material on the existing national culture" [3].

Generally speaking, the global changes in the modern Scandinavian design took place only by virtue of new technique, new technologies and new material. But northern traditions are still preserved. The main leading motive in the modern design is the process of tradition imitation using the new up-to-date way of its interpretation.

Literature

1. *Aalto Alvar.* Architecture and humanism. - M.: Progress, 1978. – 224 p.
2. *Gidion Z.* Space, time, architecture. – M.: Stroyizdat, 1984. – 455 p.
3. *Danylenko W.Ya*. The design of Ukraine in the world context of artistically-projected culture of the XX century (national and global aspects).: 05.01.03. – Lviv, 2006, - 36 c.
4. *Ikonnikov W.A.* Swedish modern architecture. - M.: Stroyizdat, 1978. – 152 p.
5. *Ikonnikov M.A*. New Finnish architecture. - M.: Srtoyizdat, 1972. – 143 p.
6. *Jodido Philip*. Contemporary European Architects. Volume 4-B. - Koln: Benedikt Tashen, 1996. – 176 p.
7. *Lun*. The Lunning Prize. – Stockholm: National museum, 1986. – 186 p.

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GENESIS OF CONFLICTS IN INTERNATIONAL ECONOMY AND INTERNATIONAL ANTI-TERRORIST LAW

The report deals with economic producing of global terrorism and designing of proper international legal instruments to counter it.

Agreeing with a possibility of further acceleration of terrorism under worldwide economic and social transformances one should try to figure out instruments for an efficient international legal deterrence for this threat. The best methodological basis for that should be approaches and conclusions coming from an analysis of worldwide economic and social processes which propose by experts to prevent and solve signs of global crises. As a starting point to present a new concept of what an international anti-terrorist law should look like, it should be stated that the real efficiency of law depends on social peculiarities of a human community in which that law is now in force.

None of today's economic system is capable for a rapid growth but with large-scale use of technological know-hows (including the ones landed from abroad) and active exports of domestic products. That evidently causes considerable problems for poor countries to enter the world's "post-industrial club". Therefore the disputes between richer and poorer nations are sharpened worldwide. Such disputes differ dramatically from so called "disputes of equals" which could be solved in the worst case by an undisguised war, and could cause an evident growth of an international terrorist threat – just because of rapid economic polarization worldwide. It is just the terrorism that is often used to try to overcome economic and military differences between communities and nations. But it does not mean at all that the terrorism is a "weapon for weak people". Far from that economic grands also use terrorist instruments both open and disguised [1, p. 40-62; 66-68].

While the economic and social gaps between more and less developed nations grows more and more threatening, and from another hand the nations become closer to each other due to the globalization, the global system of terrorist threat management (including the nations' responsibility) system is highly needed. The only possible fundament for such a system should be definitely the international law which should be use to deal with the terrorism as a phenomenon with no restrictions on particular terrorist actions as objects like it happens for nowadays.

Looking for the solutions for a global economic crisis the world community inevitably comes across the common responsibility and more active participation of world economic grands (mostly G8 and/or G20) in overcoming that crisis. At the same time, speaking about the efficiency of contemporary anti-terrorist law, it should be stated that the gap between post-industrial and "third world" countries is among the most highly-influence factors here and its proper estimate should create a chance for due coordination between national and international actions aimed at overcoming the economic gap and those aimed at overcoming the terrorism itself.

The disparities between post industrial and "third world" nations are growing dramatically. Moreover, the post-industrial nations' spending for an economic aid to the "third world" are steadily reduced. In spite of some western governmental declarations about a relatively small "third world's" financial debt, it grows also steadily. It is a real fact that the investments to the "third world" from richer countries excel the economic aid, but at length there are only few regions which feel a real profit from that. Egyptian writer Mohammad Sidi Ahmad wrote: «All that is over. The dialogue between the North and the South is the same way dead like the dispute between the East and the West. The idea of development is also dead. There is neither common language, nor common glossary to name the problems any more. South, North, "third world", liberation, progress – none of those terms has any more sense» [3, c. 2].

The gap became growing in the 80s when the Western world trying to overcome its internal crisis managed to overcome also its excessive dependence on raw materials exporting countries. Growing use of high technologies makes the producing process more complex and therefore, reduces the importance of such factor as a cheap labor force from the "third world" countries.

Having utilized considerable amounts of «third world's» natural, human and financial resources, post-industrial nations now become "encapsulated" to swallow those resources and to prepare a new breakthrough for themselves. At the same time, post-industrial nations prudently fence them off from numerous negative phenomena taking place within the "third world" as the result of the resources' loss. [2, c. 146-147].

The trans-national companies (TNC) take an active part in "pumping out" of natural resources, unilateral use of hi-techs and in other decisive global processes. While new technological principles were and still are mostly designed by states, but up to 80 % of new technologies, i.e. means to realize those new principles are designed within TNC laboratories. At the same time TNCs gave mostly the technology with high capital capacities. It causes quite a number of negative phenomena: growth of unemployment and of social inequalities, reduce of "third world" countries' national technological progresses, etc.

Another source of conflict is the investment policies where TNCs are also dominating. As TNCs are not really interested in adaptation of using technologies to local situations in the "third world" affiliating countries they place those technologies in the most highly-developed "third world" countries where those technologies are a bit less needed. At the same time those investments reduce the development tempo in those countries. But these factors also produce some negative consequences to post-industrial countries which form an exclusive community countering this way to the rest of the world as an informational civilization and having all the appropriate instruments to cause a decisive influence on world processes.

The estimates of experts that such a way of global economy's development means just a technological dead-end, are justified in the world crisis. Among possible options to overcome that crisis someone considers a provocation of armed violence in different forms among principal victims of the crisis. Having driven lots of people into violence and terror the world elite would catch the moment to shift the civilization's development onto a new technological level, replacement of TNCs for some new forms of economic domination. Actually one can see quite an evident domination of Western world over raw materials exporters with the perspective of its further absolute domination worldwide.

Thus, there is quite a number of disparities within a developed society that display the growth of dramatic social conflict which also contains quite a dangerous internal component which is the imposing hostility towards everything alien. Particular danger here is caused, alongside with further international economic differentiation, by formation of several countries community incapable to integrate a contemporary economic progress within themselves.

A disastrous situation within the poorest regions as for both savings and investments force the businesses and the foreign governments to give up their past-time policies of crediting those countries – both governmental and non-governmental. The reasons are that: a) local governments are not capable to conduct any responsible economic policies in favor of their people and b) international lawns and aid preserve law-efficient and outdated political systems in those countries.

Another extremely dramatic factor here is inequality of profits between individuals in most of "third world" countries. This leads to a danger of a conflict strengthened by equal ethnic and/or religious intolerance, territorial disputes etc. Another worse thing is that such new intra-national conflicts would hardly focus an attention of world public opinion.

As long as the disaster in Africa comes to its highest point, world community tries to put a blind eye to this problem. As Robert D. Caplan wrote: «Africa looks no less important for future world policy, than Balkans a hundred years ago, before the two of Balkan wars the World War I. It is because the major part of Africa is at the edge of the abyss, we can make a prognosis about which would be wars, borders and ethnic policies in some decades» [4, p. 54]. Then R.D. Caplan wrote that as 95 % of human population growth took place within the poorest regions, the question could be not about whether there would be any new wars or not, but what would those wars look like and who would fight with whom. He came to a conclusion that «the Islam would be attractive for oppressed people because of its bellicoseness. This religion, whose congregation worldwide grows most rapidly, is the only one ready for fight» [ibid.].

Thus, it is not a surprise that separatists and religious fanatics become more and more popular spreading from Morocco and Algeria to India and Indonesia. Due to well-known reasons one can presume that wars of abovementioned type would be mostly terrorist, because under such dramatic differences in people's well-being and growing poverty in Southern countries any other fighting form would be senseless.

Conclusions

Therefore, social degrading policies of driving back the most of people capable to work; onto outskirts of world civilization has evidently no reasonable perspectives and could bring back a dramatic blow on economically powerful nations. Continuation of such a policy will be a considerable source for new social conflicts, regional disputes and local wars, which in the case of accumulation of critical mass, would be transformed into a global dispute. Due to a considerable gap in well-being between more and less developed countries, a terrorism as an instrument of fight would be more and more welcomed.

First of all, any actions of world community aimed at bringing of world economy to an order so as to remove economic causes for terrorism would create some opposition. Scale and means of deterrence would depend on properness of the instruments selected for most of the people. But, anyway, one can foresee mostly terrorist kind of deterrence because it means the instruments necessary for and welcomed by most of people and used under a real interest from the part of the most developed part of the world community. Another thing here, looking most importantly, is the approach to solution of global problems, due to which the common responsibility is defined and the most of the efforts to overcome the global threat is the special responsibility of the most efficient part of the world community.

Therefore, low efficiency and partly, harmfulness of acting international criminal law dealing with terrorist activities is caused by the fact that it is aimed at suppression of each single terrorist action, not an activity as a whole, paying almost no attention at another party's actions led to the terrorist attack (e.g. annexing, aggression, colonization, expropriation of natural resources by force, economic pressure, restrictions of rights and freedoms, etc.) All this results in the acceleration of clash between fighters and finally – in growing rate of terrorism. Therefore, acting instruments of international criminal law should be considerably improved. This need becomes more evident, accounting contemporary ever-growing economic and social disparities within the world community leading to terrorist threats.

As such disparities would hardly be solved by forceful (military) actions of highly-developed nations, terrorist activities are most likely to grow or, at least, to stay at the present level. Legal analysis of this problem should take the economic factors into a considerable account, because those factors are capable to accelerate the terrorist threat dramatically. At the same time, on displaying complicated internal mechanics of terror, it could help to find better ways to block a further growth of terrorism. It could help the law to transform the terrorism from an efficient political instrument to an unacceptable means of struggle (mostly because of inevitable further liability even in the case of circumstantial involvement) for everyone.

References

1. *Антипенко В.Ф.* Современный терроризм: состояние и возможности его упреждения (криминологическое исследование) / НАН Украины. Институт государства и права им. В.М. Корецкого. - К.: НБУВ, 1998. - 190 с.

2. *Братимов О.В., Горский Ю.М., Делягин М.Г., Коваленко А.А.* Практика глобализации: игры и правила новой эпохи. — М.: ИНФРА - М., 2000. - 344 с.

3. New Perspectives Quarterly, Fall, 1994. – 352 p.

4. *Robert D. Kaplan*, Die Kommande Anarchie in: Lettre, Fruhjahr, 1996. – 455 p.

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OPPORTUNITIES TO PARTAKE IN INTERNATIONAL COOPERATION FOR UKRAINIAN ENGINEERS OF AIRCRAFT ENGINES

The article reviews examples of international cooperation of world leaders of aircraft construction and aeroengines producers, analyses running Ukrainian and Russian joint projects in aircraft engineering, stresses on National Aviation University in joint Russian-Ukrainian programs.

The current congregative processes at the world market prove the benefits from cooperation between scientific research, developmental and production entrepreneurships. Joint companies like Airbus, Boeing, EADS, etc. are becoming the leaders of aircraft construction executing complete set of processes of engineering, production chain and service for aircrafts.

The leaders of world aircraft engines engineering General Electric, Pratt & Whitney, Snecma, Rolls-Royce, etc. have similar integrated companies combining scientific and production potential and best practices in the programs of applying new technologies. Such experience is reasonable, since development and implementation of production chain of a modern aircraft engine is a complex process, based on the results of research work in more than 30 fields of science and technology (thermo- and gas dynamics, heat conductance, heat exchange, durability, hylology technologies, electronics, etc.).

The necessity to meet advanced demands to engine performance such as cost effectiveness, noise pollution control, exhaust emissions, improved reliability, reducing life-cycle cost of the engine, etc., presupposes the increase of costs for engineering and production of an engine, it becomes still more complex and expensive. Thus, the cost of 1 kg of the engine mass in civil airplanes is over USD 2k, and in military airplane – it is 2…2,5 times more expensive. Developing, testing and certifying a new engine costs hundreds of millions if not billions of dollars. [1]

Thus, engineering of an engine involves considerable costs, centralization of financial and intellectual resources of plants, companies and organizations. That is why consolidation of funds from several sources of financing, developing of blocks and technologies of dual application – commercial and military – is the only way for efficient implementation of various projects within reasonable time with least possible investments and minimized technical and financial risks (Diagram 1).

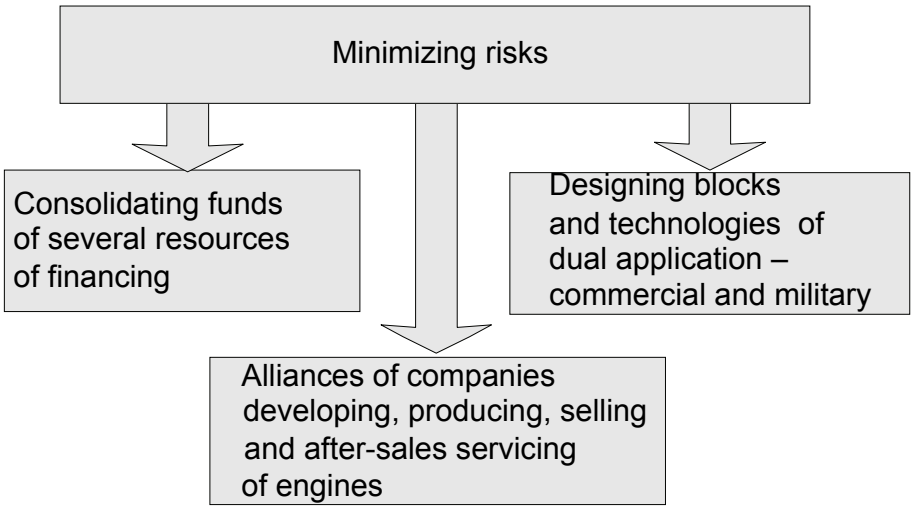

Diagram 1. Ways of minimizing technical and financial risks when producing new aircraft engines.

This is the reason why abroad they establish alliances of companies for developing new engines with further joint production, sales and servicing, maintaining best scientific and technical practices to provide for modernization of the operating engines and inventions of new ones.

For Ukraine, given historical, economical and social reasons, cooperation of the national companies in aviation industries in Ukraine, Russia and other CIS countries is the most promising, as they have maintained and developed strong relationship both in aircraft construction and in aircraft engine engineering.

Aviation remains a vast branch in high-tech industry of defense-industrial sector in Ukraine and Russian Federation. It covers considerable part of engineering export and is an integral part of industrial production and system of defense and economic progress of our countries. Every successful project of airplane or helicopter construction earns billions of dollars of profit.

Given the necessity to maintain and expand the integration in the sphere of aviation technology that have been established during the decades, and as well in order to provide favourable conditions for economic, production and scientific technological cooperation of companies and organizations of aviation in Ukraine and Russia, a number of Intergovernmental Agreements of Cooperation in the sphere of development, production, sales and service of aircraft machinery. [2]

Problematic issues raised during implementation of works consequent to the Agreements are solved on the spot by the Sub-committees of aviation and military technical cooperation of Ukrainian-Russian Interstate Committee.

The Intergovernmental Agreements have become the basis for long-term partner relations of aviation industry of the two countries and by the present moment provided for complete or partial implementation of number of joint programs such as commissioning the planes Tu-334, An-140, An-38, An-70, An-148, Be-200, Yak-130 and engines to the planes.

Long-term cooperation between Open Joint Stock Company Motor Sich, State Enterprise Ivchenko Progress with Production Company Salut, Moscow, the companies equipped with modern machinery, applying advanced manufacturing sciences of world standards and staffed with professional engineers and specialists can serve as an example of successful cooperation for engineering and manufacturing aircraft engines. These factors allow producing the best aircraft engines of the relevant class – D -436T1/TP for planes Tu-334 and Be-200, D-436-148 for planes An-148, AI-225-25 for training combat planes Yak-130 and D-27 for military transport plane An-70. The share of the Russian Federation producing engines D-436TP, AI-222-25 and D-27 is 48,87%; 62,3% and 70,8% of costs accordingly (diagram 2).

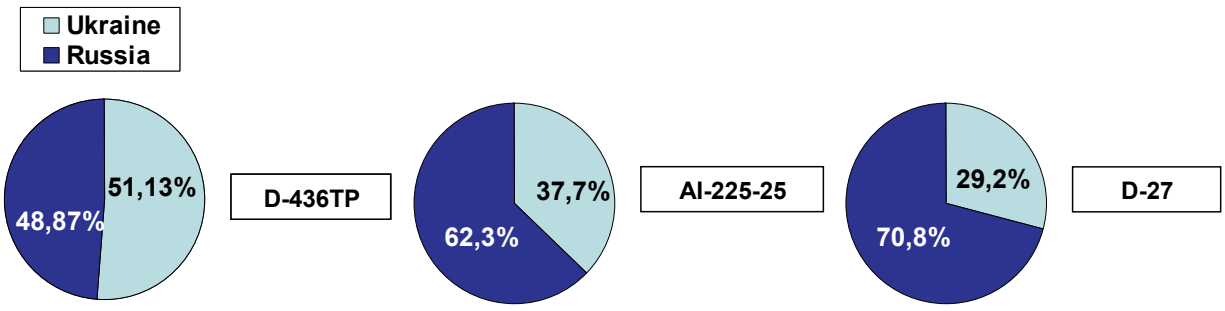

Diagram 2. Share of costs for producing engines between Ukraine and Russia.

It should be noted that OJSC Motor Sich according to Viacheslav Boguslav, the Chairman of the Board of Directors, purchases manifolds, materials, half-finished units, etc. from Russia for more than USD 100m. Out of this amount OJSC Motor Sich returns finished engines for USD 90 m which are installed on Russian planes and helicopters, earning profits for Ukrainian and Russian aviation industry.

Ukrainian aircraft engine engineers purchase the assembly components from around three

hundred plants of Russian Federation and deliver the engines to more than 20 Russian design offices and plants.

Ukrainian companies closely cooperate with All-Russian scientific-research institute of Aviation materials and All-Russian institute of light alloys solving issues of new materials and coating and new metallurgical processes.

The trend towards integration of plane construction and aircraft engine engineering industrial branches of our countries has become more evident at the level of governments of Ukraine and Russia. This is a consequence of long-term policy of consolidated experience, scientific and technical potential pursued by Ukrainian and Russian companies in order to introduce and manufacture new competitive samples of aircrafts.

As an evidence of this trend there are provisions regarding the aviation industry of the Protocol of the fourth meeting of the economic Cooperation Committee of Ukrainian-Russian Interstate Commission dated April 29, 2009. The Protocol stipulates closer integration of aviation industry of Ukraine with aviation companies and scientific organizations of the Russian Federation with the purpose of effective implementation of joint aviation programs.

Thus, the State Aircraft Construction Concern Antonov and Russian OJSC Joint Aviation Corporation, corporation scientific research company A. Ivchenko and Russian OJSC Joint Engine Construction Corporation are entrusted to prepare the plans of joint actions for 2009 – 2010 in developing the procedure if introducing the integrated structures in plane construction and engine construction accordingly; to fulfill the task joint working groups shall be established – one for developing aviation programs and another – for developing engine construction programs.

Many issues of cooperation were solved at the meetings of Ukrainian-Russian Interstate Aviation Aircraft Construction Coordination Council. The agenda of the 28th meeting of IACCC comprises the issue of Russian-Ukrainian cooperation in development and production of power plant for main-line plane MS-21 of the 21st century.

Engineering of family of planes MS-21 – the main perspective project of the Joint Aircraft Corporation (JAC) provides for construction of regional and main-line passenger airplanes with capacity from 70 to 350 seats (diagram 3). Technically MS-21 shall outbid all operating planes, as many parts of the new plane shall be produces of carbon-filled plastic for the first time. The first flight of the plane of this family is planned for 2015. The estimated cost of the project is USD 8 billions. [3]

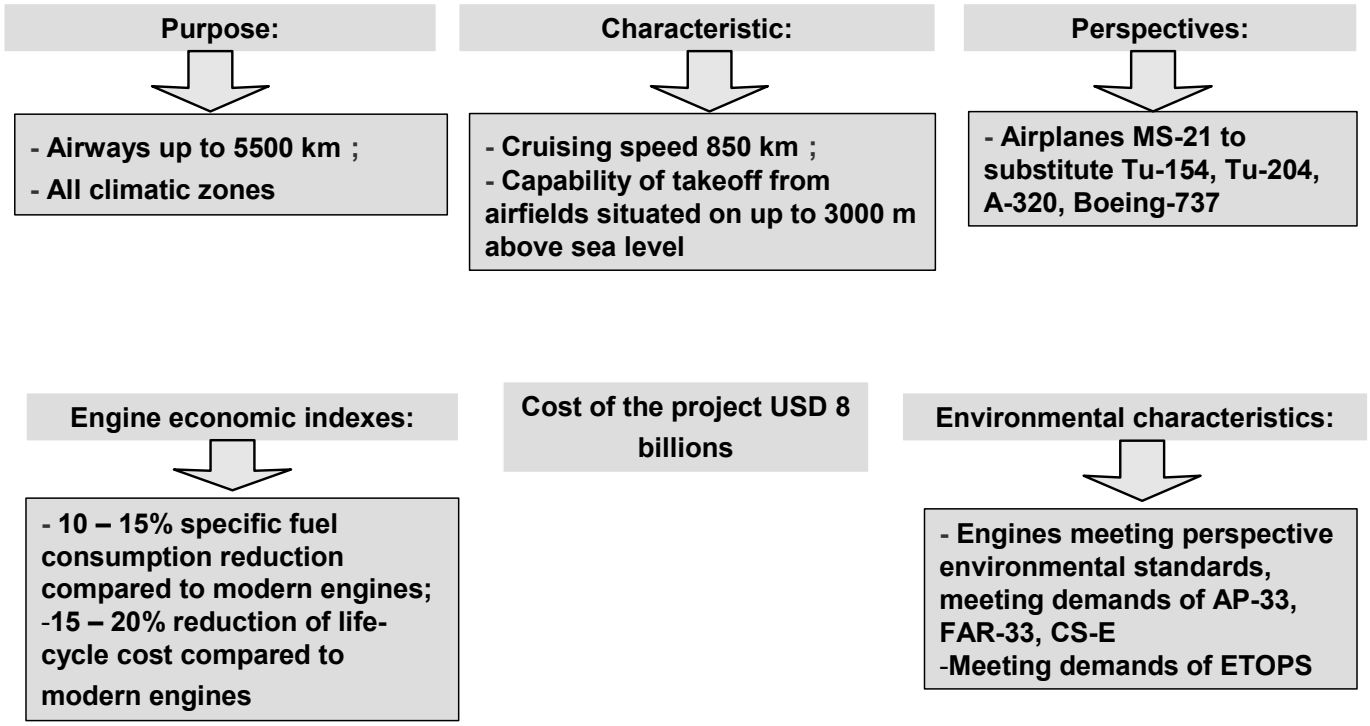

Diagram 3. MS-21 – main-line plane of XXI century.

The family of engines for MS-21 is intended both for passenger and transport planes with handling capacity of 10-60 tones. Application of advanced technologies shall provide for the opportunity for the new family of engines drastically increase reliability and efficiency ratio, namely:

- high reliability: time of engine switch-off nonrecoverable during the flight should exceed 200 000 hours;
- 10 – 15% specific fuel consumption reduction compared to modern engines;
- 15 – 20% reduction of life-cycle cost compared to modern engines;
- reduction of flight hour cost, increase of recurring resource of main components in cold and hot parts;
- engines meeting perspective environmental standards ICAO, meeting demands of AP-33, FAR-33, CS-E;
- meeting demands of ETOPS. [4]

Nowadays it is impossible to develop a competitive engine within set timeframe with only one design office. This is why almost all leading Russian engine construction companies of Joint Engine Construction Corporation JECC) in the lead with OJSC Aviaengine, Perm and scientific research institutes, and a Ukrainian state-owned company Ivchenko-Progress take part in the program of inventing the family of perspective engines, engine PD-14 for MS-21 in particular.

It is worthwhile saying about the participation of National Aviation University, Kyiv in the program, as it took part in scientific research work on defining the resource capacity of the engines at the phase of development jointly with Zaporozhie machine building design office Progress, Kuibyshevo engine plant, Kazan machine building design office, Perm engine construction design office, etc.

In terms of the program of development of family of perspective engines for MS-21 planes the National Aviation University, Kyiv, jointly with OJSC Aviaengine, Perm, according to p. 1.4. of the 29th meeting of Interstate Coordination Council for questions of cooperation between the Russian Federation and Ukraine in aviation industry is entrusted to consider the suggestions on systems of diagnostics and after-sales service for engines PD-14 for MS-21 planes.

Conclusions.

Thus, the corporation shall allow reducing the amount of required investments for introducing and implementation of production chain of aircraft engines, reduce the production period, reduce technical and financial risks due to:

- application of current best practices in science and technology available at the plants;
- consolidation of design and technological potential of all partners;
- pre-production capacities, manufacturing and testing of trial series of engines;
- application of the best technologies, accumulated by Russian and Ukrainian companies;
- rational utilization of production, repair and service capacities of partners' plants.

References

1. *В.А. Поклад.* Вместе мы сильнее // Крылья родины: национальный авиационный журнал. - № 11, 2009. – С. 11-13.

2. *Тарасенко А.А.* Перспективы развития авиатранспортных предприятий Украины в условиях международных интеграционных процессов / Г.А. Тарасенко // Стратегія розвитку економіки України (економіка, соціологія, право). – 2004. – № 3-4. – С. 714-720.

3. *П. Мироненко, А. Екимовский.* МС-21 полетит на Pratt & Whitney // Комерсантъ. - № 232, 2009 – С.5.

4. *А. Иноземцев.* Мы в начале большого пути! // Пермские авиационные двигатели: информационно-технический бюллетень. № 19, 2009. – С. 48-50.

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THE GLOBAL FINANCIAL CRISIS AND FINANCIAL POSITION OF UKRAINE

Influence of global financial crisis on emerging markets is considered in the article. The financial position of Ukraine is analysed and the measures for the improvement of financial situation in a country are offered.

The global financial crisis that has unfolded over the past 3 years has underlined the central role that financial systems play in the economic development of countries. In particular, the importance of financial stability as a key aspect of financial systems that has implications extending well beyond a country's border and deep into the real economy has been made painfully clear.

The sheer scale of the response required by policymakers to avert a deepening of the crisis has led countries to rethink the mechanisms for governance and oversight of financial systems at the global and local levels. As countries continue to examine their response to the current crisis to minimize the possibility of similar occurrences in the future, as well as to ensure the efficacy of their actions, it is crucial to take a longer-term perspective on the role and nature of financial systems [1]. Specifically, it is imperative to consider all the different factors that are important in facilitating the central role of financial systems in furthering economic prosperity for all participants in the global economy [2].

The performance and long-run economic growth and welfare of a country are related to its degree of financial development. Financial development is measured by factors such as size, depth, access, and the efficiency and stability of a financial system, which includes its markets, intermediaries, range of assets, institutions, and regulations. The higher the degree of financial development, the wider the availability of financial services that allow the diversification of risks. This increases the long-run growth trajectory of a country and ultimately improves the welfare and prosperity of producers and consumers that have access to financial services.

Economic theory suggests that financial markets and intermediaries exist mainly because of two types of market frictions: information costs and transaction costs. These frictions lead to the development of financial intermediaries and financial markets, which perform multiple functions, such as facilitating the trading, hedging, diversification, and pooling of risk; providing insurance services; allocating savings and resources to the appropriate investment projects; monitoring managers and promoting corporate control and governance; mobilizing savings efficiently; and facilitating the exchange of goods and services [4].

Financial intermediation and financial markets contribute directly to increased economic growth and aggregate economic welfare through their effect on capital accumulation (the rate of investment) and on technological innovation. First, greater financial development leads to greater mobilization of savings and its allocation to the highest-return investment projects. This increased accumulation of capital enhances economic growth. Second, by appropriately allocating capital to the right investment projects and promoting sound corporate governance, financial development increases the rate of technological innovation and productivity growth, further enhancing economic growth and welfare. Financial markets and intermediation benefit consumers and firms in many other ways that are not directly related to economic growth. Access to financial markets for consumers and producers can reduce poverty, such as when the poor have access to banking services and credit. The importance of microfinance can be seen in this context. This access allows consumers to smooth consumption over time by borrowing and/or lending and stabilizes consumer welfare in the presence of temporary shocks to wages and income. By contributing to the diversification of savings and of portfolio choices, it can also increase the return on savings and ensure higher income and consumption opportunities. Insurance services can help mitigate a variety of risks that individuals and firms face, thus allowing better risk sharing of individual or even macroeconomic risks.

To understand and measure the degree of financial development, one must consider all of the different factors that together contribute to the degree of depth and efficiency of the provision of financial services, first of all:

1. ***Factors, policies, and institutions:*** the foundational characteristics that allow the development of financial intermediaries, markets, instruments, and services.
2. ***Financial intermediation:*** the variety, size, depth, and efficiency of the financial intermediaries and markets that provide financial services.
3. ***Financial access:*** access by individuals and businesses to different forms of capital and financial services.

The first category covers those foundational features that support financial intermediation and the optimal provision of financial services and includes: the institutional environment, the business environment, and the degree of financial stability.

The institutional environment encompasses the laws and regulations that allow the development of deep and efficient financial intermediaries, markets, and services as well as the macroprudential oversight of financial systems. This includes the overall laws, regulations, and supervision of the financial sector, as well as the quality of contract enforcement and corporate governance.

The second pillar focuses on the business environment and considers:

- the availability of human capital—that is, skilled workers who can be employed by the financial sector and thus provide efficient financial services;
- the state of physical capital—that is, the physical and technological infrastructure; and
- other aspects of the business environment, including taxation policy and the costs of doing business for financial intermediaries.

The third pillar addresses the stability of the financial system. The severe negative impacts of financial instability on economic growth can be profoundly seen in the current financial crisis as well as pervasive past financial crises. This instability can lead to significant losses to investors, resulting in systemic banking crises, systemic corporate crises, currency crises, and sovereign debt crises. This pillar tries to capture the risk of three types of crises: currency crises, systemic banking crises, and sovereign debt crises.

The risk of currency crises includes the change in real effective exchange rate, the current account balance, a dollarization vulnerability indicator, an external vulnerability indicator, external debt to GDP, and net international investment position.

The systemic banking crises combines measures of historic banking system instability, an assessment of aggregate balance sheet strength, and measures of the presence of "bubbles."

An important proxy for the risk of sovereign debt crisis is sovereign credit ratings, an average of both local currency sovereign credit ratings and foreign currency sovereign credit ratings. Sovereign ratings measure the degree to which a country is willing and able to pay its debt in a timely manner and in full. Thus, a high sovereign credit rating signifies less likelihood of default occasioned by a sovereign debt crisis. Credit default swaps provide a quantitative, market-based indicator of the ability of a country to repay its debt.

The second category measures the degree of development of the financial sector as seen in the different types of intermediaries: banking financial services, non-banking financial services (e.g., investment banks and insurance firms), and financial markets. Consensus exists on the relationship between the size and depth of the financial system and the supply and robustness of financial services that are important contributors to economic growth. This relationship occurs because the size of financial markets is viewed as an important determinant of savings and investment. The size (total financial assets within a country) of the financial system also matters because the larger it is, the greater its ability to benefit from economies of scale given the significant fixed costs prevailing in financial intermediaries' activities. A larger financial system tends to relieve existing credit constraints. This facilitates borrowing by firms and further improves the process of savings mobilization and the channeling of savings to investors. Given that a large financial system should allocate capital efficiently and better monitor the use of funds, improved accessibility to financing

will tend to amplify the resilience of an economy to shocks. Thus, a deeper (total financial assets as a percentage of GDP) financial system is an important component of financial development as it contributes to economic growth rates across countries.

This third and final category (financial access) represents the measures of access to capital and financial services through both commercial and retail channels. Greater access to financial services has been associated with the usual proxies for financial development and resulting economic growth. The presence of financial services *per se* as reflected by size and depth does not imply their accessibility by the different types of users within an economy.

Measures of commercial access captured include venture capital availability, access to local equity markets, access to credit, access to loans, and an overall level of financial market sophistication. Retail access includes measures such as the penetration of bank accounts, the number of automated teller machines and points of sale, and microfinance penetration. These measures capture access to capital by individuals and small enterprises that can be important contributors to growth in developing countries. Accessibility, along with the size and depth of the financial system has a significant effect on a country's real activity, economic growth, and overall welfare.

According to the Financial Development Report 2009 of World Economic Forum [5], Ukraine has the 53rd ranking out of 55 countries (table 1).

Table 1.

The Financial Development Index of Ukraine

№	Factors	Rank (out of 55)	Score (1-7 scale)
I. Factors, policies, and institutions			
1	*Institutional environment*	*51*	*3.1*
1.1	Financial sector	50	2.1
1.2	Corporate governance	52	3.7
1.3	Legal and regulatory issues	50	2.9
1.4	Contract enforcement	45	3.6
2	*Business environment*	*45*	*3.7*
2.1	Human capital	28	4.3
2.2	Taxes	53	2.8
2.3	Infrastructure	33	3.6
2.4	Cost of doing business	46	4.3
3	*Financial stability*	*55*	*3.2*
3.1	Currency stability	48	3.3
3.2	Banking system stability	51	3.9
3.3	Risk of sovereign debt crisis	55	2.2
II. Financial intermediation			
4	*Banking financial services*	*52*	*2.4*
4.1	Size index	n/a	n/a
4.2	Efficiency index	53	3.0
4.3	Financial information disclosure	51	1.1
5	*Non-banking financial services*	*27*	*2.4*
5.1	IPO activity	44	1.3
5.2	M&A activity	39	1.4
5.3	Insurance	32	2.5
5.4	Securitization	7	4.3
6	*Financial markets*	*54*	*1.3*
6.1	Foreign exchange markets	n/a	n/a
6.2	Derivatives markets	n/a	n/a
6.3	Equity market development	51	1.3
6.4	Bond market development	n/a	n/a

III. Financial access			
7	*Financial access*	*45*	*2.9*
7.1	Commercial access	48	3.1
7.2	Retail access	29	2.7

Ukraine has the lowest ranking in Eastern Europe, with a last-place finish in financial stability (55th) and room for improvement across most aspects of its institutional environment, including corporate governance (52nd) and legal and regulatory issues (50th). Human capital (28th) emerges as a relative bright spot. For a number of reasons, the crisis has had a greater impact on Ukraine than on its neighboring countries. The global financial crisis hit emerging Ukrainian market through trade channels, financial channels, and commodity channels via the sharp drop in commodity prices. The economic recession creates great risks for society and the state [3].

Therefore, now Ukraine will need to implement a number of reforms to increase the competitiveness of the financial system, and economy on the whole, and ensure its growth throughout the post-crisis period. Ukraine cannot increase its competitiveness and ensure steady economic growth during the post-crisis period, without realizing tactical anti-recessionary measures and implementing long-term reforms. The crisis creates unique opportunities for structural change.

The following reforms should be implemented: banking system reform, the approval of a new tax code, the simplification of the conditions for carrying out business activities, the development of a public-private partnership institute, the improvement of bankruptcy procedures, and state administrative apparatus reform. Firstly, these reforms can increase competitiveness and improve the business climate. Secondly, they may be accomplished relatively quickly and realized within nearest time. Thirdly, the realization of these measures does not require major financial resources.

The stabilization of the banking sector is the most realistic goal. Inflow of foreign capital through foreign banks' support would allow the situation to stabilize. Public confidence will return to the banking sector, and more deposits will be made.

Conclusion

The global financial crisis swiftly spread beyond the United States and spillover effects were felt in emerging markets, including Ukrainian market, very rapidly, triggering the start of their own economic and financial downturn. The financial tsunami was associated with a dramatic increase in risk aversion; massive liquidity shortages in global financial markets; plunging asset prices in both advanced and developing economies; increased emerging market spreads; the unraveling of carry trades, which translated into a sizeable weakening of the high-yielding emerging market currencies; downward pressures on currencies; and a significant retrenchment of bank lending to emerging economies.

References

1. *Барановський О.І.* Фінансові кризи: передумови, наслідки і шляхи запобігання: монографія.— К.: Київ. нац. торг.-екон. ун-т., 2009. — 754 с.

2. *Бураковський І.В., Плотніков О.В.* Глобальна фінансова криза: уроки для світу та України. — Х.: Фоліо, 2009. — 302 с.

3. *Геєць В.М.* Розгортання фінансово-економічної кризи в Україні у 2009 році: негативні наслідки та засоби їх пом'якшення: наук.-аналіт. доп.— К.: Ін-т економіки та прогнозування НАН України., 2009. — 159 с.

4. *Унковська Т.Є.* Системне розуміння фінансової стабільності: розв'язання парадоксів // Економічна теорія. — 2009. — № 1. — С. 14-33.

5. *The Financial Development Report 2009* // http://www.weforum.org/en/initiatives/gcp/FinancialDevelopmentReport/index.htm

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SOME CHALLENGES OF MODERN STATE OF INTERNATIONAL INFORMATIONAL SECURITY

During last decades achievements in science and technologies as never before begin to determine the dynamics of economic growth, standard of population living, competitiveness of states in the world community, degree of support in their national security and equal integration into world economy.

The rapid development and broad use of informational communication technologies (ICT) have marked themselves as transit of humanity on absolutely new degree of development, having become the result of the revolution in the field of informational technologies. ICT have transformed not only principles and forms, information accumulation, information processing and information circulation, also they have caused very powerful effect on cultural, economic, political and military-strategic aspects of society's life, becoming one of the main factors of providing and supporting of stable development.

At the same time the development of the information technologies process of the world community raises the whole complex of negative geopolitical consequences.

Nowadays it is known that man-made technosphere has become comparative with biosphere, technomass being man-made by Homo Sapiens during last 200 thousands years surpasses significantly natural biomass, created by the nature during last 5 billions years. By means of mass using of informational technologies speed and volumes of creation the results of human vital activity will expand in many times, including waste products and the great part among them will be the informational waste products and so-called harmful information. Analogous activity has significantly accentuated present contradictions and has created the real threat of destruction of the natural balance of biosphere, and in this connection these challenges have been put into the global dimension.

At the same time, cybercrime intensifies and its main aim is not mass media and Internet as it is often presented in the press, but the system of state, economic and financial management, manipulation of individual and social consciousness.

The greatest cyberattacks of the last years have caused to the dangerous errors in the functioning of telecommunication networks, have often caused a severe material loss to the dangerous critical objects physical of infrastructure. One of the greatest informational attack on Internet within its whole history started on the 26 January, 2003 and lasted during 2 days. This was an attack of a network Helkern worm. The Helkern's effect on the world informational resources have been accepted by the experts in computer security as an unprecedented in the speed of spreading and extents of caused loss – according to some evaluations, is more than 10 billions dollars.

The vulnerability of cyberspace makes it very attractive mean of realization the criminal activity for terroristic organizations, criminal groups and individual intruders, which is aimed at public interests, security of states, organizations and citizens. The analysis of famous cyberattacks shows that ICT have been already familiarized by the terroristic an extremist organizations (Hamas, Al-Qaeda) and national separatist movements (The Liberation Tigers of Tamil Eelam and so on).

Moreover, ICT rapidly become an important motive for the development of military potential due to the increase of their informational security. The possibility of using informational potential appears for the countries developed in the field of scientific-technological with the aim of reduction and making less-developed and poor countries subordinate. It inevitably leads to the acceleration of the world's polarization. Instability which becomes the source and the foundation for the origin and development of real and potential conflicts, including some which can growth to the global extent.

The particular anxiety in such situation arises in the connection of development, using and circulation of informational weapons and as a result, the informational wars and informational

terrorism becomes possible, which can cause global catastrophes and its destructive consequences can be comparable with consequences of using mass-destruction weapons.

Using of informational weapons is a reality, which can not be disregarded. The realization of informational operations and special informational support of military conflicts in the Near East (Israel – Palestine), in the South-Eastern and Central Europe (Yugoslavia, Macedonia, Kosovo), in Africa (Sierra-Leone, Zambia, Somalia, Ethiopia, Congo), in Asian-Pacific region (East Timor, India-Bangladesh, China-Taiwan), on the territory of the former USSR (Chechnya, Moldova, Transcaucasia) has led to the political and social demonstrations of protest, illegal influence on the state Internet-sites of one or another countries, military international organizations in order to destroy or block strategic and informational networks and systems.

The recognition of informational security challenges on an international level depends on some factors of globalization communication such as: in most industrial-developed countries the researches and developments of new informational weapons are carried out and it allows keeping under the direct control of the informational resources of a potential enemy and in essential cases to influence directly on them. According to the information of analytic centers of the USA, the developments of such weapons are carried out in 120 countries of the world: in comparison, developments of nuclear weapons are carried out in not more than 20 countries; in some countries it was finished the development of means of informational confrontation (war) with a possible enemy in the conditions of military conflicts of different intensity as well as during the peace time on the strategic, operative, tactical levels and in the field conditions in order to protect the national infosphere against an aggression and illegal interference; in developed countries the conception of the informational war is the component of the military doctrine, which determines a special training of personnel and individual subdivisions for the realization of informational operations; the practice of the international, regional and ethnic conflicts showed the singularity of the application of the informational weapons for the influence on an international community and for a fight for the geopolitic interests.

Nowadays, in the world community, understanding the importance of the question, there are different opinions on the regulation of global challenges of international informational security. They reasonably reflect the views of scientists according the further development of modern international relations.

However, today two main points of view have been formed in the field of further regulation of international relations on an international level. They belong to Russia and the USA.

Some domestic researches call the position of the Russian Federation as the position of the «overtaking leader» in the field of international informational security. Its representatives lobby actively in the UN and other international forums of the initiative concerning contraction of potential threats of new informational technologies, emphasizing a new factor of disbalance of powers and domination in the global sphere of the one country (USA) or the alliance of countries (EU). The point of the Russian Federation's position is the creation of an international mechanism under the aegis of the UN and general principles of the international informational security support, which would be fixed step-by-step in the multilateral declaration, extensive conception of an international informational security, complex international treaty or convention taking into consideration the structure of the international threats (military, criminal, terroristic, civil). For the realization of propositions Russia has proposed to develop the system of concepts for the analysis and discussion of the problem, to determine the technological sources and the nature of informational threats; to develop the general principles of the structure of the global system of international informational security; to adopt within the UN multilateral declarations, conventions on the international informational security based on the developed principles; to coordinate the principles of contraction the international informational terrorism and criminality with the principles of functioning of the international organizations in the field of an information, telecommunications, means of mass communication (MMK) and human rights; to develop the general principles for the harmonization of national legal systems with an appropriate international norm; to develop the general principles of organization the mechanism of control of the international infosphere's security and its cooperation

with international systems of regulation of global communication and economic control (informational products and services of double-use, and also the means for the production of psychotropic weapons); and in such a way to guarantee the international community the solution of new complex problems in times of formation of global civilization and informational society and real providing with global and international informational security. Geneva meeting (1999) has showed the strategic challenge for the international informational security – the problem of domination in the global infosphere with an application of informational weapons that is aspiration for the control of significant territories and societies problem of an informational disbalance of powers in the world order.

Russian theory obtained recognition of quite a few adherents in the world. In general it is supported by the countries of Non-Aligned Movement (especially China, India, Republic of South Africa), countries of CIS. These countries supported the conception of a complex consideration of international informational security problem with emphasizing as the priority task of limitation of the potential threat of unleashing of informational war. Herewith, it was stressed the necessity of an exigent starting of the discussions and practical development of the international legal base of universal regime for the international informational security. In particular, it was also suggested a proposition of creation of an international social court in the field of crimes in informational sphere.

Experts of the chain of countries, including the USA, took into account the priority of consideration and development of informational security means, concerning the threats of terroristic and criminal nature.

Herewith, the threat of informational weapons creation and the beginning of informational war was considered to be more theoretical by the adherents of such theory. According to this the disarmament aspect of the general problem of an international informational security dropped off. Further discussion of this problems was proposed to scatter it to the regions and thematic forums (The European Union, G8, Organization of American States, Organization for Economic Co-operation and Development, and so on), and within the UN to remove from the First committee (security problems) to the Second (economic problems) and to the Sixth (legal problems).

It is necessary to mention that some changes have been recently outlined in the position of the USA in the field of international informational security. Thus, though America strives for providing its domination in the field of information that concerns the field of armament and continues firstly to raise a question of the informational terrorism, informational criminality and providing the security of computer networks, but in Washington the understanding began to circulate as counteraction of modern forms of terrorism are directly connected with the questions of spreading the informational weapon.

After the terroristic attacks on September, 2003 in the USA, Europeans also came to a conclusion that informational infrastructure of the EU member states is not guaranteed against the possible informational attacks. The particular disquietude in such a question was caused by the represented conclusions of the European Parliament report about the functioning of American system electronic-spying system «Echelon» on May, 2001.

Taking into account the modern world community's recognition of the necessity of activation international cooperation in the field of international informational security and own very active participation in programs for fight with computer crimes, especially European, the USA supported the creation of the expert group in the field of international informational security.

Taking no notice of different opinions of countries concerning the examining problem, we should not say about their incompatibility and impossibility of making compromise. This is affirmed by the slow, but systematic work in the creation of international informational security regime.

Taking notice of global problem of informational security, developed countries began the realization of long-term state programs directed to the security providing critically-important informational structures, and from 1996 the problem of international informational security has been put into political and international legal level:

a) the conception of international informational security was discussed on the international conference on the challenges of informational society and global civilization formation (Republic of

South Africa, 1996).

b) in joint communiqué meeting on the highest level the USA – the Russian Federation was emphasized the threat of informational weapons creation and accepted the military component of the global informational technologies process.

c) During the 53rd session of the United Nations General Assembly, the resolution 53/70 of the 4th December, 1998 was adopted by the consensus, and it was mentioned that international community accepts the problem of informational security as complex-aspect strategic direction of countries cooperation in the global world.

Especially, in the Resolution 53/70 it was proposed to the member states of the UN to consider the concrete typology of informational threats, to determine the criteria of a problem, including the development of international principles of security of the global informational systems, to table propositions to the complex report of the Secretary-General of the United Nations for creation of the international mechanism counteraction of using ICT with aims directed against security.

The Resolution 53/70 initiated the discussion of creation fundamentally new international legal regime concerning information, informational technologies and methods of their use.

The 54th session of the UN GA, among the other documents, adopted the Resolution 54/49 «Achievements in the field of informational technologies and telecommunications in the context of international security» of the 1st of December, 1999, where the concept of international security was recognized as the global challenge of the present time.

The impartial preconditions of the making such decision, as it was emphasized in the political discussion, were fundamentally new potential threats to the international peace, determined by the scientific-technological progress and the global interdependence of all the vital activity spheres of the world community. The representatives of different countries emphasized that the use of new information technologies and means of influence of the highly-developed countries on the less technically-developed countries led to the change into global and regional powers, determined new fields of confrontation between traditional and new centers of resistance, made possible the reaching of advantages in informational technologies and means of manipulation of the society's consciousness for the wide-scale expansion with the use of international legal unlimited types of weapon.

As a result of the discussion and the examination of applied aspects of the international informational security, it was determined the specificity, essential characteristics and typology of informational threats, it was proposed the terminology and the content of basic concepts in the new sphere of the international cooperation.

It should be mentioned that stated above international treaties are not the only. Nowadays there are approximately 60 documents of an international nature of different level and purposes that regulate international informational security. There is a hope that these steps of the humanity to more safety existence will be successful. Furthermore, it should be remembered that there are precedents in the international experience when countries came to an agreement on the complex problems in the field of high technologies and military sphere.

References

1. Political doctrines of the global informational security. *Makarenko E. A.* The Institute of International Relations of Kyiv National Taras Shevchenko University, Kyiv - www.its.org.ua/

2. International cooperation in the field of informational security (reference information) - www.ln.mid.ru

3. To the politically-legal bases of the global informational security. *Andrey Krutskih.* - http.portalus.ru

4. International cooperation in the field of informational security. *Krutskih A. V., Safonova I. L.* - www.ict.edu.ru

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INFORMATIVE PROVIDING OF HIGHER PUBLIC AUTHORITIES OF UKRAINE

A lecture exposes essence and methods of the informative providing of higher public authorities of Ukraine. Particular work of the special service of the informative and analytic providing of the Ukrainian imperious structures are shown here, and the increasing of efficiency of their activity by creation of E-state and introduction of the E-management system.

Efficiency of administrative activity of any public authority depends on the level of his communicative and informative providing. It is known that for optimization of decision of problems, which rise up during administrative activity, a leader needs to have the considerable volume of information about a country and the world. In order to increase the efficiency of work of imperious structures of Ukraine the universal informative system of continuous receipt, analysis and distribution of information of political, economic and social life of the state was created. The last one got the name of the system of the informative and analytic providing of public authorities. The work of the informative and analytic systems is directed on satisfaction of all the queries of state organs in order to grant necessary information for making a decision. In the opinion of specialists the informative providing of all levels of state administration determines perception of those or other actions of power public, level of coordination of activity of its central and local organs and the adequacy of decisions which are accepted.

Introduction of the system of the informative and analytic providing requires the knowledge of foreign experience because such system is created in Ukraine actually from the very beginning. Difficulties in creation of this system are the absence of the proper informative infrastructure and unfavorable economic situation in the state in the conditions of world financial crisis. Large libraries and scientific and technical centers in which documents are accumulated in relation to all of spheres of activity of the state are among department establishments which would be able to take responsibility for creation of subsections of the system of the informative and analytic. Such establishments must be regenerate on the centers of the informative and analytic providing of public authorities. The National library of Ukraine the name of V.I. Vernadskogo as a main scientifically informative center of the state has become the base establishment for creation of the special subsection for providing the special information for imperious structures. The special subsection, oriented to the collaboration with public of Ukraine authorities was created in 1992 on the initiative of director of library of O. Onischenko. This subsection got the name of service of the informative and analytic providing and finally designed the work after the proper decision of Presidium of NAN of Ukraine from December, 14 in 1995. The special agreement between NAN of Ukraine and Presidium of SR in order to adjust the collaboration of service of the informative and analytic providing with informative subsections of Verkhovna Rada and Cabinet Ukraine was celled in 2005 on December, 12.

The main task of service was introduction to the public appeal through the administrative sphere of the most necessary scientifically informative materials of the National library of Ukraine the name of V.I. Vernadskogo.

Among the basic constituents of activity of service of the informative and analytical providing should be defined:

- an analysis of political, socio-economic processes during market transformations in Ukraine;
- an analysis of attitude of state structures, public opinion of countries of the CIS and distant foreignness toward public life in Ukraine;
- study of state creative, law creative processes in foreign countries and comparison them with the same practice in Ukraine;
- generalization of experience of the informative and analytic structures in order to appeal the information with the purpose of improvement of efficiency of activity of public authorities.

The necessity of creation of such subsection was caused by the necessity of analysis of experience of countries with developed democracy and market system. The work of the service of informative and analytic providing is carried out by a selection and analysis of necessary information with its subsequent presentation not only for imperious structures but also to wide public. On the basis of magazines the service of informative and analytic providing prepares the daily annotated materials, oriented to the public agents, reviews of MASS-MEDIA, analytic geometry which represents actual events in life of Ukraine. Such reports are published in special bullets of abstract materials "Ukraine: events, facts, comment", which was first issued in 2001. At the same time subsection helps to engage the preparation of analytical materials about important questions of economic and political development in foreign countries, conducts the comparative analysis of legislative acts of different countries with the proper projects of legislative acts of Ukraine. Considerable achievement of the service of informative and analytic providing is an assistance towards the Ukrainian state to get into the international arena in the context of strengthening of intercommunications with euro-atlantic structures, especially to help the higher authorities of power in preparation of background papers for providing work of delegations in different countries. During the period of the activity of the service of informative and analytic providing helped Ukrainian delegations during visits to South Korea, Turkey, France, Macedonia, Greece, Sweden etc. This service was also an instrument in adjusting of connections of imperious structures with the countries of GUAM in collaboration with their informative structures by an exchange most essential information about the course of events in the state. The collaboration of the service of informative and analytic providing with subsections of Foreign Office of Ukraine has activated, and is directed on the informative providing of the Ukrainian embassies abroad. At the same time service helps higher imperious structures in legal consultations related to the appeals of citizens.

At the same time, one of leading directions of activity of the service of informative and analytical providing is study of situation in regions by the analysis of regional press. According to this service has found an edition called "News from the regions". Legislative and executive power is interested in analytical materials of the service of informative and analytic providing that are related to democratic transformations in the Ukrainian society, its political structure, forming of electoral mechanisms. The service of informative and analytic providing is also engaged in the analysis and illumination of economic problems, summarizing the thoughts of experts about the functioning of power industry, banking system, decision of important economic problems, development of international economic cooperation. The workers of the service of informative and analytic providing were engaged in watching the process of introduction of internal revenue code in the country for a long time. Considerable achievement of service is an active development and usage of electronic information technologies. This project was embodied in life by caring out the preparation of electronic magazines with the subsequent placing them on the sites of public authorities. All of that allowed to accelerate checking of considerable volumes of information, extend geography of the use of information generators, accelerate delivery the of informative and analytic products to customers. In our fast-moving world the subject of analytical materials broadened, among the new magazines of service "Political parties and public associations", "Political technologists and technologies", "Review about activity of imperious structures", "Resonance", "Ways of reformation of Ukrainian science" and others should be underlined. Due to the high professionalism, service constantly joins to the decision of scale informative tasks of national value and analysis of the governmental programs, and independently executes the planned research themes like the "Informative and analytical providing of public authorities related to the study of socio-political, economic situation in the regions of Ukraine".

Thus the considerable failing in-process system is an inconsistency of the activity of informative centers that can cause the dispersion of informative resources, fragmentariness of information. Foreign credits are often taken on development of the informative providing of imperious structures outlaid not on purpose, mostly in order to purchase the computer technique which go out of order really quickly. At the same time one of basic lacks of work of the informative

and analytic systems is the absence of the generally accepted methodology of their functioning which often results in the loss of time in acceptance of administrative decisions. The last is related to the considerable volumes of information. In order to avoid the confusions experts offer subsequent development of analytical, situational and other centers, which will be concentrated on a consumption, but not on creation information. The decision of similar problems should be directed on strengthening of skilled and financial potential of the service of informative and analytical providing, creation of "cerebral centers" and bringing into working with considerable volumes of information different informative subsections and establishments.

The service of informative and analytical providing of public authorities is directly related to the system of domestic electronic government and electronic management (farther E-state; E-management). Under the term of e-state should be understood the method of organization of state power by the system of local informative networks. At the same time some authors in place of "E-state" suggest to talk about a state network infrastructure as an informatively communication system which provides the optimum functioning of all of branches and levels of state power. In spite of the fact, that today there is not synonymous determination of concepts "E-state" and "E-management", overwhelming majority of them decline to the electronic socializing of power with public, more precisely organizations of state administration on the basis of facilities of treatment of transmission and distribution of information in order to grant services of public organs of all of branches of power to all of categories of citizens. The Internet and automated government services are referred to these ones. The necessity of creation of the national, multifunction computer-integrated informative system on the base of the Internet, which will help to govern the country and create better cooperation of government bodies of all of levels, is seen. One of terms of transition to the E-state is wide informatization of all of processes in activity of ministries, departments, local organs of executive power, thus both internal and external through the system of service of the informative and analytical providing. Present organization of Ukrainian power is slow in rates and insufficiency of resources in order to bring in public organs to the national segment of global informative network Internet. Unlike the leading countries of the world, which made alteration in administrative principles in the middle 1980th, Ukraine considerably falls behind in the rates of introduction of E-management. Overall, successful implementation of tasks in the conditions of the informative mode of economy depends exactly on the use of the adequate systems of informative support of acceptance, realization and monitoring of administrative decisions and grant of state services. Until now discussions, related to expedience of immediate introduction of E-management and expansion of the system of service of the informative and analytical providing, are conducted. However, the overwhelming majority of experts agree that introduction of electronic technologies will be instrument in the increasing of role of state institutions in Ukrainian society. The heads of public organs should care of their openness for the whole society, assist in informing the public about their activity and activity of the departments headed by them. These will serve subsequent development of domestic democratic properties and image of institutions, which present the state.

Conclusions

Thus, the valuable functioning of public authorities is impossible without an appropriate informative providing. According to this it was decided to create the system of informative and analytical providing at state level, and the National library of Ukraine in the name of V.I. Vernadskogo became base for this. The basic task of this system is granting to the imperious structures the most necessary information for optimization of acceptance of administrative decisions. For the sake of communication between power and society, and the increasing of efficiency of activity of imperious structures the E-state was created and the E-management system was introducted.

References

1. Baranov O. Elektronniy government in Ukraine? It will be! When? / Baranov of O. // Mirror of week – on January, 2002 – 5-18.
2. Gazhienko G. Deyaki aspects of the informative providing of public authorities (at regional level) / Gramme. Gazhienko // Collection of scientific labours of UADU at President of Ukraine. – 1998. – Vip. 1. – P. 406-412.
3. Goroviy In., Nechay of M. of SIAZ: maintenance of imperious structures / Goroviy In., Nechay of M. of // www.niss.gov.ua/Table/Ostrog/003.htm
4. Goroviy v.M. Service of the інформаційно-аналітичного providing of public of the National library of Ukraine of the name of V.I authorities. Vernadskogo (1992-2006): becoming stages / Goroviy v.M. // www.archives.gov.ua/Publicat/AU/AU-1-6-2006/05.pdf
5. Access to information and electronic management / Center of політико-правових reforms / Avt. managers of M.S. Demkova, M.V. Figel'. - K.: Fact, 2004. – 343 p.
6. Kirichenko v.M. the Informative providing of state administration in Ukraine / V.M. Kirichenko // Collection of scientific labours of UADU at President of Ukraine. – 2003. – Vip. 1. – P. 233-238.
7. Klimenko I.V. Problemy внедрения информационной системы of "электронное правительство" in государственном управлении / I.V. Klimenko, G.S. Liteynoe // Collection of scientific labours of UADU at President of Ukraine. – 2003. – Vip. 1. – P. 98-105.
8. Sosnin O.V. A place of informative activity is in the innovative model of development of economy of Ukraine / O.V. Sosnin of // the Strategic panorama – 2004. - № 1. – P. 170-176.

SYMPOSIUM 4

ENVIRONMENT PROTECTION

UDC 629.7.01

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INFRASOUND DANGER IN AVIATION

Results of experimental researches of acoustic aviation noise influence on atmospheric processes are considered in present work. The main attention is given to infrasound in a range 1,0-10,0 Hz. It's shown that the acoustic noise derivate electromagnetic indignation in an atmosphere in a wide range of frequencies and can create danger both for aircrews and passengers.

Introduction

Practically, all modern flying devices are sources of intensive acoustic disturbances in an atmosphere. Usually, the literature describes air noise in an acoustical range of frequencies without taking into account interaction with a real atmosphere. Interaction of air noise with an atmosphere requires wide consideration of a problem of acoustic influence on environment.

Electromagnetic indignation is derivates by acoustic indignation in an atmosphere in a very wide range of frequencies. Synergism of acoustic and electromagnetic indignation action can intensify a negative influence on people and environment.

The experiments show that such influence effect atmospheric processes. One can expect that the strongest influence should be observed on the infrasound frequencies.

The general scheme of flying device complex wave influence on environment is shown in a fig. 1.

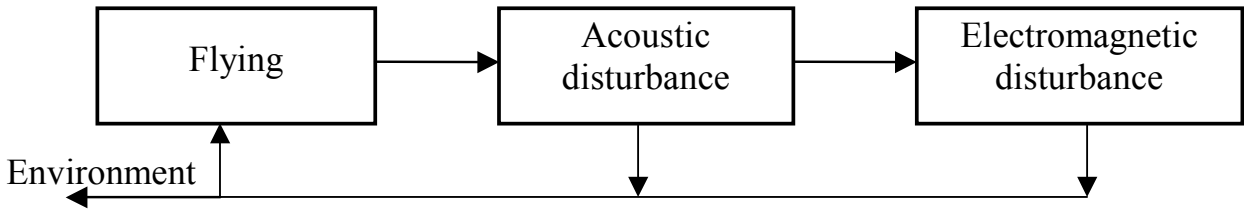


Figure 1 Scheme of flying device complex influence on environment

The purpose of the present work consist in conduction of infrasound and variations of vertical electrical field measurements within the airport zone as well as in modeling of acoustic influence on atmosphere and electromagnetic responses observations.

Infrasound and variations of electrical fields measurement within the airport zone

Infrasound and electrical field measurements were conducted in monitoring conditions within the International Airport "Lviv" territory during the period from 12.03.2010 to 19.04.2010. The recording was carried out in the digital form on different distances from a takeoff strip (from 20m to 100 m and on distance ~ 5 km) in a 1,0 -10,0 Hz range. The range of frequencies, which has the maximal influence on man nervous system, was chosen. It was made, because after that, obtained results can be used for estimation of planes takeoffs and landings influence on maintenance personnel, viz, flying control officers from which the safety of flights depends.

The change bending infrasound envelope in a range 1,0-10,0 Hz (line 1, electrical field - line 2 and change infrasound on distance of 5 km - line 3) is shown in a fig. 2. The vertical arrows show the moments of aircraft takeoff and landing.

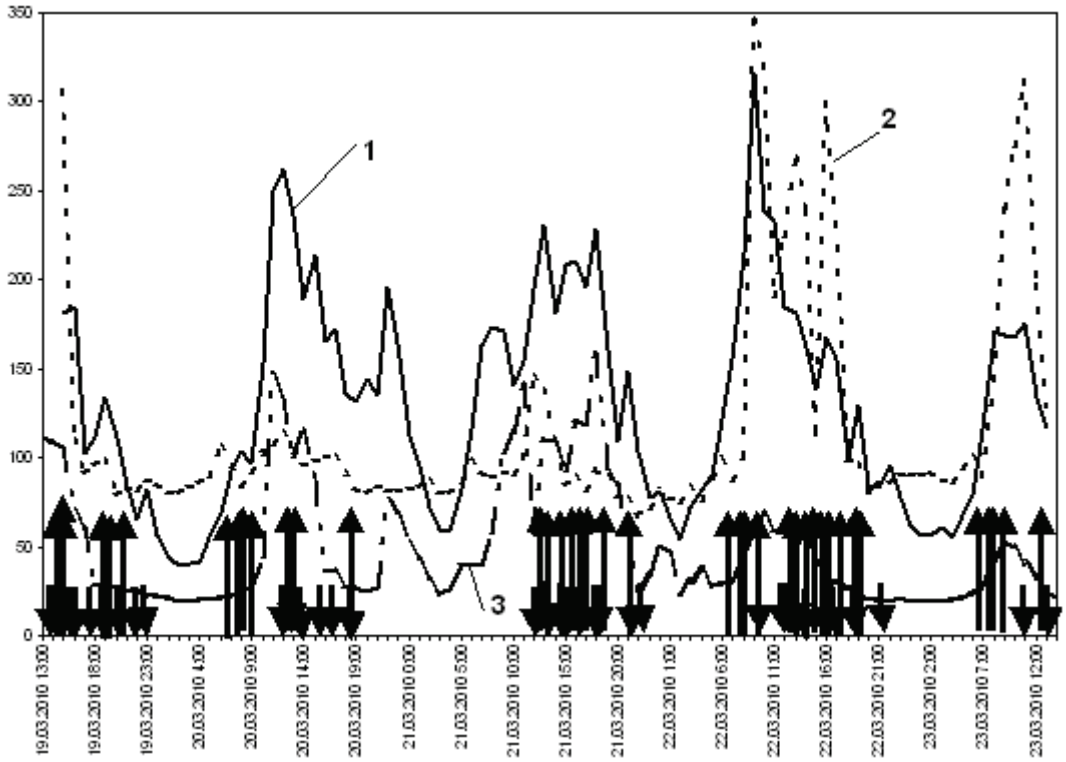


Figure 2 Change of envelope infrasound and electrical field on aircrafts takeoff and landing

Maximal reaction in infrasound and electrical field on takeoff and landing is observed in day time and much less in night time (fig. 3).

Aircraft takeoffs and landings are well displayed in infrasound. On distance of 5 km the level infrasound falls, but the general course of changes is kept. The variations of an electrical field in most cases repeat infrasound changes.

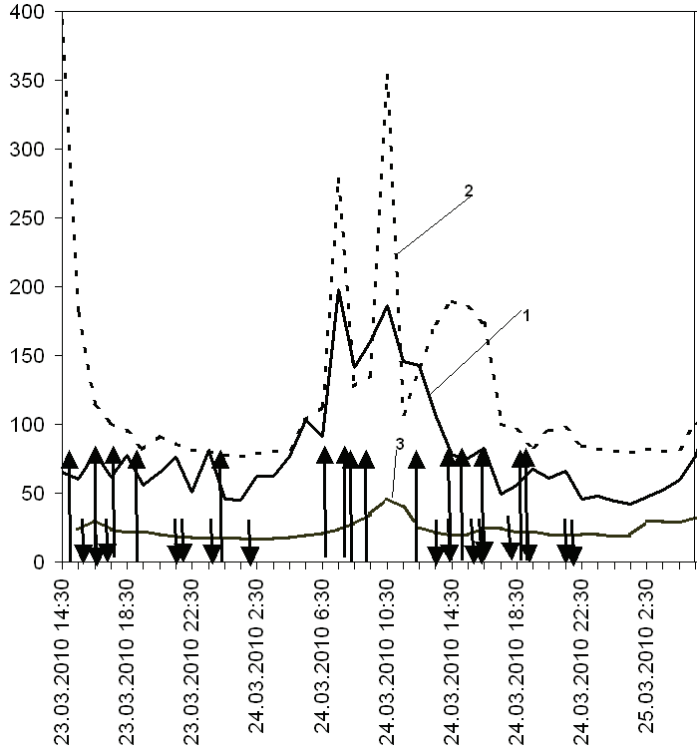


Figure 3 Infrasound and electrical field reaction on aircraft takeoffs and landings during night time

The spectral analysis of infrasound during aircraft landing was conducted. During takeoff the spectrum is concentrated in a range of 1,0-2,5 Hz. The aircraft landing differs by wider spectrum (1,0-6,0 Hz) and higher infrasound level.

Modelling of acoustic influence on an atmosphere

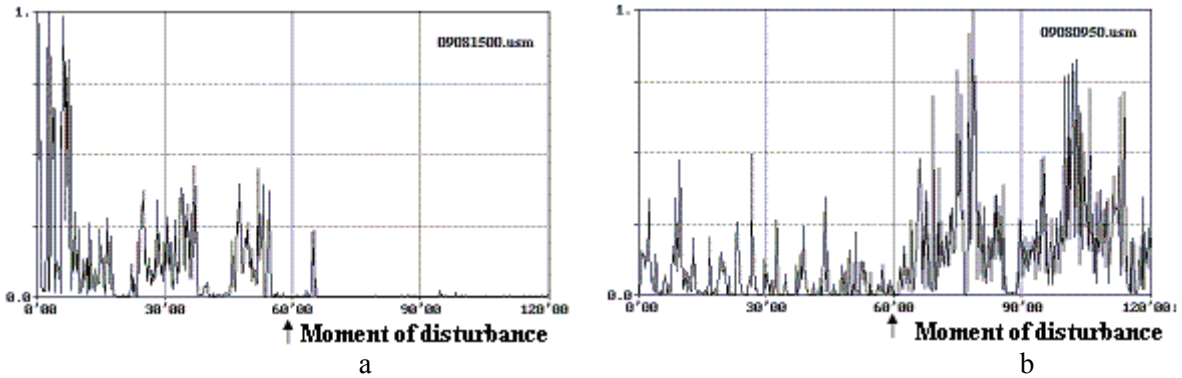
Two high-powered acoustic radiators were used for realization of experiments. One of them was stationary and the second one - mobile with the large power for application within the special polygons. The mobile acoustic emitter appearance is shown in a fig. 4.

The purpose of active acoustic experiments was detection of electromagnetic reactions on acoustic indignation of an atmosphere. The realization of such experiments with use of real planes would be expensive and it is technically difficult. Controlled acoustic radiator can be used in any time and under different weather conditions, that is impossible with the real aircraft.

Figure 4 Mobil acoustic radiator

The measurement of electromagnetic radiations responses was carried out in different ranges of frequencies from 1 Hz to 150 MHz during 1-2 hours before acoustic disturbance on an atmosphere and as much of time after disturbance. Duration of acoustic influence on atmosphere made from 60s up to 120 s.

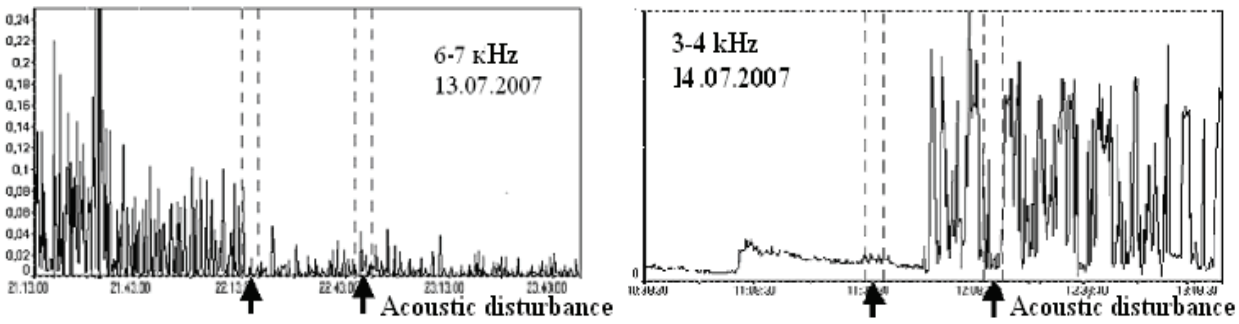
The electromagnetic responses to acoustic disturbance were observed practically on all frequencies. In a fig. 5a, b the changes of a magnetic field in a range of 1-30,0 kHz are shown. It turned out that the variations of a magnetic field can go up (fig. 5a) and go down (fig. 5,b) after acoustic indignation.



a b

Figure 5 Change of magnetic variations energy distribution after acoustic excitation

The similar effects were observed and on other frequencies. Changes of signals in VLF range before and after acoustic indignation are presented in the Fig. 6 a, b.



а б

Figure 6 Change of a magnetic field in a VLF range

More detailed experimental researches have shown that after short-term acoustic influence on an atmosphere, natural infrasound grows or falls. Such effect can be explained by that the artificial disturbance influences atmospheric moisture condensation [1]. Additional heat from condensation results in atmospheric infrasound generation. The similar mechanism of atmospheric infrasound generation is theoretically considered in works [2-4].

The conducted researches show that the flying device can influence atmospheric processes through an acoustic field and, in addition, generates as infrasound so electromagnetic indignation.

Conclusions

1. Taking into account significant allocation of energy within airports zone and it increasing, in the future, it's necessary to expect local changes of atmospheric processes. It's reasonable to monitor main geophysical parameters (variation of electrical and magnetic fields, infrasound) within the large airports zone for these changes control.
2. The modelling experiments show that at interaction of flying device acoustic noise with real atmosphere, effects of noise amplification and electromagnetic disturbances occurrence can appear which can have essential influence on crew at the critical moments.

References

1. *Galechan G.A.* To a question of stimulation of deposits by acoustic waves. A magazine of technical physics., 2005, v.75,, №9, p 85-88.

2. *Netreba S.N.* Mechanism of generation and amplification infrasound in atmosphere.- Preprint Institute of space researches AS USSR, №62-97-09,1991, p. 26-27.

3. *Kotyusov A.N., Nemtcov B.E.* Acoustic "laser". An acoustic magazine, 1991, №1.

4. *Netreba S.N.* Mechanism of generation and enhancement of infrasound by water vapor condensation in the atmosphere.- Meteorology and hydrology, 1998, №12, p. 45-63.

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INTERACTING NEURONS 2D-MODELING

This paper is dedicated to the study of cells such as group of neurons treatment by means of high frequency external electromagnetic radiation. This technique can repair the damaged neurons connection in human brain, spinal brain or peripheral neural system is caused by neural disease like neuroinfection.

Introduction

According to recent statistics of World Health Organization the quantity of patients subjected by different aggressive virus attacks have been greatly enlarged in the last years.

One of possible problems that could occur after such intoxication is symptom of broken or partly broken neural impulse signal, coming from patient's brain through the spine and peripheral neural system to body, hands and legs, causing invalid movements of patient [1, 2].

neighbouring Model

Firstly, an easy way to describe the difficult 3D structure of human brain, which contains more than 100 billion neurons, is to solve the problem in 2D model approximation in small region of neurons. Second step of approximation consist on taking into account that the body of the neuron is made mainly from water (cytoplasm, which is making a main part of neuron cell) [3,4]. Water fill up space between neurons also. We presume also that the border conditions on the neuron surface are the "perfect conductance" case.

A. Method realization

We used Comsol Multiphysics software [5] for the problem solution with next approximation:

System consist on two random interacting neurons (approximately 0.4E-4 m each in linear size);

Water medium linear size around them is 43 mm (2E-4 m);

Number of finite elements of the numerical calculation method is 114 832 elements.

B. Physics of process

The mathematical equation for description the physical processes for this model is:

$$\nabla \times (\mu_r^{-1} \nabla \times E) - (\varepsilon_r - j\sigma / \omega \varepsilon_0) k_0^2 E = 0,$$

where μ_r - relative magnetic permeability of substance; E - intensity of electric field at the monitoring point, (V/m); ε_r - relative dielectric permittivity of environment; σ - conductivity of proxy element, (Sm/m); ω - circular frequency of oscillations, (Rad/s); $\varepsilon_0 = \frac{10^{-9}}{36\pi}$ - electric constant, (F/m); $k_0 = \frac{2\pi}{\lambda}$ - wave number; λ - wavelength of oscillations.

Different oscillation regimes research

Let's analyse what happens with system of two neurons are treated by high-frequency radiation in the range of wavelength compatible with their sizes.

Radiation frequency f = 10E12 Hz

Digital modelling for 2 neurons are interacting inside circular area around these neurons give results are displayed on Fig. 1. These two neurons are interacting through the electromagnetic field (EMF).

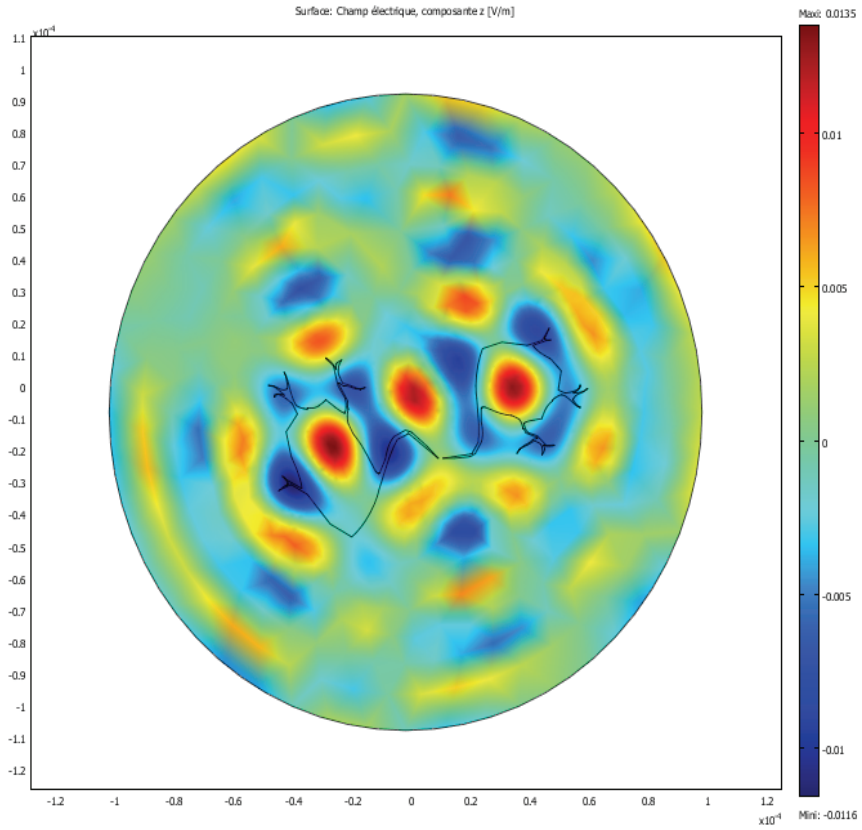

Fig. 1. Intensity E of EMF around two interacting neurons at EMF frequency equal to 10E12 Hz. More intensive colours correspond to more EMF intensity E values

For example, if synaptic connection between neurons is broken by neuroinfection disease, then a "healthy" neuron can treat a "sick" neuron and restores broken signal transition under external EMF action.

Radiation frequency f = 30E12 Hz

Neurons are interacting in a more "precise way" (Fig. 2). Possible "treatment effect" is kept. The external EMF can provide remodelling the conductivity between neurons and restores normal connection and signals transition between neurons.

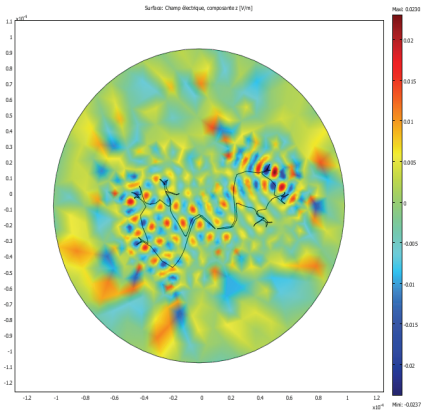

Fig. 2. Intensity of EMF around two interacting neurons for external EMF frequency equal to 30E12 Hz

Radiation frequency f = 90E12 Hz

We can observe a very "precise" EMF penetration in space between 2 neurons. Treatment effect is still OK (Fig. 3). As the EMF penetrates into water medium between neurons, as treatment effect can be present for other surrounding neurons also. These surrounding neurons are not represented in Fig. 3.

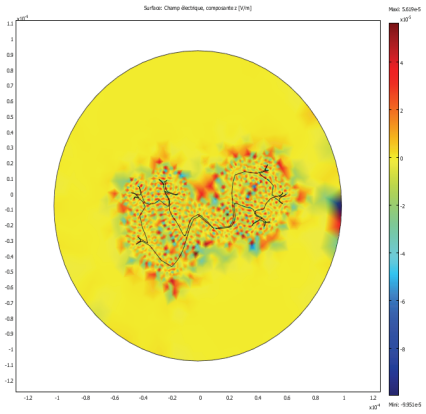

Fig. 3. Intensity of EMF around two interacting neurons for external EMF frequency equal to 90E12 Hz

Radiation frequency f = 270E12 Hz

In this case interneuronal connection almost is lost. Nothing treatment effect is presented because frequency is too large (Fig. 4).

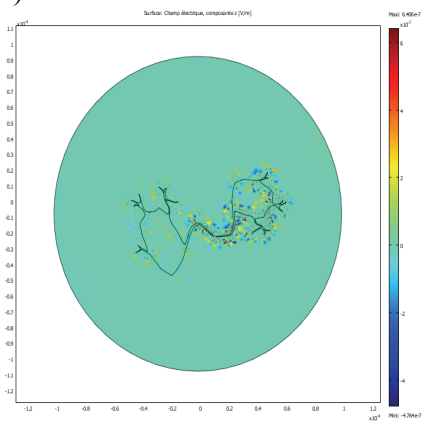

Fig. 4. Intensity of EMF around two interacting neurons for external EMF frequency equal to 270E12 Hz

Radiation frequency f = 3E12 Hz

EMF irradiation frequency becomes too low. 2 neurons become to live as one object. But EMF connection still exist (Fig. 5).

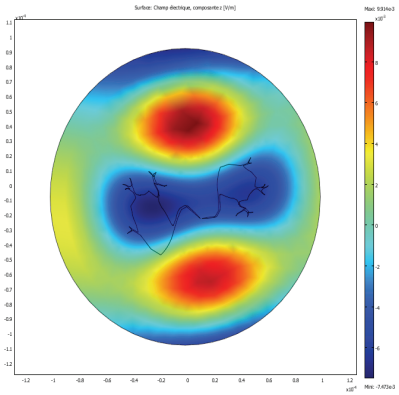

Fig. 5. Intensity of EMF around two interacting neurons for external EMF frequency equal to 3E12 Hz

Radiation frequency f = 1E12 Hz

Two neurons merge in one neuron from the electromagnetic point of view at this EMF radiation frequency (Fig. 6).

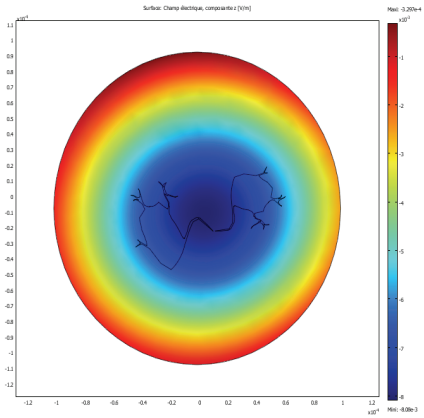

Fig. 6. Intensity of EMF around two interacting neurons for external EMF frequency equal to 1E12 Hz

It is an unpredictable result from the point of view that "one neuron treats another neuron". In this case a 'sick' neuron can result 'healthy' neurone in illness, what is unacceptable.

Conclusions

Neuron can 'treat' the neighbouring neuron if external EMF radiation frequency value is correct. For example, at ultraviolet radiation wavelength range of water equal to (270÷315) E-9 m.

The magnitude of external electric and magnetic field 'treating' group of neurons should be comparable with their own electric and magnetic field magnitudes.

This is very important, because possible brain damage can be produced by external EMF radiation applied to neurons if magnitude and frequency of EMF exceeds acceptable thresholds.

Acknowledgment

Authors would like give an acknowledgement to Professor Werner Arber from University of Basel (Switzerland) whose lessons on biologic evolution greatly impact their enthusiasm during this paper preparation.

References

1. *W. Arber,* Lessons to be learned from microbial population biology and genetics: www.sciencedirect.com, 2004.

2. *Abul K. Abass, Andrew H. Lichtman, Shiv Pillai,* Cellular and molecular Immunology, -6th ed., Saunders Elsevier, 2007, 567 p.

3. *P. Singleton, D. Sainsbury.* Dictionary of Microbiology and Molecular Biology, 3rd ed., John Wiley & Sons Ltd., 2006, 895 p.

4. *E.G. Aznakaev,* Biophysics. Text-book – Kiev: NAU Publishing House, 2005, 308 p.

5. *A.V. Vishnevsky,* Computation Method of Mutual Impact Coefficient of the Quarter-wave Wire Antennas Placed on Airplane Wire-grid Model: Proceedings of the 3rd World Congress 'Aviation in the XXI-st century. Safety in aviation and space technology', IEEE Microwaves, radar and remote sensing symposium 'MRRS–2008'. – Kiev: NAU, 2008, p.279-282.

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SIMULATION OF SWITCHING PROCESSES IN CARDIOMYOCYTES

Sources of cardiomuscule tessue development are the myoepiccardial plates. There are 5 types of cardiomyocytes during histogenesis. Paper is based on the theory of electrical circuits for simulatation the most complex physical and physiological structure without defining their internal structure.

Cardiomyocytes are formed the chains. They being shortened provide a cardiac muscle reductions. Cardiomyocytes are capable to transfer the control signals to each other. Sinus cadiomyocytes are capable to replace automatically a reduction condition into relaxation conditionin a certain rhythm. They perceive the control signals from nervous fibers and change a rhythm of stretching strain activity. Sinus cardiomyocytes transfer the control signals to transitive cardiomyocytes, which transfer them to spending cardiomyocytes. Spending cardiomyocytes are formed chains of connected cells. The first cell in a chain perceives the control signals from sinus cardiomyocytes and transfers them further to spending cardiomyocytes. The last cells in chain transfer a signal through transitive cardiomyocytes to working cardiomyocytes. Secretory cardiomyocytes carry out the special function. They produce hormone which participate in regulation processes and in some other processes.

At stimulation of a muscular fiber under the influence of chemical, electric or mechanical action the intracellular electrode registers the action potential (AP). It results from consecutive changes of physical and chemical properties of a cellular membrane which lead to infringement of its conductance for various ions and to changes of membraine potential (so-called ionic hypothesis of Hodgkin-Huxley). AP consists of two main phases: depolarization and repolarization.

Existing methods of cardiomyocytes simulation are very sensitive to initial data and values of parameters. In particular, the unsuccessful choice of knots and blood vessels parameters can lead to the non-physical resonance phenomena in blood vessels and to “lock-out” effects in nodes, etc.

Methods of the theory of electric circuits can be applied to complex physical and biological structures modeling without defining their internal structure. Let’s consider the equation of state - functional relationship between the parameters of state corresponding to the system interaction with environment. One of parameter is the cause of processes in a system, the other parameter represents the system’s reaction into external influence.

To describe the functional relationship between the parameters of state the one-dimensional model as a special form of the equation of balance for some co-ordinate of state Q is used. The model has the form

$$\frac{dQ(t)}{dt} + \frac{1}{\tau_r(Q)} Q(t - \tau_0) = \sum_{k=1}^{n} x_k(Q) F_k(t) \qquad (1)$$

Formula (1) have the following sense. If to denote any of system’s extensive properties at the moment of time t and on elementary physical volume dr with co-ordinate r through $G(t,r)$,

$$Q = \int_V G(t, r) dr$$

it is possible to called the variable as quantity of property in volume V. Thus Q is the macroscopic quantity is averaged on corresponding system.

The value that determines the input external action is Fk (t). Input characteristics of the system are xk. The value τr - called the relaxation time - reflects a balance between conservative and dissipative properties of systems, thereby determining its dynamic inertia.

Model represents the equation (1) with deviating argument $\tau 0$ thus reflecting movement of Q in space with a finite velocity.

Equation (1) describes a system's state depending not only from the factors influencing on it at the present moment of time, but also from a system condition during some previous time moment.

Let's consider as the electric resonator such element of an electric chain as segnetoelectric capacitor that is caused by similarity of its nonlinear behaviour with nonlinear processes occurring in cardiomyocytes.

Let's consider inclusion regime of segnetoelectric capacitor into the simple electric chain. The scheme of such electric chain is presented on Fig. 1.

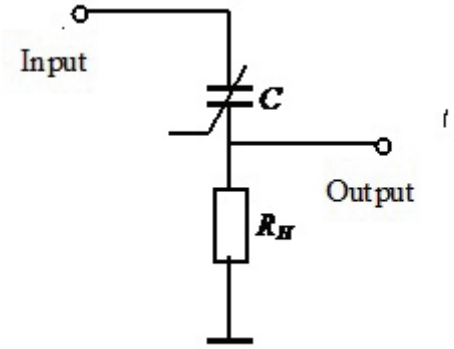

Figure 1. Researching circuit

Taking into account an electric chain with resistance is included consistently with the capacitor, the equation of investigated model (1) is transformed into the form:

$$\begin{cases} U_c(t) = U(t) - R\dfrac{dq}{dt} \\ \dfrac{dq(t)}{dt} + \dfrac{1}{\tau_r(q)} q(t) = \sigma(q)u(t) \end{cases}$$

Research of forced oscillations in such electric contour allows to receive AP characteristics are presented on Fig. 2, which provide an acceptable description of the electrical processes at different initial conditions of the model.

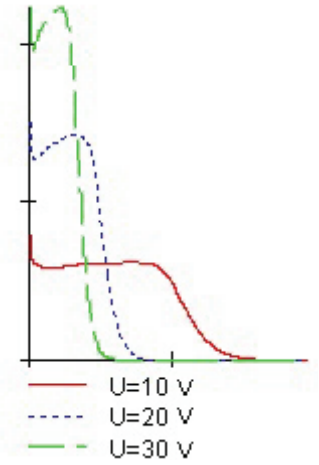

Fig.2

Solving the equation model for different input signals with varying their frequency f and amplitude (for constant *u0* and variable components with amplitude *um*), it is possible to investigate influence of parameters of model on the form of output signals.

The obtained simulation results are presented in Fig. 3-7 in the form of oscillograms of an output signal and phase portraits for different modes of an output signal at action of a harmonic signal, and for the regime of chaotic oscillations also.

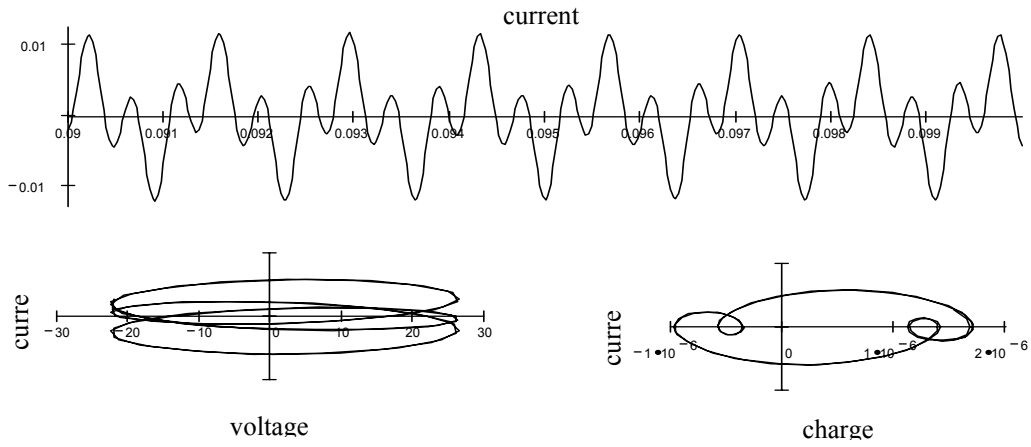

Fig.3. f=60 Hz, u0=2 V, um=24 V

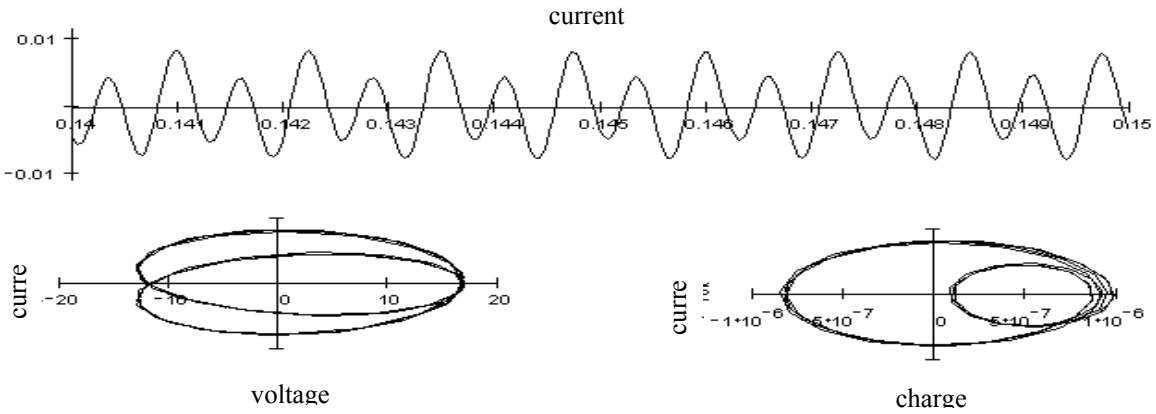

Fig. 4. f=40 Hz, u0=2 V, um=15 V

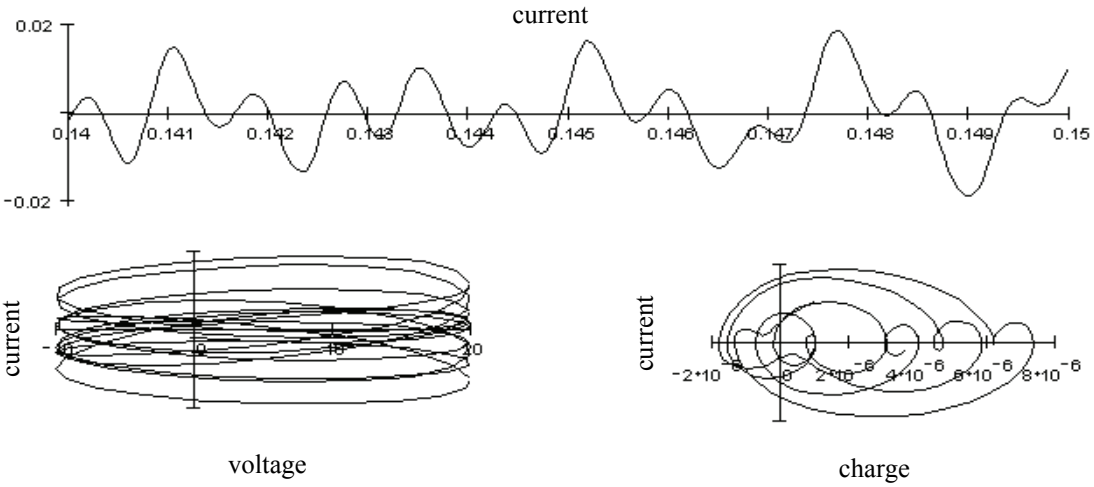

Fig. 5. f=60 Hz, u0=5 B, um=15 V

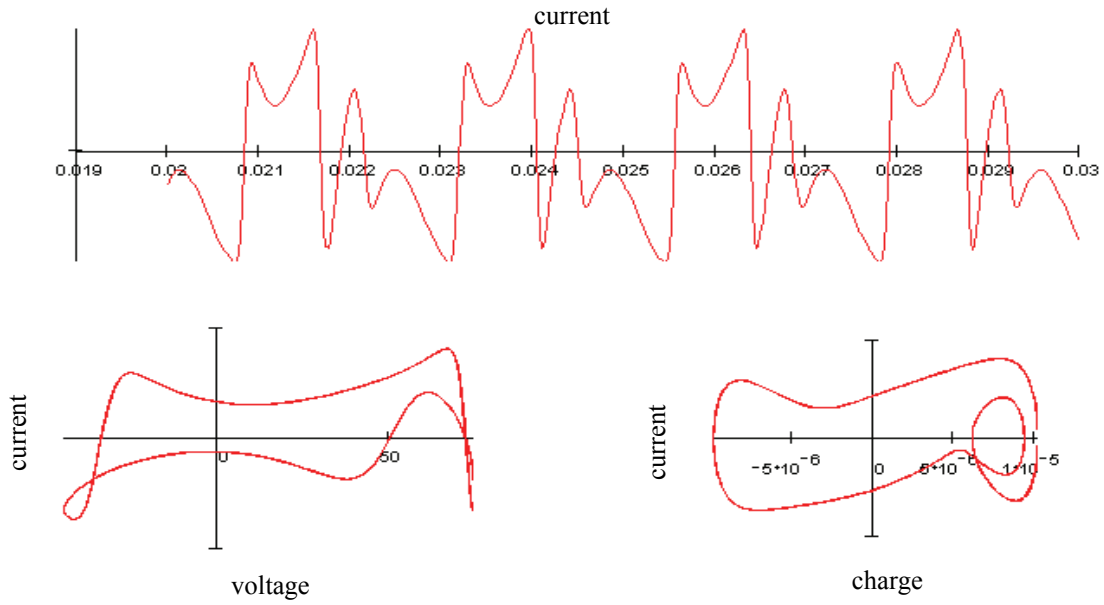

Fig. 6. f=30 Hz, u0=15 V, um=60 V

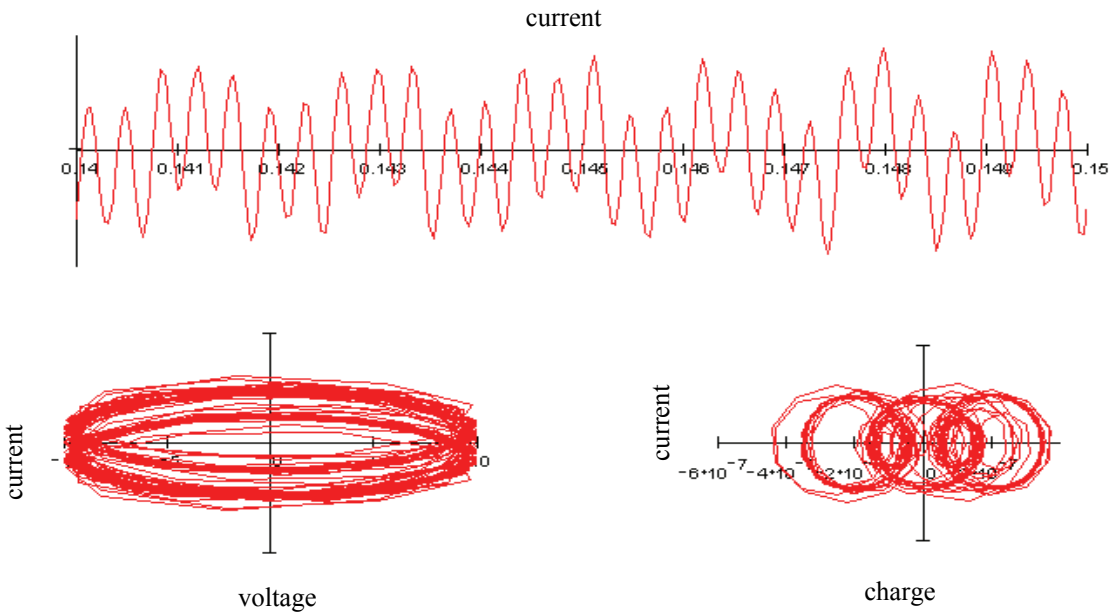

Fig. 7. f=80 Hz, u0=0 V, um=10 V

Conclusions

Application of such approach for electric processes modelling in cardiomyocytes of cardiac muscle will allow not only to describe real processes, but also to simulate the action potential, depending on different pathology of heart by means of various initial conditions for the model equation.

UDC 504.064.3:534.83

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DEVELOPMENT OF PROGRAM PROVISION FOR CALCULATION OF NOISE OF THE SYSTEM "VEHICLE'S TIRES - ROAD SURFACE"

In presented work are researched less studied problems, connected with development practical and accounting methods of the study of the noise of the passenger car. Greater attention is spared study of the influences action, directed on reduction of the noise tires passenger car of the class Ml, before required factors on external noise, and realization of the calculation in the manner of program of the personal computer.

The noise, which appears at interaction of the tires of the car with road at velocities of the motion over 50 km/h, is a stronger acoustic source on information of the European federation of the transport and protection of environment. It defines the level of the external noise of the car of the facility.

At present reserve of the reduction of the noise to account of the modernizations of the acoustic factors of the car in essential degree exhausted. The further reduction of the noise of the cars is expected by using to more noisy design tire and road. So change the constructive particularities of the tires allow to reduce the general level of the noise on 2-3 dBA (the reduction to intensities of the sound on 3 dBA subjective is perceived person as reduction of the sound pressure approximately in 2 times).

At present, there is row of the programmed products high level on calculation of the spreading the noise of the cars in condition of the populated areas, calculation of the noise separate unit cars etc. However programmed products of noise level calculation of the system "vehicle's tires - road surface", taking into account complex data required for calculation of the noise with it is enough high degree to accuracy, no not only in Russia, but also in foreign state. Particularly actual is a noise level calculation of the system "vehicle's tires - road surface" in condition of the Russian Federation, taking into consideration high intensity transport flow and quality of the roads.

Designed mathematical model and methods of the calculation of the noise of the system "vehicle's tires - road surface" takes into account the broad complex a factor, including: velocity of the moving the car; the features road; the climatic features (the temperature, precipitation in the manner of дождя or snow and pr.); the constructive features of tire; the drawing of the protector of tire; gabarit sizes and mass of the car and others.

The Exterior window programmed exhibit for calculation of the external noise of the buses when moving the passenger car is shown on figure 1.

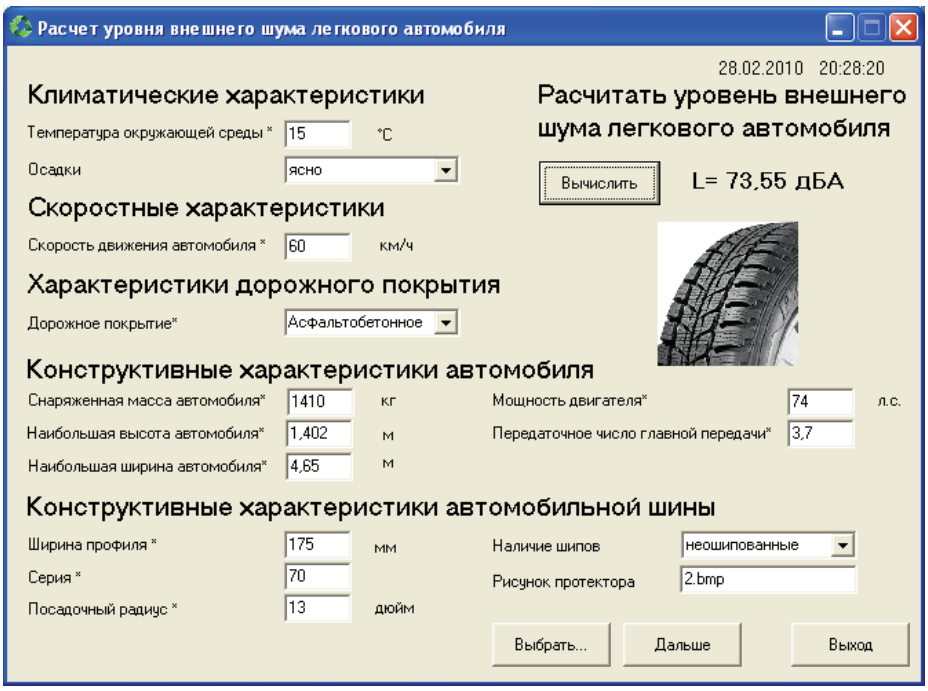

Figure 1. Programmed exhibit for calculation of the noise of the system "vehicle's tires – road surface"

The Mathematical description of the process of the shaping the sound, appearing under streamlined moving object by flow of the air, is reduced to decision of the problems of the acoustics. The Decision given problems is founded on acoustic analogy Laythilla. The Calculation of the turbulent flow of the air, generating sound, is produced in relatively small final volume. Hereinafter on turbulent field is calculated appearing from this field sound (the noise).

Piece of evidence model

Experimental test tires on noise were conducted in accordance with requirements "GOST R 52800-2007" (ISO 13325:2003) on technically fault-free car on "GOST R 51616-2000". The Height of the location of the mike is 1,2 m from level of the road covering. The Distance from mike before axis of the moving the car is 7,5 m. The final result is taken the average importance of five measurements for each tire, under alike velocity of the moving the car.

The External noise of the car's tires were measured on test area of the road in mode of the free swing of the tires, with switched off by engine, with neutral issue and with mode of the runaway. As object of the experimental study was used front drive car of the VAZ 21099 with gasoline engine by volume 1,5 liters and 5-speed mechanical gearbox.

The Results of the test the noise from contact of the tires with road covering, got in process of the undertaking the experimental studies, are presented in graphic type on figure 2.

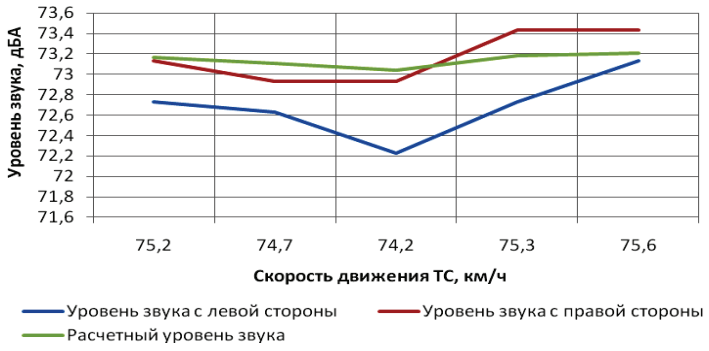

Figure 2. Results experimental and accounting test data of the car tires on correspondence to "GOST R 52800-2007" (ISO 13325:2003)

Designed programmed exhibit, allows with high degree of accuracy to define the level of the sound pressure, created when moving car's tire of the facility. The Comparison experimental given with accounting show pinpoint accuracy designed to models. Inaccuracy of the calculation external noise level with use of programmed exhibit forms not more than 3 %. The Solved problem of the calculation of the noise of the system "vehicle's tires – road surface" has as scientific, so and practical importance.

Influence working and constructive parameter of tire on her noise

The Analysis of the experimental studies on noise level measurement of tire, executed with use designed programmed exhibit, shows:

– the intensity of the radiation of the noise tires practically does not depend on landing diameter of the rim, from correlation of the height of the profile to width and from width of the profile tire (so increase the landing radius of the rim on 1 inch bring about increase db level on 0,25% (within the range of R13-R14); tire 70 series bring about increase db level on 0,1%, in contrast with bus 65 series, other things being equal (the width of the profile, landing diameter of the rim, model, load on wheel and etc); but increase the width of the profile on 5,5% brings about growing db level on 0,07%).

– when change drawing protector tire difference does not exceed 1 - 2 dBA..

– change the temperature surrounding ambiences, other things being equal (the velocity, constructive features cars, features of the car tires and etc) renders not significant influence upon intensity of the radiation of the noise of the cars. So each her (its) increase on 15 ^{0}C brings about reduction db level on 0,5 dBA at the average.

– the dependency of the noise of the cars from velocity of the motion carries the complex nature, so each reduplication to velocities of the motion causes increase a db level on 6 - 7 dBA.

– on features of the noise of the cars by essential image affect the composition and condition of the road covering (so, soil covering on 2,1 dBA more noisy, than asphalted; but concrete on 1,3 dBA less noisy, than soil).

Conclusions

Designed automatic system allows calculating and forecasting the noise of the system «vehicle's tires - road surface», producing the estimation of the ecological influence given systems on bio sphere, developing optimum on its feature of the designs of tire and road. Is it hereinafter expected increase the list a factor, which are taken into account at calculation that will raise accuracy a calculation. The Offered actions under their the most further introduction will allow to solve the important problem of the reduction of the acoustic contamination surrounding ambiences and vastly reduce the level of the noise, created when moving the cars.

References

1. *Ivanov N.I.* The Engineering acoustics. The Theory and practice of the fight with noise. The Textbook - Moscow: Logos, University book , 2008.

2. *Klennikov V.M., Klennikov E.V.* The Theory and design of the car. Moscow: Machine building, 1967.

3. *Lighthill M. J.* The Waves in liquid. Moscow: Science, 1981.

4. *Zarembo L.K., Krasilinikov V.A.* Introduction to nonlinear acoustics. Moscow: Science, 1966.

5. *Varyuhin A.N., Iliin K.A., Konishin V.N., Ryzhov S.A.* The Analysis of the acoustic noise of the car bus Moscow: journal "CAD and graphics", 2005.

6. *Butorina M.V., Drozdova L.F., Ivanov N.I.* The Engineering ecology and ecological management. The Textbook - Moscow: Logos, University book, 2006.

UDC 656.7.076 (043.2)

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THE BASIC SAFETY REQUIREMENTS TO PERSONNEL AT PERFORMANCE OF AVIATION-CHEMICAL WORKS

The procedure of obtaining a license for working with pesticides and agrochemical substances is clarified by the current legislations.

Workers who work with pesticides and agrochemical substances have to pass medical check according the Procedure of medical checks of workers of particular categories (an order of the Ministry of Health Protection of Ukraine of 21.05.2007 № 246).

Operations of mixing of mortar of pesticides and agrochemical substances have to be mechanized.

Concentration of harmful substances in the air of working zone during work has to be lower than the maximum permissible concentration established by the state standard ГОСТ 12.1.005-88.

Chemical substances stored on the loading area must to be protected from sun light.

Chemicals loading in an aircraft must be performed by mechanical loaders. Safety during loading and unloading is according to requirements of the state standard ГОСТ 12.3.009-76 Safety System Standard "Operations of loading and unloading. General safety requirements".

It is necessary to:

- after each loading to remove all accidentally scattered or spill chemical substances from aircraft surfaces;
- protect chemicals from contamination during mixing of mortar and loading aiming not to decrease efficiency of avia-chemical equipment of an aircraft;
- for the personal to stay at leeward side aiming protection from spray and dust;
- crew performing flights for aviation chemical operations is not allowed to participate in mixing of mortar and loading;
- aiming detection of pesticides drain to perform inspection of aviation chemical equipment during preflight and postflight maintenance.

The basic task for the signalmen is providing clear and accurate signals, according to which a captain perform flight over operating surface.

All crews which flight in an area of aviation chemical working have to have respiratory protective devices and first-aid sets for the first aid.

For protection of organism from penetration of pesticides and agrochemical substances trough respiratory organs, skin and jelly coats workers must be provided by special clothes, special shoos and other respiratory protective devices.

Giving out, storing and use of protective devices is performing according to the Provisions of providing workers with special clothes, special shoos and other protective devices (the order of Держгірпромнагляд of 24.03.2008 № 53).

Removing of protective devices should be done according to the following procedure: not taking off gloves to clean elastic gloves using disinfectant (3-5% solution of calcined soda, lime milk), to clean them with water; then to take off protective glasses and respirator, special clothes and shoos; to clean gloves again using disinfectant and water and only after that to take them off.

For protection of harmful influence of pesticides and agrochemical substances on organism it is necessary to fulfill rules of individual hygiene:

- it is prohibited to take off protective clothes, smoke, eat and drink during work;
- before going to a toilet it is necessary to clean thoroughly dust from the protective clothes and wash hands with a soap;
- not to dry hands with protective clothes, not to carry any things or meal in protective clothes pockets;

- before lunch time and also after finishing of working day it is necessary to take off protective clothes, fulfilling aforesaid rules, to take a shower and after to put on everyday clothes;
- eating, smoking, drinking water is allowed at special places, allocated minimum 200 m far in leeward side from operating surface, loading place, runway, after taking off protective clothes and cleaning hand and face using soap;
- it is not allowed to bring protective devices home, to wear protective clothes or shoes at home.

Protective clothes has to be deactivated everyday shaking out or using vacuum cleaner and stored in a special dry clean and ventilated room. It is prohibited to store protective devices is the same room with pesticides.

Except mechanical cleaning protective clothes has to be washed and deactivated periodically as needed, but not rarely than 6 working days.

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AIRCRAFT-NOISE PERFORMANCES DATA BASE FOR AIRCRAFT OF FSU DESIGN AND PRODUCTION

1. Introduction

The international Aircraft Noise and Performance (ANP) data meet in full the requirements of the ICAO aircraft noise contour modelling methodology "Recomended Method for Computing Noise Contours Around Airports", ICAO Doc 9911/1, 2008 [1]. The ANP database covers a high proportion of the aircraft types, models and variants that make up today's civil aircraft fleets [2]. This allows most cumulative noise contours to be generated with reasonable accuracy. Till the day all the FSU, RF and Ukrainian aircraft are still not listed in ANP and INM databases. Consequently they are still used for noise calculations with substitution approach. Their contribution in flight schedules inside some regions of the world is quite dominant, so a necessity to include their flight-noise performances in appropriate databases is sufficient for accuracy of modeling results.

In order to complete the initially developed ANP database some appropriate working groups were defined in Modelling and Database Support Group (MDG) of the Committee on Aviation Environmental Protection (CAEP) – to develop updated databases, as required. Particularly Ukrainian (Kiev National Aviation University) and Russian (Centre of Ecological Safety of Civil Aviation, GosNII GA and TsAGI, Moscow) partners combined their efforts for preparing the necessary data on FSU, Russian and Ukrainian aircraft types, to be included in ANP database. Thus data on FSU, Russian and Ukrainian aircraft types, old and new, may be added as soon as they have been supplied to, and verified by, the database managers.

2. ANP database

Using the data from the international ANP database there are many of applications of aircraft flight performance analysis possible, equations for which are detailed in Appendix B of the ECAC Doc [3]. Each equation contains coefficients (and/or constants) which are based on empirical data for each specific aircraft type. The aerodynamic-performance equations in Appendix B [4] permit the consideration of any reasonable combination of aircraft operational weight and flight procedure, including operations at different takeoff gross weights. When the unlisted aircraft contribute a significant proportion of the total noise around an airport under consideration, an aircraft must be selected from the list on the basis of the substitution criterion.

A typical departure flight profile as shown in Fig. 1 may consist of up to 10 segments defining the takeoff roll and climb to 10000 ft. A departure profile must begin with a takeoff ground roll. After rotation the ground roll segment is normally followed by climb at constant speed to a given altitude. Following this, segments are defined to accelerate the aircraft to en-route climb speed and retract the flaps from the takeoff setting.

The Noise-Power-Distance data (also in the ANP database, Fig. 2) define noise from aircraft traversing idealized horizontal flight paths of infinite length at constant speed and power. To adapt this data to terminal area flight paths that are characterized by frequent changes of power and velocity, every path is broken into finite straight-line segments; the noise contributions from each of these are subsequently summed at the observer position.

The departure flight profile consists of similar segments to that used in the SAE method [4]. However, the takeoff ground roll has been split into two discrete segments, including a ground roll segment that accelerates the airplane to liftoff speed, followed by a transition segment where it is assumed that the airplane follows a circular arc trajectory from rotation until it reaches the initial

climb angle. At the end of transition the aircraft will be at some height above the runway elevation and the departure profile may proceed with either a constant speed climb or an accelerating climb.

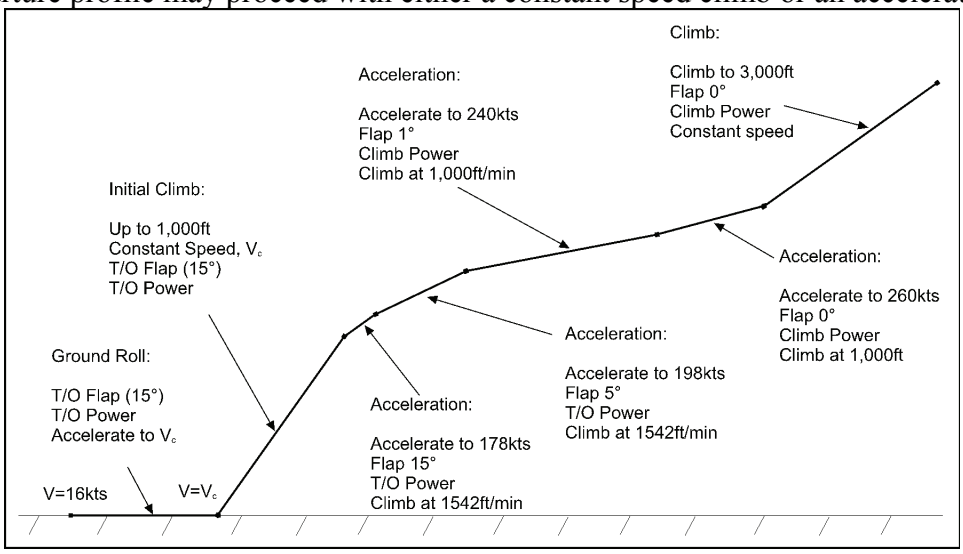

Figure 1. Construction of a departure flight profile

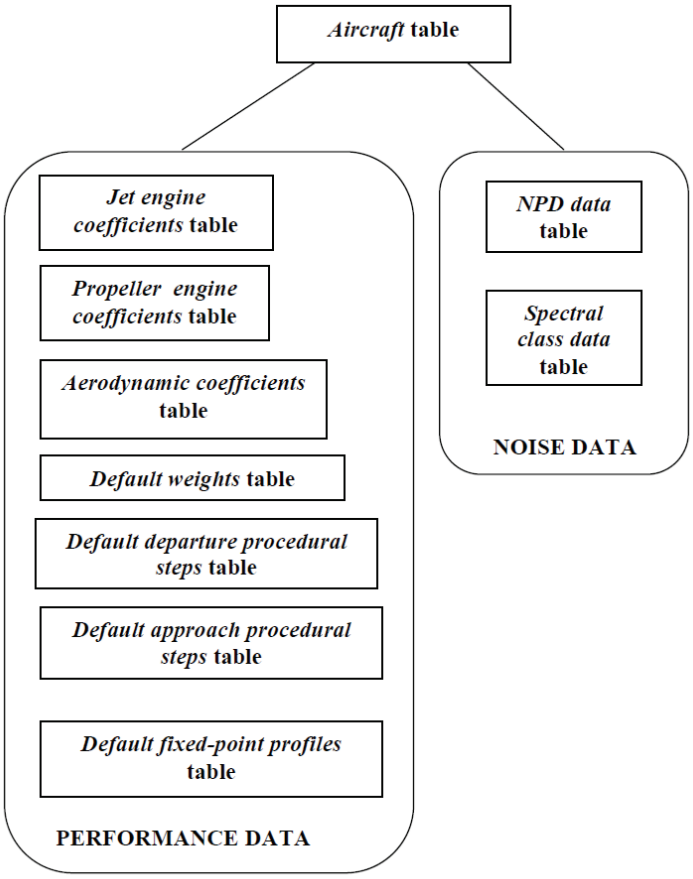

Figure 2. Database structure

3. Software tools for the aircraft-noise performances data assessment

Appropriate software tools for the aircraft-noise performances data assessment were designed and used. Database and program ***NoBel*** were designed before [5] grounding on the methods of specific aviation noise sources [6].

PROGRAM INM_coeff: Defines coefficients **C** & **D**, which are related to the maximum lift coefficient C_{LMAX} for a standard flap deflection angle at take0ffs and approaches and coefficient is the ratio of the aeroplane's drag coefficient to its lift coefficient appropriate to the given flap setting (the landing gear is assumed to be retracted).

Coefficients **C**, **D** & **R** are defined for standard flap settings, described in Aircraft Operation Guide (at least three – cruise, takeoff & approach), and for two specific: 2 and 5 grad of flap deflection.

PROGRAM SAETOlength: Defines the equivalnt roll lenth and coefficient **B** in accordance with SAE-1845 [4]. Input of initial data for considered airplane type, polara, engine parameters, frame parameters, etc, is realised using subroutine ISHOD and database of the program (software) ***NoBel***.

PROGRAM Thrust_coeff: Approximation of the thrust data by least square method for the engine parameters, using subroutine ISHOD and database of the program (software) ***NoBel*** in format of SAE-1845 Thrust_Coefficients.

Program TETAMAX: Defines a point of the flight path from which a maximum sound level is produced in point of noise control. Input of initial data for considered airplane type, polara, engine parameters, frame parameters, etc, is realised using subroutine ISHOD and database of the program (software) ***NoBel*** [5].

Program NOIRAD: It is a NPD-calculator – defines Noise-Power-Distance-(NPD-)data for the aircraft using its Basic calculation models. It tabulates main noise indices *EPNL,* L_{max} and L_E as functions of propagation distance *d* - for specific aircraft types, variants, flight configurations (approach, departure, flap settings), and power settings *P* – NPD-data.

Particularly *PROGRAM INM_coeff* defines some flight coefficients directly from the database of the program (software) ***NoBel***. Its output results are printed as following:

For usual flap deflection:

Coefficient C, D:

m = 1 Cymax= 1.290 C= 0.098964 D= 0.107211
m = 2 Cymax= 2.050 C= 0.078505 D= 0.085047
m = 3 Cymax= 2.600 C= 0.069709 D= 0.075518

Coefficient R:

m = 1 DELF= 0.000 Cymax= 1.290 Cxmax= 0.199 R= 0.154109
m = 2 DELF=25.000 Cymax= 2.050 Cxmax= 0.324 R= 0.158049
m = 3 DELF=40.000 Cymax= 2.600 Cxmax= 0.451 R= 0.173462

For specific flap deflection:

Coefficient C, D:

DELF = 2.0 Cymax= 1.351 C= 0.096712 D= 0.104771
DELF = 5.0 Cymax= 1.442 C= 0.093603 D= 0.101404

Coefficient R:

DELF = 2.0 Cymax= 1.351 Cxmax= 0.196 R= 0.145382
DELF = 5.0 Cymax= 1.442 Cxmax= 0.194 R= 0.134474

Program ***SAETOlength*** defines output results by solving the equations of aircraft movement during rolling up and initial climbing:

equivalnt roll lenth = 3345.8 m
equivalnt roll lenth coefficient B_{SI} =0.003534
equivalnt roll lenth coefficient B =0.002385

They both allow to define flight performance coefficients in a following from<which is used in ANP data base:

ACFT_ID	Op type	Flap_ID	B	C	D	R
Il86	A	D-40			0.075518	0. 173462
Il86	A	D-25			0. 085047	0. 158049
Il86	A	U-5			0. 101404	0. 134474
Il86	D	40	0.001214	0. 069709		0. 173462
Il86	D	25	0.001561	0. 078505		0. 158049
Il86	D	5	0.002385	0. 093603		0. 134474
Il86	D	2	0.002682	0. 096712		0. 145382
Il86	D	ZERO	0.002722	0. 098964		0. 154109

Program **NOIRAD** NPD-data for the aircraft using its Basic calculation models and tabulates main noise indices *EPNL,* L_{max} and L_E as functions of propagation distance for 25C (without Lateral effect):

Distance, *ft*	EPNL, *EPNdB*					
	MaxTakeoff	MaxClimb	Climb	1-st Cruise	2-nd Cruise	Approach
61.0	122.1	113.5	110.7	108.3	107.5	99.8
122.0	117.7	109.3	106.2	103.4	102.4	94.6
192.1	114.6	106.5	103.2	99.9	98.8	90.6
305.0	110.9	103.4	99.8	96.2	94.8	86.0
610.0	105.2	98.7	94.9	90.8	88.8	79.7
1220.0	98.7	93.1	89.0	84.6	82.3	71.6
1921.5	94.2	89.1	85.0	80.7	78.1	67.5
3050.0	89.4	84.6	80.7	76.5	74.0	63.6
4880.0	84.0	79.7	76.1	72.1	69.8	59.8
7625.0	77.7	74.2	71.1	67.5	65.4	56.4

Conclusions

Draft of the report for MDG with explanations of the developed methods and software is prepared. In 2-nd part of the report first preliminary data for Iljushin-86 and Yakovlev-42 aircraft are presented. After the verification of the used methods and software the work will be continued for other FSU, Russian and Ukrainian aircraft types.

References

1. *Recomended* Method for Computing Noise Contours Around Airports. ICAO Doc 9911/1, 2008.

2. *Gulding, J.M.; Olmstead, J.R; Fleming, G.G.*: *Integrated Noise Model (INM) Version 6.0 User's Guide.* Department of Transportation, Federal Aviation Administration, Report No. FAA-AEE-99-03, September 1999.

3. *Report* on Standard Method of Computing Noise Contours around Civil Airports. ECAC.CEAC Doc 29. Volume 2: Technical Guide. 3rd Edition.

4. *Society* of Automotive Engineers: Procedure for the Calculation of Aircraft Noise in the Vicinity of Airports. SAE AIR-1845 (1986).

5. *O. Konovalova, O. Zaporozhets.* NoBel – tool for aircraft noise spectra assessment account of ground and shielding effects on noise propagation. World Congress Proc.: "Aviation in XXI Century", *Environment Protection Symposium*, September 19-21, 2005.

6. *Tokarev, V.I., Zaporozhets, O.I., Straholes, V.A.*, (1990) *Noise Abatement for Passenger Airplanes in Operation* [in Russian], Kyiv, Tehnika.

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ACOUSTIC WAVE GENERATED BY PLANE'S ENGINE JET

Understanding the mechanism of sound generation by plane components are an important step toward the minimization of noise in the vicinity of the airport. In this work we solve a linearized form of compressible Navier-Stokes, energy and continuity equations in the jet coupled with acoustic wave equation in the far field in order to have jet's resonance frequency. The coupling with wave equation via the boundary conditions allow the elimination of hydrodynamics modes and entropic mode generated by the jet to focus on the acoustic mode at the origin of the acoustic nuisance in the vicinity of the airport. Knowing the frequency and the amplitude of the acoustic wave generated by plane engine, hopefully, could improve the cost function used in the minimization of the noise in the vicinity of the airport.

Introduction

The planes, nowadays, become an important component of the whole transport structure in the entire word. It is very hard to imagine a country in the present time, without an efficient air transport, to be well connected with the rest of the world and to have economical and cultural prosperity. According to the available statistic data, this mode of transport is in expansion, therefore, it should be expected to have crowded air traffic in the days to come. Notwithstanding the important contribution made by the air transport to the economical, cultural development of the whole world, it has a large negative impact on the environment. Two important environmental issues are of concern.

1) The pollution of the atmosphere at high altitude, in particulate the ozone layer which protect the earth from harmful solar radiation. For, the planes burn a large amount of fuel at high altitude and nobody knows with exactitude the consequence of such chemical waste in the high altitude layers of the atmosphere at long-date.

2) The second issue is the acoustic pollution in the vicinity of the airport which hampers the quality of the life of the population living nearby. In this work we focus in the second issue, namely, the acoustic pollution.

In order to minimize the noise in the vicinity of the airport, the researchers developed a mathematical model to find a optimal bath and optimal flight configuration permitting the noise reduction during the landing and during the take off procedures. The method consists of minimization of a functional describing the level of noise induced by the planes near the airport. A technique well developed by the researchers working on optimization and optimal control. The functional to be minimized involves the trajectory of the plane, the flight parameters and the constraints imposed by safety concern or technical limitation. Not withstanding the impressive mathematical tool involved in this approach, the terms in the mentioned functional concerning the noise generation, noise frequency and noise amplitude are, to say, intuitive. The amplitude and the frequency of the acoustic wave generated by the organ of the plane depend on a verity of parameters as the plane speed, engine jet speed and temperature, form of the nozzle and the form of the other part of the plane. The large number of parameters involved in the noise generation makes it difficult to do an extensive experimental prediction analysis of the terms modeling the level and the frequency of acoustic wave in the aforementioned functional. The difficult remains when it is about figuring out those terms by an extensive numerical simulation. Then it necessary to develop a method allowing the modeling of the terms relating to noise generation in the aforementioned functional with a reasonable time

In this work we focus on the engine's jet's noise generation. It is well known that a compressible fluid support three sort of modes, namely, the hydrodynamic mode, the entropic mode and the acoustic mode. Those three modes are uncoupled in the limit of infinitesimal perturbation. Our aim here is to find the generation of the acoustic wave by jet of plane engine. One aspect of the acoustic wave is that it does not die away in the vicinity of the jet as the hydrodynamic and the

entropic modes do. Rather, the acoustic waves propagate far from the jet (in the far field). In mathematical point of view, this requires a particular treatment of the boundary condition at the out circumference of the jet when looking for the acoustic wave generated by the jet itself. To this end, a linearized system of partial differential equations deduced from compressible Navier-Stokes equations, energy equation and continuity equation are coupled, via the boundary conditions at the jet surface, to the Helmholtz equation governing the acoustic wave in the far field. In order to predict the generation of the acoustic wave, the homogeneous system of partial differential equations are solved numerically to find the acoustic resonance frequency of the system which leads to the frequency of the acoustic wave generated by the jet.

Basic flow near the outlet

The velocity profile near the leading edge of the jet could be approached by the equation

$$U = \frac{V_b}{2}\{1 + tanh[b(\frac{R}{r} - \frac{r}{R})]\} \tag{1}$$

where R – jet's radius, r – radial distance $b = \frac{R}{4\delta}$, $\delta = \frac{3}{100}\left(x + \frac{4}{3}R\right)$. x – is the axial distance. V_b – the velocity of the jet at the leading edge of the jet. The numerical simulation of the jet shows that in this part of the jet a strong acoustic wave is generated. The direction of the propagation of this wave is perpendicular to the direction of the jet. We will use this profile to linearized the basic equations.

Basic turbulent flow in similarity zone

Far enough from the leading edge of the jet, the velocity profiles are similar and could be obtained by similitude hypothesis. Let's suppose that the axial velocity component U takes the form

$$U = V_b(x)\frac{d^2G}{d\xi^2} \qquad ; \qquad \xi = \frac{r}{h(x)} \tag{2}$$

where G satisfies the equation

$$\frac{1}{CRe}\frac{d^4G}{d\xi^4} = -(\frac{d^2G}{d\xi^2})^2 + \frac{1}{\xi}G\frac{d^3G}{d\xi^3} - \frac{d^3G}{d\xi^3}\frac{dG}{d\xi} \tag{3}$$

where $\mathrm{Re} = \frac{V_0 h_0}{\nu_t}$: Reynolds number based on the turbulent viscosity. C – coefficient of expansion of the jet. The radial component is

$$V = V_b C(\xi\frac{d^2G}{d\xi^2} - \frac{dG}{d\xi} + \frac{G}{\xi}) \tag{4}$$

and the basic temperature

$$\tilde{T}(x,r) = T_b(x)\Theta(\xi) \qquad ; \qquad \xi = \frac{r}{h(x)} \tag{5}$$

where Θ satisfies the following equation

$$\frac{1}{CPrRe}\frac{d^2\Theta}{d\xi^2} = -\frac{d^2G}{d\xi^2}\Theta + \frac{1}{\xi}\frac{d\Theta}{d\xi}G - \frac{d\Theta}{d\xi}\frac{dG}{d\xi} \tag{6}$$

Re and Pr are the Reynolds number and the Prendtl number based on the turbulent diffusivity and C is the rate of jet expansion. We can show that the following decays lows are verified

$$V_b(x) = \frac{h_0 V_0}{Cx + h_0} \quad ; \quad h(x) = Cx + h_0 \quad ; \quad T_b(x) = \frac{h_0 T_0}{Cx + h_0} \quad ; \tag{7}$$

where the values of the variable are scaled by their values at *x=0*.

Equations related to the perturbation.

Let's add to the basic flow an infinitesimal disturbance, substitute in the basic equation, neglect the no linear terms, suppose the effect of the viscosity is negligible and subtract the steady solution to obtain the following equations describing the evolution of the disturbance in the jet.

$$+V\frac{d}{dr}(v_x) + i\omega v_x + ikUv_x + v_r\frac{\partial U}{\partial r} + \rho U\frac{\partial U}{\partial x} + \rho V\frac{\partial U}{\partial r} + v_x\frac{\partial U}{\partial x} + ikP_0 p = 0 \tag{8}$$

$$P_0\frac{dp}{dr} + V\frac{dv_r}{dr} + i\omega v_r + \rho U\frac{\partial V}{\partial x} + \rho V\frac{\partial V}{\partial r} + ikUv_r + v_x\frac{\partial V}{\partial x} + v_r\frac{\partial V}{\partial r} = 0 \tag{9}$$

$$V\frac{dv_\theta}{dr} + ikUv_\theta + i\omega v_\theta + \frac{V}{r}v_\theta + \frac{in}{r}P_0 p = 0 \tag{10}$$

$$V\frac{d\rho}{dr} + \frac{dv_r}{dr} + i\omega\rho + \frac{V}{r}\rho + \frac{in}{r}v_\theta + \frac{v_r}{r} + ikU\rho + ikv_x + \frac{\partial V}{\partial r}\rho + \frac{\partial U}{\partial x}\rho = 0 \tag{11}$$

$$p = \rho + T \tag{12}$$

$$-VE_0P_0\frac{dp}{dr} + V\frac{dT}{dr} + U\frac{\partial\Theta}{\partial x}\rho + V\frac{\partial\Theta}{\partial r}\rho + i\omega T + v_x\frac{\partial\Theta}{\partial x} + ikUT + v_r\frac{\partial\Theta}{\partial r} - ikUE_0P_0p - iE_0P_0\omega p = 0 \tag{13}$$

The lower case Latin letter stands for the disturbance. The solution is supposed to be in a normal form in time and axial and azimuthal directions, that is of the form $e^{i\omega t+ikx+in\theta}$

Wave equation in far field

The wave equation in a frame moving with constant speed U_0 reads

$$\frac{\partial^2\phi}{\partial t^2} + 2U_0\frac{\partial^2\phi}{\partial x\partial t} + U_0^2\frac{\partial^2\phi}{\partial x^2} = a^2\left(\frac{\partial^2\phi}{\partial x^2} + \frac{\partial^2\phi}{\partial r^2} + \frac{1}{r}\frac{\partial\phi}{\partial r} + \frac{1}{r^2}\frac{\partial^2\phi}{\partial\theta^2}\right) \tag{14}$$

wher *a* is speed of sound. *a* solution in the form of normal mode is sought:

$$\phi = p(r)e^{i\omega t+ikx+in\theta} \tag{15}$$

the wave equation becomes

$$a^2r^2\frac{d^2p}{dr^2} + a^2r\frac{d^2p}{dr} + (\omega^2r^2 + 2U_0\omega kr^2 + U_0^2k^2r^2 - a^2k^2r^2 - a^2n^2)p = 0 \tag{16}$$

the solution is a compbination of bessel functions, namely,

$$p(r) = C_1J_n(\Omega r) + C_2Y_n(\Omega r) \quad ; \quad \Omega = \frac{1}{a}\sqrt{[(\omega - (a - U_0)k)(\omega + (a + U_0)k)]}. \tag{17}$$

The velocity in the far field is

$$(v_x, v_r, v_\theta) = \frac{i}{\omega}\left(ik, \frac{d}{dr}, in\right)p(r) \tag{18}$$

where

$$\frac{dp}{dr} = \frac{C_1}{a\Omega}[-J_{n+1}(\Omega r) + \frac{na}{r\Omega}J_n(\Omega r)] + \frac{C_2}{a\Omega}[-Y_{n+1}(\Omega r) + \frac{na}{r\Omega}Y_n(\Omega r)] \tag{19}$$

Conclusion

It is found that the mentioned system has a set of unstable acoustic modes. An extensive analysis of the frequency of those modes and their temporal amplification rates has been made. A procedure is described to find the amplitude of those modes. Those results, hopefully, could be used in the time to come to improve modeling the terms related to the amplitude and the frequency of the acoustic waves in the functional used in the minimization the noise near the airport.

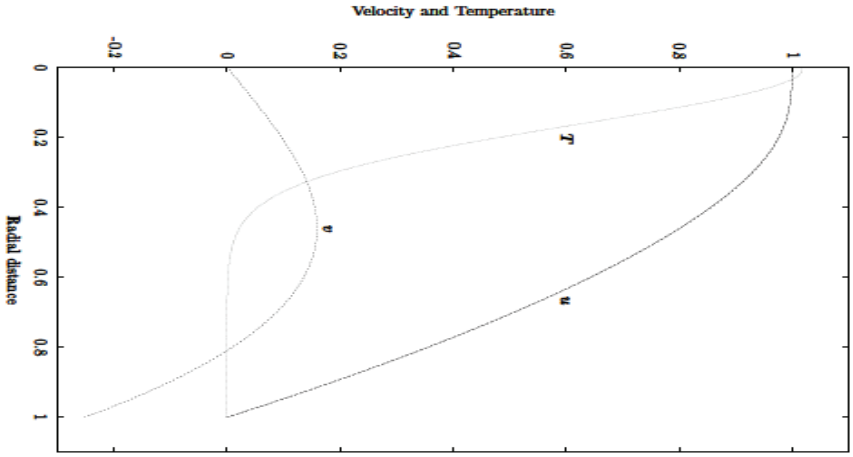

Figure 1. Velocity components and temperature in similarity zone of the jet

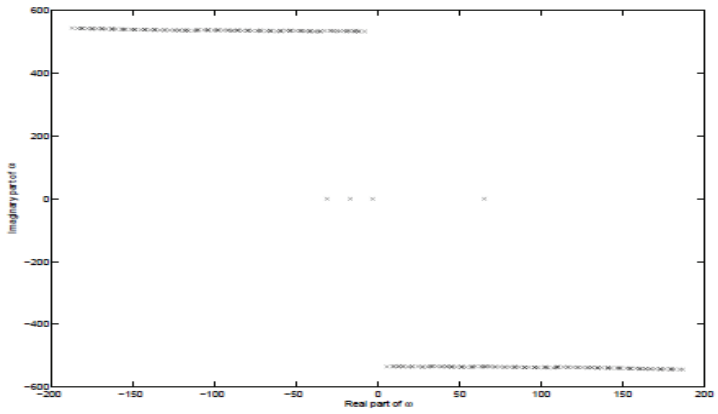

Figure 2. The eigenvalues related to acoustic wave emitted at the begenning of the jet: Obtained with velocity profile shown in equation 1

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ESTIMATING THE LONG-TERM ECONOMIC AND ECOLOGIC IMPACT OF THE INCLUSION OF INTERNATIONAL AVIATION INTO THE EU EMISSIONS TRADING SCHEME FOR THE LIMITATION OF CO_2-EMISSIONS

This paper investigates the long-term economic and ecologic impact of the EU-ETS for aviation by employing an empirical simulation model. Especially, the economic effects of the upcoming EU-ETS on the aviation sector in total as well as on selected groups of airlines are analysed. It can be shown that the aviation sector as such will be affected significantly by the new EU legislation whereas certain airline groups will be affected more than others.

1. Legal Framework

In February 2009, the European Union's (EU) Directive for the inclusion of international aviation into the EU Emissions Trading Scheme (EU ETS) for CO_2-emissions came into force (Directive 2008/ 101/EC). Directive 2008/101/EC provides provisions for the first year of the inclusion of aviation into the EU-ETS, hence 2012. From this year onwards, the EU-ETS will cover virtually all flights departing or arriving in the EU. Aircraft operators will be obliged to hold and surrender allowances for CO_2-emissions. Allowances are required for flights by fixed-wing aircraft with a maximum take-off mass of 5,700 kg or above. Flights performed under visual flight rules and rescue flights (amongst a number of other exceptions) are excluded from the scheme. The CO_2-emissions of all airlines under the EU-ETS will be capped on the level of the average of the years 2004-2006, multiplied by 0.97. This way, growth can only be realized by purchasing additional allowances. The initial allocation of emission allowances to airlines will be based on a benchmark which is calculated by dividing the 2004-2006 CO_2-emissions by the transport performance of the year 2010. Initially, allowances will be allocated to aircraft operators mostly free of charge. In the year 2012, 85 % of the allowances shall be allocated for free. Additionally needed allowances can be purchased from stationary sources in the EU without limitations and from project based Kyoto instruments "Joint Implementation" and "Clean Development Mechanism" up to 15 % of the amount of allowances the aircraft operator is required to surrender per year.

The EU Directive for the period 2013-2020 aims at improving and extending the greenhouse gas emission allowance trading system of the European Community (Directive 2009/29/EC). It came into force in June 2009. Due to its broader nature, it adopts regulations for all sectors included in the system and very few aviation-specific rules. It is understood that most of the regulations for the first year of the inclusion of aviation into the EU-ETS which are described above will be further applied. However, the CO_2-emission cap for aviation will be lowered by another 2 % compared to the already remarkable reduction target set for 2012. And the ability to use the project based Kyoto instruments "Joint Implementation" and "Clean Development Mechanism" will be lowered significantly for aircraft operators. In the period 2013 until 2020, aircraft operators may use emission permits from "Joint Implementation" and "Clean Development Mechanism" only up to 1.5 % of the amount of allowances they are required to surrender per year. However, purchasing emissions permits from stationary sources will be possible without limitations.

2. Modelling Approach

How will the inclusion of aviation into the EU-ETS affect the air transport sector both economically and ecologically? In order to analyse this question, an estimation of European aviation's fuel consumption (and hence CO_2-emissions) and the corresponding transport

performance measured in tonne-kilometres is required. This is not an easy task since detailed and publicly available statistics of European air transport sector's CO_2-emissions do not exist to date. Hence, modelling is required. The data basis chosen for our study combines global flight schedules of the Official Airline Guide (OAG) for the years 2004-2010 with an additional DLR developed flight plan for cargo and integrator airlines. On this basis, all flight movements are simulated by DLR aircraft performance software in order to calculate the specific and total fuel consumption and CO_2-emissions. By employing this model, current and future CO_2-emissions and transport performance data of European aviation are estimated.

As the EU-ETS will be introduced in 2012, forecast flight schedules were produced based on the latest available scheduled data. Given the current economic situation, no traffic growth was assumed June to December 2010. For the years 2011-2020, on the other hand, regional growth factors derived from common manufacturers' forecasts [1, 2] were applied to the base year flight schedules. The introduction of more fuel-efficient aircraft, potential improvements in the field of Air Traffic Management and a further increase in terms of load factors were considered by assuming a 1 % efficiency improvement per year resulting in a corresponding reduction of fuel-consumption and emissions per tonne-kilometre. This way, a reliable and best possible estimation of traffic volumes and CO_2-emissions of European flight operations up to the year 2020 could be performed.

It is worth noting that the modelled CO_2-emissions and the transport performance for flights to and from the European Union are not directly comparable to any publicly available data. However, as our model covers not only flights to and from the EU but the global air transport system, it is possible to compare the results for the world-wide transport performance with statistics published by ICAO. It can be observed that, on a global level, the goodness of fit between our modelled transport performance and ICAO data is within a range of 5 %. Generally, it seems that our model overestimates available seat-kilometres (ASK) and revenue passenger-kilometres (RPK) slightly compared to ICAO statistics.

Given the modelled world-wide flight movements, the transport performance in tonne-kilometres and CO_2-emissions, core elements of the upcoming EU-ETS can be calculated. The most important determinants for modelling the economic effects of the upcoming EU-ETS for aviation are the initial allocation of CO_2-emission allowances and the future development of CO_2-allowance prices.

The first step in modelling the initial allocation of the upcoming EU-ETS is the calculation of the total amount of emission allowances available to the aviation sector in the first trading period in 2012. The total constitutes 97 % of the average 2004-2006 historical aviation emissions:

$$\text{Total Allowances}_{2012} = 0.97 \times \text{Historical Emissions}_{2004-2006} \quad (1)$$

As 15 % of the total allowances will be auctioned, the number of allowances allocated to the operators free of charge will be calculated as follows:

$$\text{Free Allowances}_{2012} = 0.85 \times \text{Total Allowances}_{2012} \quad (2)$$

For the calculation of the benchmark, which will be applied for the free allocation of allowances to each individual operator in 2012, the total allowances allocated free of charge will be divided by the revenue tonne-kilometres reported for the year 2010:

$$\text{Benchmark}_{2012} = \frac{\text{Free Allowances}_{2012}}{\text{Reported RTK}_{2010}} \quad (3)$$

The initial allocation for the period 2013-2020 is estimated accordingly with the total amount of allowances being calculated by multiplying the historical emissions by the factor 0.95. Correspondingly, the amount of allowances issued for free and the benchmark applied in this period will decline compared to 2012's levels.

Our assumptions on the price of EU Allowances (EUAs), certified emission reductions (CERs) from Kyoto-based Clean Development Mechanism projects and emission reduction units

(ERUs) from Kyoto-based Joint Implementation projects in the years 2012 up to 2020 are based on the following three thoughts:

1. The carbon price is directly determined by the abatement costs for an additional unit of CO_2. This is because emitters can either abate CO_2 or buy CO_2 permits to comply with their individual reduction target in an ETS. In the course of time, CO_2 abatement in the EU will become more costly due to the tightening of the EU-ETS overall cap. It is reasonable to believe that the ambitious CO_2-reduction target set by the European Commission for 2020 can only be realised by the deployment of CCS coal plants (coal plants that are equipped with carbon capture and storage technology) and renewable energy sources. In the medium term it could become viable at prices of 35 €/t CO_2 to 50 €/t CO_2 (3). For this reason, we assume a maximum price of 50 € per tonne of CO_2 in the period 2008-2020.

2. The progressively rising level of auctioned allowances and the ambitious overall greenhouse gas cap will lead to rising prices for EUAs until 2020.

3. The prices for CERs and ERUs will mirror the EUA price developments because the prices for these project-based permits are in principle also determined by the factors explained above. Due to a higher risk of non-delivery related to CERs and ERUs (compared to EUAs), CER/ERU prices are currently a little lower than EUA prices. We believe that this spread between the prices for both kinds of permits, which amounts to about 5 € at present, will persist in the future.

On this basis, we assume price ranges for EUAs and CERs/ERUs for the years 2008-2012 and 2013-2020 of 15 – 50 €/t CO_2. Taking into account the rather high levels of uncertainty of these future developments, we assume a price spread for each trading period and permit type.

3. Results

The four main results of our analysis can be summarised as follows:

First, if the EU will be politically successful in integrating non-EU carriers into the EU-ETS as planned today, a relatively ambitious CO_2 control will be possible: Our results show that roughly one third of global aviation's CO_2-emissions will be subject to the new regulation.

Second, the benchmark, which is the basis of the initial allocation of allowances to aircraft operators, is estimated by our model at 0.607 kg CO_2 per RTK for the year 2012. In the following years, an even tighter benchmark can be expected. Apart from very few exceptions, virtually all passenger airlines will need to purchase additional CO_2 allowances for their operations in 2012 and beyond. On average, carriers operating from and to EU airports will have to purchase allowances for about one third of their emissions in 2012.

Third, based on the estimated range of future allowance prices (25-50 € per ton of CO_2), the total cost for the aviation sector is expected to be in the range between 1.9 and 3.0 billion € in the year 2012 alone (with a maximum allowance price of 40 €/t CO_2 assumed for this year). As the potential for endogenous emission reduction in the aviation sector is rather low, the airlines will have to buy allowances for about 48.1 million tonnes of CO_2 from stationary sources taking part in the EU-ETS.

Fourth, a more detailed analysis of selected airline groups reveals that resulting from the EU-ETS, European network carriers will be affected by a competitive disadvantage compared to non-EU airlines. For EU-based carriers, the percentage of allowances issued for free compared to the total allowances required will remain below the corresponding level for non-EU carriers. This is because the former operate their feeder network with relatively high specific emissions under the ETS, while the latter operate only long-haul flights to and from Europe. This implies a systematic cost disadvantage for European network operators. This may be subject to change if non-European countries introduce comparable CO_2 reducing measures, as currently discussed in a number of states worldwide.

4. Conclusion

Even though the outcome of the 15th Conference of the Parties (COP15) of the United Nations Framework on Climate Change (UNFCCC) in Copenhagen in December 2009 was almost nil, within the European Union, international aviation will be subject to ambitious CO_2 reductions from 2012 up to (at least) 2020 since virtually all flights starting from or landing at any European airport will be included into the EU emissions trading system from 2012 onwards. Our model-based empirical estimations indicate significant economic impacts on airlines' costs, airfares and competition within the airline sector. In order to avoid competitive distortions within the aviation sector to the most possible extend, the introduction of equivalent CO_2 reducing measures on a global level is highly recommended.

References

1. *Airbus*, 2009. Global Market Forecast 2009-2028. Blagnac Cedex.

2. *Boeing*, 2009. Current Market Outlook 2009-2028. Seattle.

3. *Lewis, M. and Curien, I.*, 2008. It takes CO_2 (Carbon Dioxide) to Contango, Research Report of Deutsche Bank, Fulton Publishing. London.

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COMMERCIAL AIRCRAFT NOISE MODELING. EFFECTS OF AIR TRAFFIC AND AIRPORT INFRASTRUCTURE CHANGES

This paper gives detailed operations data of Lyon Saint-Exupéry International Airport (France) and provides noise contours using the Integrated Noise Model for a short term. This study analyzes the distribution of air traffic, the noise contours, and the impacted areas for the current situation of the airport, and the forecast of the traffic for 2015. It is also shown that the traffic distribution up to now was not optimized for noise reduction.

Introduction

The noise in the vicinity of airports, in particular under take-off and landing flight paths remains highly disrupting the quality of life of local residents. Technological solutions and positive measures taken by airport authorities failed to reduce their impact near airports because of the growth of air traffic [1]. This problem can only be solved within the framework of a global vision for sustainable development involving new technology engines and fuselages, breakthrough technologies, the design of new procedures and flight paths [2, 3], airspace management, new regulation rules and certification [4]. It is a major challenge for the future of air transport in the context of economic development linked to compliance with the conditions of people living near airports. The control of the effects of air traffic around airports can be carried out either by monitoring or by modeling with predictive methods. The second approach is economical and practical, but it could provide erroneous results. It needs continuous validation and optimization. Predictive mathematical models are based on simulation and integrated models [5, 6]. The integrated approach has been mainly selected for the development of aircraft noise predictive models, such as the "FAA Integrated Noise Model" [7]. The mathematical model INM is based on the SAE-AIR-1845 document which is the most worldwide used and accepted model. The software allows the calculation of sound levels in different ways, depending on the nature of the data available. Possible uncertainties due to imprecise input, and therefore the reliability and stability of the model can be reached if compared to data recordings and aircraft noise calculations based on theoretical approach.

The sensitivity of INM and its reliability have been studied. It was quantified for input parameters and criteria for the minimization of global error resulting from uncertainties in the input parameters, were stated [8, 9]. This paper presents details and accuracy of the ICAO and standard landing and takeoff procedures [2, 3], which are considered to be consistent. We calculated, by INM, the noise contour areas (footprints) around Lyon Saint-Exupéry International Airport (France) for which the aircraft type and number of operations are known.

Airport noise and operations data have been used including aircraft fleet mix, runway use, thus enabling independent development of noise contours using the Integrated Noise Model [7]. The most basic parameter that influences the noise contour size is the number of daily aircraft operations which is integrated in this study. Using the detailed data, the relationship between the L_{DEN} [10, 11, 12, 13] contour area and the total number of daily jet aircraft operations is shown.

INM methodology and calculations initial data

1. The airport features are as follow: Since 1975, Lyon Saint-Exupéry International Airport (France) has two main parallel runways presented in the Figure 1.

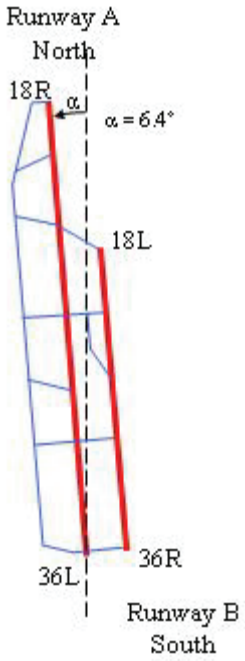

Figure 1: Lyon-St Exupéry International Airport

This topography is used in the INM.

2. The statistical data of the aircraft movements in 2006 is given in the table 1. For 2015 a low traffic progression of 2.5% per annum has been considered. This percentage is estimated using the increase in the number of transported passengers with the constant progression of the rate of filling of aircraft and also taking into account the maximum volume of the traffic, synonymous with a possible saturation.

Table 1

Air traffic

Total of the movements	2006	2015 forecast
	128397	160350
Monthly average	10699.75	13362.52
Daily average	351.77	439.32

The number of movements presents a daily average of 352 in 2006, but it reaches approximately 400 during summer period. The distribution according to the period of the day is the following: day (6h - 18:00) – 70%; evening (18h - 22:00) – 25%; night (22h - 6:00) – 5%.

The air traffic distribution of the airport is presented in the figure 2.

3. Database of INM aircraft: INM aircraft have been used in exception of A340, L1011, L188, B 727-200, B E3A, MD11-GE, TU-154 and Yak-40/42 which seldom land in this airport. Indeed, the traffic of helicopters, representing 270 movements in 2006, has not been considered.

4. Trajectories and procedures: the general distribution of the traffic in 2006 is given in the following scheme. Because of the direction of the wind, 60 % of the departures and 63 % of arrivals are in the north direction. The precise distribution is detailed. Procedures implied a complexity, they are not straightforward, and it is necessary to follow a sequence of stages in order to obtain precise and reliable results. In this paper, the common used procedures are carried out. The standard takeoff procedures for some aircraft have been modified from an “ICAO B”-like procedure to one that applies cutback power at 1000 feet AFE. This may lead to a reduction in contour areas. The ICAO B procedure is still retained as core standard.

5. L_{DEN} and L_{Amax} are calculated and impacted areas (footprints) have been analyzed. Calculation of the significant contributors to the total noise in absolute terms (engines and aerodynamic noise) has been performed by INM.

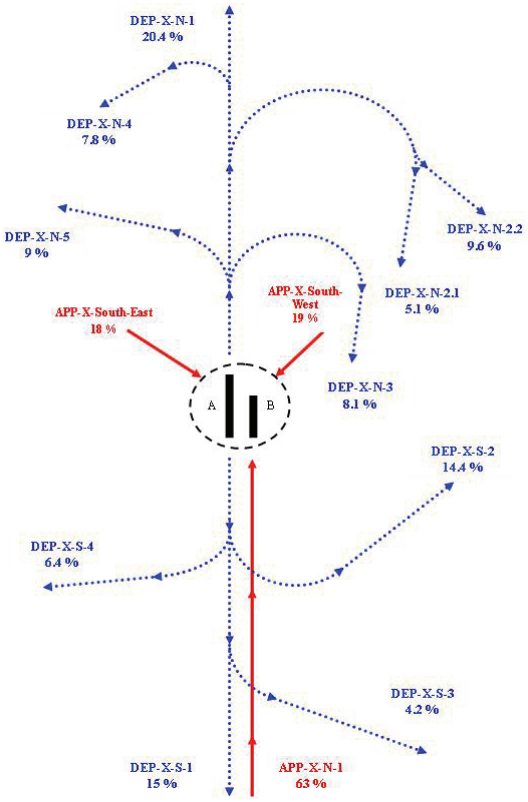

Figure 2: Traffic distribution for 2006 (procedure: APP or DEP – track X: A or B – initial direction: North N or South S – identification number) using the existing runways.

90% of approaches are made on the track B (north or the south direction).

ICAO A procedures have been applied for this airport in the major case compared to the standard ones [13]. Trajectories and procedures are simulated by INM. We noticed that ICAO procedures can not be performed by INM for the whole set of aircraft landing or taking off. ICAO procedures have been used each time when it is possible because of their INM availability. When it is impossible, the standard procedures are performed. Regarding the aircraft load during take-off and the performed slope, we assumed the maximum loadings even if this provides a noisier situation giving significant impacted areas.

Two cases are performed in this paper:

1. Real traffic distribution observed in 2006
2. Traffic distribution forecasted for 2015

Results and discussion

The obtained results are presented in figure 3 according to the official levels of the French Noise Exposure Map recommended by the airport and the environmental authorities “PEB” which provide the Building Permits (50 dB / 55 dB / 62 dB / 70 dB). They are the results of applying standard procedures within INM. Footprint of 2006 air traffic is shown in the form of contours for average daily operations at the airport.

The forms of noise contours are similar and the scenario of 2015 does not present a dramatic aspect with regard to the impact on the population living around this airport. The zones A and B seem to be in favor of the scenario of growth 2015 when approaches are at 90% on the A runway and with a slope of a weak descent of 5%. The zone impacted by aircraft noise is given in table 2.

17.8 % is an average progression of the impacted by noise of the four zones between 2006 and 2015. The zones progression is not homogeneous. What is certain is the extent of the zones in particular towards the critical zones A and B. The evolution of the aircraft technology, the management of the traffic, the design of new procedures of flights, and the renewal of the fleets will certainly have an influence on the impacted areas and their progression between 2006 and 2015. As

described, the estimated data of the traffic in 2015 are based on an annual progression of 2.5% per annum movements.

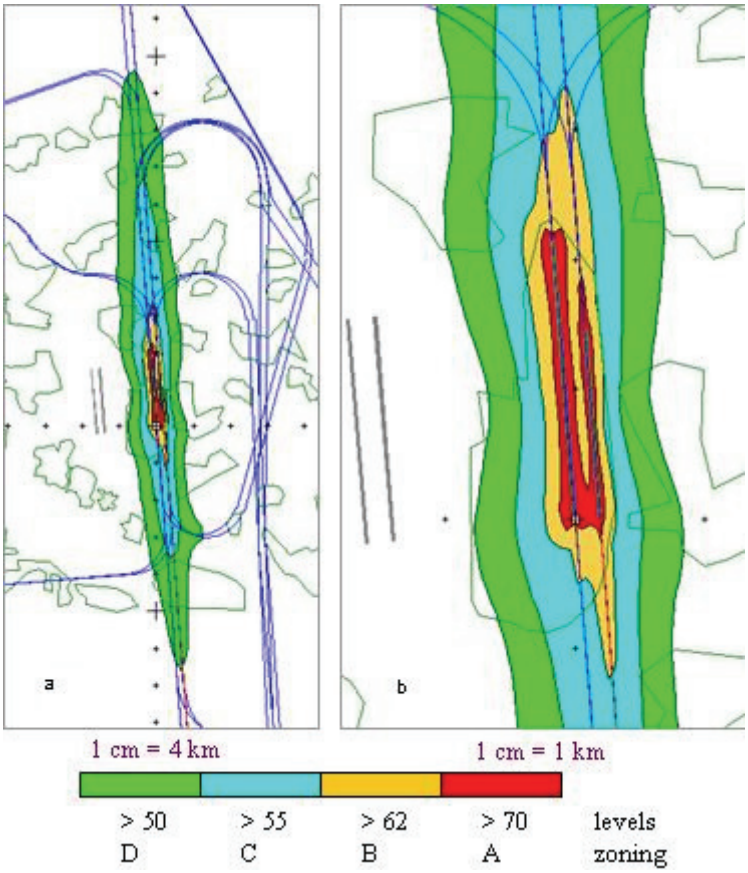

Figure 3: Noise footprint for the air traffic in 2006 and 2015

Table 2

Zone impacted by aircraft noise in 2006 and 2015

L_{DEN} (dB(A))	Area in 2006 (km²)	Area in 2015 (km²)	Evolution 2015 / 2006
Zone D	65.2	76.1	+16.6 %
Zone C	24.7	29.1	+17.8 %
Zone B	5.9	7.0	+18.2 %
Zone A	1.9	2.2	+18.7 %

Conclusions

The INM applied for aircraft landings and takeoffs at Saint-Exupéry Lyon International Airport has used to give and estimation of the airport noise contour areas. This is also performed to provide airport and environmental authorities with the basis of the official noise levels of the French Noise Exposure Map. The analysis reveals the fundamental nature of the noise contours and the various factors influencing their size and shape. The impact of multiple flights has been handled. Consequently, aircraft noise contours can readily be generated by the present analysis. The number and type of aircraft operations characterizing air traffic in 2006 and its prediction of 2015 have been used and noise contours have been established. We provided accurate estimates of both noise contour sizes and shapes.

The total predicted noise at zones around airport, the aircraft type and the air traffic distribution are well defined. Errors and uncertainties in the estimation depending on the aircraft weight, the airspeed calibration and flaps positions have been simplified by the use of aircraft type known. The forms of noise contours are analyzed for the air traffic scenario of 2015 which do not cause a dramatic aspect with regard to the impact on the population living around this airport.

The zones A and B seem to be wider in favor of the scenario of growth in 2015 when approaches are at 90% on the A runway and with a slope of a weak descent of 5 %. 18 % is an average progression of the area impacted by noise in 2015 compared to 2006. The zones

progression is not homogeneous. The evolution of the aircraft technology, the management of the traffic, the design of new procedures of flights, and the renewal of the fleets will have an influence on the impacted areas and their progression between 2006 and 2015. These technological advances associated with the fleet renewal are in favor of slow progression or slowed down zones impacted by the aircraft noise.

We obviously took into account the foreseeable growth in 2015 compared to the current situation for which we suggest an additional increase by 30% due to the new management rules of the traffic on the new runways. Aircraft noise and noise contours around airport have been carried out by considering fixed-points because we obtained precise values for distance source-receivers and by segmentation of flight paths. Different flight procedures are simulated for the air traffic distribution. It is shown that air traffic distribution up to now was not optimized for the reduction of the noise impact on the population living around the airport.

References

1. *Kannepalli, C., Kenzakowski, D. C. and Dash, S.M.* (2003). Evaluation Of Some Recent Jet Noise Reduction Concepts. Paper No. AIAA-2003-3313, 9th AIAA/CEAS Aeroacoustics Conference & Exhibit, Hilton Head, SC.

2. *Zaporozhets O. I., Tokarev V.I.* (1998). Predicting Flight Procedures for Minimum Noise Impact. Applied Acoustics, Vol. 55, N°2 - Great Britain

3. *Zaporozhets O. I. and Khardi S.* (2004). Optimization of aircraft trajectories as a basis for noise abatement procedures around the airports. Theoretical considerations and acoustic applications. Les collections de l'INRETS. Rapport INRETS n° 257. 97 pages.

4. *European* Civil Aviation Conference (ECAC, 1997). Doc 29 (2nd edition)

5. *Hullah P, Cavadini L.* Aircraft noise modeling validation through the use of full 4-D flight trajectories including thrust calculation. In: Fourth FAA / Eurocontrol R&D Conference

6. *SAE AIR 1845*, Aerospace Information Report, "Procedure for the calculation of airplane noise in the vicinity of airports". Prepared by SAE committee A-21, aircraft noise.

7. The Integrated Noise Model (2007). FAA: The Federal Aviation Administration (USA). http://overflights.faa.gov/.

8. *Error* Sensitivity Analysis of the Integrated Noise Model, doc, EUROCONTROL Experimental Centre. EEC/ENV/2002/006, 2002

9. *Clemente F.J.* Uncertainties in Aircraft Noise Modeling. Institute of Sound and Vibration Research, Southampton, United Kingdom, 2003

10. *Nelson P.M.* (1987). Transportation Noise reference book. Butterworth & Co. Ltd. Part. Aircraft Noise

11. *Smith M.J.T.* (1989). Aircraft noise, Cambridge Univ. Press

12. *Commission* of the European Communities (CEC, 1999). DG XI. Working group on noise indicators. Position paper on EU noise Indicators

13. *Koppert A.J.* (2000). Fact sheets on different European noise calculation methods (RLD)and Signal Processing ICICS. Volume 3, 1593 – 1597

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USING ANALYTICAL HIERARCHY PROCESS FOR AVIATION ENVIRONMENTAL DECISION MAKING AND INTERDEPENDENCY MODELING

As legislation governing air quality, emissions and noise pollution becomes increasingly stringent, environmental impact assessment is undoubtedly of paramount importance. In recent years, significant progress has been made in both physical monitoring and computer modeling of these problems. Yet, the decision making process into which such data feeds is a complex one in which multiple criteria must be compared, compromises agreed and quantitative data combined with qualitative information and subjective opinions. As yet, there exists little agreement on the best way of considering such a myriad of information using a single, consistent method.

In this paper, we explore the application of multi-criteria decision making, specifically the application of analytical hierarchy process (AHP) as a method of allowing quantitative, qualitative and subjective data to be combined into a single, statistical and self-defining model that could greatly assist in decision making and interdependency assessment. Using realistic test cases run by industry experts, we aim to provide a summary of the methodology, identifying its strengths and weaknesses in the context of aviation environmental decision making. We conclude by suggesting areas of current research and development in which this model could have immediate application.

Related topic areas:

14. Operations research in air transport: modeling and / or applications
15. Air transport and the environment
16. Air transport and other social sciences
17. Airport economics, policies, planning and/or operations

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STATE SYSTEM OF ASSESSMENT OF GREENHOUSE GASES EMISSION IN AVIATION SECTOR

In-service aircraft engines burn fossil fuel refined from petroleum and produce emissions of greenhouse gases, particularly carbon dioxide. Aviation is estimated to contribute currently about 2% of the global CO_2 emissions, with international aviation's contribution estimated to be a little over half of this amount or 1%. International Civil Aviation Organization (ICAO) recognized in adopted Resolution A36-22 (2007) "Consolidated statement of continuing ICAO policies and practices related to environmental protection", *inter alia*, "…the critical importance of providing continuous leadership to international civil aviation in limiting or reducing its emissions that contribute to global climate change". Group on International Aviation and Climate Change (GIACC), formed by ICAO (with technical support provided by the Committee on Aviation Environmental Protection – CAEP), agreed on a global annual fuel efficiency improvement of 2% for the medium-term (up to 2020) and an aspirational global annual fuel efficiency improvement of 2% for the long-term (up to 2050). These goals are unlikely to deliver the level of reduction necessary to stabilize and subsequently reduce aviation's absolute emissions contribution to climate change, and that more ambitious goals will need to be considered to deliver a sustainable path for aviation.

Approach to the problem of greenhouse gases (GHG) emission, produced by international civil aviation, is one of the number of vexed questions considered within the framework of process of United Nations Framework Convention on Climate Change (UNFCCC). The main reason that UNFCCC and Kyoto Protocol on Climate Change eliminate this sector from the obligations under reduction/limitation of the emission. GIACC considered this sphere of activity on the 3-th and 4-th conferences, taking into account recommendations of own working groups and results of CAEP on evaluation of present level of the CO_2 emission and quantitative definition of future tendencies in regard to CO_2 emission and rise of fuel efficiency of the global aviation system during a period within 2006 and 2050 years.

ICAO Member States use today all existing measures for solution of the problem of international aviation GHG emission and widely support the basic elements of different suggestions, in particular in relation to the use of wide range of approaches, including a complex of measures of technical and operating character. However expediently to get the greater volume of information, with that the States could make grounded decisions in relation to the most economic effective and carefully thought scopes of the strategy and measures for providing to reduce the aviation GHG emission by means of estimation of consequences of all measures in use. In whole the working group of GIACC/4 agreed that without the developed ICAO scopes all the market measures, implemented by the States or Regions, with different principles and parameters in use, are far from optimum.

Current negotiations under the UNFCCC process on a new global agreement to address climate change beyond 2012 have touched upon different aspects of dealing with GHG emissions from international aviation. Such aspects include: targets and baselines; guiding principles (e.g., the principles and provisions on common but differentiated responsibilities and respective capabilities under the UNFCCC and the Kyoto Protocol); means for implementation (including financial issues); and the specific roles of ICAO and UNFCCC. Thus far, no agreement has been achieved on any of these issues.

National systems of environment protection must include today a whole number of possible elements of GHG emission control. In Chapter X «Protection of natural environment» of the current draft of Air Code of Ukraine it is declared in the Art. 87, item 6: «Market measures, including application of the emission quotas trade system in relation to operators of the aircraft are used for achievement of ecological goals with less expenditures and more effectively, than traditional normative measures. They must be implemented only taking into account the recommendations of International Civil Aviation Organization and on the basis of mutual agreement between the Contractual States».

In Russian Federation (RF) for pursuing a state policy, and also for implementation of current liabilities of the state on preparation of the annual National Report on the anthropogenic emission, including the contribution from aviation sector, presented in accordance with the Art. 4 and 12 of UNFCCC and Art. 7 of Kyoto Protocol, the state system of assessment of GHG emission in the aviation sector as a result of activity of civil aviation must be created. In RF a scientific research is carried out for that on a theme: «Development of the system of estimation of the anthropogenic GHG emission and emission of contaminating matters in civil aviation and preparation of annual statistical report».

On results of the analysis of international and national approaches to realization of monitoring of the anthropogenic emission, defined by civil aviation activities, an optimum methodical approach to estimation of the emission of GHG for RF civil aviation will be chosen. On the basis of this approach the method of estimation of the anthropogenic emission from the civil aviation sector will be developed. To provide the most optimum result on the given point the concordance is initially assumed with the RusHydroMet (Federal Service on Hydrometeorology and Monitoring of Environment) form and data composition on civil aviation activities in RF during 2009. It is necessary for the inclusion in the National Report and National Cadastre of GHG emission, because in accordance with Order of Government of Russian Federation from March, 1, 2006 №278-r, RusHydroMet is an authorized organization on conducting of estimation of GHG emission in RF, and also in preparation of the National Report and Cadastre. Within the framework the monitoring features of the anthropogenic GHG emission will be investigated also, such as it is carried out by RusHydroMet with the use of the methodical guides accepted within the framework of UNFCCC, both in aviation industry, and in the non-aviation industries of national economy, attended with incineration of oil-fuel. European Union normative base will be used too, which is determining an order and features of GHG emission input data for airlines (Monitoring and reporting guidelines, Commission decision on 16 April 2009, 2009\339\EC). The list of measures on work organization of the national system of monitoring and estimation of the anthropogenic GHG emission from the results of civil aviation activities will be developed, with pointing of terms and volumes of information necessary for providing of the stable functioning of the system, and also normative documents, which it will be required to confirm.

The analysis of existent RF statistical base will lie in the basis of work, including data of state statistics, data about the volumes of the GHG emission in different sectors of economy, prepared on the regular basis by RusHydroMet, and also the statistical data of RF aviation industry.

UDC 656.7.076 (043.2)

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AIRCRAFT AND AIRPORT DE-ICING TOXICOLOGICAL IMPACT ON ENVIRONMENT

Aircraft de-icing fluids are used at Ukrainian airports to remove ice and snow which accumulates on aircraft. Heated de-icing fluid is sprayed on the aircraft: the major portion of the fluid spills onto the apron and eventually enters the airport sewer collection system. Urea and glycol are also cheaper than less toxic de-icers based on potassium acetate. Glycol, the main component of the de-icing fluid, exerts an extremely high oxygen demand: consequently, discharge of untreated run-off into receiving waters will result in a rapid depletion of available dissolved oxygen.

Ethylene glycol (1,2-ethanediol) is the major component of many antifreeze: coolant and deicant formulations. Its use as an aircraft: runway deicant ensures that it is a major but intermittent pollutant of surface waters in the vicinity of those airports where it is used.

The use of ethylene glycol deicants at airports and on roads results in episodically high concentrations in nearby waterways. In the winter of 1971–1972, the concentration of ethylene glycol in the storm water runoff at the Montreal International Airport ranged from below detection levels to as high as 4780 ppm, with 7 consecutive days in March above 1000 ppm [1,2]. Other high concentrations that have been reported in storm water runoff have been; 3100 ppm at Toronto's Lester B. Pearson International Airport; 3130 ppm at Salt Lake City International Airport; 5050 ppm at Denver's Stapleton International Airport [3]. Therefore, while aquatic organisms in such sites periodically experience high concentrations of ethylene glycol, the precise levels to which they are exposed are largely unknown.

Schulz and Comerton [2] recommended that no treatment of runoff from runways was required because urea was 'a minor pollutant of low toxicity', a view supported by Stewart and Kaul (1986). Its hydrolysis however produces ammonia. Ammonia toxicity is primarily due to un-ionised ammonia. It has been extensively studied in fish and has been found to be greatest at low levels of dissolved solutes, oxygen and pH [4].

Because of the episodic nature of the urea pollution, routine chemical monitoring was not the most effective technique for detecting its occurrence in the system. Continuous water quality monitoring has the advantage that it can record such events as they happen and proved useful in this study [5]. However water quality loggers are costly and notoriously difficult to maintain, and because of the limited range of available sensors are unable to detect the majority of toxins.

Because of bio-accumulation, the three biological techniques responded to the intermittent pollution which may have otherwise been missed. The bacterial analysis revealed concentrations of bacteria indicative of urea pollution long after de-icing had ceased. The integrated use of a range of techniques appears to give a better explanation of the causes, mechanisms and effects of episodic de-icing pollution than the use of any single method.

References

1. J.T. Barber et al. The physiological consequences of ethylene glycol-induced changes in the frond structure of *Lemna gibba // Aquatic Toxicology* 45 (1999) 253–264

2. Schulz, M., Comerton, L.J., 1974. Effect of aircraft deicer on airport storm runoff. J. Water Pollut. Control Fed. 46, 173–180.

3. Sills, R.D., Blakeslee, P.A., 1992. The environmental impact of deicers in airport stormwater runoff. In: D'Itri, F.M. (Ed.), Chemical Deicers and the Environment. Lewis, Chelsea, MI, pp. 323–340.

4. Szumski, D. S., Barton, D. A., Putman, H. D. & Polta, R. C. (1982). Evaluation of EPA un-ionized ammonia toxicity criteria. J. *Water Pollut. Contr. Fed.,* 54, 281-91.

5. D. A. Turnbull & J. R. Bevan. The impact of airport de-icing on a river: the case of the Ouseburn, Newcastle upon Tyne // *Environmental Pollution 88* (1995) Elsevier Science Limited. – p. 321-332

UDC 665

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GAS TURBINE & SOFC APU BASED CO_2 EMISSIONS IN TURKEY AND UKRAINE

Aircraft based emission characteristics are drawn according to Landing and Take-off cycle (LTO) for engines and auxiliary power units (APU). In this document, we will examine both classic gas turbine (GT) and solid oxide fuel cell (SOFC) APU based CO_2 characteristics in Turkey and Ukraine according to annual LTO data.

APU typically provides 30-45 PSI bleed air. This air is taken from the load compressor or the power compressor and used for main engine start, air condition system and de-icing system. APUs with load compressor have lower fuel consumption. Because; if the aircraft does not need bleed air, pilot can disarm the load compressor. Thus, this system can overcome EGT (Exhaust Gas Temperature) limits and prolong APU life [1].

The other main task of APU is the production of electrical energy which is necessary for the aircraft systems such as back-up purposes. This electricity is provided by the AC generator which is operated by the gear box. Unlike the main generators the APU generators, does not have CSD (Constant Speed Drive). APU fuel control unit provides fixed-speed operation. Figure 1 shows main sections of a classic GT – APU [1].

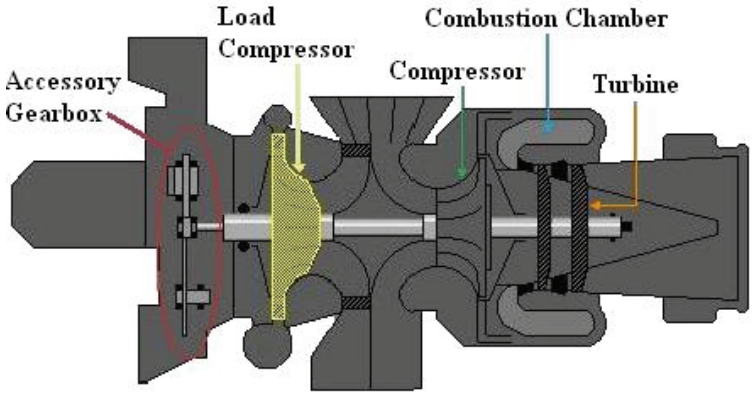

Figure 1. GT - APU Sections [1]

SOFC AUXILIARY POWER UNIT

In principle, a fuel cell operates like a battery. Unlike a battery, a fuel cell does not run down or require recharging. It will produce energy in the form of electricity and heat as long as fuel is supplied. A fuel cell consists of two electrodes sandwiched around an electrolyte. Oxygen passes over one electrode and hydrogen over the other, generating electricity, water and heat. There are different types of fuel cells such as [2];

- Phosphoric Acid fuel cell (PAFC)
- Direct Methanol fuel cell (DMFC)
- Proton Exchange Membrane fuel cell (PEM)
- Regenerative fuel cell

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- Molten Carbonate fuel cell (MCFC)
- Solid Oxide fuel cell (SOFC)
- Alkaline fuel cell (AFC)
- Zinc Air fuel cell (ZAFC)
- Protonic Ceramic fuel cell (PCFC)
- Microbial fuel cell (MFC)

There are several experiments in the literature about PEM and SOFC applications in aviation.

A fuel cell system which includes a "fuel reformer" can utilize the hydrogen from any hydrocarbon fuel - from natural gas to methanol, and even gasoline. Since the fuel cell relies on chemistry and not combustion, emissions from this type of a system would still be much smaller than emissions from the cleanest fuel combustion processes [2]. The system configuration is shown in Figure 2;

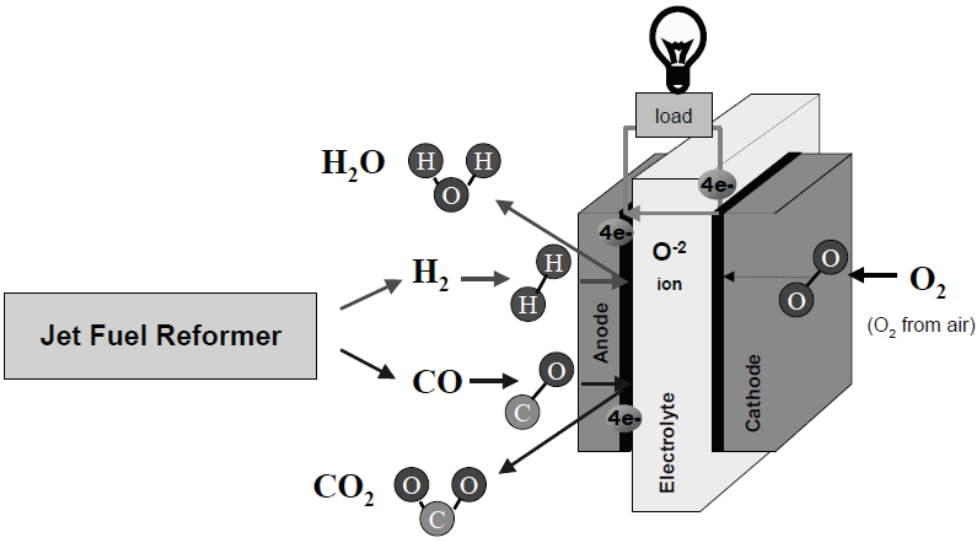

Figure 2. System Description of SOFC-APU with Jet Fuel Reformer [3]

Figure 3 shows the eliminated ground based emission sources with the use of fuel cell technology during aircraft ground operations [4];

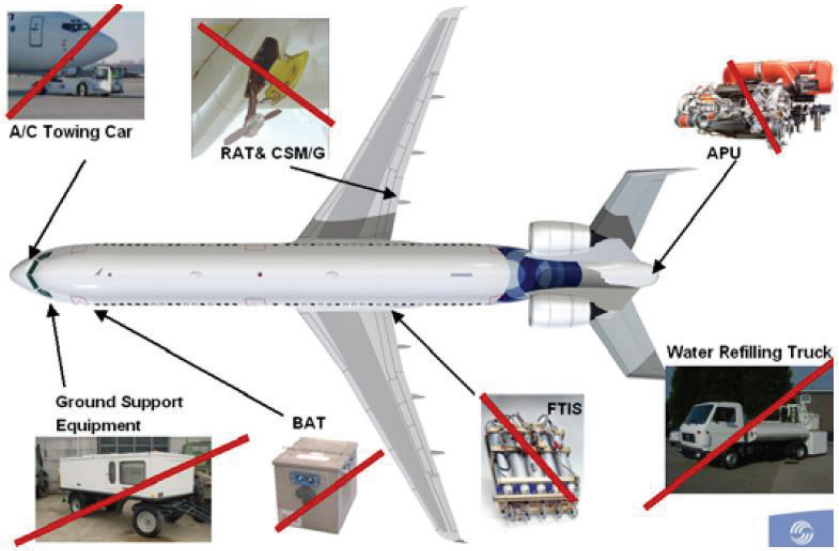

Figure 3. Ground based emission sources to be brought away by fuel cells [4]

METHODOLOGY

ICAO defines simple, advanced and sophisticated approaches for emission calculation methods for APU. In this document simple approach was applied and APU operation time taken from ICAO's data as 45 minutes per LTO [5].

Winther et. al., were examined the real time fuel consumption value for a classic GT APU. The APU model is Honeywell GTCP 131-9A, 131 HK which is mostly used in Airbus 321-200, Boeing B737 and MD90 series of aircrafts. The given fuel flow is 0.013 kg/s [6].

Liming Shi and David J. Bayless have analyzed jet fuel reforming for SOFC-APU applications in aircrafts. The fuel consumption given by them for SOFC based APU with jet fuel reformer is 4.12 gal/h. This type of APU can generate enough power such as Boeing 737 series aircrafts [7].

Weight gain after system changes and the increase in emissions resulting from this extra weight are ignored.

Total fuel consumption per LTO calculated and applied to total LTO numbers in Turkey and Ukraine. Figure 4 shows total LTO numbers in Turkey and Ukraine and Figure 5 shows total fuel consumption of classic GT and SOFC based APU.

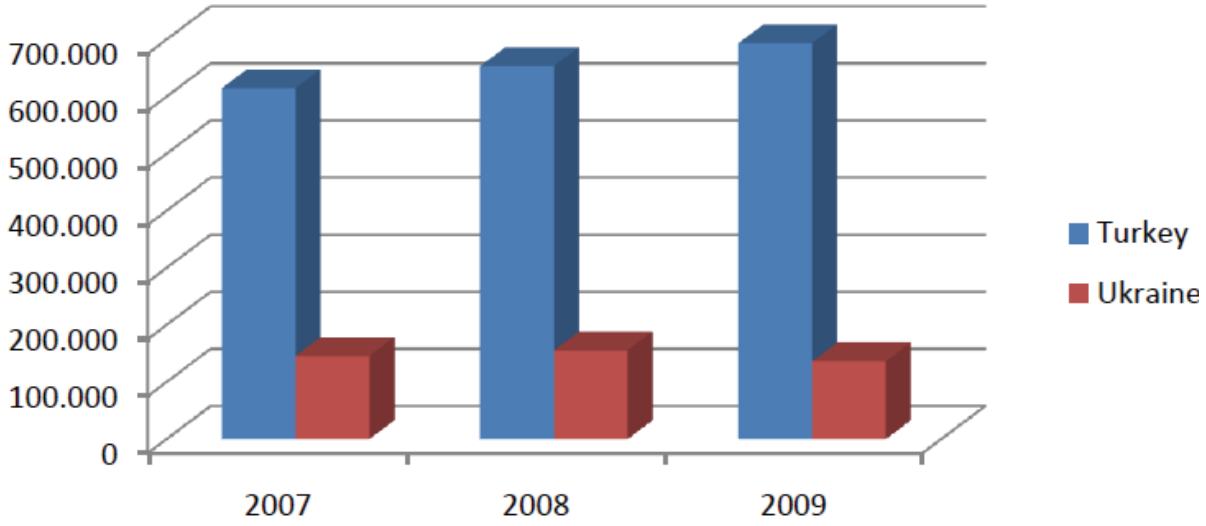

Figure 4. Annual LTO Numbers in Turkey and Ukraine (LTO/yr) [8, 9]

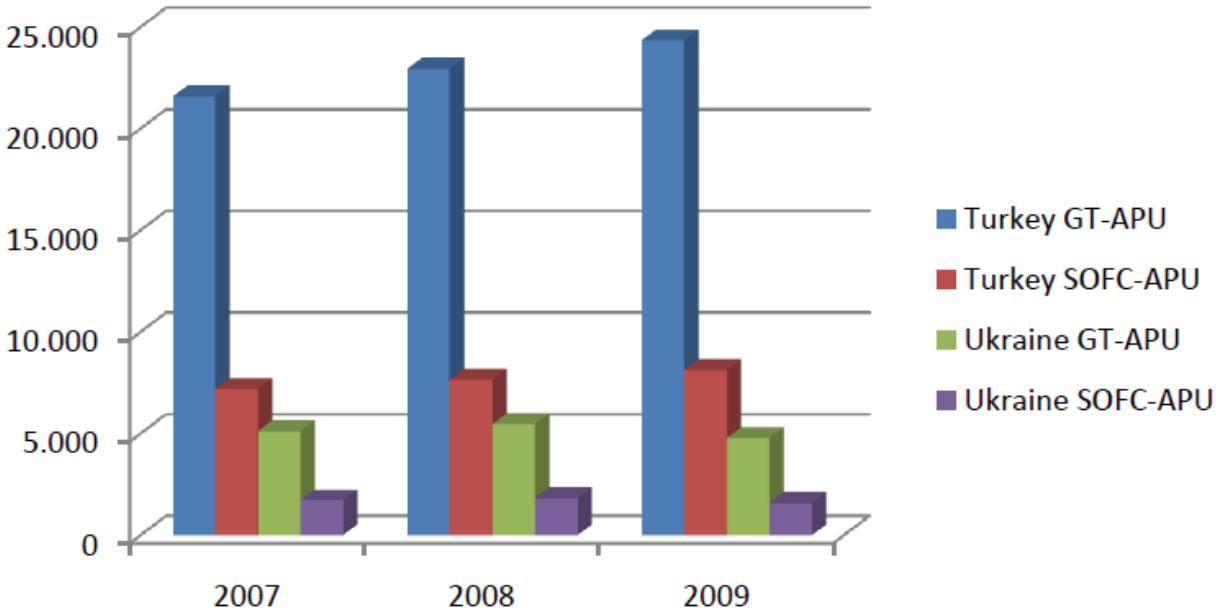

Figure 5. Total Fuel Consumption of GT and SOFC Based APU in Turkey and Ukraine (Metric ton/year)

RESULTS AND DISCUSSION

Due to its nearly constant carbon to a hydrogen ratio, the combustion of one kilogram kerosene directly results in about 3150 g carbon dioxide (CO_2), about 1240 g water (H_2O) and leads to an average 0.6 g sulphur dioxide (SO_2) [10]. By using those numbers CO_2 values for Turkey and Ukraine was calculated and shown in Figure 6;

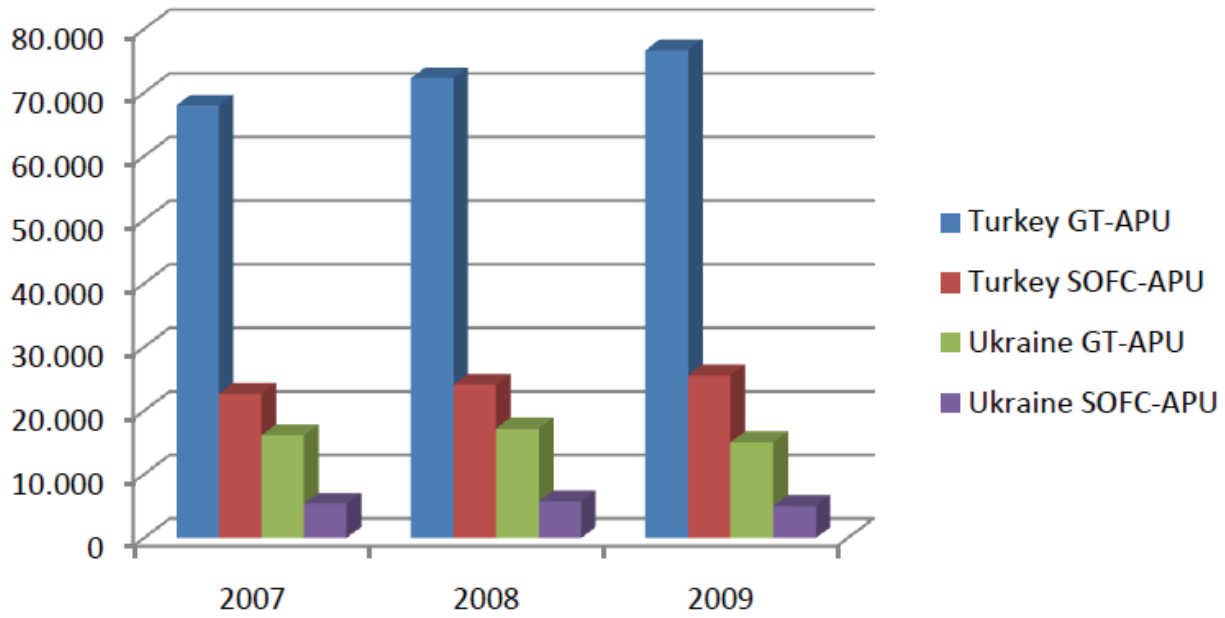

Figure 6. CO_2 Emissions of GT and SOFC Based APU in Turkey and Ukraine (Metric ton/year)

Results show that with SOFC-APU usage, APU based CO_2 production would decrease by 0.66 in Turkey and Ukraine.

References

[1] *Karakoc T. H. and Turgut E. T.,* Gaz Türbinli Motor Sistemleri, Anadolu University, School of Civil Aviation Publications; No. 17, Eskisehir, 2008 (Turkish)

[2] *The Online Fuel Cell Information Resource* - www.fuelcells.org [Accessed in May 2010]

[3] *Daggett D.,* Commercial Airplanes – Fuel Cell APU Overview, presented at SECA Annual Meeting in Seattle, WA on 15 April 2003

[4] *International Coordinating Council of Aerospace Industries Associations*, Non-Drop In Fuels And Advanced Aircraft System Power Technologies, presented in Conference On Aviation And Alternative Fuels, Rio de Janeiro, Brazil, 16 to 18 November 2009

[5] *ICAO Secretariat*, Airport Air Quality Guidance Material (ICAO – Doc 9889, 15.04.2007)

[6] *Winther M.,* Kousgaard U. and Oxbøl A., Calculation of odour emissions from aircraft engines at Copenhagen Airport, Science of the Total Environment 366 218– 232 (2006)

[7] *Shi L.and Bayless D. J.,* Analysis of jet fuel reforming for solid oxide fuel cell applications in auxiliary power units, International Journal Of Hydrogen Energy 33 1067 – 1075 (2008)

[8] *General Directorate of State Airports Authority of Turkey* - http://www.dhmi.gov.tr/istatistik.aspx [Accessed in May 2010] (Turkish)

[9] *Ukrainian State Air Traffic Service Enterprise (UkSATSE)* - http://www.uksatse.ua/index.php?act=Part&CODE=229#stat [Accessed in May 2010] (Ukrainian)

Dopelheur, A., Aircraft Emission Parameter Modelling, Air and Space Europe 2: 34-37 (2000)

SYMPOSIUM 5

AVIATION CHEMMOTOLOGY

UDC 665

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ECOLOGICAL PERSPECTIVES OF DIESEL FUEL USE FOR REDUCTION OF POLLUTANT AND CO_2 EMISSIONS

This paper will provides an analysis of the consequences the new technologies will have on diesel fuels formulation strategies, determining what could be the future relevant parameters for diesel fuels and will propose alternative strategies for diesel fuel formulation, taking into account the products that can be expected for the next future: conventional fuels, advanced fuels, first and second generation biofuels, synthetic fuels.

As environmental constraints are increasing with the need to diversify energy sources to preserve sustainable development, automotive manufacturers and refiners will have to handle two major challenges over the next few years:

· Reductions in greenhouse gas emissions, strongly linked to energy savings,

· Limits on local pollutants such as CO, unburned hydrocarbons (UHC), NOx, PM, O_3 and noise, to improve quality in urban environments without undermining economic development.

Diesel engine is one of the most promising candidates able to meet these challenges realistically; in Europe, the market share of diesel vehicles is continuously increasing. To fulfill future requirements, technology providers will have to invest in new combustion processes and to improve diesel fuel formulation.

European context: EuroV level, alternative fuels

Particulates and NOx will be by far the most troublesome diesel engine emissions to be addressed by the Euro V standards. This emission limit has been set so that reductions can be achieved by further internal engine improvements, without NOx post-treatment. As the technology for further NOx reduction is still to be established definitively, it is therefore proposed not to reduce NOx emissions below 200mg/km. Besides, a strong weight reduction (80%) in particulate emissions from diesel vehicles will be required. This low emission limit will de facto require the introduction of diesel particulate filters (DPFs). At a later stage, a new standard limiting the emission of particles taking into account their size ranges can be expected.

The high thermodynamic efficiency and consequently, low CO2 emissions of diesel engines could attract an increasing part of the automotive market. Considering CO_2 emission targets, European car manufacturers are committed to reduce the new car fleet average CO_2 emission to less than 140 g/km. If the current trend is maintained, the target could be reached, but the trend so far is largely due to diesel's increasing market share. To keep the curve slope, significant improvements in both gasoline and diesel will be necessary.

For NOx reduction, SCR is a solution which is becoming effective for industrial use and, overall, for heavy duty vehicles. Its implementation for cars is still under development. De-NOx catalysts and NOx-traps need some improvements to be strongly competitive. Issues involving durability, sensitivity to sulphur and high cost need to be cleared up.

Particle filters are very active after pollutants have been produced. An alternative approach could be to curb pollutant emissions upstream in the combustion chamber. Modifications in the combustion process to produce fewer pollutants have to be studied. Advanced combustion processes used in HCCI engines have been investigated with very promising perspective in terms of NOx and PM emissions. However, hydrocarbon (HC) and carbon monoxide (CO) emissions remain high at full load, and limit both operating range and power output. Further, Euro V emission levels will not be reached without further technology adaptations such as active, for example, management of the cooling function.

Considering this evolution, it appears that two strategies could enable manufacturers to at least comply with the drafted Euro V emission standards: the use of conventional engine technologies coupled with advanced post-treatment, particularly DPF, and the development of new technologies using advanced combustion processes that could need a more simple post-treatment strategy.

Diesel Engine Technologies: developments in conventional diesel engines

Many technological improvements have been recently developed to comply with increasingly severe regulations and to improve an engine's specific consumption. Direct injection of diesel fuel is now common practice, together with the introduction of post-treatment devices such as the oxidation catalyst which enables a better control of emissions of CO, UHC and, to a lesser extent, particulates. General acceptance has been rapid for the high pressure (up to 2000bar) direct injection diesel engine, such as the "Common-Rail" or "Unit Injector".

Moreover, turbocharged engines with pre-injection are making further progress, especially regarding reduced fuel consumption.

Plans for the near future include obtaining very low pollutant emission levels simultaneously with lower consumption aimed to reduce CO_2 emissions. To reach this target, several strategies will be used: continued engine downsizing, closer control of the injection process, through increased injection pressure, multiple injection points and reduced injection hole diameters, increased application of turbo charging and introduction of variable valve timing, expanding use of exhaust gas recirculation (EGR), advanced post-treatment devices, especially DPFs and NOx traps.

Diesel Engine Technologies: development of advanced diesel engines

To pass the emission requirements for near-zero pollutants and low CO_2 levels, which are the challenges for future power trains, many research efforts are currently carried out worldwide on new engine combustion processes, such as the LTC (Low Temperature Combustion) and the Homogeneous Charge Compression Ignition (HCCI). These new processes have the potential to reduce NOx and particulate emissions (PM) by a factor between 10 and 100 compared to conventional gasoline or diesel engines. The main issue in developing such combustion modes remains the limited ranges of engine speed and load that enable good engine operation according to required levels for NOx and noise emissions.

To overcome limitations in power output, IFP developed a "dual mode" engine. The engine uses highly premixed combustion (HPC) at low and medium loads to reach very low NOx and particulate emissions, and conventional diesel combustion at high load, to reach diesel engine power and torque standards. This means that the combustion system should be able to switch between the two combustion modes.

To achieve highly premixed combustion (HPC) and globally to control closely the HCCI combustion process, it is important to mix fuel and air properly prior combustion. It is also important to control and develop the combustion auto-ignition phase. A very efficient method to do it is to reduce air temperature and oxygen content. This is the reason why high EGR and internal gas recycle (IGR) rates, reduced compression ratios (values between 14:1 and 16:1), and an EGR cooler need to be considered. Ultimately the added benefit is a lower combustion temperature.

The diesel engine will then continue its technical development and this evolution process will have significant consequences on the fuel requirements.

Alternative pathway

Diversification of the energy sources and the proposal of solutions having high potential for CO2 reduction are among the major research axis. As a prelude, let us precise that every pathway have to be explored for their global performances, which means taking into account the CO2 emission balance from well to wheel. Following will be consider possible alternative pathways, with special attention given to biofuels, which have very positive CO_2 balance.

Since many years, the biodiesel label was only given to the methyl ester of fatty acids. Since the beginning of the century, biodiesel covers a larger spectrum of compounds: FAME but also

FAEE (Fatty Acid Ethyl Esters) and synthetic fuel obtained from biomass (called synthetic biodiesel).

FAME and FAEE are obtained by transformation of biomass products (vegetal oils) by reaction with an alcohol (methanol or ethanol). This process, called trans-esterification, aims at converting the oil (obtained by treatment of the seed) into an ester which properties are close to EN590 diesel fuel. These products are identified as "First generation Biodiesel".

Nowadays, methanol is commonly used to get FAME (Fatty Acid Methyl Esters). Some strict specifications have been defined on these products, such as EN14214 in Europe, to enable their use as diesel fuel bases without major risk. In Europe, biodiesel is a blend of RME and SME and is used either without being mentioned, according to EN590 specifications up to 5% in volume, or at higher levels: B100 in Germany, B30 in France on dedicated fleets.

Due to its properties: cetane number, distillation curve, lubricant effect…, biodiesel has demonstrated since the beginning of the 90's its potential as a diesel fuel substitute, in terms of combustion and pollutant emissions. Further, the studies done on modern engine technologies do not reveal any issue die to compatibility. Yet, some parameters still have to be closely controlled, especially those that could be linked with the product oxidation stability.

Now it is proposed to replace methanol with ethanol to produce Fatty Acid Ethyl ester. The main advantage of this new pathway lies in the opportunity to use bio-ethanol instead of methanol produced from fossil fuels. The technical characteristics of FAME are not strongly different from those of FAME and substitution could happen without major concern. In the next future, an enlargement of the raw material used to produce biodiesel can be foreseen, including animal fat, the final biodiesel product having to remain in line with the EN14214 specification. CO_2 balance and compatibility with engines give to this pathway a very promising potential. The main drawback of FAE are linked with the co-products. To reach high CO_2 reduction levels, the valorisation of the co-products is mandatory.

A lot of research is currently been led to find ways to use the entire plant, which means to make diesel fuel not only with the corn, but also the cellulosic parts. One promising way uses processes such as gasification / Fischer-Tropsch synthesis. This process, commonly called BtL (Biomass to Liquid), allows using various types of plants (farming products, but also trees) to synthesize a liquid diesel fuel.

Moreover these products, called synthetic biodiesel or second generation biodiesel are characterized by a simple composition: pure paraffinic products, no aromatics, no sulphur, high cetane index, density around 0.775, high H/C ratio, properties similar to those of the synthetic GtL diesel fuels. This gives them a very high potential either when used pure as fuel or as high quality diesel fuel bases. Of course, these properties allow a strong reduction in pollutant emissions of vehicles (over 60% reduction of CO emissions, over 40% reduction of HC emissions, 20% to 50% reduction of PM emissions).

Another pathway to produce second generation biodiesels is the transformation through direct high hydrotreatment of renewable raw material such as vegetal oils, followed by a post-treatment to obtain diesel fuel cuts with characteristics similar to those already described. The most well-known products of this category, called NextBtL (or NExBTL), are produced through a process developed and patented by Neste Oil and are currently developed with the support of Total.

The process converts biological triglycerides – such as vegetable oils and animal fats- to a high quality diesel fuel. The products can be directly incorporated in the diesel fuel, as BtL or use as a pure component.

Synthetic diesel fuels account among the important alternatives, using as raw material either natural gas, or coal to produce the Syn Gas which, via a Fischer-Tropsch synthesis will lead to components with high quality as Diesel fuel.

These products have a high potential as diesel fuel, either used pure or as diesel fuel bases, taking benefit from the lack of aromatic compounds, sulphur and of their high cetane number. These products offer very significant performances for the reduction of pollutant

emissions (over 60% reduction of CO emissions, over 40% reduction of HC emissions, 20% to 50% reduction of particulates emissions), but their CO_2 emissions should also be considered in terms of well the wheel balance. On this point, this pathway still need strong efforts.

Perspective

In the coming years, the development of diesel engines will continue, with an increasing market share of engines having very low pollutant emission levels, highly turbocharged, and with direct injection at very high injection pressure. Simultaneously, the homogeneous combustion mode for diesel engines appears a very promising alternative with interesting possibilities concerning the control of particulate and NOx emissions from their origin. These technical developments will generate increased demand for advanced fuels. Future diesel fuels will have to contribute to a better control of pollutant emissions such as particulate matter via the control of their polyaromatics content. Moreover, the coexistence of homogeneous and conventional combustion modes within the same engine could lead to emerging needs to control the auto-ignition and volatility of diesel fuels, lead to "technological" fuels.

However, considering the time it takes to renew the diesel automotive fleet, it will take several years before advanced diesel fuels and engines achieve a significant share of the market. In parallel, as described by the European Directive, biofuels will certainly increase their market share due to their very advantageous CO_2 balance and on their good compatibility with the advanced diesel engines. It is then toward largely open areas that diesel fuel formulation will evolve in the next future.

Yet, advanced diesel fuels and second generation Biodiesel will be accessible only in a medium term, whereas the NextBtL pathway could quickly emerge. The other synthetic diesel fuels have large development perspectives but their evaluation should consider them globally, taking into account their CO_2 emissions.

UDC 665

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AIRCRAFT SCRAP TIRES TREATMENT AND UTILIZATION: TRENDS AND PERSPECTIVES

Described a problem of aircraft scrap tires accumulation, main features and differences in comparison with scrap tires for land transport, as well as the basic methods of disposal and recycling, the advantages and disadvantages of using these methods for aircraft scrap tires.

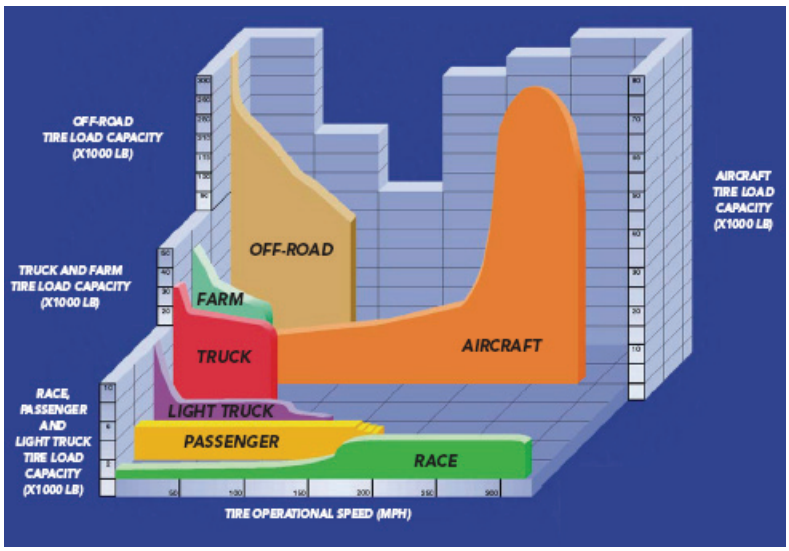
It is well-known that ground transport is a main source of scrap tires formation. Tires for passenger and truck vehicles, for special and agricultural techniques supply approx. 70% of scrap tires; rest 30 % comes from aviation sector. From one side this quantity is no significantly essential in comparison with land transport, but steady trend on increasing of aircraft fleet both in Ukraine and other countries all around the World attests that in the nearest time there will be expected increasing in the number of used tires for aircraft.

Aircraft tires are tires which are designed to be used with aircraft. Companies which manufacture aircraft tires usually produce three separate kinds of tires. The first are tires designed for general aviation, including sport aviation. The next is tires for commercial aviation such as passenger airliners and air freight [1]. Aircraft operating conditions require a wide variety of tire sizes and constructions. The modern aircraft tire is a highly-engineered composite structure designed to carry heavy loads at high speeds in the smallest and lightest configuration practical. They are a multi-component item consisting of three major materials: steel, rubber and fabric. By weight, an aircraft tire is approximately 50% rubber, 45% fabric, and 5% steel. There are different types of nylon and rubber compounds in a tire construction, each with its own special properties designed to successfully complete the task assigned [2].

Any deviations to the proper operating practices will have immediate consequences on the tires' performances.

The primary issue with aircraft tires is that they are subjected to tremendous stress. When planes land, the tires take the weight of the plane and endure some extreme friction as the plane hits the runway and starts to slow down. Friction quickly wears away the treads of the tires, and can lead to blowouts and other failures if tires are of poor quality or has not been well maintained. Aviation tires also need to be prepared for some serious weight, especially if they are used in commercial aviation, and to cope with conditions like wet and icy runways.

Distinctive feature of aircraft tires compared to tires for land vehicles is the fact that the number of retreading can be up to 5-6 times. Structure of aviation tire is extremely strong. Many have bands made from кevlar or similar materials to help maintain the integrity of the tire, along with thick tread made from high quality rubber. Initially aviation tires are designed to be retreaded, a procedure which cuts down on cost by reducing the number of times an entire tire needs to be replaced. Most aircraft tires can handle about 250 to 300 landings before they need to be retreaded. Since they can usually be retreaded about five-six times, that makes their lifetime capacity about 1500 to 1800 landings [3].



Scheme 1. Comparative chart of various types of tires and their speed versus load operating ranges

Heavy loads combined with high speeds and high deflections make the operating conditions of aircraft tires extremely severe. This statement is a main distinctive feature between aircraft tires and tires for land transport. Scheme 1 shows various types of tires and their speed versus load operating ranges [2]. The operating range for aircraft tires covers the upper right hand corner, meaning that maintenance practices and operating techniques that work fine for passenger tires are not acceptable for aircraft tires.

All of retreads are done using a mold-cure system. After buffing, it's typically apply two layers of reinforcing fabric and add new tread rubber by winding long strips onto the casing. Then, the tires are balanced, by adding small pieces of tread rubber in strategic spots [4]. So, unlike truck tires, balancing the tire is as part of the retreading process. Retreading advantages and disadvantages are listed below:

Advantages

-Efficient reuse of resources.
-Saving of natural resources.
-High quality buffed rubber can be resold as a high value resource.
-Reduces overall tire raisings as fewer new tire needed.

Disadvantages

-Does not deal with ultimate problem of post-consumer tire casing.
-Public perception of poor quality.
-Lack of market demand across all of the wide range of tire types and sizes.

Any tire that doesn't pass inspections can't be used on aircraft, but its life may not be over. Some aircraft sizes are similar to those used in agriculture, and they can be sell as used casings to be retreaded for tractors and other farm equipment [5].

These are usually very slow-moving applications where a large tread area for flotation is important. Obviously, aircraft tires are held to a very high standard. For example, if one tire in a dual pair fails for any reason, its mate is automatically scrapped. Currently, there is no legislation relating to the reuse of part-worn tires other than those relating to safety. And also re-use as a method to prolong tire life has some advantages and disadvantages, namely:

Advantages:

- No reprocessing required.
- No additional material resources required.
- Ensures tires are not disposed of before full use has been made.

Disadvantages:

- No potential for growth in sector.
- Only delays tire risings, does not prolong life above that already expected.

After retreadings and reuse of part-worn tires for land vehicles, tires that have come to the end of their life are currently classified as a waste, and need to be processed in a manner that causes the least impact in environmental, economic and social terms.

Although essentially inert in the natural environment, aircraft scrap tires that have been illegally dumped or stockpiled present a considerable fire risk, with the potential to produce

pollutants that can contaminate both the atmosphere and groundwater. In addition, the manufacture of tires consumes considerable inputs of valuable resources that need to be recovered at their end-of-life. How to process the growing number of aircraft tire casings in a sustainable manner is now an important international issue. Now there are few adopted methods, which are directed on treatment and materials back into manufacturing processes. They are recycling, material and energy recovery [6].

In general recycling intends both engineering use and shredding/crumbing.

At present the most common engineering use is for landfill engineering (drainage layers and daily cover) [7]. Other uses include creation of artificial reefs and use in embankments on golf courses and motorway verges. Engineering applications for tires are small scale and often 'single projects'.

This makes engineering applications an unstable market with the quantity of tires used in this manner varying from year to year. However, it is recognized that this form of application is under-utilized and represents a potential significant growth area for post-consumer tires. Other applications either under development include breakwaters, construction anchors, drainage culvert beds, road embankments, sea embankments, slope stabilization, sound barriers, roof tiles, road surfacing, lightweight fill, insulation, backfill for retaining walls and bridge abutments, playground surfaces. Advantages and disadvantages of engineering use are listed below:

Advantages	*Disadvantages*
-Tires need little/no processing.	-Uncertain/variable market at present.
-Potential to use large volumes.	-Lack of specifications limits use in larger scale applications e.g. highway construction.
-Variety of uses therefore not dependant on one 'market sector'.	

Regarding shredding it involves the mechanical shearing of whole tires into pieces ranging in size from 25-300 mm. Shredded tires are used directly in roadside filter drains or other road construction projects. More often, they are shredded as a pre-treatment either to facilitate their transport, or for use in energy recovery processes.

Crumbing usually involves removal of the steel and fabric component and reduction of remaining rubber to granular rubber. Three main types of crumb rubber can be identified [8]:

-Buffing: produced when scrap tires have tread worn off to prepare them for retreading (not technically crumb).

-Whole tire crumb: tires are shredded and then passed through a grinding mill.

-Cryogenic crumb: tires are cooled to temperatures of between -80 and -120º C and then fragmented.

Current applications of crumb rubber include solid wheels, casters, moulded products, equestrian mats, carpet underlay, road surfacing, playground surfacing, sports ground surfacing, bowling greens, golf courses and grass car parks. Advantages and disadvantages of crumbing are listed below:

Advantages	*Disadvantages*
-Limited use of natural resources.	-Expensive processing may be required (cryogenic crumb).
-High up the waste hierarchy.	-Market currently limited.

Rubber component of tires yields large amounts of energy on combustion. As a comparison coal provides about 29MJ/kg while tire rubber provides about 32.5MJ/kg of heat energy [9].

At present energy recovery from tires can take three forms:

-Burnt in cement kilns.

-Burnt in dedicated incinerators.

-Broken down by pyrolysis for energy (and material) recovery.

Within cement kilns, the steel content of the tires provides an essential source of iron, avoiding the need for shales and clays, and reduces the amount of oxides of nitrogen formed in the process [10]. The high temperatures within the kilns enable the tires to be combusted 'cleanly', reducing solid waste. Also scrap tires can be burnt in special incinerators to produce electricity for use by industry and local communities.

The future of this application is now uncertain as installation and operating costs are high, and public concern regarding emissions makes planning consents difficult to obtain.

Advantages	*Disadvantages*
-Reduction in nitrous oxide emissions and no solid ash residue.	-Unfavourable public image.
-Stability of market/guaranteed market for large volume of tyres.	-Emission controls are expensive.
-Saving of natural resources.	-Low in waste hierarchy.

Pyrolysis involves the breakdown of tires into its component parts: oil, gas, carbon black (char) and steel, in the absence of oxygen [11-12]. In this way pyrolysis is both an energy and material recovery process, with most plants concentrating on one aspect.

For example, the char produced can normally only be used for industrial processes; however, if microwave technology is used then the carbon black produced is of higher quality and has a wider variety of applications including reuse in new tire manufacturing.

Advantages	*Disadvantages*
-Stability of market/guaranteed market for large volume of tyres.	-Batch and continuous facilities have been commercialised but technology not seen as proven.
-Recovery of raw materials.	-Difficult to obtain investment.

Conclusions

1. Although the number of aircraft scrap tires is considerably smaller in comparison with the tires for land transport, trend of constant increasing of aviation fleets in most countries of the world can cause a sharp increase aircraft scrap tires.

2. Structure and composition of the aircraft tires are different from the tires for ground transportation, because of use high quality rubber compounds as well as a lot of kevlar and other durable materials. This makes the aircraft tire more durable and can withstand higher loads during operation. Thus, it's more expedient to treat aircraft tires separately from other rubber waste in terms of recycled material value and the possible areas of secondary application.

3. In this connection recycling and utilization of aircraft tires can be successfully implemented using the already known methods for treatment of waste rubber. The main advantage is the ability to extract valuable secondary materials separately from other types of scrap tires.

4. Today the question about possible fields of application of recycled materials is the most unexplored and requires more attention. Due to structural features and value of the materials used for production of aircraft tires, these studies may become a new stage in the development of new efficient energy and resources saving technologies.

References

1. *Aircraft Tire Data Book*. - Goodyear Tire and Rubber Company Manual. USA. 2002.- 24 p.

2. *Aircraft Tire Care and Maintenance*. - Goodyear Tire and Rubber Company Manual. USA. 2004.-52 p.

3. *General Practices Manual for Aircraft Tires and Tubes*. - Dunlop Aircraft Tires Limited. England. 2008. – 42 p.

4. *Retread Tire by Goodyear Dunlop*.- Goodyear Luxembourg Tires S.A. Europe. 2007. – 24 p.

5. www.wrap.org.uk/materials/tyres (WRAP - Tire Re-use and Recycling).

6. *Valery Shulman* The Status of Post-Consumer Tires in the European Union. - European Tire Recycling Association. EU. 2002. – 134 p.

7. *A. B. Hird, P. J. Griffiths and R. A. Smith* Tire Waste and Resource Management: a Mass Balance Approach//Viridis Report VR2. - Copyright TRL Limited 2002. – 78 p.

8. *Tom Newman, Paul Koziar, Aian Justice and others* Scrap Tires Handbook // EPA Publication, USA. 1994. – 28 p.

9. *Kirsten Norquay* End-of-Life Tire Management // Final Report for the Ministry for the Environment, New Zealand. 2004. – 41 p.

10. *Managing End-of-Life Tires* // Full Report World Business Council for Sustainable Development. 2008.- 18 p.

11. Basel Convention Working Group (1999) *Basel Convention Technical Guidelines on the Identification and Management of Used Tyres.* Basel Convention on the control of transboundary movements on hazardous wastes and their disposal. Document No. 10.

12. *Effects of Waste Tires, Waste Tire Facilities, and Waste Tire Projects on the Environment*. California Integrated Waste Management Board, USA, 2003.- 54 p.

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ON SOME REASONS OF FASTER FORMATION OF SLIME IN TURBINE OILS

The article is about some reasons of faster formation of slime in turbine oils. Turbine oils provide workability of one of the most responsible elements of thermal and nuclear power plants, namely availability of the main turbine.

Turbine oils provide workability of one of the most responsible elements of thermal and nuclear power plants, namely availability of the main turbine. Disorder of lubricating condition of turbine supports may cause disastrous effects, as immediate stop of turbine is practically impossible due to its weight and rotational frequency. Numerous researches, carried out both in our country and abroad have shown that contaminations of working liquids with mechanical impurity particles and water lead to the whole row of unfavourable consequences and cause in the end significant economic losses.

One of the most important parameters of turbine oil quality is its life time. Normative documents [1] stipulate that oil must preserve its physical andchemical characteristics for not less than 5 years.

Clamman in his work [5] indicates that the main factor characterizing the turbine oils ageing degree and therefore the resource is the parameter of thermal-oxidative stability.

Practice of turbine oils application in thermal and nuclear power plants shows that almost in all cases the contamination level of oils with mechanical impurities and slime is increasing during operation. While analyzing oils, which were in operation under ГОСТ 17216 or ГОСТ 6370, the slime layer, as a rule, is well observed by naked eye as colourful (as a rule, a brown)sediment on the surface of filter elements after filtration of them through the hangings of turbine oils.

It is known that the process of slime formation in turbine oils is stipulated by oil oxidation.

The question arises, why the slime level on one object is insignificant, and in others – rather high. We carried out hundreds of oil contamination analyses at various thermal анв nuclear power plants under ГОСТ 17216 to provide deep purification of turbine oils in lubricating and regulating systems during the period of 1996- 2008. More than two third of all analyses had strongly pronounced content of slime. A typical view of Millipor type filter elements with 0,8 mcm fineness filtration after passing 100 ml of oil is represented in photo 1 (a1 and b). Fig. a1 shows samples of the regulating system of turbine in NPP№1 and fig.b1 that of the lubricating system.

In the photo we can see both the zone boundary through which the oil passed and clean filtration paper zone. The represented micro photos turned out very interesting for us. It was stipulated by the fact that both regulating and lubricating systems had not being operated on the given object. The event of new a turboset launch had taken place.

That is why:

- Any sediment of old oil slime, which could intensify the process of ageing are absent;
- Both systems were simultaneously filled with OMTI type new oil, which had not been used before;
- Temperature modes of both systems were within the limits of established norms, e.i. +40°C temperature;
- The total oil running time at the moment of sampling was not more than one thousand and five hundred hours;
- Samples were simultaneously taken with an interval of not more than 1 hour.

Theoretically, the process of oil oxidation could be increased at the expense of different contamination level in the system. However, the analyses of oil contamination level have shown that both the first and second oils are on the same contamination level. In micro photos in fig. 1, a2

and b2 fragments of the same filter elements at 100 multiple magnification respectively are represented.

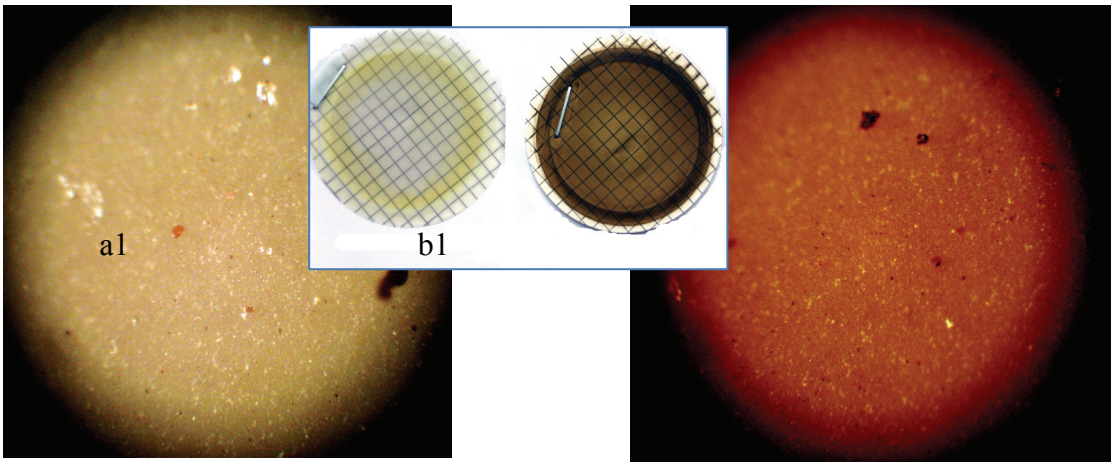


Fig. 1. Micro photos of filter elements during test of oil. The process of intensive ageing in result of active oxidation (NPP №1); a) –regulation system; b)-lubricating system. a2) and b2) Magnification factor x100

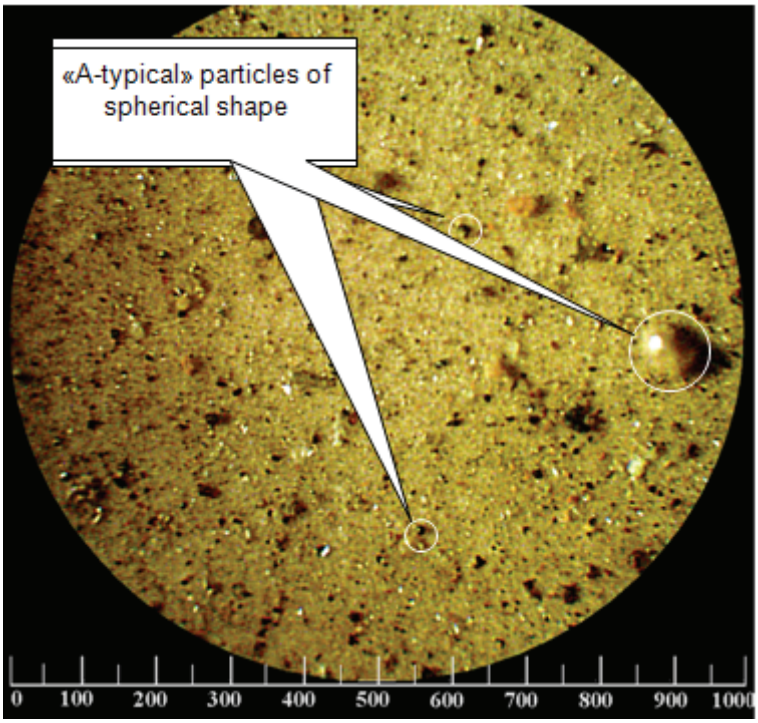


Fig. 2. «A-typical» particles of spherical shape. NPP №2 Turbine lubricating system. Oil of FURQUEL-L type during operation

Thus, the question was not clear, why the concentration of slime in lubricating system during the same period has sharply raised.

At that moment, we couldn't answer the question what are the reasons of this effect? Thorough research of oil state in the systems has allowed to reveal only one difference –the lubricating system was heavily gassed by air 10-100 mcm size bubbles. While observing, it was established that a big amount of bubbles in oil seen through the gage glass is in the main oil tank.

As for the regulation system of the oil system air bubbles were not observed.

In our opinion, it was gas contamination high level which caused the slime formation swift process in the turbine lubricating system.

The increased contact surface is not the main reason of this process.

To our mind the main reason of those processes is high temperature oil burning. Oil burning is high temperature chemical transformation processes which are significantly higher than the flash point of oil.

From this point of view, gas contamination is a precondition of the given process. In the work [2] it has been noted that the chemical transformations speed depends on lubricant composition, oxygen concentration, temperature and presence of substances speeding up or retarding reactions in the lubricating material.

Within 20-30°C temperature range oxidation occurs very slowly and oil quality isn't change with passing years. At 50-60°C temperatures oxidation spped is becoming noticeable. Namely due to this oil temperature in lubricating system should be kept not exceeding +40°C.

At temperature higher than +40°C the oxidation and thermal-oxidative processes take place, and as for higher temperatures process of thermal decomposition occurs.

Air bubbles provoke the processes accompanying cavitation. It is about the second phase of hydrodynamic cavitation development, namely about the processes of cavitation bubbles collapse on getting into a high pressure zone.

The classical process of cavitation development cavitation bubbles are formed in these places, where the liquid pressure is becoming lower than some critical value, while alone moving with the flow and getting to the low pressure area, they lose stability and obtain the ability to unlimited growth, coming into the pressure zone and depletion of kinetic energy start to diminish.

Cavitation bubbles depletion takes place at a high speed and is accompanied by acoustic impulse (something like a hydraulic impact), the more powerful that the volume of gas in bubbles. Bubbles are slammed at the time of compression subperiods, creating short-term (approximately 10^{-6}sec) pressure impulses (up to 104kgs/sm^2 and more), are able to destruct even rather strong materials.

Bubble collapse is accompanied with adiabatic gas heating in the bubbles, according to data [5, 6, 7] up to104°C temperature range. Source [10] gives some other values of temperature rise at collapse of bubble. Due to the fact that cavitational bubbles, on coming into the high pressure zone, are collapsed (locked, condensed) by cumulative trickles in points; cumulative effect lead to point pressures rise up to dozens of thousands of atmospheres alone with creating point temperatures up to ten thousands degrees by Kelvin. The so-called cavitational heat-generators, which are serially produced by industry, are based on the effect of temperature rise during cavitational processes.

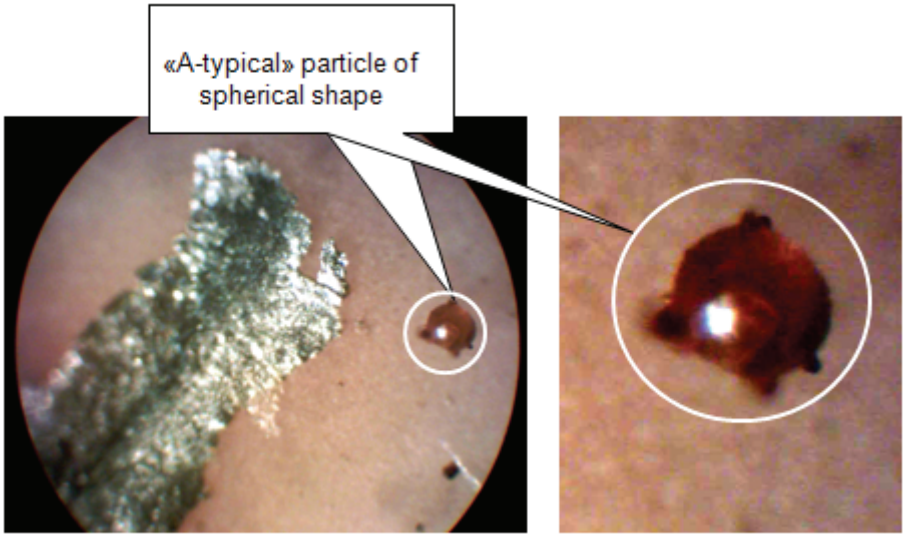
Parameters of pressure changing and temperature inside a ten micron vapour bubble are given in fig. 3. According to the data, given in [9] the temperature in such bubble increases up to 5000°C and pressure – up to 5000°MPa for approximately 3 nanoseconds. It is necessary to note that cavitational bubbles sizes are compatible with the sizes of contamination particles inside oil.

While studying the micro photos of turbine oils contaminations samples we had found out the documentary confirmation of above mentioned theoretical calculations. In fig. 2. micro photo «A typical» particles have been observed alone with ordinary contamination particles on the filter field. If the standard particles of contaminations in turbine oils have a random shape. As a rule, particles edges have sharp splits independent of particles nature, then the given case «A-typical» particles (further in text A-particles) have the shape, tending to the regular ball shape. Sizes of spherical A-particles, observed in different samples can be from 5 to 50-100 mcm. The scale of measuring is shown in the photo, represented in fig.2. The view field diameter in accordance with the scale is 1000mcm.

Micro photo of oil sample from the other turbine is presented in fig. 5.

In a fig. 5 the micro photo test is presented oils, selected from other turbine. The A-particles sizes reach 120 mcm here. It is well seen that A - particles are glass spherical bodies. A spherical shape can be conditioned by the fact that after the melting of particle at a high temperature the last cools off in the self-weighted state of oil. Approximately the minimum melting temperature can be

estimated as a material particles melting temperature. In fig. 4 and 5 the silicon oxidation particles are well visible. The melting temperature of this material makes 1410°C for silicon and 1610°C for silica respectively according to data [11].
1.



a) b)

Fig. 3. NPP №3 Turbine lubricating system. Oil of FURQUEL-L type.
a) – x100; b) фрагмент, «A – typical particle »

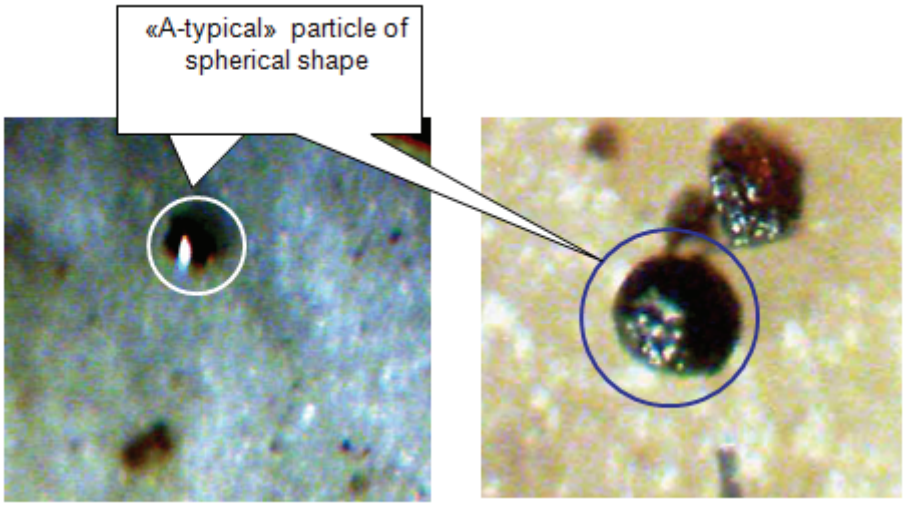


Fig. 4. A – typical particles in lubricating systems of TPP

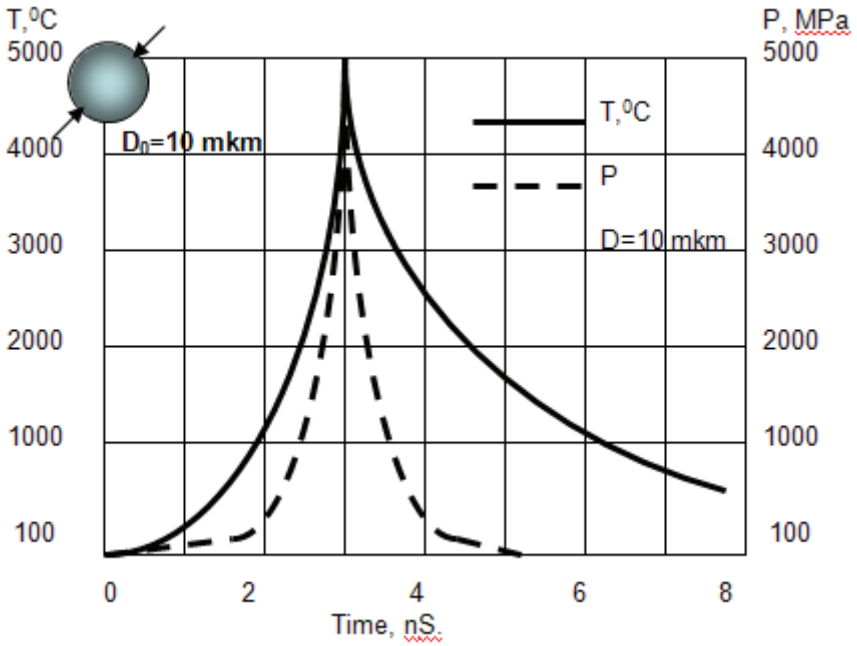


Fig. 5. Changing of the temperature and pressure inside of vapour bubble with the initial size of 10 mcm

The silicon surface-tension at 1550°C temperature makes 750 mN/m. This value is higher in 1,6 time for silicon than the mercury surface-tension +25°C (for mercury of 465 mN/m) and this causes the formation of a spherical shape while cooling.

Taking into account that temperature rise at bubble collapse is followed for a short period (3-6 nanoseconds), it is possible to suppose that the actual temperature is substantially higher at the place of bubble collapse. It is not important for us how far. It is important that this local temperature is substantially higher, than flash point in open oil crucible, i.e. 186°C for Tp-22c type oil and 240°C for OMTI type oil and even rather higher than temperature of spontaneous ignition of 744°C for FURQUEL-L type oil.

Looking at micro photo of oil sample given in fig. 4 the peculiarity should be noted. In spite of the fact that the oil life time in this turbine exceeded seven years, the visible slime sediment as in micro photo, the same as in micro photo (fig.1), is almost absent in oil, the running time of which doesn't exceed two months.

Conclusion

It has been experimentally stated that the local values temperatures the higher than 1500°C take place in turbine oils during normal functioning at average temperature +40°C.

Thus, it is possible to state that one of the main reasons of slime faster formation in turbosets oils is the processes of oil burning taking place in lubricating system during the finishing phases of local cavitational processes.

In spite of presence of degassed equipment, its operation can't be recognized as sufficient in the row of cases.

The removing reasons of oil gas contamination (so-called inflation) are rather difficult technical problem. It becomes still harder that the current air bubbles control is not only stipulated by reference documents but it is very difficult to fulfill.

It should be recommended putting into the system of oil control in turbines the equipment parameters for current ail bubbles control in system with the aim of revealing and preventing the possibility of emergency faster slime formation at an early stage.

References

1. РД ЭО-0444-03. Methodical guide on operation, organization and test operation of transformer and turbine oil at nuclear power plants. Ministry of the Russian federation on Atomic energy. M. 2002. The valid term is unlimited. P.129.

2. *Gulin E.I., Iakubo D.P., Chechot I.M.,* The reference book on fuels and lubricants in a ship technique. 2-edit. L.; Shipbuilding, 1987.-224.

3. *Klamman D.* Lubricants and analogous products. Synthesis, properties application international standards. M. Chemistry 1988г. Translation from engl. 487p.

4. *Papok. K.K., Ragozin N.A.* Dictionary about fuel oils, greases, additives and special liquids. M.»Chemistry». 1975.392 p.

5. *Roy N.A.* Origin and flowing of ultrasonic cavitation, «Acoustic magazine», 1957, t. 3, in. 1, p. 3.

6. *Roy N. A.* Ultrasound in a hydrometallurgy, M., 1969.

7. *Sirotyuk of M.G.,* Experimental researches of ultrasonic cavitation, in book: Physics and technique of powerful ultrasound, t. 2, M., 1968.

8. Patent of Russian Federation, S1, 6 F 24 J 3/00, G 21 B 1/00. Method of energy receipt. *Kladov A.F. Byul.* № 5, 1996.

9. Device of wave treatment and heater of new type http://www.energoinform.org/professionals/waveheater.aspx

10. http://www.kavitational-technology.com/.

11. Physical values Reference book / *Babichev N.A.* and other - M.; Energyatompublish, 1991.-1232 p.

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ECOLOGIZATION OF FUEL POWER COMPLEX OBJECTS

The article is about modern situation in ukrainian fuel-power complex and ecologization of fuel power complex objects

Modern situation in Ukrainian fuel-power complex (FPC) is characterized by limitation of own oil deposits and low efficiency of oil refinery plants. As a result transport sector is provided with energy source due to import mainly.

During last years Ukrainian FPC is demonstrating development of the main economical indexes. It is observed a positive tendency in growth of main activity indexes in FPC branches. However, there are a number of problems, which requires immediate consideration and search for their solutions.

The problem we pay attention to is degradation of environment components (air, soils, water objects, flora and fauna) in a result of FPC objects' activity and ways to reduce this impact. Solution of the outlined problem of environment pollution requires implementation of complex approach.

Ukrainian FPC includes the following objects: oil producers, oil refineries, system of oil pipelines, oil transporting means, filling stations, etc. Each of these objects influence on environment in their own specific way. In our research the problem of environment components contamination in a result of FPC objects activity is described on example of filling station (FS). The FS was chosen for investigation due to its suitability according to many requirements for FPC in ecological and economical areas.

As FSs' functioning is tightly connected with human activity (beginning from driving personal motor transport) in Ukraine there is a quite well-developed net of FS. Nowadays FSs are present in big industrial centers, small villages and along highways and routes. But independently on the place of displacement FSs' activity causes its negative impact on urbocomplexes, in which FS is functioning and environment.

Negative impact of FS on environment is revealed much greater than comparing to other objects of FPC. It is explained in a following way.

From one hand filling stations are displaced in large cities with high density of buildings and high concentration of motor transport; from another hand emissions at filling stations take place at height just 2 – 3 m above the ground.

Contamination by FS is done by 2 main pollutants: FS itself and motor transport exhaust gases. Implementation of ecologization methods first of all requires identification of pollution sources and elements they interact with. The basic sources of polluting substances appearance at FS are:

- reservoirs for oil products storage (evaporation of oil products during "big" and "small" breathes);
- fuel distribution pumps (evaporation during filling of auto transport fuel tanks);
- clearing constructions objects (evaporation of oil products and dump of the residues (after clearing) in system of the water drain);
- emergency and inadvertent spills of oil products on territory of FS;
- unhermetic technological equipment and communications;
- ventilation systems of industrial premises of the FS and technical services placed on territory of FS;
- emissions of auto transport exhaust gases at FS.

As it was mentioned before, the problem of environment components contamination is a complex task. According to the sources of pollution it is proposed measures of ecologization at FPC objects which can be united into three groups:

1. Improvement of working properties of fuels.

2. Improvement of working properities of motor oils.

3. Improvement of filling complexes.

Pollution caused by exhaust gases can be reduced due to improvement of fuel working properties. Now, fuel additives are the main way to increase fuel quality characteristics. Fuel additives perform a variety of functions and now are indispensable components of automotive fuels. In general, fuel additives are used to enhance the qualities of the base fuel or to add new required performances.

However, additives possess not only positive characteristics; they pollute environment as well as other technical liquids that take place in functioning of both engines and FS.

Lubricants, technical liquids and fuels influence environment components that leads to degradation of biosphere elements.

To overcome results of oil products spillages it may be used sorbents of various origin. Among them are synthetic, organomineral, inorganic sorbents, for example, ecolan, perlite, oxizin, etc.

One more measure to reduce FS's impact on environment is introduction of new technologies and equipment. There are number of methods for reduction of oil products evaporation at FS. Among them are:

1. During fuel discharge into reservoir the system of recirculation of fuel vapors is used. It provides return of fuel vapors from reservoir through the pipeline, quick disconnect coupler, and special flexible hose into hermetic neck of tank.

2. During filling of auto transport tank the secondary system of recirculation of vapors is used. It provides return of fuel vapors from tank through the special filling hose, petrol pump and special pipeline back into reservoir. For maximal suction of vapors coming from consumer's tank the special head on the filling nozzle is used.

3. Gas equilibrating systems with application of soft gasholder-reservoirs. They take expanded vapor-air mixture from the internal cavity of storage reservoirs at temperature increase due to natural warming ("small" breathing) during daytime; and also during "big" breathing in a process of fuel discharge from cistern. Vapors return back into reservoirs at temperature decrease at evening and night time or during fuel distribution to consumers.

4. Systems for catching of light oil products fractions. They provide utilization of vapors that are formed during filling of automobile transport. Principle of action is based on step-by-step compression of vapor-air mixture with further cooling. Condensate is gathered in accumulating cavity, from which it is pumped under the layer of product.

5. Systems for catching and recuperation of oil products vapors. The essence of these installations is a principle of absorption – catching of hydrocarbons by liquid sorbent. As a sorbent it is possible to use oil derivatives, in particular diesel fuel.

Another ways to decrease negative impact from filling station exploitation is building of new ecologically clean filling stations and reconstruction of old into new ones. It is necessary to use double wall horizontal underground reservoirs with nitrogen filling between walls and deeping not less than 0,3 m. Double walls prevent fuel spills into soil and deeping into soil prevent its evaporation. Electronic control of underground spills must exist obligatory.

Also it is necessary to install systems of control of fuel level in reservoir (to prevent overflows) and control of fuel vapors concentration in air (to prevent explosion hazard). Recommendation for filling stations that include such services as car wash is obligatory purification of water (using special grease catchers, oil removers and various membrane filters for mechanical impurities) and its further recirculation use.

Summarizing our investigation we can say that the problem of environmental safety in the processing of FPC requires improvement of working peculiarities of fuels, motor liquids and filling complexes. One of the main ways for pollution decreasing in cities is implementation of new technologies in production of motor fuels.

Quality of motor fuels, that are used nowadays, is one of the factors that are limit increasing of ecological safety in Ukraine transport sector.

Providing analysis of hazardous processes in FPC by environments' components, such as atmosphere, soil, water and impact in transport sector on human's health define a distinct tendency to expressed degradation of all elements of technosphere according to many indices, including state of atmospheric air, quality of soil and surface and underground objects.

Problems of pollution caused by FPC directly connected with qualitative characteristics of motor liquids exploitation such as fuels, additives, oils, lubricants, transmission liquids, etc. Analyses of abovementioned motor liquids impact on ecosystems (in case of merge), on elements of the environment, their peculiarities are the research objects of our investigations.

Conclusion

More ecologically safe and economically beneficial methods of their modification should be found and technology of merges liquidation in the case of emergency situation occurring should be applied.

Additional positive effect will be reached by biodegradable materials usage that allow decreasing oil concentration in the soil and water objects, city municipal sewage system also. Biodegradability of oils is one of the most important parameters that increase ecosystem's ability to self-renewing, and define the order and ability of these processes intensification.

UDC 629

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ULTRASOUND ANALYZER FOR DETERMINATION OF CHANGE OF CHEMICAL COMPOSITION OF ENVIRONMENT

The article is about ultrasound analyzer for determination of change of chemical composition of envir

It should be noted that nowadays there's a very acute issue of economical and full utilization of energy resources, i.e. oil, gas, coal, which require special attention of its condition control and a change of a chemical composition.

Many areas of industry for ensuring of optimal technological process and / or quality control of raw materials and finished products require high-precision measurement of low concentrations of sulfur, chlorine and nitrogen. For this purpose, department of Dutch business group Thermo produces thermo analyzers, based on the principle of complete oxidation of samples in oxygen at high temperature, followed by detection of oxides of sulfur, chlorine and nitrogen by various methods. To analyze microsulphur and microchlorine principle apply coulometric titration (model of analyzers of ECS series), particularly for the analysis of small amounts of sulfur install ultraviolet fluorescence detector (series TS), for analysis of nitrogen apply chemiluminescent detector series (TN). Devices can be supplied in a special performance for the analysis of one element, and in various elements' combinations.

All analyzers consist of a primary transducer (sensor) and a multichannel amplitude analyzer (electronic unit).

Meter of ultrasound rate consists of high-frequency generator of electric pulses DD1, which simultaneously generates ultrasonic pulse fluctuations in the pulses of ultrasound emitters DD2 and DD3. Emitted ultrasonic pulses, passing through a controlled environment, transmit to the receiver - converters of ultrasound pulses DD4 and DD5 into electrical ones. It is known that the velocity of ultrasound deterministically depends on the density of matter, hence, the velocity of ultrasound is determined by the chemical composition of matter, in which it propagates.

In practice, measuring of ultrasound rate is as follows: at determined distance L from an acoustic emitter install acoustic transmitter and receiver with an electronic counter and measure the time of delay t_d of received signal relatively to emitted one:

$$t_d = L/\vartheta_d \quad (1),$$

where ϑ_d is ultrasound propagation in medium.

On the other hand t_d, determined by the counter, is expressed by the formula:

$t_d = n_c T_u$ (2),

where: n_c – a number of pulses recorded in the counter during the delay time t_d ; T_u - pulse period of counter filling.

On the ground of (1) and (2) it is easy to obtain:

$\vartheta_d = L/n_c T_u$.

Conclusion

It is predicted that the device must be portable, low cost, easily of produced and mobile. Its use is expected at the gas station, oil and other industries, functioning of which is related to oil, fuel and gas for rapid control of the chemical composition.

UDC 665.635:665.753.3

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BOIODIESEL FUEL RELATED PROPERTIES OF FATS AND OILS

Quality standards and fuel-relevant properties of various fats and oils both in the form of straight vegetable oil (SVO) *and its alkyl esters (AEVO) as of biodiesel precursors are selected and presented.*

Due to increasing environmental awareness biodiesel is gaining recognition worldwide as a renewable fuel which may be used as an alternative to diesel fuel without any modifications to the engine. Biodiesel fuels can be produced from methanol, ethanol and vegetable oil the last two are both agriculturally derived products. As such, biodiesel provide substantial advantages: the starting materials are renewable, they are safe, biodegradable, they contain little or no sulfur and they reduce engine exhaust smoke. Currently, the cost of biodiesel fuel is a primary factor that limits its use. One way to reduce the cost of biodiesel is to use a less expensive form of vegetable oil such as waste oil from a food roasting processing plants. Major contemporary biodiesel components - alcohol esters of vegetable oils are made in the process named **transesterification** which is an exchange chemical reaction.

Tranesterification typical procedure:

Rapeseed oil methyl ester can be made successfully under the following conditions for transesterification:

1). Room temperature;

2). Used 0.5% sodium methoxide catalyst based on weight of rapeseed oil and 50% excess of the stoichiometric amount of required absolute alcohol or 1.0% potassium hydroxide catalyst and 100% excess of the stoichiometric amount of absolute alcohol;

3). Extremely vigorous agitation with a little splashing until the reaction mixture becomes homogeneous.

4). Since the ester has an extremely high tendency to form an emulsion on contact with water, care must be taken to maintain low levels of agitation during washing.

Alcohol esters of vegetable oils (AEVO) appear to be the most promising alternative to traditional diesel and SVG. Vegetable oils are triglycerides glycerin esters of fatty acids. Alcohol esters of fatty acids have been prepared by the transesterification of the glycerides, wherein linear, monohydroxy alcohols react with vegetable oils in the presence of a catalyst to produce alcohol esters of vegetable oils (AEVO) and glycerin as a by-product. AEVO when used as an alternative diesel fuel has been identified as a “biodiesel”.

Previous publications reported the use of methyl, ethyl, and butyl alcohols for the transesterification of rape oil, sunflower oil, cottonseed oil, peanut oil, soybean oil, and palm oil to produce methyl, ethyl, and butyl esters. The transesterifications is enhanced by the use of potassium hydroxide, sodium hydroxide, sodium methoxide, or sodium ethoxide as a catalyst. Important reaction parameters for the transesterifications are: 1) ratio of alcohol to vegetable oil; 2) temperature; 3) rate of agitation and 4) - amount of water present in reaction mixture. AEVO has a viscosity approximately twice that of petrochemical diesel fuel. Viscosity is of prime concern because of its effects on spray patterns and deposit formation. AEVO performs similarly to diesel in both short- and long-term engine tests while the raw vegetable oil develops severe injector fouling after 200 hours of operation.

Ethanol is much less toxic, making it safer to work with it than with methanol. Diesel and biodiesel fuels are characterized by evaluating the parameters for specific gravity, viscosity, cloud point, pour point, flash point, heat of combustion, total acid value, catalyst, and fatty acid composition, the boiling point, water and sediment, carbon residue, ash, sulfur, cetane number, copper corrosion, Karl Fischer water, particulate matter and iodine number.The properties of some AEVO are presented in the table 1.

Table 1

Fuel-related physical properties of esters of oils and fats						
Ester	CN	ΔH (kJ/kg)	Viscosity (mm^2/s)	CP (^oC)	PP (^0C)	FP[1] (^{0} C) [1]
Methyl						
Cottonseed		-	6.8 (21^oC)	-	-4	110
Rapeseed		40449	6.7 (40^oC)	-2	-9	84
Safflower		40060	-	-	-6	180
Soybean		39800	4.08 (40^oC)	2	-1	171
Sunflower		39800	4.22 (40^oC)	0	-4	-
Tallow	-	39949	4.11 (40^oC)	12	9	96
Ethyl						
Palm		39070	4.5 (37.8 ^oC)	8	6	19
Soybean		40000	4.41 (40^oC)	1	-4	174
Tallow	-	-	-	15	12	-

Table subscripts & items explanation:
CN = cetane number; CP = cloud point, PP = pour point, FP = flash point.
[1.] Some flash points are very low. These may be typographical errors in the references or the materials may have contained residual alcohols

At preparation of vegetable oil **ethyl ester** (VOEE) fuel production process is used 70 percent stoichiometric excess of absolute ethanol, or at molar ratio of 5.1: 1 ethanol to oil. The total free fatty acids are neutralized with the calculated addition of catalyst. By weight, 1.3 percent of KOH is used plus the amount to neutralize the free fatty acids. The following calculation equations were used:

EtOH = 0.2738 x Oil; KOH = Oil/85, where: Oil = desired amount of oil, in liters; EtOH = amount of ethanol needed, in liters, KOH = amount of KOH, in kg.

Vegetable oil is heated to 50 ^oC and the catalyst is dissolved into the alcohol. The oil is transferred into the biodiesel reactor; catalyst/alcohol mixture is pumped into the oil and stirred vigorously for two hours. A successful reaction produces two liquid phases: ester and crude glycerol. Crude glycerol will collect at the bottom after settling. Separation can be observed within 10 minutes and can be complete within two hours but also can take as long as 20 hours. After settling is complete, water is added at the rate of 5.5 percent by volume of the oil and then stirred for 5 minutes and the glycerol allowed settling again. After settling is complete the glycerol is drained and the ester layer remains.

Washing the ester is a two-step process which is carried out with extreme care. A water wash solution at the rate of 28 percent by volume of oil and 1 gram of tannic acid per liter of water is added to the ester and gently agitated. Air is carefully introduced into the aqueous layer while simultaneously stirring very gently until the ester layer becomes clear. After settling, the aqueous solution is drained and water alone is added at 28 percent by volume of oil for the final washing.

VOEE thus obtained had a viscosity 1.9 times that of usual diesel, a cloud point for 19 ^oC higher, the pour point 23 degrees higher than usual diesel. It has 1.56 times less sulfur than the low sulfur diesel fuel, 12.3 percent less energy on a mass basis than diesel. Since VOEE has a 4.1 percent higher specific weight, the energies average 8.2 percent lower on a volume basis.

Performance tests demonstrated that VOEE can be used to successfully fuel a diesel engine. In general, the testing performed has shown that torque and power are reduced about 5 percent compared to usual diesel and fuel consumption is increased by 7 percent

Vegetable oil can be used as diesel fuel just as it is, without being converted to biodiesel. The downside is that straight vegetable oil (SVO) is much more viscous than conventional diesel fuel or biodiesel, and it doesn't burn the same, many studies have found that it can damage engines. In order to optimize production and to prepare bases for national standards of Ukraine for biodiesel

SVO we have reviewed, selected and generalized some major fuel related characterisrics for the biodiesel immediate precursors – the fats and oils of bioorganic origin. The results are presented in the table 2 for comparision.

Table 2

Quality Standard for Rapeseed Oil as a Fuel				
Properties /Contents	Unit	Limiting Value		Testing Method
		Min.	max.	
Characteristic properties for Rapeseed 0il				
Density (15ºC)	kg/m^3	900	930	DIN EN ISO 3675 DIN EN ISO 12185
FlashPoint by P.-M.	ºC	220	-	DIN EN 22719
Calorific Value	KJ/kg	35000	-	DIN 51900-3
Kinematic Viscosity (40ºC)	mm^2/S	-	38	DIN EN ISO 3104
Low Temperature Behaviour	-	-	-	Rotational Viscosimeter (test conditions in development)
Cetane Number	-	-	-	Testing method will be reviewed
Carbon Residue	Mass-%	-	0.40	DIN EN ISO 10370
Iodine Number	g/100 g	100	120	DIN 53241-1
Sulphur Content	mg/kg	-	20	ASTM D5453-93
Variable properties				
Contamination	mg/kg	-	25	DIN EN 12662
Acid Value	mg KOH/g	-	2.0	DIN EN ISO 660
Oxidation Stability (110ºC)	H	5.0	-	IS0 6886
Phosphorus Content	mg/kg	-	15	ASTM D3231-99
Ash Content	Mass-%	-	0.01	DIN EN ISO 6245
Water Content	Mass-%	-	0.075	EN ISO 12937

The final version of the **European biofuel directive**, Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport, published in the Official Journal of the European Union, L 123 Volume 46, 17 May 2003, accepts SVO as a biofuel: «Pure vegetable oil from oil plants produced through pressing, extraction or comparable procedures, crude or refined but chemically unmodified, can also be used as biofuel in specific cases where its use is compatible with the type of engines involved and the corresponding emission requirements.» The results are presented in the tables 3 and 4.

Table 3

Comparison of fuel related properties of diesel, canola oil and commercial (US) biodiesel			
.	Diesel	Canola Oil	Biodiesel
Density kgL^{-1} at 15.5 deg C	0.84	0.92	0.88
Calorific value MJL^{-1}	38.3	36.9	33-40
Viscosity mm^2s^{-1} at 20 deg C	4-5	70	4-6
Viscosity mm^2s^{-1} at 40 deg C	4-5	37	4-6
Viscosity mm^2s^{-1} at 70 deg C	-	10	-
Cetane number	45	40-50	45-65

Cetane numbers of SVG

Cetane numbers rate the ignition properties of diesel fuels, just as octane numbers determine the quality and value of gasoline (petrol). It's a measure of a fuel's willingness to ignite when it's compressed. The higher the cetane number, the more efficient the fuel. Biodiesel has a higher cetane number than petrodiesel because of its oxygen content.

Ignition Quality or Cetane Number—This factor influences ease of starting, duration of white smoking after start-up, drivability before warm-up and intensity of diesel knock at idle. Studies have correlated ignition quality with all regulated emissions. As ignition delay is reduced, the combustion process starts earlier and emissions (primarily carbon monoxide and hydrocarbons) are reduced. Ignition delay is measured by the Cetane Number (CN) test (ASTM D 613), which uses a

single-cylinder, variable compression ratio engine analogous to the Octane Number engine. In this case, the ignition delay of the test fuel is measured at a fixed compression ratio. This result is compared with the results from standard reference fuels consisting of blends of n-cetane and heptamethylnonane. Diesel engines vary widely in their cetane requirements, and there is no commonly recognized way to measure this value. In general, the lower an engine's operating speed, the lower the CN of the fuel it can use. Large marine engines can tolerate fuels with CNs as low as 20, while some manufacturers of high-speed passenger car diesel engines specify 55 CN fuel. These requirements are given in the US standard—D6751-02 Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels and in the EU standard—DIN EN 14214, Publication date:2003-11 Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines -Requirements and test methods.

Table 4

Fuel-related properties and iodine values of various fats and oils							
Oil or Fat	**Iodine Value**	**CN**	**ΔH (kJ/kg)**	**Viscosity (mm^2/s)**	**CP (^oC)**	**PP (^oC)**	**FP (^oC)**
Babassu	10-18	38	-	-	-	-	-
Castor	82-88	-	39500	297 (38 C)	-	-31.7	260
Coconut	6-12	-	-	-	-	-	-
Corn	103-140	37.6	39500	34.9 (38 C)	-1.1	-40.0	277
Cottonseed	90-119	41.8	39468	33.5 (38 C)	1.7	-15.0	234
Crambe	93	44.6	40482	53.6 (38 C)	10.0	-12.2	274
Linseed	168-204	34.6	39307	27.2 (38 C)	1.7	-15.0	241
Olive	75-94	-	-	-	-	-	-
Palm	35-61	42	-	-	-	-	-
Peanut	80-106	41.8	39782	39.6 (38 C)	12.8	-6.7	271
Rapeseed	94-120	37.6	39709	37.0 (38 C)	-3.9	-31.7	246
Safflower	126-152	41.3	39519	31.3 (38 C)	18.3	-6.7	260
High-oleic safflower	90-100	49.1	39516	41.2 (38 C)	-12.2	-20.6	293
Sesame	104-120	40.2	39349	35.5 (38 C)	-3.9	-9.4	260
Soybean	117-143	37.9	39623	32.6 (38 C)	-3.9	-12.2	254
Sunflower	110-143	37.1	39575	37.1 (38 C)	7.2	-15.0	274
Tallow	35-48	-	40054	51.15 (40 C)	-	-	201

Table subscripts & items explanation:CN = cetane number; CP = cloud point, PP = pour point, FP = flash point. Iodine values from reference 2.

Conclusion

Quality standards and fuel-relevant properties of various fats and oils and straight vegetable oils and theirs methyl and ethyl esters as of biodiesel precursors and components are selected and presented. It creats a basis for production optimizing and preparation of national standards of Ukraine for biodiesel.

References

1. *Novoselov E.F. , Belokopytov Y. V.,* Biodiesel characterization by GLC, IR, NMR and TGA methods of instrumental analysis // Матеріали IX міжнародної науково-технічної конференції „Авіа-2009", 21-23 вересня 2009 р.- К.: НАУ, 2009. - С. 68-69.
2. *Applewhite, T.H.,* Encyclopedia of Chemical Technology; Third Ed.; John-Wiley & Sons: New York, NY, 1980, Vol. 9; pp. 795-811.

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CALCULATION THE THICKNESS OF THE POLLUTION LAYER ON THE ABSORBING PLATES OF GRAVITY FILTER

The continuous operation gravity filter (GF) with parallel absorbing plates analytical research results are represented in this article to prove the principle possibility of the same type filters' functioning. The methodology of calculations for quantitative evaluation of the aviation liquids pollution particles sedimentation process was suggested, provided that there is no friction along the absorbing plates, as well as on the surface of the pollution layer emerging.

The object of the research is the gravity filters; the principle scheme of one of them is given on the
fig. 1.

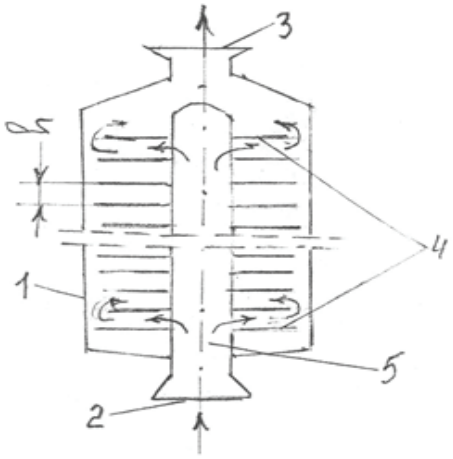

Fig.1 The scheme of the continuous operation GF

The gravity filter consists of a frame 1 with the inlet 2 and outlet 3 branch pipes, and a block of absorbing plates 4, set on the central tube 5 at the distance of h.

The filter works in the following way: the stream, for example of the aviation fuel, reaches the central tube 5 through the inlet branch pipe and then gets to the absorbing plates canals (slits) 4 through the holes in the central tube, where mechanical admixtures generally precipitate on the plates, and filtered fuel flows towards the outlet branch pipe 3.

To prevent the precipitating pollution particles from washing away first from the surfaces of the absorbing plates, than from the formed layer of accumulated particles' surface, the force of sliding friction is required between the individual particle and the surface (F_{fric}) to surpass the force of interaction between the particle and the fluid (fuel).

The last of these forces can be expressed according to the Stokes' law known from hydraulics by means of the formulae $Fs = 3\pi dV_l \rho_l V$, where V is the speed of the fluid near the surface of precipitation; d is the diameter of the polluting particle taken as a sphere with a sufficient approximation, V_l is the fluid viscosity kinematic coefficient, and ρ_l is the liquid density.

It is important to add that the given formula works in the presence of liquid streamline motion, the existence of which is characterized by the transition Reynolds number, known from hydraulics; for liquid streamline motion it is $Re_{cr} \leq 2000$. This number is defined by means of the formula

$\mathrm{Re} = \frac{V_{aver} D_e}{V_l}$, where V_{aver} is the mean speed of the liquid, Dr is so called hydraulic diameter for the flat sleet Dr = 2h.

The fluid average velocity is measured by means of the formula [2]:

$$V_{aver} = \frac{V_{inl} V_{out}}{2},$$

where $V_{out} = \frac{Q}{S_{inl} n}$ is the average velocity at the inlet to the slit between neighboring absorbing plates;

$V_{out} = \frac{Q}{S_{out} n}$ is the average velocity at the outlet from the slits.

In this formula:

Q is the overall liquid intake for the time unit, n is the number of slits, $S_{inl} = 2\pi r_0 h$, $S_{inl} = 2\pi r h$ (r_o is the radius of the inlet branch pipe, and r is the radius of outlet pipe). That is $V_{inl} = \frac{Q}{2\pi r_0 hn}$, $V_{out} = \frac{Q}{2\pi r hn}$, hence $V_{aver} = \frac{Q}{4\pi hn}\left(\frac{1}{r_0} + \frac{1}{r}\right)$. Now $\mathrm{Re} = \frac{Q}{4\pi hn}\left(\frac{1}{r_0} + \frac{1}{r}\right)\frac{2h}{V_l}$.

For instance, with Q = 3330 cm/s; h = 0,3 cm; d = 0,001 cm; r_o = 5 cm; r = 60 cm; n = 90; V_p = 0,014cm^2/s, ρ_p = 0,78 h/cm^3, $\mathrm{Re} = \frac{3330}{2 * 3{,}14 * 90 * 0{,}014}\left(\frac{1}{5} + \frac{1}{60}\right) = 91{,}18 \le 2000$, that is the mode of the liquid motion in every slit is streamlined, so that the Stokes formula application is already proved.

According to the work [2] the liquid velocity near the surface of precipitation is defined by means of the formula $V = \frac{2}{3} V_{aver}\left[1 - \frac{4y^2}{h^2}\right]$, where, in accordance to the fig. 2, y is the distance from the slit pole to the precipitation surface. The scheme of forces that influence the polluting particle precipitated.

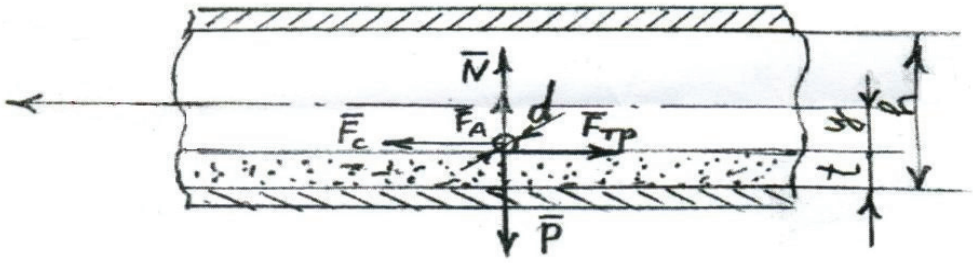

Fig.2 The scheme of the forces influencing the precipitated polluting particle

At the fig. 2 P is the weight force of the particle, F_A is buoyancy force, N is a normal reaction of the precipitating surface, F_{fric} is the frictional force, F_c is the Stokes force.

Inserting the received expression for the average velocity we have

$$V = \frac{3Q}{2 * 4\pi hn}\left(\frac{1}{r_0} + \frac{1}{r}\right)\left[1 - \frac{4y^2}{h^2}\right].$$

Taking account of this expression Stokes force is

$$F_c = 3\pi d V_p \rho_p \frac{3Q}{2*4\pi hn}\left(\frac{1}{r_0}+\frac{1}{r}\right)\left[1-\frac{4y^2}{h^2}\right] = \frac{9Q\pi d V_p \rho_p}{8hn}\left(\frac{1}{r_0}+\frac{1}{r}\right)\left[1-\frac{4y^2}{h^2}\right].$$

As for the frictional force, regarding our research [3] it is defined by the means of the formula $F_{mp} = A + fN$, where f is the sliding friction coefficient (according to the research [4]) A is the constant quantity dependant from the accuracy of the solid bodies contacting surface (so called adhesion force) , *f=0,6.*

According to the scheme of the forces as it is shown in the fig.2 $N = P - F_A = \frac{\pi d^3}{6}\rho_r g - \frac{\pi d^3}{6}\rho_p g = (\rho_r - \rho_p)\frac{\pi d^3}{6} g$, where ρ_r – is the density of the particles of pollution, for example, as it is accepted in practical researches ρ_r = 3 g/cm^3. So $F_f = A + f(\rho_r - \rho_p)\frac{\pi d^3}{6} g$.

Let's take a look at the notion of adhesion in more detail. First of all, it is the molecular bond between the surfaces of the precipitating plates and the first particles, which have sunk with new sinking particles. As a result of this there arises a so-called free energy E. It is determined with the value of the surface tension and the total interface.

It is calculated according to the formula: $E = \delta S$, where δ – surface tension, S – so-called area of the interface.

Considering the particles of the pollution as the spheres with the diameter d, we have: $S = \pi d^2$.

According to the figures of the work [3] the force of adhesion is $A = 4\pi d\delta$

$$\text{So, } F_f = 4\pi d\delta + f(\rho_r - \rho_l)\frac{\pi d^3}{6} g.$$

According to the condition of absence of the washing-off precipitating particles of pollution, $F_f \geq F_c$, and after substitution of expressions for these forces we have:

$$4\pi d\delta + f(\rho_r - \rho_l)\frac{\pi d^3}{6} g \geq \frac{9Q\pi d V_l \rho_l}{8hn}\left(\frac{1}{r_0}+\frac{1}{r}\right)\left[1-\frac{4y^2}{h^2}\right]$$

Solving this inequation under y:

$$y \geq \sqrt{\frac{h^2}{4} - \frac{8\pi h^3 n\delta + f\left(\rho_r - \rho_l\right)\frac{\pi d^3}{3} g}{9QV_l\left(\frac{1}{r_0}+\frac{1}{r}\right)}}.$$

For example, for particles which size d = 0,005 cm. in consideration with the fact that according to the work [3] δ = 0,0000483. As the result of solving we have: y = 0,074 cm.

Then, the thickness of the sphere of the contamination sphere is $t \leq \left(\frac{h}{2} - y\right) = 0{,}15 - 0{,}074 = 0{,}076$ cm. It means that the maximum volume of the generated sphere of the pollution in every chink composes $\frac{0{,}076}{0{,}3}100\% = 25{,}3\%$ of the volume of the chink.

Conclusions

1. We justified the ability of the developed filters of the continual action to fulfil their main purpose: obtaining pure liquid on the outlet, when admixtures of the pollution of that liquid are left on the precipitating plates of the filter.

2. The volume of the created sphere of the pollution is 25,3% of all the volume between the plates of the filter. It gives a try to create the interval between the washing of the filter from the accumulated pollutions and do not prevent from the functioning of the filter during certain time.

References

1. *Френкель Н.З.* Гидравлика. – М. : Госэнергоиздат, 1987. – 480 с.
2. *Справочник* машиностроителя, Т.2 – М. : Машгиз, 1956. – С. 467 – 468.
3. *В.І. Терьохін*, *С.О. Пузік*, *Е.Г. Азнакаєв*, *В.С. Манзій* Розрахунок параметрів гравітаційного очисника з урахуванням іммобілізованого шару та адгезії забруднень: зб. наук. праць за матеріалами міжнар. наук.-практ. конф. «Авіа-2000». – К.: НАУ, 2000
4. *Мозяков В.М.* Исследование процесса и повышения качества очистки масел гидравлических и смазочных систем тракторов в аксиальной центрифуге: автореф. дис. на здобуття наук. Ступеня канд. тех. наук: спец. 05.20.03 «Эксплуатация и ремонт сельскохозяйственных машин и орудий»/В.М. Мозяков. – Саратов, 1982. – 20 с.

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RESEARCH OF STEEL-BRASS FRICTION PAIR TRIBOLOGICAL CHARACTERISTICS IN MAGNETIC FIELD

In the article the processes, going during friction in the unidirected magnetic field and in the impulsive magnetic field are considered, frequency of impulses is regulated. Optimal parameters for friction pair renewal are determined.

During machines and mechanisms exploitation they lose the working capacity, and wear is one of the primary factors, negatively influences on friction knots work.

There are many methods of friction pairs renewal: galvanic, plasma, detonation, electrochemical. In the given work the method of renewal with the help of magnetic field is considered.

Research of authors [1] have shown that at passing of magnetic lines through contact zone wear resistance of steel surfaces increases.

Also work is known [2] where it is experimentally proved that the electromagnetic field promotes selective carrying.

Also recently magnetic impulse processing is widely applied for reliability of cutting tool work.

Increasing of mechanical and tribological properties of tool steels after processing by impulse magnetic field [3] is known.

The work purpose: to investigate condition of tribological system in unidirectional MF and impulse unidirectional magnetic fields. To define conditions of working capacity and renewal parameters of friction pair.

Materials and methodic of experiment carrying out. For research specimens from steel 65Г, tempered on martensite are used, for rider used copper alloy ЛС59-1. As the working environment mineral oil М10Г2к served, in friction zone paramagnetic powder of tin was added. Researches were conducted at speed 0,12 km/s, normal loading 3,5 MPa and magnetic induction 0,19 Tl on tribological installation [4]. Installation consists of the power supply, oscillograph, the breaker, the ampermeter for current registration in friction zone, the ampermeter for registration of current passing through the coil of inductance, the coil of inductance, capacities for working environment, loadings element, friction knot.

For creation of impulse magnetic field to the electromagnetic coil connected the breaker, depending on magnetic field direction its location concerning the coil has to be changed, fig. 1 position 1 or 2.

Results of researches. At the first stage experiment conducted both without influence of magnetic field and in magnetic field with direction S/N, N/S. In the process of experiment in friction zone modifying powder was added, powder of paramagnetic class – tin (Sn – fraction to 20 microns).

At direction S/N magnetic power lines are directed in the specimen, and paramagnetic is involved in a magnetic field, hardness Sn (5HB) it is much less, than steel 65Г (66HB) and brass ЛС59-1 (30HB), therefore working specimen surface is renewed (fig. 3 – 1).

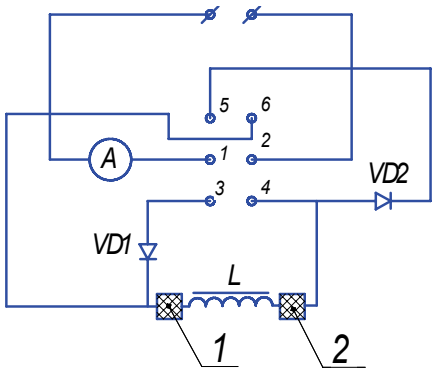

Fig. 1. The electric scheme of installation connection. 1 – arrangement of the breaker for creation of MF with N/S direction, 2 – arrangement of the breaker for creation of MF with S/N direction.

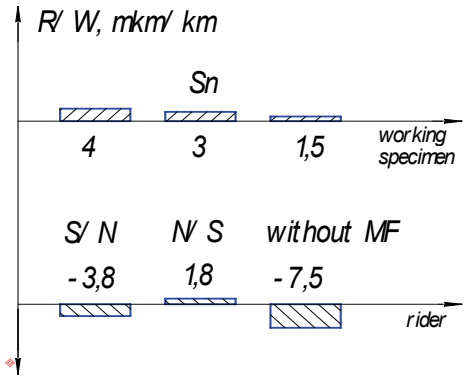

Fig. 2. The dependence diagram of tribological characteristics in a uniform magnetic field in the environment of М10Г2к

At MF N/S direction (fig. 3 – 3, 4) process of reparation of both friction surfaces is explained by common action of deformation component and direction of MF positive. Without MF total wear is maximum, and plus on working specimen is explained be mechanical component of friction (fig. 3 – 5, 6).

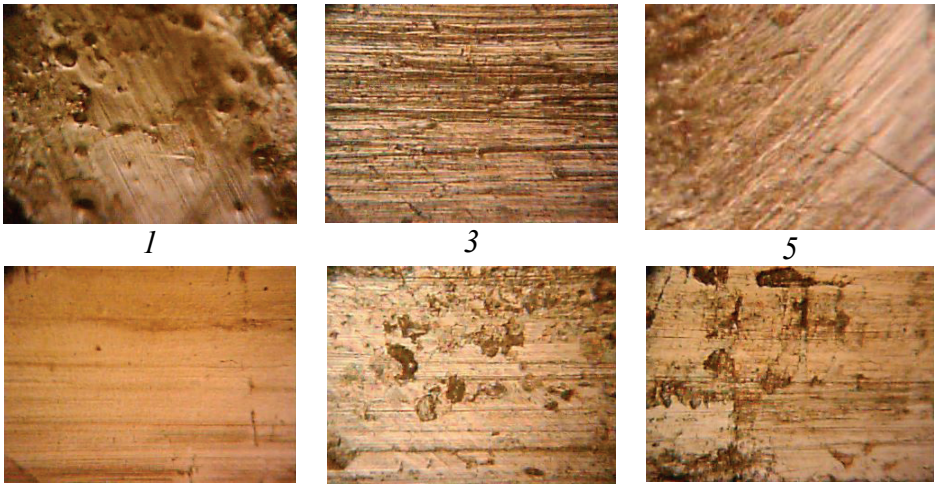

Fig. 3. Friction surfaces topography

The next stage of researches was defined conditions of wear process and change friction pair surfaces condition in IMF (fig. 4a). The impulse swing of a crystal frame increases deformation component in metal layers [5, 6, 7].

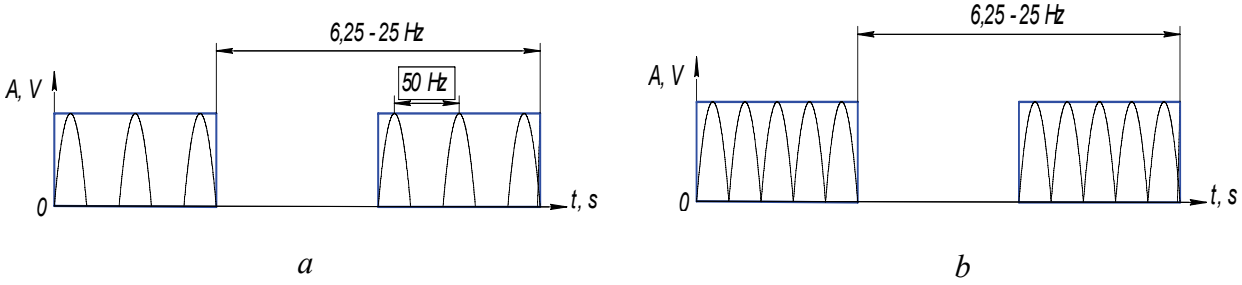

Fig. 4. Frequency of impulse current: a) – impulse one-half-period current, b) – impulse straightened current

The particular interest represents the straightened action of MF on the deformed friction surface. For this purpose the current direction is changed by parallel connection to the diode coil magnate wire. It has allowed to cut off the bottom half wave of a signal (fig. 4b) that generated impulse MF, directed to one side, and it has accelerated processes of plastic deformation on friction surface.

Results of tests for friction 65Г on ЛС59-1 in engine oil М10Г2к are presented on graphs fig. 5a (IMF is created according to fig. 4a) and fig. 5b (character of a signal is shown on fig. 4b).

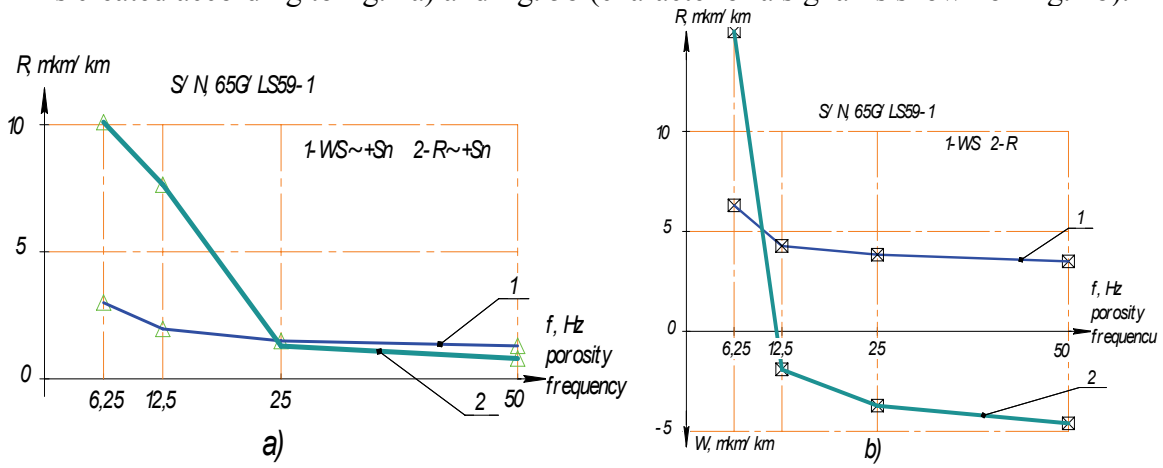

Fig. 5. Graphs of wear (renewal) dependence due to current interruption frequency at S/N direction of magnetic field: a) one-half-period signal of electric current (fig. 4a), b) straightened signal of variable electric current (fig. 4b)

Friction processes in straightened IMF (fig. 4b) narrow total wear to positive values at interruption with frequency 6,25 Hz, surfaces are restored due to the formation of dense tribotapes from structure of both specimens wear products and chemical interaction of oil components. Deformation processes at impulse influence of the breaker with frequency 6,25 Hz actively influence to crystal frames of metals, making active processes of oxidation in the environment of oil. The further increase of interruption frequency reduces the process efficiency.

On fig. 5 both curves displaced in a renewal zone with interruption frequency 6,25 Hz. It means activation of friction surfaces deformation, at which powder sticks on both surfaces (fig. 6c and 6d), especially on rider. Under condition of straightened IMF influence fig. 4b, thin tapes of the modified powder create on ferromagnetic – working specimen fig. 6c. Tin also covers rider, thereby accelerating renewal process. Rider surface is rougher, but received tin eliminates these disadvantages fig. 6d. Increase of interruption decreases the deformation components of friction system.

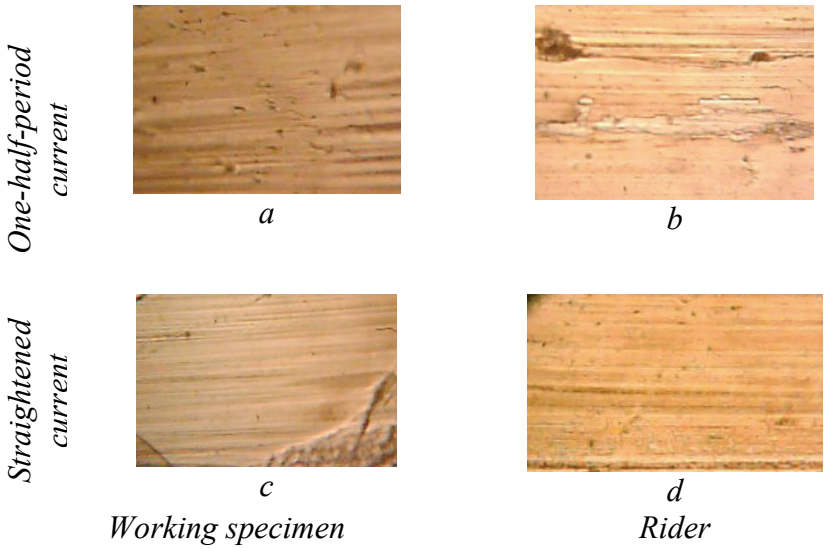

Fig. 6. Friction surfaces topographies with modifying brass powder adding with IMF S/N direction

Change of IMF direction on N/S, displaces the process of wear products moving from working specimen in direction to rider. Such mechanism is dictated by a direction of power lines in a backlash of magnet wire. MF direction to the rider specifies the participation of ferromagnetic parts in the mechanism of abrasive wear process as they present in zone of MF operation, and actively scratch softer material of rider. Then the products of brass wear– diamagnetic material are taken out by MF from the friction zone, due to what the wear of rider increases. According the graph (fig. 7a), all curves have fallen downwards that specifies the wear increasing.

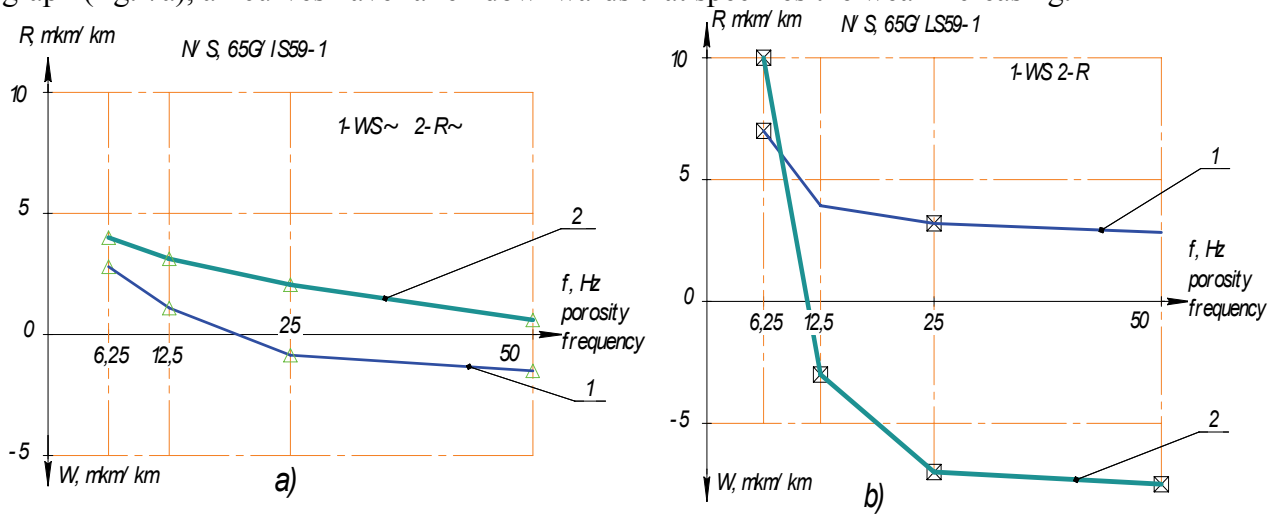

Fig. 7. Graphs of wear (renewal) dependence from interruption frequency with N/S direction of magnetic field: a) with one-half-period signal of electric current (fig. 4a), b) with straightened signal of electric current (fig. 4b)

The additive of paramagnetic powder increases mechanical component which means displacement of a paramagnetic to positive gradient of MF with further it smearing on friction surfaces. The tin additive in friction zone durng influence unidirectional bearing with interruption of a signal with MF frequency 6,25 Hz considerably increases resistance to wear. Such processes occur due to the paramagnetic properties to which deformation of friction surface that increases diffusion of external components in a friction surface is added.

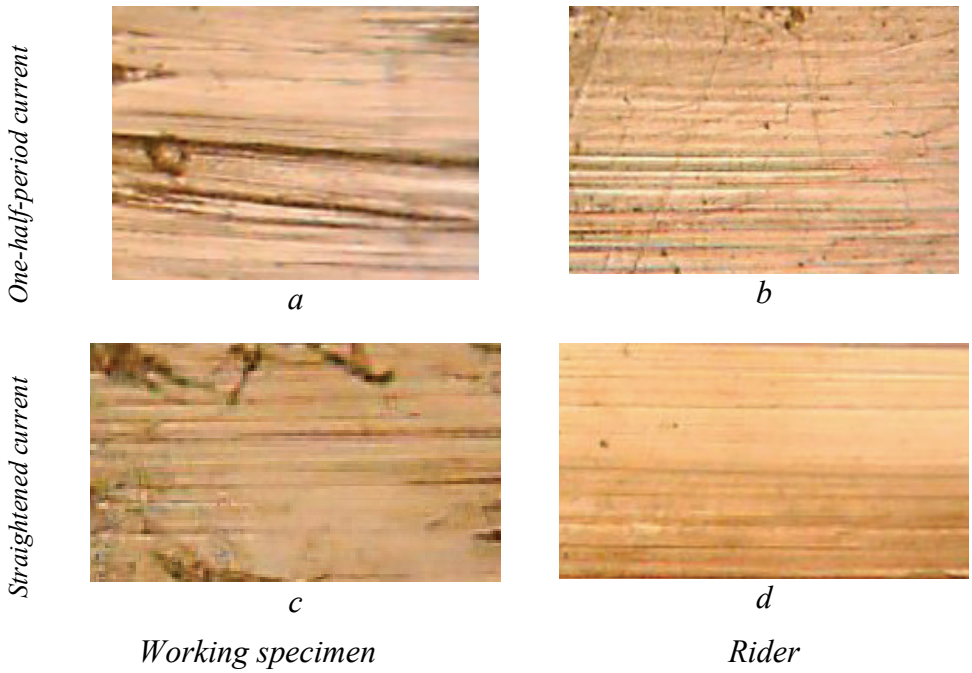

Fig. 8. Friction surfaces topographies with modifying brass powder adding with IMF N/S direction

On fig. 8a and 8b there are the tapes of the stuck brass, it means the presence on friction surface the smeared tin powder that specifies the process of surfaces renewal fig. 7a curves 1 and 2.

Conditions of steel on brass friction under the influence of unidirectional IMF with the tin additive are characterized by restoration process of ferromagnetic 65Г and wear of diamagnetic material ЛС59-1.

The duality mechanism is explained by knocking-out of diamagnetic material (copper and zinc) from brass structure, and paramagnetic tin is smeared on steel.

Conclusions

1. Influence of unidirected magnetic field and unidirected impulsive magnetic field is considered due to tribological characteristics of friction pair, also determined, that surfaces are the most capable in the conditions of the straightened signal of electric current, which creates impulsive magnetic field.

Due to these parameters of outsourcing there are the tribological tapes, with small quantity of oxygen, it characterizes formation of servo tapes.

2. It is determined that during the straightened signal of MF and impulsive breaking with frequency 6,25 Hz tribosystem is restored, with using the elements of renewal powder and working environment.

3. It is established that the arrangement of friction surface on S/N pole during reversive movement of specimens is a preferable direction of MF for renewal.

References

1. *Макаренко А.С., Евдокимов В.Д.* Влияние электромагнитного поля, проходящего через зону фрикционного контакта, на знос при высокоскоростном трении // Проблеми техніки: Науково-виробничий журнал. Одеса: Диол.-Принт, 2005. – № 1. – С. 77–84.

2. *Евдокимов В.Д., Макаренко А.С.* Влияние магнитного поля на избирательный перенос при трении // Проблеми техніки: Науково-виробничий журнал. – Одеса: Диол.-Принт, 2006. – № 4. – С. 70–783. В.И. Альлшиц, Е.В. Даринская, О.Л. Казакова, ЖЭТФ 111, 615 (1997).

3. *М.Т. Галей и др.* Изучение влияния магнитного поля на стойкость быстрорежущего инструмента // Станки и инструмент. 1981. – № 4. – С. 31-32.

4. *Патент* на корисну модель № 45574, МПК G01N 3/56. Пристрій для дослідження матеріалів на тертя та зношування при зворотно-поступальному русі / Свирид М.М., Кудрін А.П., Задніпровська С.М., Ловейко М.Г., Морозова І.В. Заявлено 29.07.2009; Опубл. 10.11.2009, Бюл. № 21

5. *Ю.А. Осипьян*, Ю.И. Головин, Д.В. Лопатин, Р.Б. Моргунов, Р.К. Николаев, С.З. Шмурак. Влияние импульсного магнитного поля на микротвердость монокристаллов $C_{60.}$ // Письма в ЖЕТФ, том 69, вып.2, стр. 1999г. с.110-113.

6. *Galligan J.M.*, Lin T.H., Pang CS. Phis. Rev.Lett., 1977, v. 38, № 8, p. 405-407.

7. *Galligan J.M.*, Pang CS. Appl. Phis. 1979, v.50, № 10, p. 6253-6256.

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CHEMMOTOLOGICAL SCIENTIFIC AND PEDAGOGICAL SCHOOL WITHIN THE SYSTEM OF INFORMATION SUPPORT OF EDUCATIONAL PROCESS

In the condition of science and higher school in the context of creation of experimental university, as one major directions of the current stage of development of higher professional education, the phenomenon of scientifically pedagogical school is reproduced in the prospect of the informative providing of educational process.

The phenomenon of scientific and pedagogical school is reproduced in the prospect of the informational support of educational process as one of the major directions at the current stage of development of higher professional education, under the conditions of integration of science and high school in the context of creation of research university.

The essence of classic research university is integration of educational process and fundamental scientific research. For the first time this approach was defined systematically by V. Humboldt in the XIX century. The motto of the university in Berlin, founded in 1809 by William Humboldt, was: "Devotion to science".

Informational support, as the component of complex scientific support of the educational process, is directed toward formation of organizational and content bases of informational and educational field, which meets the requirements of the modern level of informational society.

The origin of scientific schools took place mainly in the field of education and they became widely spread with the appearance of universities. Organic unity of scientific and educational processes, aimed on reproduction, scientific personnel "self-filling" and advanced training, orientation on generation of knowledge about knowledge can be attributed as main features of such schools and allow to consider their activity as a model of science and education integration.

Generally, scientific and pedagogical schools are the centers of crystallization, concentration, productions and application of scientific and educational information. Their activity contributes to stability, determination, predictability and manageability of the systems and of education process. As the open, self-organized systems, scientific and pedagogical schools are able to flexible and active co-operation with external informational environment, constant support and renewal of scientific potential of their representatives and students.

The orientation on reconstruction of the invariant "teacher (founder) - students (followers)"is the feature of scientific and pedagogical schools. Their primary aim is the training of scientific and pedagogical personnel, able to innovative activity in education.

The conditions of higher educational institution transform the relations "teacher-students" into "scientific and pedagogical school" in the aspect of specialist training, who is a person with higher special education, recived systematic theoretical and practical training.

The following basic functions of any scientific and pedagogical school could be defined in the informational and educational field of higher educational institution:

−generation of new knowledge, primarily scientific and pedagogical (notion “information” is considered here as the data processing method and system, knowledge being considered as a the product of informational activity);

−theoretical grounds of discoveries and inventions in the light of generally accepted methodological scientific principles or establishment of new principles with the high level of scientific basis and methodology;

−formation of primary knowledge – knowledge about knowledge – among students in order to attract them to the basics of cognitive activity, reflecting the features of modern informative paradigm;

−support of succession of original techniques, methods and principles of research program;

−advanced training for personnel;

−provision of basic training of specialists in the area of education;

−formation of personality of innovative type, who is the source of novelty and has research and creative abilities, used for expansion of scopes of social practice;

−scientific and organizational activity in the context of both claimed of results of conducting fundamental research and necessity of developing of scientific contacts (conferences, seminars, round tables and etc.);

−saving and development of scientific and pedagogical potential of university;

−support of informative communication of university with global informational and educational areas;

– achievement of high level of general communicative culture of specialists, theoretical views and organizational experience of informational co-operation in the dialog mode.

The bases of chemmotological scientific and pedagogical school started to form in National Aviation University in the 50s of the past century, Professor Kostetsky B.I. and Professor Golego N.L. organized frictional laboratory. They used special equipment to explore the processes of physical and chemical mechanics of materials friction, and based on the results of investigations the recommendations to increase longevity, reliability of machines and mechanisms and improvement of fuels and lubricants properties were developed. Active participants of these researches were students and some of them became well-known scientists and organizers (Prof. Alyabev A.Y., Prof. Zaporozhets V.V., Prof. Nazarenko P.V. and others).

In the same years Prof. Bashty T.M. was working in the area of theoretical and experimental research of hydraulic drives and their elements.

The Chair of machines and mechanisms details (Prof. Rayko M.V.), Chair of airplanes exploitation (Prof. Chernenko Z.S.), physicists (Prof. Solovev A.N.), electrical engineers (Prof. Groholsky A.L.) and other subdivisions also participated in the process of chemmotological problems solutions.

In the 60-s chemmotological researches were targeted at working on issues related to maintenance of reliable work of fuel, oil and hydraulic systems of aircrafts.

The results of the conducted research were discussed at the seminars and conferences, thus proving the interaction of fuel and lubricants properties, structural features and technology of machines and mechanisms exploitation.

The sources of the chemmotological scientific and pedagogical school of the NAU can be found in 1964. That year Prof. Alexander Aksyonov initiated formation of the scientific group for resolving scientific and technical problems of fuels, lubricating materials and technical liquids usage at the Chair of technical exploitation of aircraft and engines (the head was associated professor Vasiliy Sukharnikov). Within the framework of the advanced studies of school such scientist as Belyansky V.P., Teryokhin V.I., Litvinov A.A., Kozachenko A.I., Nekipelov Y.G., Borodin A.E., Shepel A.Y. have been working since student times.

With the purpose of research work co-ordination and discussion of their results chemmotological scientific direction was formalized under the supervision of rector Alexander Aksyonov.

Activity of the school is closely related to educational work. In 1968 the independent department of chemistry and technology of fuels and lubricants was created and in a year – the department of fuels and lubricants was created (the head and the first dean was associate professor Alex Litvinov).

The Chair of fuels and lubricants created by Prof. Litvinov A.A. trained specialists in area of aviation chemmotology. The considerable increase of professional level of quality control system of aviation fuels and lubricants became the result of this.

The follower of these traditions was Chair of chemmotology created in 2007 (the head is doctor of technical sciences, Prof. Boychenko Serhiy).

In 1972 at the department of "Chemistry and fuels and lubricants" the testing laboratory of physical, chemical and operating properties of aviation fuels and lubricants was created (ONIL-12). Anatoly Shepel managed the laboratory, scientific supervision was carried out by Alexsey Litvinov (1972-1977) and Victor Belyansky (1977-1997).

Prof. Chernenko Z.S. and Vasylenko V.T. created the laboratory of operational reliability and technology of fuel and oil systems of aircraft. The base research complex of laboratory includes two unique climatic thermal pressure chamber, sophisticated control-measurement apparatus. Researches of influencing of fuels and oils influence on operational reliability of systems in all range of possible external environments of aircrafts are conducted in the laboratory.

The mechanism of action of lubricating materials were studied by the faculty, guided by Prof. Rayko M.V. The laboratory developed some additives to lubricating oils, increasing anti-frictional, anti-wearing and anti-scoring properties.

Combination of experimental researches based on the original technical solutions and methods with deep theoretical analysis is tradition of school.

The study of influence of fuels and lubricants contamination on the work of functional systems and development of untraditional methods of their cleaning were conducted under the supervision of professors Nikitin G.A. and Chirkov S.V. They patented electro-purifiers and gravitation purifier, having noticeable advantages is compared with traditional filters.

In the 70s, when the question of chemmotological reliability provision for aircraft was raised in the conditions of increasing requirements to the modern aircraft, the problem of aviation fuels cleanness having become exceptionally important.

Due to the introducting of new technologies of production of fuels for gas-turbine engines the problem of their anti-wearing properties became crucial. The collective of researchers under the supervision of Prof. Aksyonov A. F. started working on the methods of determination of reactive fuels anti-wearing properties, investigation of influence of fuel chemical composition on their anti-wearing properties and development of the methods of fuel anti-wearing properties improvement. These tasks have been successfully solved. In subsequent years the school of researchers created by Prof. Aksyonov A. F. conducted large work in the area of chemmotology.

In the early of 70s realized configuration, creation of solid experimental base and well trained on the research basis specialists in the area of fuels and lubricants operational properties contributed to the enhancement of researches quality and general scientific and industrial level. Finally, it resulted in opening educational process on the basis of existing specialties with specialization on fuels and lubricants testing and application.

The first graduation of specialists in fuels and lubricants testing and application took place in 1975 Practically all graduates (about 50 specialists) were claimed and employed in operating enterprises, R&D and educational establishments of civil aviation.

Research of chemmotological direction were continued. Fundamental research on influence of dissolved gases on fuels operational properties were conducted under supervision of Prof. Belyansky V.P. Then number of scientific methods of fuels stability and anti-wearing properties improvement, detonation stability of low-octane fuels enhancement were developed and over 20 patents on the inventions in area of chemmotology were received.

Research of physical and chemical properties of jet fuels and improvement of standard quality testing methods were executed under supervision of Prof. Solovev A. N.

Scientific research of chemmotological direction have been conducted by the chairs of chemistry, chemistry and fuels and lubricants, physics, chemistry and chemical technology (heads of chairs professors Chumakov Y.I., Litvinov A.A., Solovjev A.N., Ivanov S.V.).

Today the department of chemmotology and Ukrainian R&D center of chemmotology and certifications of fuels, lubricants and technical liquids of the NAU is the moving force of chemmotological motion.

Currently, when the requirements to all types of products and services, including consulting and educational, grew considerably, collaboration and interrelation between participants in the system of petrochemicals provision changed, the role of chemmotological scientific and pedagogical school in

the system of the informational support of the personnel training is gaining extremely important character.

Today the chair of chemmotology teaches complex of special disciplines (15 names) for the following specialties: «Technologies and technological equipment of airports», «Chemical technology of fuel and carbon materials», «Ecology and environment protection», «Gas-turbine installations and compressor stations». The chair also carries out advanced training of specialists through the post-graduate school. The subjects of scientific research of the chair are various, such as development of alternative fuels, additives of different purpose, reduction of petrochemical losses, enhancement of production and quality renewal technologies, research of operational properties of fuels and lubricants and technical liquids of a special setting.

The Ukrainian R&D center of chemmotology and certification of fuels, lubricants and technical liquids was created and has been working under the supervision of Prof. Boychenko S.V. This center continues the work and follows the traditions of the Ukrainian center of aviation chemmotology and certification of products, created by Professor Belyansky V.P. in 1994.

On the basis of center and the chair of chemmotology the Institute of post-graduate education organized the courses of advanced training for the personnel of gas-transport enterprises and petrochemical laboratories of refineries of Ukraine, in particular jet fuel producing enterprises (together with «SE UkraviaPMM»). The testing equipment of laboratories of the center allows conducting researches of most petrochemicals according to the requirements of standards, including international ones. The laboratories of the center are accredited in compliance with the international standards of the series 17025, 9001. Except carrying out research, educational work on retraining and in-plant training of personnel, involved in production, application and quality control of fuels, lubricants and technical liquids, is carried out in the center, thus its work is related to development of educational and teaching and standard literature.

The center and the chair of chemmotology take active part in scientific and educational activity of the university, in particular they organize scientific and technical conferences, seminars, symposiums, including international ones, as well as conduct research and research-designing works for both domestic and foreign customers.

The basic scientific applied issues studied by representatives of the school are:

−development of competitive resource and energy saving technologies of fuels storage, transport and filling;

−development of alternative types of fuel for transport vehicles;

−research of physical and chemical and operational properties of fuels, lubricants and technical liquids in different technological operations;

−development of express techniques and methods of fuels, lubricants and technical liquids quality testing;

−development of organizational-technical and standard measures of saving quality level of fuels, lubricants and technical liquids;

−development of new competitive additives and additions to fuels and lubricating materials;

−creation of complex methods of qualifying tests of fuels and lubricants and technical liquids.

Concept of development of chemmotology scientific direction (school) with the NAU being orientated to innovative model, which allows keeping and promotion of achievements of past and present NAU researchers, improvement of developments and inventions quality and compatibility in order to implement them in a short period under the conditions of crisis situation on the market of fuels, lubricants and technical liquids. It will also promote creation of grounds for the improvement of working conditions of scientific-pedagogical staff of chemmotological direction, implement their teaching and scientific, finding and development of talented creative personalities among students, training of personnel with higher qualification.

The target of chemmotology scientific direction (school) is stimulation of research and development works, designing work as well as personnel training (including qualification enhancement, in-plant training, internship) in accordance with international regulations and standards to solve actual and perspective tasks of chemmotology in the field of fuels, lubricants materials and

technical liquids testing and admittance to production and use, in particular, in aviation industry, as well as nature protection and energy saving innovations.

The strategic task of chemmotology scientific direction (school) activity is the achievement of modern level of research conduction and scientific-pedagogical personnel training.

The basic task is conducting fundamental, searching and applied research, research and development works in accordance with scientific directions of the university, namely: chemmotology, frictional chemistry, tribology, natural environment protection and living safety, certification and quality management, testing, diagnostics, admittance to production and use of fuels, lubricants and technical liquids, in particular, in aviation industry, with the purpose of solution of topical jobs of science and practice.

Conclusions

The tasks of chemmotology scientific direction also include:

1. Use and development of existent scientific-pedagogical potential to develop and introduce innovative environmentally sound technology in the field of petrochemicals supply.
2. Organization of production of competitive highly technological scientific and technical production for the world market in order to increase efficient use of fuels, lubricants and technical liquids. Wide collaboration with foreign partners in this task.
3. Creation of necessary conditions for the highly skilled personnel training (retraining, internship, practical workers) for those industries of economy, where fuels and lubricants and technical liquids are used.

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MECHANICAL STABILITY OF LUBRICATING GREASES AND ITS ASSESSMENT

The article is about mechanical stability of lubricating greases and its assessment.

Lubricating grease is one of the most important and irreplaceable lubricating material. It provides the reliability and durability of service performance of the wide variety of modern technical devices. The production of this kind of lubricants is significantly less than total production volumes of lubricating oils.

However the number of friction points being lubricated by lubricating greases is well above those that are lubricated by oils.

The number of friction points for which greases are used increases every year, i.e. the field of their application is essentially broadening.

The increasing of the field of application of greases at stable production level is a result of significant improvement of the quality of these products, and development of multifunctional long-operating ("eternal") greases produced with highly efficient base oils, new thickeners and different additives.

Mechanical properties of greases and their service performance are predetermined by the nature and structure of their structural matrix to a great extent.

Greases undergo different kinds of deformations while being filled into the friction points and, especially, during their operation.

An application of force exceeding the fluidity limit during the deformation of greases leads to the destruction of structural matrix, and, as a result, the firmness of the grease decreases.

The structure of grease can be restored in the time of less intensive deformation or rest. Therefore, during the friction point operation the processes of destruction and restoration of grease structure combined with the change of their mechanical properties take turns continuously.

While being applied, the grease can be destroyed to such an extent that it will not be able to withstand forces which are trying to throw it away from the lubricated device. Normal operation of a friction point can be ensured only in the case of grease having enough resistance to a mechanical destruction, i.e. grease being mechanically stable.

Consequently, the change of volumetric and mechanical properties of grease, for example, the change of breaking point, as a result of mechanical handling and the following its rest is called mechanical stability.

Mechanical stability of greases is regulated by ГОСТ 19295. According to this state standard, the firmness limit for rupture is determined for initial undestroyed grease, for destroyed grease, and for the grease that has rested for some specific time. ГОСТ 19295 also sets the determination of destruction index and shear stability index.

In accordance with this standard, with the help of a method for mechanical stability assessment rheological state of grease in a friction point is assessed. Breaking point for rupture of initial grease is characteristic of its state in a bearing before its operation and also for that part of grease which is located out of friction area during the operation.

Grease in a friction area, for example, bearing raceway, can be relatively characterized (depending on its deformation degree) by breaking point of a destroyed grease; and after the stop of bearing, depending on its length, it can be described by breaking point after rest.

Different grease depending on their composition (disperse medium, dispersed phase, presence of fillers, additives, etc.) and technology of production have significantly different dynamics for breaking points change.

Mechanical stability is an important service performance characteristic of greases that are used in the roller bearings and especially of those, used in all kinds of joints, flat bearings, sliding bearings, since in this case the whole volume of grease is involved in operation.

Mechanically unstable grease, i.e. the one that is heavily destroyed and that can not renew its initial properties after removal of deforming loads can flow out the friction point.

A significant sealing of grease after its destruction and the following rest is also unwanted. Dry friction can appear in this case because of the grease not leaking to a friction area.

There are also other methods for mechanical stability assessment. According to methodologies of ASTM D 217 – 1150 and FTMS 313 mechanical stability assessment is conducted by determination of grease penetration after 100000 double hits (the mixing in penetrometer's mixer. The other method is also based on the evaluation of grease penetration before and after its destruction in a device of Roll Schel Test (ASTM D 1831).

Conclusions

All these methods have some lacks in common, including methodological ones (for example, the time of experiment), and also practical ones (limits to application and different efficiency for different kinds of greases).

Thus, the device and methodological recommendations for assessment of mechanical stability of lubricating greases is being developed.

It should eliminate the lacks of methods mentioned above. This methodology will allow technicians to optimize the assessment of mechanical stability and conduct the determination of it for different kinds of lubricating greases with a goal of creating recommendations for improvement of greases production and service performance.

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FEATURES OF DISTRIBUTION OF FRACTIONAL COMPOSITION CONTAMINATION IN TURBINE OILS AT THE OPERATIONAL PROCESS

The article sis about features of distribution of fractional composition contamination in turbine oils at the operational process

As a rule, industrial machinery contains lubricating systems, which ensure their functioning. Existing normative documents regulate strictly ultimate level of system dirtyness, so as contaminations in working liquid significantly influence the reliability characteristics in an unfavourable way. In forming of purification subsystems, which have to provide necessary level of purity in lubricating systems it is faced an issue about their efficiency.

In general case, at the efficiency evaluation, three characteristic types of systems can be distinguished.

Efficient system of purification.

Efficient system of purification allows to carry out the purification process of system from contaminations. During application of such purification systems the contamination concentration in the system is reduced constantly and, in the ideal case, reduced to zero.

Less efficient system of purification. Though such system can't provide the lowering of contamination concentration, it allows to maintain the initial level of oil concentration. Its efficiency is not enough to purify the system, but enough to maintain the initial level of oil concentration.

Low-efficient system of purification (ineffective) – a system, which is not able to maintain the initial level of oil concentration. Dirtyness level in such systems is raised constantly.

In the fig.1 the graph of dirtyness changing in the system depending on the purification efficiency is represented. Efficiency analysis of purification systems of turbine oils of thermal and nuclear power plants has been performed by us on the base of 26 turbosets. It revealed that almost in all cases the staff purification systems showed their inadequate efficiency. As a rule, rise of dirtyness level always takes place and, in a year from the beginning of operation, it reaches the critical values, defined by the normative documents, at which the operation is impossible.

Dynamics of contaminations removal from the systems described by the equation:

$$C_\tau = C_0 \cdot e^{-(Y \cdot Q/W) \cdot \tau}; \quad (1)$$

Where:

C_τ - concentration of contamination in the system through the time of purification;

C_0 - concentration of contamination in the system before purification;

Y - coefficient of filter(s) sifting;

Q -pumping of liquid through the system;

W - liquid capacity in purified system;

τ - purification time .

Theoretically, if the purification system is effective, the concentration of contamination must asymptotically tend to zero. If it doesn't occur, it means that either liquid pumping through the system is absent Q=0, or pumping takes place, Y=0 or tends to zero.

In connection with this, the important task is the selection of filters for purification systems.

First of all, filters must have the positive number of sifting coefficient minimally, Y>0.

Secondly, filters must have the sufficient fineness of filtration for purification. Ex facte the mentioned requirements stand to reason. However, if they stand to reason, the question is appeared - why can't real purification systems manage with their task? Why does the level of contamination raise constantly?

Actually, filters of general machine building must have the sifting coefficient not less than 50%, and aviation – not less than 97%, in accordance with theoretically adopted regulations. However, it has been shown above, these regulations are not fulfilled in practice.

The main reason of such regulation is that filters, installed in systems, are selected with no account taken of dependence of sifting coefficient on purified fraction from one side, and from another side - is that, as a rule, developer is focused on the nominal characteristics of filter elements, but not on their physical value.

Our experimental researches shown, that the sifting coefficient for membrane filtration elements heavily depends on such parameter as value of liquid pumping through the purifier. As our researches shown, declared values are confirmed only at values of pumping not more than 10% from the nominal values of pumping.

Not less important is the selection of required value of fineness filtration of element of filtration. At forming of purification systems it is necessary to equip filtration systems with maximum fineness of filtration, which is selected on the basis of parameters of dangerous gaps in systems. So, if the values of working gaps in pump elements are 10-15 mcm for turbine lubricating and regulation systems, filters in systems are installed with filtration fineness 10-15 mcm.

Don't dwell on the issue of appropriateness of such approach to fineness filtration selection in this article, concentrate your attention on the fact, that distribution of granulometric composition of contaminations is changed at operation.

At fig.2 graphs of distribution of contamination particles in turbine oils of different objects at various time of oil operating in the system are represented.

For new oils, recently set in operation, the number of particles of fractional group 10-15 mcm is maximum. At the same time for fraction 10-25 mcm the distribution of particles has the reverse character. At operation of real lubricating systems of turbosets the rise of particles amount of fraction 5-10 mcm and reduction of particles amount of fractional group 10-25 mcm takes place.

Therefore, this process indicates on the insufficient availability of equipment of purification systems of turbosets namely by filters, which are able to remove effectively fraction particles of 5-10 mcm from the stream of oils. For practical realization of task for making of effective purification systems it should be installed in system filters able to provide the high values of sifting coefficient on these fractions at nominal modes of purification. It should be expected that in this case the purification systems will change from the class of ineffective ones to the group of effective ones. Industrial purifications of systems with the use of filters of FPDL- MEPP carried out by us in many industrial projects have shown that in this case systems are effectively purified during short time.

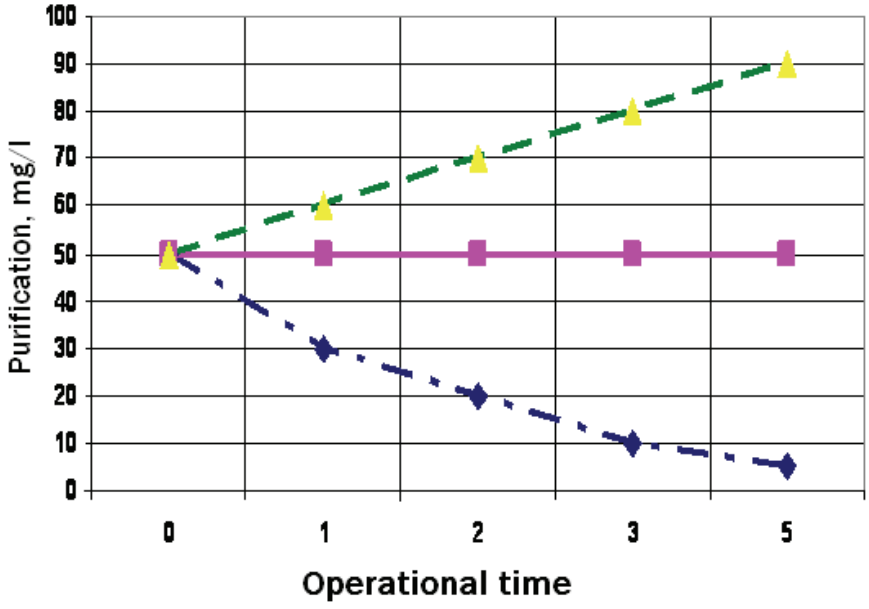

Fig. 1 . The dynamics process of contamination level changing in systems during life time 1 - Rise of contamination level in system; 2 – Constant concentration of contamination; 3 - System cleaning.

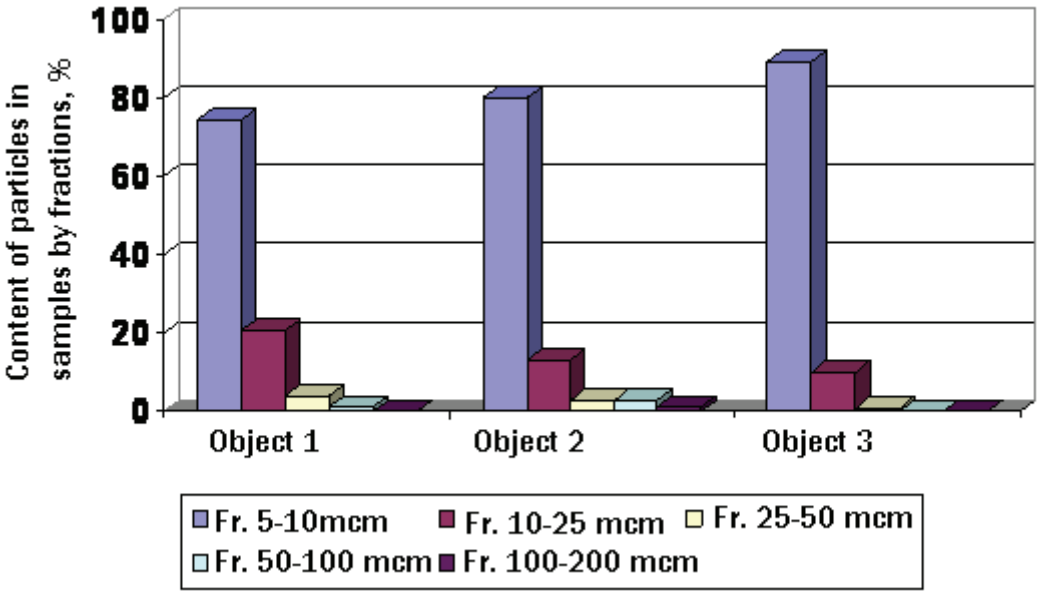

Fig. 2. Changing of fractional composition contamination during operation.

UDC 665

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QUALITY OF FUELS FOR AIR-FEED JET ENGINES

This article is about quality of fuels for jet engine, about brands of fuels, about distinctions in the requirements of domestic and foreign standards and technical conditions to them, about advantage of domestic fuels

Production of fuels for aircraft engines is one of the priority directions of the oil refining industry in the World. First of all this is connected with increasing of aircraft fleet. Referring to the forecast of marketing company "Forecast International" approx. 5835 units of large passenger and cargo aircrafts will be built in a period from 2004 till 2013. At present, according to the data of World Airfleet, there are about 2 thousands of airlines with total aircraft fleet in 50 thousands of aircrafts in the whole World [1].

Quality of fuels for air-feed jet engines (AJE) in comparison with other petroleum products mainly depends on the crude oil nature and boiling limits of oil fractions, emitted during the atmospheric distillation. Factions of direct distillation can be purifying in different ways, depending on oil composition and requirements to the fuel quality. Some fuels for air-feed jet engines are obtained by catalytic destructive processing at the presence of hydrogen of distillates of atmospheric or vacuum fractionation and catalytic cracking products. Mode of catalytic processing depends on the quality of raw materials and, in turn, almost completely determines the quality of fuel [1].

Contemporary environmental requirements are proffer additional requirements to the quality of fuels for air-feed jet engines too. For example, resolution of European Parliament about reduction of impact on climate changes from aviation industry (INI/2005/2249) clearly says that: "European Parliament urged to facilitate the introduction of aviation bio-fuels thereby promote the reducing of impact on climate change". Basic requirement of international aviation is a possibility of worldwide use of aviation fuel for air-jet engines with satisfactory characteristics. IATA guidebook about aviation fuels for air-feed jet engines used in civil aviation was published after meeting of representatives of airlines and fuel suppliers, which took place in Stockholm in September 1957 and after next 10th Technical Conference of IATA (International Air Transport Association). Currently, this document identified the characteristics of 4 brands of air-fuels for gas-turbine engines, namely: Jet A, Jet A-1, TS-1 (kerosene) and Jet B (large-fraction fuel).

As it's known, quality category is a complex conception (ISO 8402). The quality of fuels for air-feed jet engines is determined by a set of relevant physical, chemical, environmental and operational properties. Many of these properties are governed by the relevant standards (international, interstate, national, etc.). There are distinguishing following operational properties of fuels for air-feed jet engines: fluidity, volatility, flammability, combustibility, tendency to form deposits, compatibility with structural materials, anti-wear, protective, cooling and toxicity. Each property is characterized by complex physical-chemical quality values [2]. Indicators of volatility (boiling limits), flammability (flash) and pumping (crystallization temperature) are used for the classification and indexing of fuel for air-feed jet engines in the World. Basic requirements to the quality of fuels for air-feed jet engines are formed by: International Air Transport Association (IATA), American Society of Test Materials (ASTM), British Specification (DERD), "Check List" and state industrial standards (GOST, DSTU) for Post-Soviet Union countries. In Ukraine there are produced two brands of fuels for air-feed jet engines: PT and TC-1. Petroleum refineries in Odessa, Kremenchug and Lisichansk are main manufacturers of fuels for AJE. Requirements to the quality of these fuels are regulated by branch standards OSTU 320.00149943.007 "Fuel for jet engines brand "PT". Technical conditions" and OSTU 320.00149943.011 "Fuel TC-1 for jet engines. Technical conditions".

Quality of fuel mainly depends on used doping agents during production process. Antistatic, anti-water-crystallization, antioxidant and anti-deterioration doping agents are added to fuel mixtures. Using of doping agents for aircraft fuels is carefully controlled and limited because of potential probability of un-desire side effects. In some cases doping agents can influence on fuel purity during transport, storage and transferring procedures, and have a negative influence on fuel system of aircraft and on operational and technical service of gas-turbine engine. Only accepted doping agent in determined quantity and composition can be use, approved by aircraft producers and also manufacturers of engines, and specified by correspondent organizations - developers of specifications.

Specifications are determined requirements to doping agents in following way:

- Required use - must be present in fixed minimum and maximum limits, or within the properties limits;
- Use on discretion - can be added up to a maximum concentration or within the properties limits;
- Use above agreement - can be added only regarding to agreement with the consumer / buyer within established limits.

After entry of Ukraine into World Trade Organization a question about unification and optimization of the requirements to quality of manufactured goods, especially for aviation fuels has become acute .

The overwhelming number of countries, including China and India, produce jet fuels for civil aviation such as brand Jet A-1, which conform to ASTM D 1655 (USA) and DEF STAN 91-91 (England). Fuel for jet engines of Ukrainian origin - TC-1 and RT in spite of the differences in compare with fuel Jet A-1, not rebate to this fuel for some characteristics, and in some cases superior it. Analysis of the data shows that domestic brands of aviation fuels do not rebate on the level of quality to fuels from other countries (for example, the Russian Federation and the USA), and for some indicators, even surpass them. However, some differences of norms on certain quality indicators and methods of their determination do not allow Ukrainian fuels to correspond respective foreign fuels complete. Fractions of straight-run distillation of crude oil are most widely using for production of TS-1 in Ukraine, therefore its physical-chemical and operational properties are entirely dependent on the quality of processed oil. If this method do not allow obtaining of fuel TC-1 with required quality, then there are use a processes of de-mercaptan or blend of straight-run hydrotreated or de-mercaptan component.

Ukrainian and foreign standards regulate practically the same operational properties of fuels, including anti-wear properties whose definition provides by DEF STAN 91-91, but does not provide GOST 10227. Ukrainian standards envisage an evaluation of these properties at the certification tests [4].

Despite the fact that the serial domestic jet fuels of brands TS-1 and RT (GSTU) are significantly rank over jet fuel Jet A-1 on a number of operational properties and physical-chemical parameters, their application in aircraft engines of companies "Pratt and Whitney", "Rolls -Royce", "General electric" severely restricted. This is due to different approaches to assessing the reliability of the aircraft depending on the operational properties of fuels for jet engines. In domestic practice, reliable operation of fuel systems is evaluated primarily by pumping characteristic and the tendency of fuels to form deposits. Abroad, fire safety is dominant feature of any operational fuel for jet engines. These differences are reflected in the standards of Ukraine (OSTU), USA (ASTM D 1655) and Great Britain (DEF STAN 91-91). In the Central Institute of Aviation Motor Building (CIAM) was established a correlation between generalized indicator of anti-wear properties of fuels *K*, defined according to the method CMKO on the booth UPS-01, and the diameter of the wear spot, which characterize these properties at evaluation on the device BOCLE by the method ASTM 5001, which provided definition of the anti-wear properties of fuels Jet A-1 Jet A-1 in ASTM D 1655 (USA) and DEF STAN 91-91 (England). Established by those methods a norm value on the diameter of wear - no more than 0.85 mm corresponds the value K = 68%, which is significantly below the norm for fuel CMKO for RT - at least 95% and statistical values of this index for fuel TS-

1 - 76-169% . These results clearly demonstrate the superiority of the quality of domestic fuels over the best foreign products [3].

Comparative characteristics of main indicators of quality of domestic and foreign fuels also demonstrate the superiority of domestic fuels. Steady-state experience restrictions on the use of domestic fuels for the engines of foreign companies unjustified. Base on the given analysis its necessary to restrict the use of foreign fuels for domestic flights due to poor anti-wear properties. By the time of the championship "Euro 2012" its necessary to conduct comparative tests of operational and physical-chemical properties of the methods and techniques adopted in Ukraine, for fuel PT from oil refining plants in Odessa and fuel samples Jet A-1. And also its necessary to provide by the information of airports, in which will be held the final game of Euro 2012. This is especially important for charter flights, private aircraft which are little familiar with the fuel quality of Ukrainian origin.

References

1. *Л.С. Яновский, Н.Ф. Дубовкин, Ф.М. Галимов, Т.Н. Шигабиев, Ю.Ф. Гортышов, В.В. Горячев, В.А. Кондратьев, В.А. Аляев* Инженерные основы авиационной химмотологии. – Казань: Изд-во Казанск. Ун-та, 2005. – 714 с.
2. *Л.С. Яновский, Н.Ф. Дубовкин, Ф.М. Галимов, Т.Н. Шигабиев, В.А. Скибин, А.А. Харин, В.В. Горячев, В.А. Кондратьев, М.Р. Габайдуллин* Горюче-смазочные материалы для авиационных двигателей. – Казань: Казанский Государственный Технический Университет им. А. Н. Туполева, 2002. – 400 с.
3. *Л.С. Яновский* Энергоемкие горючие для авиационных и ракетных двигателей. – М.: ФИЗМАТЛИТ, 2009. – 400 с.
4. *Н.Ф. Дубовкин, Л.С. Яновский, Т.Н. Шигабиев, Ф.М. Галимов, В.Ф. Иванов* Инженерные методы определения физико-химических и эксплуатационных свойств топлив – Казань, 2000. – 378 с.

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TRIBO-CAVITATION FOR AVIATION KEROSENE

For example, the linear contact tribo system slide shows that fuel systems together with hydraulic and acoustic cavitation arises "tribo-cavitation" occurring in diffusion areas of friction units and downward pressure on local pressures to lower pressure values and cavitation threshold.

Analyzing the current state of Tribology, U.M. Luzhnov monograph [1] points out that «in view of the complexity of the processes that form the friction, there is currently no consensus yet on its nature». To date, friction and wear are considered from the perspective of disparate terms and notions about the nature of friction.

In 2008 was hypothesized compression-vacuum friction nature [2], which was his first experiment and demanded more reasoned evidence, part of which is presented in [3].

Established laboratory machine friction one-way linear sliding contact (fig. 1) implementation of optically transparent contact. You can adjust the speed and axle load compression rubbing surfaces that enables basic modes of friction (hydro, elasto-hydro dynamical and friction in the face of marginal lubrication).

As a rotating counter body reproducing the shaft, made Teflon video (outer diameter is 80 mm, width of roll-9 mm) flat fixed parallelepiped was made of optically transparent material (disoriented Acryl glass).

In the air, without lubrication, the surface forming vertical cylinder flat face clear movie box forms a linear contact in the form of a narrow rectangle. The length of the zone of such contact is clip 9 mm and the width of the axial force compression 4 N 0.7 mm and 40 mm h-about 0.8.

As a working environment has been used lubricating kerosene or TS-1, as a transparent, low-viscosity where friction sliding speed (0.2 ... 0, 8 m/s) and small loads (1…10 v) occurrence of hydrodynamic contactless friction is unlikely.

Experimental Conditions varied: linear speed gradually changed from 0.2 0.9 MPs, axial load changed between 4 and 200 m. after the linear contact around a symmetrical relative to line contact spot kerosene by wetting those surfaces (fig. 1).

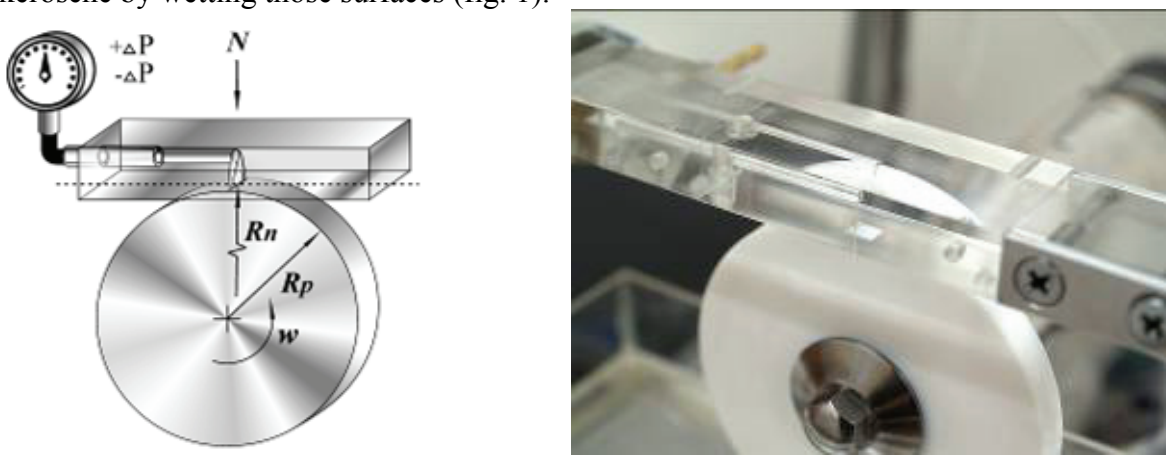
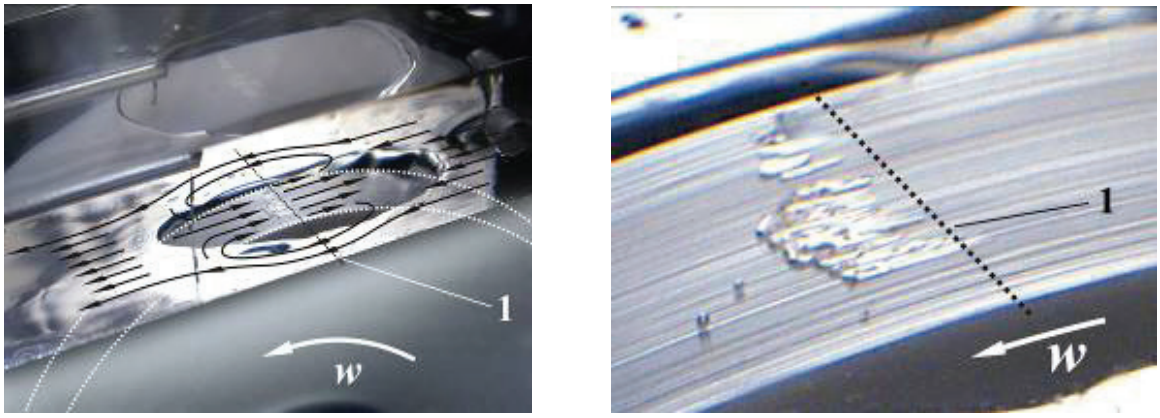


Fig. 1: diagram of machine friction with the top position of the contact (s) and the emergence of linear contact lubricated kerosene, visible through the side edge of the box

Roughness of the surface of the roller set sufficiently broad and technically implemented in industry range from the r option and from up to 0,8 μm 20nm.

Visual phenomenon. When you turn on the drive roller casting cylinder Surface friction slip on the bottom edge of the transparent parallelepiped shape is flat in the perpendicular line contact direction. viewing kerosene made roller contact, in a certain light, revealed, regular and natural behavior layer of kerosene simultaneously in two ways: through the side and the top edge of the transparent parallelepiped shape (fig. 2).



a) b)

b)

Fig.2. The current liquid surface friction sliding clips on flat edge of the box (a) and the formation of cavitation bubbles in cavities and linear contactdiffusion area (b), where 1 is the center line of contact surfaces

Sufficiently thick layers Caught roller kerosene delivered contact, along the edges of it started wrapping obstacles formed the contact, then these surface fixed prisms for macroflows meshed contact. While there has been a shift towards the most stains, soak the reverse direction. After establishing a permanent operating speeds, when the contact area under a certain angle, there has been a very intense, visually seamless fluid bolus passage of kerosene from the contact area for input clip into contact with the bottom surface of the box in the direction opposite to rotation. On exiting the working surface of contact visually observed intensified and continued for kerosene from wetting surface prisms of kerosene-contact, i.e. the slip road. The current kerosene when slide shown in Figure 2.

Increasing speed of sliding clips on the surface of a 3D box led to greater offset pin spots of kerosene in the direction opposite direction of rotation. When the monitored heterogeneity of kerosene "from the contact area of the sign-clip in touch, and" contact "in the area access clip from contact became more intense. The same happened when you increase the load, at constant speed.

Gradual bring speed to 0.3 m/s, in the area access clip from contact in layers of kerosene was the emergence of gas bubbles which moved in the direction of slip, they made a moving surface generatrix clip over a distance of about 5 mm from the contact and then disappeared. Traffic generated gas bubbles (fig. 2 g) about contact took place against Jet currents of kerosene to "contact us" on the clip. These bubbles were randomly over the full width of the linear contact due to cavitation of kerosene. For kerosene TC-1 at 20 ^{0}, vapour pressure, in a State of dynamic equilibrium with the liquid phase is 919.9 PA at the liquid to the steam volume 4: 1. Hence, the vacuum in the area access clip from contact with speed 0.3 MPs and slight axial load of 4 h. That is, in the case of vacuum pressure boundary layers to below 919.9 PA. Further increases in speed resulted in an increase in the intensity and the number of bubbles that are merged and the eruption of steam-gas cavities. The latter took shape, similar to "flames" (fig. 2 g) with base in the middle of the field contact oscillating towards sliding on land-clip out of contact.

When you change direction sliding kerosene closely observed flows, also changed its direction in the opposite direction of the skid, "contact" in the field of log clip into contact with the surface of the box and "contact" in the area access being rubbed surface out of it. Change the direction of gliding almost symmetrical diversion caused contact currents.

Thus, there has been a regular postback visually track friction currents kerosene near contact zone. The emergence of such currents caused by increased pressure in the resulting convergent channel in the direction of rotation of the cylinder and symmetrical relative minimum gap intake-diffusor channel, i.e. friction is a deformation resistance: its compression and evacuation operations.

Measurement of pressure distribution in contact: For pressure distribution measurement in contact area, inside the box are the channels that the contact surface came out as a hole or slot, probe (receiver) sphygmomanometers in lubricating layer to the side of the box via the choke off the brink joined pressure gauge to measure static pressure in contact and near contact areas by means of scanning contact appropriate probe

Measuring pressure in layers of kerosene near contact zone in the middle pane contact to the midline using resistive sensors pressure MDD-0-1. Sensing was step 0.05 mm.

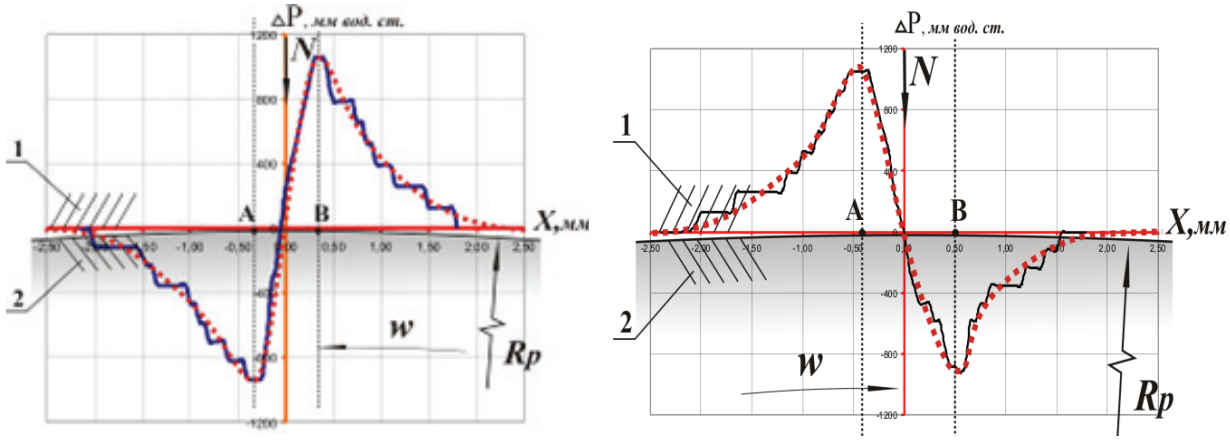


Figure 3: distribution of pressure Δp at boundary layers of kerosene TS-1
Depending on the coordinates of the scan, perpendicular to the contact with slip-x,
where AB is the width of the linear contactparallelepiped shape 1 and clip 2 with a radius R_p,
ω-rotational speed, N-thrust compression, X-axis scanning
a) clockwise rotation; b) counter clockwise rotation

Measurement results (fig. 3A) showed that the pressure in the kerosene for login clip in touch increases of 2 mm to contact parallelepiped shape with rotating roller. Then, the front edge of the input pins, reaching a peak of over 1000 mm water column pressure dropped rapidly and declined to about the middle of contact atmospheric. A further shift of holes in the area access clip from contact resulted in diluted pressure reached extreme (about 1000 mm water column), but now below atmospheric and also on the edge of contact area output movie out of it. When you move the probe from the contact pressure kerosene, remaining below the atmospheric reliably began to gradually increase and atmospheric also leveled approximately 2 mm.

Conducted a similar measure, other things being equal, but in the opposite direction sliding (fig. 3) almost symmetrical inversion data demonstrating a plausible connection contact currents of boundary layers on the sending of slip. That is, as happened at the entrance to the contact pressure kerosene, and leaving him down on the air.

When you change direction sliding ceteris paribus pressure boundary layers of kerosene or TS-1 grades have changed for the middle of contact as well as visually observed lines (fig. 3). In the field of log clip in touch with parallelepiped pressure kerosene has edge contact has reached its maximum, and about the middle of contact has decreased to air. Then also jumps occurred in downgrading pressure kerosene layers that are scanned to a minimum, and in the area access clip out of contact, remove the probe from it fades in the measured pressure began to ambient pressure.

Consequently, adhesive force of friction (99% of the total friction force) that occurs at the edge-polymer tribocontact with lubrication as a result of the downward pressure environment between surfaces, moving towards diffusor of contact. Vacuolization environment between being

rubbed surfaces, is one of the fundamental physical processes that are causing wear and friction surfaces. Averting a decrease of pressure between surfaces of friction in the lubricant, the edge, such as the various techniques described in the paper [3], tribosystem slip can become almost wear-free.

CONCLUSIVES:

1. Set a gradient aviation kerosene pressures on both sides of the contact type "tribosystem sliding shaft-sleeve" and, when entering in contact pressure is increasing, and by its withdrawal – falls on barometric pressure. These pressure differentials are causing Jet currents environment against the direction of rotation shaft.

2. it is shown that higher axial load and sliding velocity increases compression kerosene "at the entrance to the «contact» and its degree of dilution," contact ". These areas of high and low pressure kerosene symmetrical in relation to the maximum contact strain that exceed the length of the contact.

3. the example tribosystem slip with linear contact shows that fuel, oil or other hydraulic systems together with hydraulic and acoustic cavitation, there may be «tribo-cavitation» occurring in diffusor areas of friction units and downward pressure on local pressures to lower pressure values and cavitation threshold.

4. Confirmed the hypothesis coherent nature of friction and wear of the vacuum in aviation kerosene, which can be comprised of three sections of Tribology flowing, elasto-hydro dynamical and friction in boundary lubrication.

References

1. *Luzhnov U.M.* Nanotribotehnology adhesion Rails. Reality and possibilities. M.: Intekst, 2009, 176 pp.

2. *Stelmakh A. U.* Compression vacuum adhesion mechanism of friction and wear. – 28pp. the GNTB Ukraine. -07.07.2008, No. 109-UK 2008.

3. *Stelmakh A.U.* Emergence contact inkjet currents in boundary lubrication and mechanism of their education. National Aviation Univ. – Kiev, 2009. -43pp.rus. The GNTB Ukraine 14.04.09, No. 20-Uk 2009.

SYMPOSIUM 6

ECONOMICS IN AVIATION

UDC 656.71.003:658.114.25 (045)

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DEVELOPMENT OF HIERARCHICAL STRUCTURE OF CRITERIA FOR EXPERT ESTIMATION OF EFFICIENCY OF UNAVIATION ACTIVITY IN AIRPORTS BY METHOD OF ANALYSIS OF HIERARCHIES OF SAATI

The primary purpose of the article is development of hierarchical structure of criteria for the estimation of efficiency of unaviation activity in airports on the basis of method of analysis of hierarchies of Saati.

Raising of problem. Development of the system of air transport of Ukraine is the important factor of upgrading of life quality of population and competitiveness of national economy. Airports as part of a transport system are the important component of a national, regional and local transport infrastructure. As an object of economic activity an airport – is a not simply a public service provider, but independent commercial complex with own business-aims and strategy of development which is sent to the increase and economic efficiency of its functioning. Measuring of general efficiency of aviation and unaviation activity of airport is methodologically related foremost with determination of structure of criteria of estimation of effectiveness.

Analysis of the last researches or publications. The scalene analysis of integral concept of efficiency of unaviation activity and factors that influence it [1, 2, 3]. is conducted in the latest scientific publications of the Ukrainian and foreign authors. But in these publications the decoupling of concept of efficiency of unaviation activity is not conducted on component subcriteria and logical intercommunication is not certain between them.

Formulation of aims of the article. The primary purpose of the article is development of hierarchical structure of criteria for the estimation of efficiency of unaviation activity in airports on the basis of method of analysis of hierarchies of Saati.

Exposition of basic material of research. Efficiency of unaviation activity is a complex reflection of end-point of the use of capital and labor force goods for the certain interval of time.

Essence description of efficiency of unaviation activity finds a reflection in general methodology of its determination, the formalized form of which looks like:

$$E = \frac{\sum_{i=1}^{n} E_i}{\sum_{j=1}^{k} B_j} \cdot 100\% \qquad (1)$$

where E — is efficiency of unaviation activity in an airport; E_i — are constituents of effects from the conduct of unaviation activity; B_j —. are constituents of charges on the conduct of unaviation activity.

The decoupling of integral concept of efficiency of unaviation activity on separate components is conducted coming from the following functionally - logical chart in which the main factors of forming of economic effect found a reflection.

The generalized chart of process of forming of economic effect from unaviation activity is brought around to fig. 1. When forming the system of indexes of efficiency of unaviation activity of airport, it is expedient to adhere to certain principles, namely:

– providing of organic intercommunication of criterion and system of concrete factors of efficiency of unaviation activity; reflection of efficiency of the use of all types of resources which are

used in unaviation activity;

– possibilities of application of indexes of efficiency are for the management of different kinds of unaviation activity in an airport;

– implementation of stimulant function leading factors is in the process of drawing on present reserves of increase of efficiency of unaviation activity.

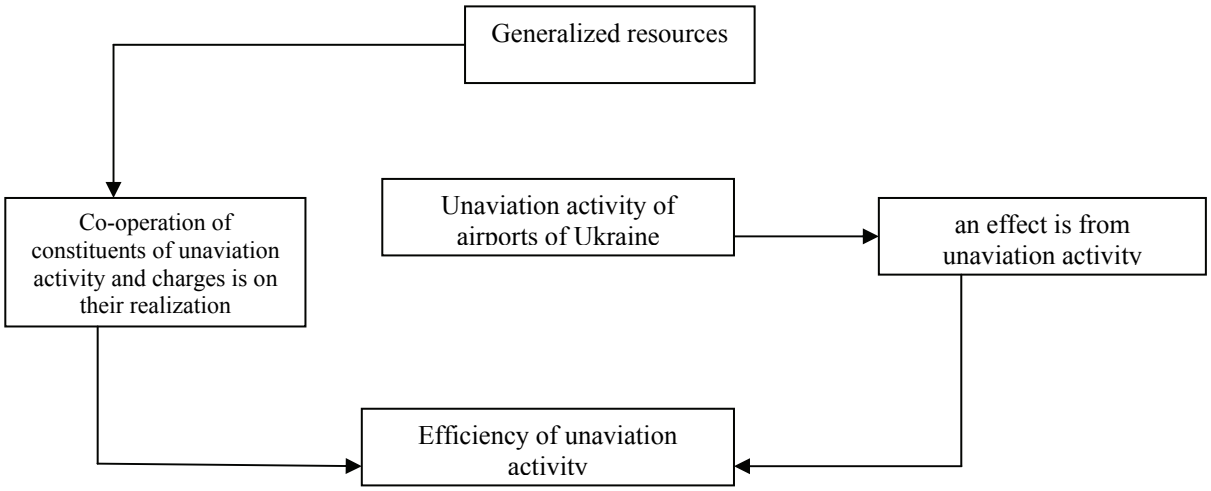

Fig.1. Chart of forming of results and indexes of efficiency of unaviation activity

If to conduct the decoupling of integral concept of efficiency of unaviation activity from the point of view of theory of the socio-ecological-economic systems, then it can be divided into three components - economic, social and ecological. Description over of indexes of these constituents is brought in a table 1

Table 1 - Criteria of determination of efficiency of unaviation activity

Criteria of determination of efficiency of unaviation activity		
Economic	Social	Ecological
An income is from unaviation activity	Level of satisfaction of market necessities	Contamination of atmospheric air
Increasing of capital productivity	Reduction of duration of workweek	Contamination of soils and subsoil waters
A grant of services is on unit of charges of resource		
Profitability	increase of working sitting capacity	mount of created wastes
General economy of recourses		
labor productivity	Improvement of terms of labor	Strength of vital functions of personnel security

The system of indexes of efficiency of unaviation activity which is built on the basis of the noted principles must include a few groups: 1) summarizing indexes of efficiency of unaviation activity; 2) indexes of efficiency of the use of labor (to the personnel); 3) indexes of efficiency of the use of productive (basic and circulating) funds; 4) indexes of efficiency of the use of financial means (circulating assets and investments). Each of these groups includes the determined amount of concrete absolute or relative indexes which characterize general efficiency of unaviation activity or efficiency of the use of separate kinds

Efficiency of unaviation activity has polymorphic of determination and application for analytical estimations and administrative decisions. Taking into account it, important is a selection on the separate signs of corresponding constituents of efficiency, each of which has a practical value is certain for an airport on the whole.

The corresponding constituents of efficiency of unaviation activity are distinguished mainly

after the types of the got effects of activity of airport. In this connection there is a necessity to point essence maintenance description of separate constituents of efficiency.

An economic constituent is represented through different cost indexes which characterize the intermediate and eventual results of production on an enterprise or in other integration productive structure.

Social efficiency consists in reduction of duration of workweek, increase of new working seating and level of employment of people capacity, improvement of terms of labor and way of life. Social consequences of production can be not only positive but also negative (unemployment, strengthening of inflation and т. other).

Ecological efficiency consists in comparison of volumes of ecological results and charges which are sent to the ecological providing of unaviation activity (ecological monitoring, system of ecological management, control system by wastes). Ecological results are calculated as a difference of indexes of ecology-economic loss from negative influence on an environment and as a difference of indexes of quality of the state of environment to and after realization of measures of the ecological providing of unaviation activity.

Coming from these positions will begin development of hierarchical structure of the system of criteria, which consists of integral criterion, partial criteria and indexes - factors of estimation of economic efficiency of unaviation activity of airports of Ukraine

For forming of integral estimation of efficiency of unaviation activity it follows to form the generalized objective function which is the instrument of package of multicriterion task to the one criterion. She is an integral criterion:

$$J_{\Sigma}(e) = f\left(J_1(e_1), J_2(e_2), ..., J_n(e_n)\right), \tag{2}$$

where $J_{\Sigma}(e)$- is an objective integral function of integral criterion, $J_i(e_i), i = \overline{1,3}$ are objective functions of partial criteria of estimation.

The type of function (2) is determined by payment of every component criterion in a complex criterion and type of package, which is here used. At package of multicriterion tasks to the one criterion, when component criteria are of different importance, usually use the additive or sometimes multiplicative functions of packages [4, 5].

Objectivity of decision of task of development of model for the estimation of efficiency of unaviation activity in the airports of Ukraine is stipulated by providing enough complete chain of estimation of factors of increase of efficiency. The model of estimation uses the receptions of calculation of ball estimations of different factors on the basis of fundamental scale of Saati that characterize the separate constituents of concrete criteria. Every partial criterion J_i consists of great number of factors f_{ij} . For the receipt of expert estimations of corresponding factors experts fill questionnaires, in which appropriate corresponding estimations to the signs of factors, the value of which can be fixed in a ball scale which answers the scale of MAI [5].

The arguments of objective function, which are signs by factors in estimations on corresponding component criteria, are expressed by points in a dimensionless kind. For the estimation of factors in partial criteria will lay down three systems of equalizations:

Economic criterion of estimation of efficiency of unaviation activity:

$$\begin{cases} f_{11}(e^1) = k_{11} \cdot e^1{}_{11} + k_{12} \cdot e^1{}_{12} + ... + k_{1k} \cdot e^1{}_{1k}, \\ f_{12}(e^1) = k_{21} \cdot e^1{}_{21} + k_{22} \cdot e^1{}_{22} + ... + k_{2l} \cdot e^1{}_{2l}, \\ f_{13}(e^1) = k_{31} \cdot e^1{}_{31} + k_{32} \cdot e^1{}_{32} + ... + k_{3m} \cdot e^1{}_{3m}, \\ ... \\ f_{17}(e^1) = k_{71} \cdot e^1{}_{71} + k_{72} \cdot e^1{}_{72} + ... + k_{7n} \cdot e^1{}_{7n}. \end{cases} \tag{3}$$

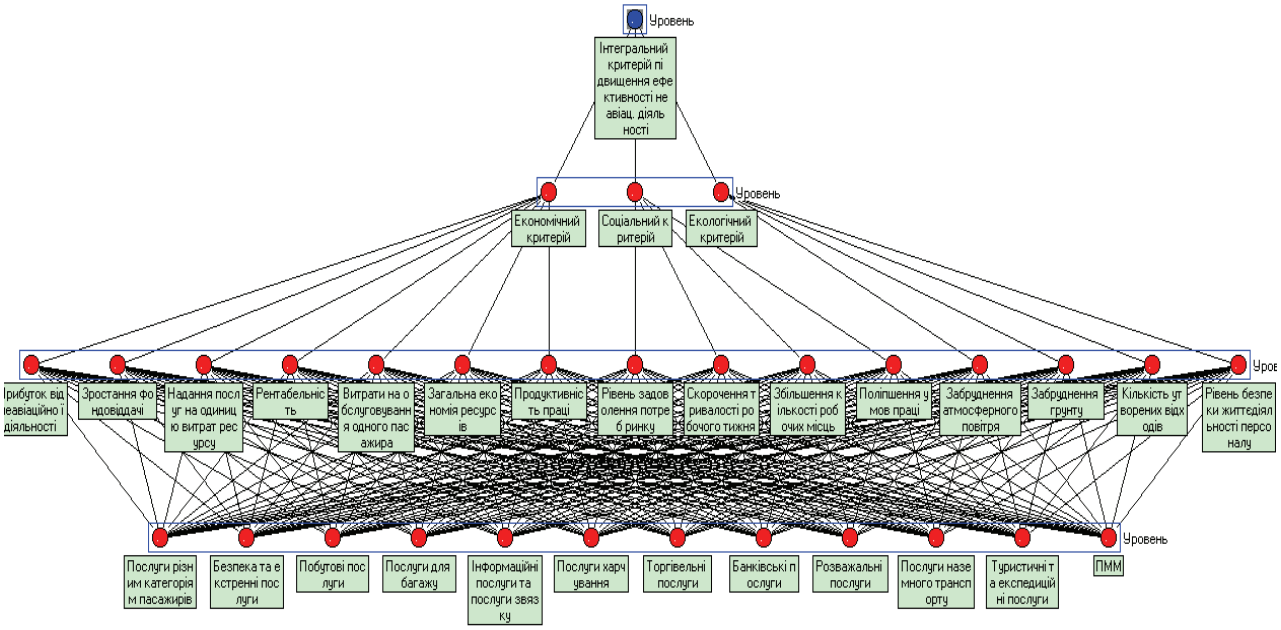

Fig. 2. Hierarchical structure of criteria of estimation of efficiency of unaviation activity of airports

Social criterion of estimation of efficiency of unaviation activity:

$$\begin{cases} f_{21}(e^2) = k_{11} \cdot e^2{}_{11} + k_{12} \cdot e^2{}_{12} + \ldots + k_{1k} \cdot e^2{}_{1k}, \\ f_{22}(e^2) = k_{21} \cdot e^2{}_{21} + k_{22} \cdot e^2{}_{22} + \ldots + k_{2k} \cdot e^2{}_{2k}, \\ f_{23}(e^2) = k_{31} \cdot e^2{}_{31} + k_{32} \cdot e^2{}_{32} + \ldots + k_{3k} \cdot e^2{}_{3k} \\ f_{24}(e^2) = k_{41} \cdot e^2{}_{41} + k_{42} \cdot e^2{}_{42} + \ldots + k_{4k} \cdot e^2{}_{4k}. \end{cases} \quad (4)$$

Ecological criterion of estimation of efficiency of unaviation activity:

$$\begin{cases} f_{31}(e^3) = k_{11} \cdot e^3{}_{11} + k_{12} \cdot e^3{}_{12} + \ldots + k_{1k} \cdot e^3{}_{1k}, \\ f_{32}(e^3) = k_{21} \cdot e^2{}_{21} + k_{22} \cdot e^2{}_{22} + \ldots + k_{2k} \cdot e^2{}_{2k}, \\ f_{33}(e^3) = k_{31} \cdot e^3{}_{31} + k_{32} \cdot e^3{}_{32} + \ldots + k_{3k} \cdot e^3{}_{3k}. \\ f_{34}(e^4) = k_{41} \cdot e^4{}_{41} + k_{42} \cdot e^4{}_{42} + \ldots + k_{4k} \cdot e^4{}_{4k}, \end{cases} \quad (5)$$

After the estimation of factors calculate the value of partial criteria. The integral criterion of estimation of efficiency of unaviation activity is estimated after a formula:

$$J_{\Sigma}(e) = K_1 \cdot J_1(e^1) + K_2 \cdot J_2(e^2) + K_3 \cdot J_3(e^3).$$

For realization of the hierarchical system of criteria shell program was used "Analysis of hierarchies" version 1.1 "neyrosplav" company. The built hierarchical structure of criteria for the expert estimation of efficiency of unaviation activity in the airports of Ukraine is brought around to fig. 1.

References

1. *Kulayev U.F.* Economics of Civil Aviation of Ukraine. Monograph. -Kiev.: "Phoenix" publishers, 2004 – p. 667: ил. of Bibliography. P. 659-666.

2. *Economy of enterprise:* Textbook/ Editor S.F. Pokropyvniy. - Kiev.: KNEU, - 1999. – 347 p.

3. *T.П. Makarovs'ka. N.M. Cooper.* Economy of enterprise: text-book. for students of institutes of higher education - K. MAUP, 2003. – 304 p. - Bibliography: P 293 - 297.

4. *Kachynskiy A.B.* Safety, threats and risk: scientific conceptions and mathematical methods. – Kiev., 2003. – 472 p.

5. *Saati T.* Decision-making. The method of analysis of hierarchies... - Moscow. Radio and telecommunications, 1993. – 320 p.

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PROSPECTS OF GROWTH OF WORLD REGIONAL COMPETITIVENESS OF HI-TECH PRODUCTION

In a lecture the problem of complication in the crisis terms of globalization, prospect of growth of competitiveness of hi-tech production is considered in the proper region in the system of world economy.

The problem of reduction of existent cross-regional differentiation of socio-economic development in the world is closely related to other important problem - necessity of providing of proof competitiveness of economy of its different regions in the conditions of action of processes of globalization.

In modern terms economy of country, equal as and any region, it is impossible to examine regardless of world economy, from requirements and terms of world market.

All more countries and regions join in hard competitive activity for the limited natural and raw material resources, highly skilled labor force, cheap credit resources, direct and portfolio external investments, front-rank technologies and now-how, informative resources. Thus as a result of processes of internationalization of different sides of public life and strengthening of integration tendencies considerably relax or fully scopes disappear at the territorial moving of different factors of production [1-3].

In these terms more become by the task of the maximally rational and effective use of present competitive edges of every region with the purpose of his steady economic development and providing on this basis of deserving, stably growing level of life of population.

Taking into account the concept of «competitiveness of regional economy» on the maintenance is more difficult, than competitiveness of separate enterprise or industry on the whole.

From one side, the competitiveness of economy of region must represent character of his external connections and relations (both cross-regional and international), his place in the system of territorial public division of labor.

From other side, a competitiveness is given means also capacity of regional economy for proof u on the basis of the most effective use of all of complex of factors of the economy growing, including inwardly regional, macroeconomic, administrativno-pravovi and external economic.

That touches problem, weak in economic relations regions, the necessity of their passing ahead development in the conditions of extreme low starting competitiveness of economy stipulates the important role of the system of state support of regional development exceptionally, that due to the use of factor in relation to cheap labor force in countries and regions high profitability of investment of capital can be arrived at exceptionally even at the middle or comparatively more low general level of the productivity of labor, what on industry in the developed countries [3-4].

In this connection a paradoxical situation is created outwardly, when on a background the improvement of basic descriptions of socio-economic general of or other region more deep pre-conditions of his subsequent lag are mortgaged from front-rank countries and regions on the level of the productivity of labor and economic welfare on the whole.

Such situation in the conditions of globalization, limits the prospects of growth of competitiveness of the proper territory in the system of world economy.

Indicated a negative tendency can be practically overcame only in the case of concentration on the national level of financial resources their effective use on the purpose of introduction of front-rank technologies and speed-up development of production of hi-tech types of products with the high particle of the added cost. However, taking into account very much weight of external debt of absolute majority

of countries, and also their considerable lag on a level and quality of education, such variant in a prospect appears very problematic.

In relation to a certain problem, it is possible to do an important conclusion, that not any increase of producing goods and services in backward regions and consequently, not any variant of the use of their competitive edges means the increase of general competitiveness of regional economy.

On principle important for the indicated regions is a question about firmness of the attained passing in the rates of economic development as compared parameters. Thus, as was it is before discovered, stability of high efficiency of cross-regional economic connections and relations comes forward the base condition of such passing.

Substantial influence on the competitiveness of economy of region gives character of his international auction connections also. The account of these connections at the estimation of efficiency of barter can be carried out in part of their export constituent.

Thus, in modern terms must key descriptions of competitiveness of regional economy become:

- stably high level of efficiency of cross-regional and external economic barter connections;
- proof dynamics of growth of the real economic welfare of region (for backward regions - by passing ahead rates).

The aspects of maintenance of competitiveness of regional economy are given it is important to take into account at development strategy of socio-economic development of region, ground of priority directions of restructuring of his economy.

It is necessary to mark that the competitiveness of regional economy is closely related to the competitiveness of economy of country on the whole, which, in same queue, is examined both on global (to international) and to national levels.

The competitiveness of country on a national market, in same queue, represents ability of domestic economy to conduct and consume commodities and services in the conditions of competition from the side of analogical foreign commodities and services.

Among factors, that it is determined, in relation to Ukraine select, in particular, the general lack of development of competition market environment, monopolies, relatively high role of shadow economy, low level and lack of development of structure of solvent demand, dug up between world and internal prices on analogical commodities and services.

However much globalization and development of competition create not only economic problems but also possibilities for commodity producers: permanent innovations, unprecedented rates of development of the most competition today industries of economy (electronics, engineer and other) of Japan and other industrially developed countries, are conditioned strengthening of internal and international competition.

The comparative estimations of competitiveness, with the exposure of strong sides of successful competitors, allow to determine the weaknesses of national subjects of world economy, specify of economic development.

A concept of international competitiveness is for a world and Ukrainian economy new and difficult enough. The proof providing of competitiveness of being in a charge subjects and producible by them commodities remains one of the most difficult tasks in a world economy. It is a decision difficultly, that Ukrainian experience in this sphere obviously small and taken mainly to the tekhniko-ekonomichnikh estimations of part of commodities which are exported, or industries, in general, without determination of levels of international competitiveness and economic system of measures of its increase.

The existent domestic and foreign decisions of problem of competitiveness poorly represent a dynamics and character those, which take a place in the world of fundamental changes in world and national economies, related to sharpening of international rivalry which is conducted in different forms, by different methods and on the different levels of economy.

Considerable legislative changes in the Ukrainian economy, conditioned passing to the market relations, did not facilitate the decision of many socio-economic problems which accumulated: commodity producers and state as well as before carry heavy resource tolls from low quality of products and labor, from insufficient efficiency of innovative and production processes, from, that potential of labors resources and the best world experience is not utilized [3].

For most known indexes of competitiveness Ukraine remains on the last places in the world, that sharpens the necessity of cardinal change of economic position of domestic commodity producers, taking into account international achievements, in this sphere, high-quality and structural transformation of world economy.

An international competitiveness is major complex description of the high-quality state of commodities, being in a charge subjects, their structural changes, comparatively with the analogues of other countries. The level of competitiveness in international business can be regulated taking into account quality of factors of his achievement and possible advantage.

The new terms of expansion of competition and narrow-mindedness of materially financial resources cause the necessity of high-quality breaches for a competitiveness and passing of competitors, which promote firmness of the economy growing, influencing and profitability of subject of world economy. From here is a necessity and systematization of the proper international information, in comparison of levels of competitiveness and its changes, comparatively with the leading subjects of world economy.

A modern management becomes the system of providing of proof competitiveness of the guided objects. In the increase of competitiveness the followings important intercommunications must be foreseen in international business: to development of the leading system with positive influence on the charges of human and other capitals, on forming of corporate strategy and policy (as sources of competition possibilities); alterations of processes (innovative and production) are in behalf of more complete satisfaction of users, workers, positive influence (economic, ecological, ethics and other) on society (as basic socio-economic results).

Firmness of international competitiveness can methodically rise by alteration, adjustment, modernization of processes on the next contours of the organizationally administrative providing of leading of the system

- statistical control of processes of transformation of initial raw material (information, materials, ready-to-cook foods and other) in eventual commodities - competition products and services (1 contour);
- to development of direct and reverse connections with users (2 contours);
- regular overvalue of levels of competitiveness taking into account achievements of leaders of world economy, changes and tendencies of its change (3 contours).

The system of the general providing of quality (products, management, and labor) is needed here will nurse from expedience combination of changes of necessities of world market with development of company through the chain of «internal users» (workers of company in a chain which provide creations of consumer value of, quality on all of the stages of life cycle of commodity), the eventual link of which a buyer comes forward. In such system international marketing information gets to all subsections of organization and to every employee, and the methodical changes of labour processes are related to interests of eventual users and own workers.

International experience showed that an quality, unethical, socially and ecologically irresponsible management and conduct brought to the loss places over on a world market, to inability of proof competition. Consequently, achievement of world competitiveness is linked and with «ecological efficiency» to subsequent directions:

- application of all of resources is with maximal efficiency and minimum losses;
- minimization of the use of unexcitable resources; maximal use of renewable resources;
- not exceeding of speed of regeneration of resources.

Despite traditional presentation about « ecological measures basic advantage of new approach, that it requires less capital investments.

Foreign experience of alteration of production processes (to the row of industries, including pharmaceutical, chemical, food, to the biotechnology) which are characterized high complication and testifies that their considerable rationalization allows to abbreviate on a 30-50% consumption of energy and other resources, prevent economic and ecological losses and without considerable modernization or purchase of new equipment.

International expansion and sharpening of competition requires achievement and maintenance of world level of competitiveness on new basis of maximally speed-up, high-quality, economic creation of consumer values. The acceleration of achievement of world level of competitiveness is related to deep high-quality and structural alteration of organization of management, innovative and production processes, systems of development of human capitals.

Conclusions

A primary value for providing of the proof economy growing and high competitiveness has an increase of level of complexity of development of economy of region, rational combination of industries of specialization. Growth of complexity of economy of most problem regions must be carried out on the base of deepening of diversification of their economic structure.

References

1. *John Cantwell*. Foreign Direct Investment and Technological Change; Edward Elgar Publishing; September 1, 1998. – 980 p.

2. *Francois Chesnais.* European Integration and Global Corporate Strategies // International Business and World Economy// Routledge ; London; June 1, 2000.

3. *Ganeshan Wignaraja.* Competitiveness Strategy in Developing Countries: A Manual of Policy Analysis : Routledge 1st edition, April 1, 2003.

4. *Charles W. L Hill.* Global Business Today : McGraw-Hill, 3rd edition, March 1, 2003.

5. *Marat Terterov.* Doing Business With Ukraine (Doing Business in the Ukraine) : Kogan Page Ltd, 2nd edition,December 1, 2004.

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CURRENT TRENDS AND MAIN DIRECTIONS FOR DEVELOPMENT IN THE AVIATION INDUSTRY WORLD INTEGRATION GROUPS

Actual trends in corporate structures of modern globalization processes are searched. Process dynamics of interaction between actors in cooperation, integration and analysis of trends in capital funding-term business aviation industry is determined.
Keywords: group integration, corporate structure, consolidation capital, the aviation industry.

At the contemporary stage of economics development, companies' strategic success factor on global markets and increasing international competitiveness is the growth of their market value, which is realized through integration and consolidation of capital. Business merger makes it more powerful, less regulated and controlled by national governments and by the international economic organizations. Therefore, the research of trends and dynamics of these processes is of great importance.

On the basis of research, one could argue that the aviation industry of any technologically advanced country is considered to belong to the strategic one and plays a significant role in its economics development. One of the directions for improvement of the efficiency of market environment is to use the powerful integrated structures that are created with the help of certain successful organizations and enterprises to improve products competitiveness. That is why in recent years in the aviation industry has actively occurred the process of consolidation (mergers / acquisitions) and global business. Development of global supply network, of aircraft service and manufacturing provides producers not only to speed-up to new markets, but also to avoid unnecessary duplication, particularly in manufacturing components and assemblies. In its turn this can enhance and improve the specialization of production.

Among modern scholars questions concerning consolidation of capital have been widely represented. In particular, considerable attention is paid to the study of contemporary forms of groups integration, analysis of merger conditions, as well as planning and organization processes of merger and acquisitions. But at the same time many aspects of these scientific problems still remain unsolved. Further study the theoretical basis of capital is required in the process of global environment unification. The research of current consolidation and restructuring trends still remain not fully solved. Positive and negative aspects identification of mergers and acquisitions, are in need of major improvement of motivational concepts of business restructuring through mergers and acquisitions. The issue of activities poor performance is also quite relevant evidence this fact. The results carried through the associations over the past decade. This question requires deep analysis and determine the best ways to resolve it.

The great importance in modern industry - and especially in aircraft manufacturing- a problem of flexibility that can be considered one of the greatest economic problems of technological process has a great importance. To place on its territory such enterprise of heavy machinery sector production as aircraft manufacturing, powerful economic and resource supply is requires. That is because of aircraft manufacturing requires enormous financial funding, highly-skilled employees, the possibility of special fields materials transportation from other countries, from other countries, special fields for new products testing and so on. The USA, Canada, UK, Germany, Spain, France, Russia, Switzerland possess such a

potential. Additional constructions for companies of mentioned above countries are produced in Italy, Ukraine, Greece, Bulgaria and other countries.

Nowadays, powerful positions in the aviation industry belong to Canada, USA, EU countries (France, Germany), Brazil, Japan. China (table 1) is also gaining a rapid development in aviation industry.

Table 1

The positions of the leading countries in the world aerospace products markets (% Of total market)

Years	USA	Canada	EU	China	Brazil	Japan	The general amounts of market, bn. USD
1980	46,6	2,0	29,6	-	16,0	0,1	196,7
1990	51,7	2,3	28,4	0,1	9,1	0,2	261,3
2000	39,5	3,3	31,5	10,1	6,4	3,7	252,4
2009	32,8	2,5	32,6	14,3	6,6	5,1	273,7

According to structural analysis of the world aircraft market, world leaders in this field are the U.S. and EU (Fig. 1).

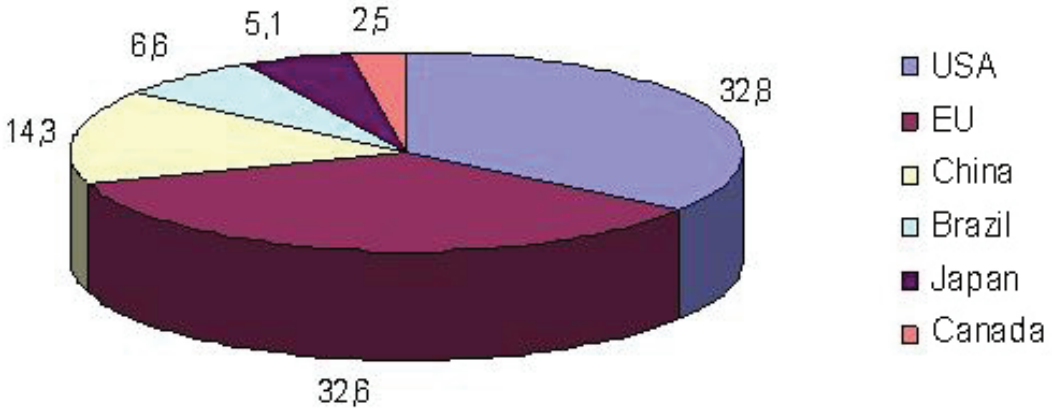

Fig. 1. World aircraft market structure

Aviation industry, based on a scientific base and highly skilled staff, has developed only in countries with high economic level.

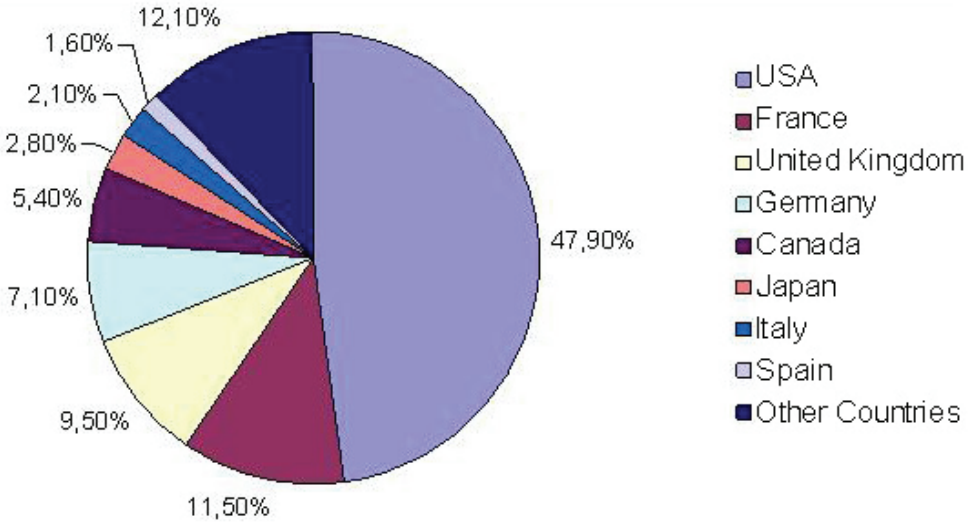

Fig. 2. Sales volume of world aviation industry products in the 2009

The main competitive advantages that contribute to market position strengthening, increase profitability and serial production, investment, development of technological base are: establishment of

international consortia, with leading corporations participation (Airbus, Eurfighter), organization of joint companies (Eurocopter), long-term cooperation (Boeing and Dassault Sistems, Snecma Moteurs and NPO Saturn), cross-border mergers and acquisition (Boeing, BAE Systems; Lockheed Martin; Aerospatiale Matra), aerospace industry state support. The main subjects of aerospace technology are diverticized companies with high share of civil products, which are usually influenced by private capital and are widely involved in international integration (Table 2).

Table 2

Integration groups in the world aviation industry

Company name	Location of country	Form of ownership	Revenue in 2008 billions, USD	Companies involved in the integration group	Transaction cost, billions, USD	Year of merger
Boeing	USA	private	52,4	Hughes Space and Communications Activities	3,8	2000
				Conquest	н.д.	2003
				Rockwell Aerospace/Defense	3,1	1996
				Frontier Systems	н.д.	2004
				McDonnell Douglas	16,3	1996
Lockheed Martin	USA	Private	35,5	Lockheed Corp. > Martin Marietta Corp.	10,0	1995
				Loral Company	9,1	1996
				Titan Corp.	2,5	2003
European Aeronautic Defence and Space (EADS)	Netherlands	Private	43,4	Aerospatiale-Matra (France)	-	2000
				DaimlerChrysler Aerospace AG (DASA) (Germany)	-	2000
				Construcciones Aeronauticas SA (CASA) (Spain)	-	2000
Bombardier Aerospace	Canada	private	15,8	Canadair Limited	-	1986
				de Havilland Canada	-	1992
				Learjet Company	-	1990
				Short Brothers (PLC)	-	1989
Embraer	Brazil	private	3,4	-	-	-
Northrop Grumman	USA	private	29,9	TRW	11,9	2002
				Litton	2,6	2001
				Newport News	2,6	2001
BAE Systems	Great Britain	private	25,4	Marconi Electronic systems (США) > The British Aerospace	12,75	1999
				Tracor	1,4	1998
				Lockheed Martin Control Systems	2,2	2000
				United Defense Industries (UDI)	4,2	2005

In such a way a production potential which is served by tremendous current assets, intellectual and labour resources gives an opportunity to set and solve correspondent problems accepting and running the competition. The greatest aviation industry global companies are: «Boeing», «Lockheed Martin», «EADS», «British Aerospace», «Raytheon-Hughes» and others. Thus, the main financial condition, which is formed by the global market for "passing" to the number of manufacturers which design and

produce modern aircraft is consolidated capital, based on the production with an annual sales volume of at least several billion dollars USA.

As a result, according to the authors, to overcome the crisis in the aviation sector of Ukraine should create favourable conditions for domestic entity, using the world's experience aviation company's integration in a single system [8-11]. Results of world leading aircraft manufacturers showed disappointing state of Ukrainian aircraft industry. But since 2005 with the help of own mistakes and experience some actions for a single aviation industry group creation have been performed. Thus in 2007 state concern "Aviation of Ukraine" was established [8]. Which includes the following state enterprises: State Enterprise "Aviation Scientific-Technical Complex named after Antonov"; State enterprise Kyiv Aviation Plant "Aviant", State "Plant N 410 of Civil Aviation", Kharkiv State Aviation Production Enterprise, State Enterprise Research Institute, Buran, State Enterprise "Kharkiv aggregate Design Bureau", State Kharkiv enterprise of machine-building plant "FED", State Enterprise "Zaporuizhya Machine-Building Design Bureau "Progress" named after A.G. Ivchenko " State Enterprise "Novator", State-owned Enterprise "Radiovymiryuvach". But October 30, 2008 the Cabinet of Ministers of Ukraine [9] excluded from these group five sub-enterprises and there appeared a new name: the State Concern aircraft Antonov. Nowadays the State aircraft Concern "Antonov" includes: State enterprise "Aircraft Scientific-Technical Complex named after Antonov" Kharkiv State Aviation Production Enterprise, state enterprise "Kyiv Aviation Plant "Aviant", State Company "Plant N 410 of Civil Aviation".

Various reasons of integration, caused by the world cyclical economic development and rate of technological changes, character of production changes, identified a wide range of different organizational forms of cooperation of business entities that are differently considered by theoreticians and practitioners because of the legal status, specification which is provided by civil and / or economic legislation in different countries.

In conclussion, according to the authors, to overcome the crisis in the aviation sector of Ukraine favorable conditions for domestic entity performance should be created by the means of applying the experience of aviation, companies integration into a single system.

References

1. *Соколенко С.В.* Производственные системы глобализации: Сети. Альянсы. Партнерства. Кластеры: Укр..контекст. – К.: Логос, 2002. – 645 с.

2. *Matveev V.V., Novykova M.V.*Construction of international economic relations system in international companies property management in the globalization conditions // Авіа-2009: Матеріали IX Міжнародної науково-технічної конференції АВІА-2009. – К.: НАУ, 2009: Том 3. – С.23.1-23.5.

3. *Lozhachevska O.M., Matveev V.V., Novykova M.V., Kravchuk N.M.* Modern trends of globalization processes in the aviation industry // Of the third world congress "Aviation in the XXI-st century". – Kyiv.: NAU, 2008: Volume 2. – p. 5.1-5.4.

4. *Гераськин М.И.* Согласование экономических интересов в корпоративных структурах. - М.: ИПУ РАН. Изд-во «Анко». - 2005. - 293 с.

5. *Ильин М., Тихонов А.* Финансово-промышленная интеграция и корпоративные структуры: мировой опыт и реалии России. – М.: Альпина Паблишер, 2002. – 287 с.

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MODERN APPROACHES TO AIRLINE REVENUE MANAGEMENT

Modern approaches in airline revenue management and pricing are researched. Revenue management models are monitored due to airline fare structures. Simple utility models are used to derive the buying probabilities dependent on the fares in the market. For revenue management practitioners this means that dynamic pricing cannot be automated completely and that long-term strategies have to be supplemented by the pricing analyst.
Keywords: airline, model, passenger, revenue management, booking.

The airline revenue management business models have changed over the past few years. The older, traditional models assumed that the different fare levels published for a given flight or flight connections are well fenced by conditions attached to purchase. A typical condition, for example, is the “Sunday rule” requirement. The lower fare can only be applied if the passenger's round-trip includes a Saturday night at the destination. For round-trips not satisfying this condition, a different fare level, usually higher, applies. Because of this fence it is possible to offer those two fare products simultaneously. The traditional revenue management model, implemented in most current systems, assumes that the demand for the different fare products is independent. That means the expected bookings for the higher fare are not dependent on whether the lower fare product is available or not. As a reaction to the pricing policy of low-cost carriers, many airlines started to drop the restricting conditions. The fare levels become, in the extreme case of dropping all differentiating conditions, pure price points. With such a fare structure, customers will always buy the lowest fare available. Practitioners realized some time ago that the combination of fenceless fares with traditional revenue management systems would lead to a spiral-down of the prices to the lowest level. A thorough discussion of this effect can be found in [3]. When customers buy down from higher to lower fares, the demand estimate of the higher fares is biased low. Hence, the optimization algorithm tends to protect fewer seats for the higher fares, inducing even more buy down. Eventually the entire demand will be predicted at the lowest fare and thus seats will no longer be protected for the higher fares.

In practice, however, airlines learned to deal with buy down by introducing new, manual controls to their reservation systems. Those controls close booking classes even if the flights are not predicted to be full, for the purpose of preventing buy down. The downside of this practice is that most of the booking control systems are no longer capable of producing automated recommendations. The revenue management discipline again became more of an art than a science.

Science progressed as well, and there are optimization and forecasting algorithms available that are capable of dealing with fenceless or semi-fenced fares [1,5,7,8]. This raises the interesting question as to whether pricing can be made automatic, since proposing the lowest open booking class is the same as proposing the optimal fare level. Those algorithms still neglect the presence of competition, which drives many, if not most, of the pricing decisions in today's airline environment. We therefore pose the question as to what will happen if, for example, both of two competitors utilize those same new techniques.

Some partial results on what happens when airlines drop fare fences in a competitive environment, obtained using PODS [9], have been reported in [9]. Because of the complexity of the involved networks and revenue management techniques, there is no conclusive outcome yet to indicate which modified revenue management methods perform best. There is also a difficulty in trying to compare the fenced with the unfenced environment, namely that in the former, price competition is not active, as the fares are fixed. Dropping fare conditions in a competitive

simulation acts like switching on price competition. In this sense it is no surprise to see airline revenues drop dramatically.

The core model typically considered has been introduced by [5]. Consider one airline operating one flight with a seat capacity C. The booking horizon is divided into T time intervals with the property that in any one time interval the probability that more than one booking request will occur is negligible. The probability that a booking request arrives in time interval t, the arrival rate, is denoted by λ_t. At the beginning of each time interval, the airline posts a fare, f_t. Let the probability of purchase, given an arrival, be $p_t(f_t)$. We assume that the derivative of the probability of purchase is negative, $\partial p_t/\partial f_t<0$. This means that demand decreases when fares increase.

This optimization problem (dynamic program) is solved by backward induction starting from the last time interval. Let the expected optimum revenue for the remainder of the booking horizon at time t, given x remaining seats, be $J_t(x)$. The Bellman equations for J are:

$$J_{t-1}(x) = \max_f \left[\lambda p(f)\left(f + J_t(x-1)\right) + \left(1-\lambda p(f)\right)J_t(x)\right] \tag{1}$$

We dropped the t indices on the arrival rate and the purchase probability, assuming those quantities to be constant over the whole booking horizon. This assumption is not relevant in the following and is purely for the sake of simplicity. The boundary conditions are:

$$J_t(0) = J_T(x) = 0 \tag{2}$$

as no more revenue can be made without seats or at the end of the booking horizon. At t=0 we set x=C, the seat capacity before bookings arrive.

We refer to the difference of the expected revenue at capacity x and $x-1$ as opportunity cost or bid price. Introducing the difference operator $\Delta J_t(x)=J_t(x)-J_t(x-1)$ as short-hand notation for the opportunity cost, the recursion formula becomes quite simple,

$$J_{t-1}(x) = J_t(x) + \lambda \max_f \left[p(f)\left(f - \Delta J_t(x)\right)\right] \tag{3}$$

The optimal fare strategy for time interval t, given remaining seats x, satisfies; therefore

$$f^* + \frac{p(f^*)}{\partial p/\partial f} = \Delta J_t(x) \tag{4}$$

Since the derivative of the purchase probability is negative, the optimal fare is always higher than the bid price. For the same reason, $p(f)$ is invertible and we can consider p as decision and $f(p)$ as dependent variable. The left-hand side of the above equation then has the economical interpretation of the marginal revenue, that is, the derivative of the expected revenue, $f(p)\cdot p$, with respect to the quantity sold, p.

The optimization problem is therefore solved straightforwardly in the dynamic programming model. The more difficult task is, however, to find good estimates of the arrival rates and the buying probabilities for given fares. In practice, airlines usually adopt a fixed set of prices indexed by a single letter, the booking class. The traditional forecast model assumes that the demand is independent per booking class and that it is sufficient to estimate the demand per booking class from historical observations. In the case of pure price points one has to modify this model and estimate the demand per booking class, given that this class is the lowest open class. We do not delve further into the problems of forecasting here but only remark that there are system components commercially available that are capable of producing such estimates.

The revenue management problem with completely unfenced fare structures can be tackled by modifications of the standard methods of optimization and forecasting, which are available from commercial system vendors. However, the interesting question is that of whether pricing can be automated, similar to the automated revenue management task with completely fenced fare structures.

One important aspect of pricing has not been touched so far, namely the question of how to deal with competition. The buying probability introduced in the previous section is, of course, very much dependent on the competitive offers available at other airlines. The competitor fares are,

however, not taken into account by the forecast model explicitly. They are taken into account implicitly, in the sense that when they change, the forecast will adapt to the new situation. This will, however, take a few iterations.

We will analyze this problem by a simulation approach. Assume that two airlines buy the same system, capable of dealing with unfenced fare structures, and just switch on the 'autopilot' mode. The exact description of the simulation is as follows. Each airline is equipped with the dynamic programming optimizer described in the previous section and a demand forecast predicting the arrival rate and the buying probability. While the former was shown to be optimal, we use a shortcut procedure for the forecast problem by letting the airlines know for each arrival what the highest fare capturing the passenger would have been. A similar trick has been used in PODS simulator studies and is called *psychic power* forecast [2]. The rationale behind this is that we want to isolate the effect of the competitive situation as sharply as possible and are not concerned with the problem of how to build the forecast itself.

The results will be given in terms of revenue per flight for varied symmetric capacities. The competitive effect will become visible when comparing the revenue per flight to the monopoly revenue value, where a single airline offers twice the capacity.

The booking process is the same as in the second section except that now two airlines offer their flights. Hence, at each time step, a customer arrives with some probability λ and then chooses between airlines A and B, or may decide not to buy at all. This choice is modeled by means of utility maximization as follows. Going from origin to destination has a random base utility U_0 for the customer. Flying usually also generates some disabilities so let us assume that flying with airlines A and B generates disabilities U and $\bar{U}$, respectively. The total utility for the customer is therefore $U_A=U_0-U$ if flying on airline A and $U_B=U_0-\bar{U}$ on airline B. If the fares offered by airline A and B are f and $\bar{f}$, respectively, the customer will choose airline A if, and only if

$$U_0 - U - f > U_0 - \bar{U} - \bar{f} \quad and \quad U_0 - U - f > 0 \tag{5}$$

The condition for choosing airline B is obtained by symmetry. If none of these two conditions are satisfied, the customer will choose not to fly at all.

In order to obtain a simple model, we assume that the base utility as well as the disutility's is independent and exponentially distributed:

$$\begin{aligned} U_0 &\approx \beta \exp(-\beta U_0) \\ U &\approx \alpha \exp(-\alpha U) \\ \bar{U} &\approx \bar{\alpha} \exp(-\bar{\alpha}\bar{U}) \end{aligned} \tag{6}$$

The *psychic power* forecast works as follows. We let each airline know, after each time step, what the willingness-to-pay of a potential customer would have been. The forecasting task is then only to build the statistics of the recorded observations and to derive conclusions on the future willingness-to-pay. Also, some kind of forgetfulness for past events needs to be applied in order to adjust for changes in the demand for the respective airline. In our toy model such changes will always be driven by the other airline's price because we leave the underlying utility model fixed and time independent. Next we describe some implementation details.

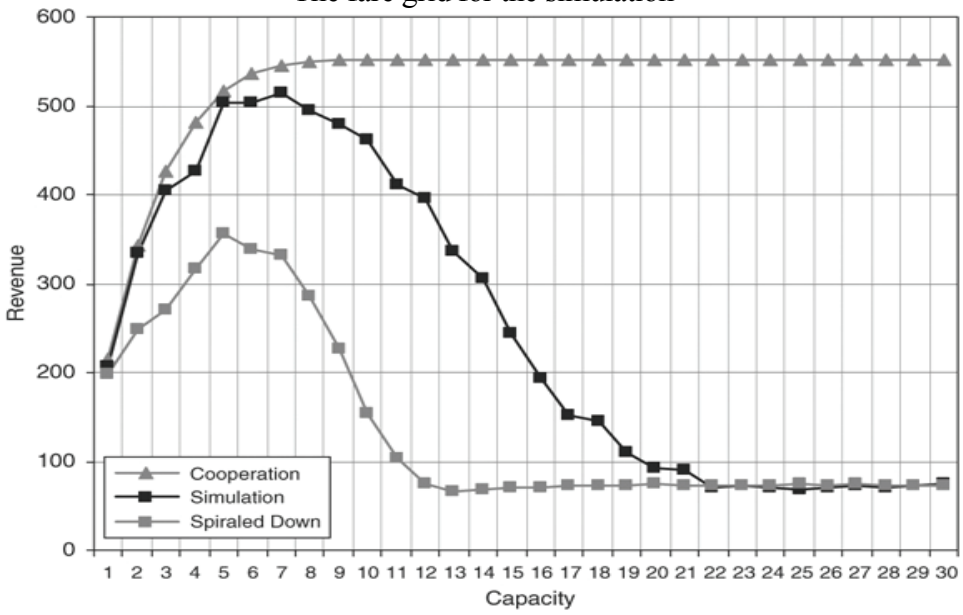
The booking horizon of each pair of departures consists of T=60 time steps, each with arrival probability λ=0.505. For forecast purposes it is useful to split the booking horizon into sub-periods, so-called data collection points, DCP for short. We work with 20 DCPs of equal length, containing three time steps.

For the utility model, we use β=0.01 and $\alpha = \bar{\alpha}$= 0.5. When the airlines have to publish their price at the beginning of a time step, they may do so choosing from a list of price points, $f_1 \geq f_2 \geq f_N$, as stated in table 1. This fare structure may look a little unrealistic at first glance, since it is tuned such that discretisation effects are minimal. (See the fifth section for further details) We can look at it either as a subset of a very fine, equally spaced grid like some low cost carriers use, or as some approximation of a continuous fare model. Since the grid is large enough and rather uniform, this is hardly a restriction

compared to continuous fares and makes implementation much easier. We will, however, admit continuous fares in the game analysis later on.

Table 1

The fare grid for the simulation



We vary the capacity *C*, being the same for both airlines, from 1 to 30. For a given capacity, one simulation run consists of 3,200 pairs of departures, with the first 200 serving as a burn-in phase and the last 3,000 being used for evaluation.

References

1. *Boyd, E. A. and Kallesen, R.*.The science of revenue management when passengers purchase the lowest available fare', Journal of Revenue and Pricing Management, 2004, v.3. - P.171–177.

2. *Cléaz-Savoyen, R.*. Psychic power and elasticity', PODS consortium summit, Minneapolis-Saint-Paul. 2004.

3. *Cooper, W. L., Homem-de-Mello,* T. and Kleywegt, A. D. Models of the spiral down effect in revenue management', Operations Research, 54, 2006, v.5 - P.968–987.

4. *Gallego, G.* and Hu, M. Dynamic Pricing of Perishable Assets Under Competition', Working Paper, Columbia University. – 2006.

5. *Gallego, G. and van Ryzin, G. J.* Optimal dynamic pricing of inventories with stochastic demand over finite horizons', Management Science, 40, 1994, v.8. - P.999–1020.

6. *Hopperstad, C. A.* Passenger O&D Simulator–PODS v.6.', *AGIFORS* Annual Sympos. Proc. 1996.

7. *Talluri, K. T. and van Ryzin, G. J.* (2004a) 'Revenue management under a general discrete choice model of consumer behavior', Management Science, 50, 1, - P.15–33.

8. *Talluri, K. T. and van Ryzin, G. J.* (2004b) The Theory and Practice of Revenue Management, Kluwer Academic Publishers, Dordrecht.

9. *Tam, W.* Dynamic programming in fully restricted fare environments', MS Thesis, MIT, Cambridge, MA. 2008.

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ORGANIZATIONAL CULTURE IS GUARANTEE OF EFFECTIVE ACTIVITY OF AVIATION ENTERPRISES

This article is necessity of the us of organizational culture is consider for providing of efficiency of activity of enterprises in the complex terms of economic crisis
Keywords: air freight, aviation enterprise, organizational culture

Raising of problem. Appearance of big industrial groups, the companies with a big financial capital did possible creation of the so-called "elite business", to which it is possible to take a business of aviation sphere. Realities of today are such, that a situation which was folded round Ukrainian aviation business repeats world, such which took a place far more early.

Aviation industry is depending enough upon the cycles of economic development, and from price-waves on a fuel. It is enough to appeal to the proper information: investments in the fixed assets after the type of economic activity of aviation transport on Ukraine in 2008 year grew short on 144,9 million of grivna's. by comparison to 2007 year. and made 160,1 million of grivna's.

The question of adaptation of Ukrainian aviation enterprises appears actual to the changers term of external environment, which becomame the hostages of economic crisis. Among the different factors of adaptation of enterprises it follows to pay a regard to the utilizinguse of influencing of organizational culture.

Analysis of the last researches and publications. The problems of functioning and development of aviation enterprises probed in the labors such scientists: Kulaev J.F., Lozhachevska O.M., Zagorul'ko V.M. but other their works are devoted research of basic progress of aviation enterprises trends.

Unsolved before part of general issue. In Ukrainian and foreign literature the not enough lighted up questions of intercommunication of organizational culture of aviation enterprises are in the conditions of the crisis state of economy.

A research purpose is a ground of necessity of the use of levers of organizational culture of enterprises in crisis situations.

Exposition of basic material. A today's situation is such, that practically all of niches for forming and increase of capital are busy. Appearance on the arena of new players results in the redistribution of business, to forming high-quality of new directions of trade and economic relations, spheres of activity. Development of world aviation has direct and direct connection with the recurrence of development of world economy, depends on its stability, welfare of users of services of industry, activity of business groups. Demand on air shipments is mainly determined economic development. Commercial activity and trade have strong enough weight in forming of market of business trips and freight transportations.

World requirements are in power resources, and also their supply and prices have a determining importance both for development of economy and for the cost of transportations. World experience proves that demand is on an air freight, popularity of air industry both from point of consumer and from point of effective investmentment in a great deal depends on socio-economic factors, situations in a power sphere.

At first events on 11September 2001, world economic crisis influenced on the sharp decline of VVP, business activity and reduction of transportations, and also level of confidence, both business circles and ordinary consumer by the air transport. After the estimations of the World bank, event, on 11 September, inflicted harm a world economy in size of $80 milliards, and the number of deprived of one's the share was increased on 10 million persons. Economy of enterprises, especially aviation industry, strongly enough rocked in connection with the necessity of introduction of additional safety measures. In 2001 it was fixed first, beginning from 1991, decline of volume of transportations on 2,9%, considerable price advance on a fuel.

Next to diminishing of operating profits, the charges of airlines grew on the increase of aviation strength security. In addition, in the item of expenses of airlines a considerable particle is occupied by charges on insurance. As a result is the considerable worsening of the financial state of airlines.

But not because of certain difficulties, the aviation transport of Ukraine in international connection is transport 4934, 8 thousands of passengers in 2008 year, that higher than previous year on 1030,5 thousands of passengers.

On the enterprises of aviation industry from data of 2008 year the average department quantity of regular workers made 12,1 thousands Reacting on the proper changes of external environment before enterprises the question of efficiency of functioning appeared a primer y concern. The task of conducting of the proper changes appeared for the improvement of the existent state.

Realities of life require conducting of changes including in the culture of organization. Realization of these changes is based on a world view and policy of guidance of enterprise, and also on their hard will indeed to realize planned.

At presence of hard will to conducting of the plan changes it is possible and needed to begin a process, but not always easily to find a correct decision, because consequences can be difficultly supposed. A right to carry out those or other changes in a culture depends above all things on financial consequences and risk with which it is linked for an enterprise. A policy and aims of guidance of enterprise must be directed above all things on safety of enterprise and receipt of income.

An organizational culture, after essence, is the subculture of national culture and mentality, which prevail in the state. From this point of view in the conditions of Ukraine next to economic and political reasons of the real crisis of management a national economy a ponder able place is occupied socially psychological factors and level of development of society.

Change of the system of values and principles that took a place in the period of transition from principles of the centralized planning and management to the market economy from a socialistic to the capitalist method production, destabilized society, moral, foundations and principles of vital functions. The same these terms of transformation entailed general destruction next to the economic aspects of companies and their organizational cultures.

From point of evolution of our state, role, and to the place of organizational culture in companies spared attention began to be only lately.

The existent organizational culture of domestic companies does not foresee application and realization of the system of strategic management which is oriented above all things on creation of favorable terms for perspective activity more frequent all, but not on satisfaction of current necessities. In practice, as a rule, a place is taken on the contrary: possibilities which are opened a market economy are use with the purpose of piling up, use and squandering of values and blessings, that inflicts enormous harm potential and prospects of long-term development of concrete company and state on the whole. By reason that is why next to uncertainty in the economic, political and financial future of the state there is absence in leaders and members of collectives of sense of manager and proprietor, and also impossibility of application of approaches of the centralized economy, to the market conditions.

The companies of the USA come forward the example of advantage of the strategically oriented organizational culture, where in the conditions of stable and developed market economy, orientation on long-term maintenance of market segment with permanent users during not less than 10 years allows to increase an income from this segment in 50 times, to increase the number of permanent users on 5%, that means growth of income to 85%. Organization fully depends on outward things - from an external environment - both in the relation of the resources and in the relation of users, users, by their results which they try to attain.

Term an external environment includes economic terms, users, trade unions, governmental acts, legislation, competing organization, system of values in society, public looks, technique and technology and other constituents. These interdependent factors influence on everything, that takes a place in a middle organization, including on its culture. The important area of management a culture is the skilled system. A process is begun with selection of people, their careful estimation, with an account above all things all their accordance of organization and to its culture. Other instrument in the field of skilled work is a method of development of personnel and its socialization. Organizations which actively use the

skilled systems for creation of the proper culture much attention and facilities spare preparation and development of personnel. A basic orientation of this process is bringing in of people to the dominant values of organization. Finally, a management appear is the potential instrument of creation and development of organizational culture. Due to it advancement and encouragement is carried out those, who answers the values of this organization in a most degree.

Any organized process, including production, is carried out and regulated people. Its efficiency to a great extent depends on that, how workers behave to implementation of the functions realization of purpose, which this process is carried out for the sake of, and consequently on the labor productivity.

Motivation is a process of motive of every employee and all of members of his| collective to active activity for satisfaction of the necessities and for achievement of aims of organization. Motivation is a part organizational of culture which is directed on the increase of the labor productivity. Basic tasks of motivation:

- forming for every employee of understanding of essence and value of motivation is in the process of labor;
- forming for every leader of the democratic going is near a management a personnel with the use of modern methods of motivation. However, for the decision of these tasks there is a necessary analysis of the followings phenomena:
- to the process of motivation in organizations
- individual and group motivation, if such is in dependence between them
- changes which take a place in motivation of activity of man in transition to the market relations.

Foundation of the conducted changes must be involvement of top management. Exactly management position can define success or failure in the conducted changes.

All their efforts are needed in an order to provide unity of actions in achievement of the put purpose on an exit from the crisis state. The prosecution of realization of changes in the culture of organization means: creative approach, careful preparation, good planning, choice of correct way, conscientious work, et cetera

It means that on condition of careful preparation a risk and resistance is taken to the minimum. It is needed from a management, that it will firmly defend the accepted decisions, successfully to overcome resistance and manage the process of changes.

If guidance of enterprise will find suddenly, that realization of project comes across strong resistance or conflicts with own plans, it can shut down above a project.

A project group and workings groups need creation for them of favorable terms that they could effectively and successfully to work. These recommendations from planning of change of culture of organization are instrument in introduction of new technological processes, stimulate people to perfect the position, promote creation, do more high-quality products and receipt of higher incomes.

It is necessary for successful realization of the programmatic planning of change of culture of organization:

1. Creation of certain central guidance is with sufficient authorities for making a decision, able to take a strong line and purposefully.

2. Determination and clear formulation of aims, selection of divergences, between an old man and new, description of changes.

3. Estimation of economy which must be attained.

4. Timely studies of persons, selected for the prosecution of project of changes it is desirable to conduct studies yet to beginning of realization of project.

5. A selection of necessary human and financial facilities is for realization of the planned changes (better specialists).

6. It is necessary to look after about that the conducted changes answered interests of majority.

7. Providing of presence in the project of such aspects which would interest all of organization.

8. To hold a collective in a course businesses in relation to realization of project by a way the enough detailed information (periodic reports, evident agitation, connection, with public, mass medias).

9. With the clear differentiating and ability to decide providing of presence of consultative and informative network conflict situations (not to abandon the least signals regardless).

10. Permanent control after bottlenecks in a project and rapid reacting is on arising up complication.

11. Permanent correction of motion of realization of project (planning, concordance, information and studies).

12. Correction of temporal chart; projects, counted on the protracted period of time, quite often become antiquated.

Conclusions

In all of prosperous companies of the world purposeful work is conducted from forming of useful qualities of organizational culture and management by it. Some companies of Ukraine also begin to realize the necessity of forming, registration, distribution and fixing of organizational culture, that allows most effectively arriving at the aims of company and economic success at the market. Speech goes about transformation correction of already existent culture of aviation enterprises, which was folded elementally and functions regardless of consciousness of its members, about measures which allow to strengthen the action of useful properties of culture and neutralize influencing of it dysfunctional elements. For successful creation of the similar programs of changes it is necessary the detailed study of existent organizational culture.

Thus, an account, analysis, share of organizational culture of anticrisis development, understanding of principles, and ability of management an organizational culture, is the key to the effective management of company.

References

1. Transport and connection of Ukraine 2008. Statistical collection, к.-2009, 281 С.

2. *Onufrieva E.I.* Analysis of methods of technological update of air enterprises [Text] of /Economy, Finances. Right: ather forms.- analytical Magazine. – К.: Analyst, 2009. – Vip. 8. – S.17-19.

3. *Pecherina N.* Ukrainian aviation in marketing relation //www. aviamir. com. ua /A-building-guest 1. htm.

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LOW COST CARRIER'S LOYALTY PROGRAMS IN TURKEY

Abstract
Airline loyalty programs play important role in today competitive airline environment. Low cost carriers (LCC's) are becoming more active in airline industry day by day. Loyalty programs bring some advantages in airline. Each loyalty programs have some differences. LCC's adopt loyalty programs more day by day. In this paper we examine LCC's loyalty programs in Turkey.
Keywords: *loyalty programs, airline, low cost carriers*

Introduction

The achievements of the low cost sector are enormous. Today on average one out of every five seats flown globally is on an LCC. In some markets, LCCs have taken the majority share of traffic, mainly on short-haul networks (www.carlsonmarketing). Traditionally, LCCs have based their value proposition on low prices and low fees. They largely avoided the frequent flyer loyalty programs that full service carriers (FSC) employed successfully. But competition among LCCs is tougher now. Low prices and low fees are not enough. Intensive competition brigs some chances in low cost carriers business models. LCC's try to offer something more than low fares and implement loyalty programs which mostly using FSC. Frequent Flier Programs (FFP) is the loyalty programs which FSC use mostly. FFP is used more and more by LCC and FSC day by day. The airline industry has been the first to offer FFP to their customers. FFP first launched by American Airlines in 1981 (http://www.wisegeek.com). FFP's aims the maintaining customer loyalty. The idea behind customer loyalty programs is for companies to award their best customers for their business.

1. Airline Loyalty Programs

Loyalty programs, which provide customers with loyalty incentives such as points redeemable for prizes or discounts, are back in the marketing spotlight. The airlines' frequent flyer schemes were amongst the first in this new wave of very large scale consumer oriented programs. Now there are programs offered by supermarkets, financial institutions and all sorts of retailers. This change has been stimulated by beliefs that marketing has not paid sufficient attention to customer retention that increased rates of retention lead to significantly increased profitability and that decreased differentiation and increased consumer cynicism has led to overall erosion in loyalty levels which, therefore, require special marketing attention to restore (Sharp and Sharp, 1997).

The frequent flyer program is an incentive program operated by an airline to reward customers for their continued loyalty. As a flyer, you earn one mile for each mile that you fly on a particular airline. The concept behind frequent flyer programs is that the airlines want their passengers to become loyal customers. It is much more costly for the airlines to get new customers than it is to retain the ones they already have. Today more than hundred million people participate, making frequent flyer programs the most pervasive and successful marketing programs ever developed and in the process, the frequent flyer mile has attained the status of a universal currency. When mileage programs started two decades ago, you could only earn miles by flying. Today, there are many ways to get frequent flyer miles without ever leaving the ground. (http://www.eflighttickets.com/airline-tickets/frequent-flyer-programs.php)

There are various factors influencing passengers' airline selection including airline service quality, value for money, passenger satisfaction, and airline image. In addition, FFPs, by effectively acting to tie individuals to a carrier or alliance, affect the degree of sensitivity passengers have towards competing airlines' ticket prices and other service factors, and thereby prompt passengers to pay higher average prices when members of a FFP program there exist relationships between significant choice factors with each factor potentially having both direct or indirect impacts on passengers' airline selection. FFPs, for example can influence passengers' selection directly or indirectly through passengers' pricing perceptions, their satisfaction levels, and airline image formation. (Park, 2010) An ARG (America's Research Group)

study shows that 46% think the benefits of a FFP are worth the effort it takes to join. Another ARG study that disclosed that only 27% of all travelers will make effort to buy a ticket from the airline that issued their card. In another ARG study 35.7% of Americans expressed that they will stop doing business with a company when being a member of its customer loyalty program doesn't result in receiving more recognition as a good customer (Beemer and Shook, 2009).

The frequent flyer program has become an important airline choice factor for air travelers. For example, have shown that frequent flyer programs significantly affect travelers choices of airlines. Becoming aware of this trend, airlines now use their frequent flyer programs as marketing tools to attract travelers. Improving the relative attractiveness of a frequent flyer program is an important issue for many airlines. In the US, there are three basic types of frequent flyer program schemes. The most popular scheme (standard scheme) is the one that gives one free round-trip to any destination within the US for a specified amount of accumulated frequent flyer miles, which is typically 25,000 miles. The second is the scheme in which free tickets are given to passengers based on the number of flown trips, rather than the amount of flown miles (non-mileage scheme). The third scheme gives free tickets to travelers by the amount of accumulated frequent flyer miles, but the amount of required miles is lower for shorter free trips than for longer free trips (discount scheme). (Suzuki, 2003)

Most frequent flyer programs rewarded customers on the basis of the distance traveled and not on the 'fare' paid by the customer. As a result, the customer who could get a cheap ticket would get the same value reward as a customer who would have paid the full published fare. In 2004 Lufthansa have begun to align their loyalty programs on the basis of ticket fare (class). (Kumar and Shah, 2004) There are approximitly 200 FFP's worldwide. (Bhagwanani, 2009)

There is an estimated 10 trillion unused frequent-flier miles in circulation now, worth some $165 billion. When programs began in the 1980s, miles had no expiration dates. In the mid-1990s, airlines put a three year life on them; each mile would expire if not redeemed within three years. (http://online.wsj.com)

Today, there are more than 180 million people participating in frequent-flier programs worldwide. Frequent-flier programs annual growth rate of about 11%. Have to take a lot of trips to get enough miles to get a free trip, and once you do get enough miles, there's no guarantee that you will get the flight you want. Airlines book only a small percentage of free seats, and popular destinations are usually booked with paid tickets and there also are blackout periods where airlines won't book any free flights on certain routes. (www.yakima-herald.com)

Many frequent flyer programs identify travelers who fly more than a few times per year by awarding them different status levels, which in turn give a number of benefits. Status levels vary from scheme to scheme, but benefits can include: Access to business and first class lounges with an economy ticket, Access to other airlines' lounges, Increased mileage accumulation (such as doubling or tripling), Reserving an unoccupied adjacent seat, The ability to reserve specific seats, such as exit row seats with more leg room, Free or discounted upgrades to a higher travel class, Priority in wait listing or flying standby, Preference in not being *bumped* if a flight is oversold, Priority of luggage (to be prioritized on transfer and to be displayed on the belt first), Ability to grant status to another person, Eliminating of program's miles expiration rules.

In most programs, these credits are earned in one of several ways: (Sharp and Sharp, 1997)

- By purchasing a ticket and flying on a participating airline, where the number of credits are usually, but not always, based on either on the number of miles flown or the number of flight segments flown.
- By spending money on specific goods or services, where the number of credits is determined by the activity performed or by the number of dollars spent.
- As a bonus for taking particular actions. Typical bonuses include credits granted to new program members, to members purchasing premium services like business or first class tickets, or as part of some other promotion by the airline or by an airline partner.
- Through a combination of one or more of the above methods.

While frequent flyer programs can offer all kinds of goods and services for loyal customers, the two basic benefits are free flights and flight upgrades. While the sophisticated frequent flyer program member can get creative and get rewards such as free hotel stays, rental cars, and a variety of other goods and services, most users are in it for the free flights or the free upgrades.

The airline industry collectively earns $10 billion by selling AOMPs (Add on Mileage Points) and airline FFP membership are growing 13% per year, mush faster than the growth of the airline industry. In the dynamic market place of 21st century air travel, airline FFP's have tied up alliances with partners ranging from credit cards companies, mortgage lenders, finance companies, fuel companies, corner grocery shops to mobile operators. Airlines normally sell their miles for 1-2 cents per mile to such partners, as a co branding strategy. And the majority of airline frequent-flier miles are earned without flying. 180 million distinct members of airline FFP's, less than a third are active participants. (www.infosys.com)

2. LCCs in the World

The deregulation of the aviation markets in the USA and EU gave new airlines the opportunity to enter markets. Low-cost airlines did so with new strategies. Even though there is no uniform low-cost strategy, all low-cost airlines aim to minimize cost. For instance, most low-cost airlines use a single aircraft type and use extensive outsourcing to lower fixed costs. Furthermore, they offer a "no frills" service, offering only seats in a single class. Low-cost airlines negotiated contracts in a deregulated environment in which all markets were open to (potential) competitors. Rent-sharing by, for instance, employees is, therefore, less likely. Most low-cost airlines avoid congested and expensive primary airports, because this reduces the expenditure on airport charges and allows for short turnaround times. (Pels, 2008)

Low cost carriers have followed a simple business strategy: achieve higher returns on assets and people by reducing the cost of operating to as low as possible. The service, operational and overhead savings allow them to offer very attractive fares (that attract incremental travelers), and improve the yield per passenger by selling an unbundled mix of products including ancillary services. Although some LCCs stick firmly to the tried and tested low cost principles, an increasing number of LCCs are trying out new models motivated by one of two drivers: reduce costs even further and generate incremental revenues.

LCC approach base on cost leadership or minimization and LCC's cut costs significantly by reducing overheads, providing a no frills service and often using secondary airports with cheaper landing charges. Inventory management is simplified and uses direct or online booking. (Hunter, 2006)

The typical LCA business model is based on a simple product that eliminates all unnecessary services, low operating costs and cheap tickets. After Southwest Airlines pioneered the concept when founded in 1971, this successful American model was adapted with the advent of aviation deregulation in Europe by carriers like Ryanair in 1991 and easyJet in 1995. The traditional network airlines like British Airways or Lufthansa operate with much higher unit costs than their low-cost rivals. Where as FFPs are part of the standard product and service package offered by established network airlines, in March 2005 according to web-site information only about 20% of European LCAs had introduced FFPs or other customer loyalty schemes. (Klophaus, 2005)Today this number is much more higher.

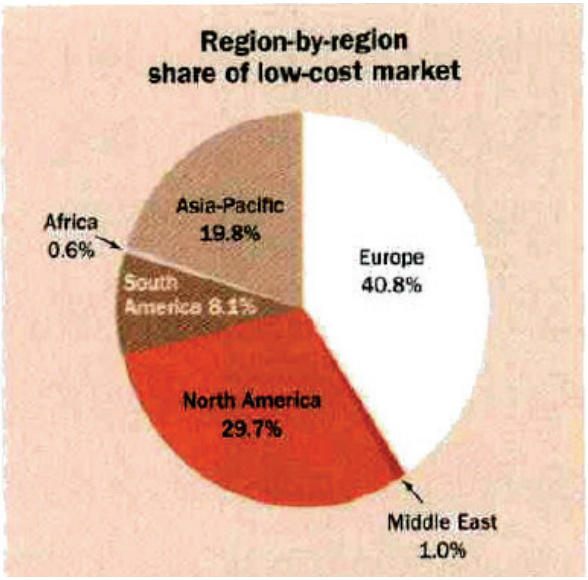

Figure 1. Low-cost Carriers' Market Share by Region 2009

Asia Leading Low-cost growth, Graham Dunn, Sıva Govindasamy, Lori Ranson, *Airline Business;* May 2010; s.56.

3. LCC's Loyalty Programs in the World

A wide variety of programs exist today in the low cost sector. They can be categorized into four distinct groups: (www.carlsonmarketing)

• Simple Frequency model; this model is characterized by a straightforward structure. Members of simple frequency models will get a reward by attaining a fixed number of flights,
e.g., fly ten times and get the eleventh flight free.
• Simple Revenue model; under the simple revenue model, credits are earned based on the
Dollar amount spent on the flight.
• Bespoke Frequency model; the bespoke frequency model is again based on frequency but has added benefits. An example is the "A" list of the Rapid Rewards program of Southwest Airlines that gives certain boarding privileges to members. The advantages and disadvantages are similar to that of the simple frequency model, i.e., an easy-to-understand structure but limited ability to recognize and reward higher value customers. Depending on how the redemption structure is set up, the airline may be restricted in offering differentiated pricing for reward seats (given that the earn structure has also been fixed)
• Bespoke Revenue model – The bespoke revenue model is based on revenue generated for the airline, and offers elite tiers that can be attained by achieving certain thresholds. Members
earn points or some other form of currency based on the dollar amount paid for their tickets.
In addition, members are provided certain benefits once they qualify for a tier level within
the program. Qualification is typically based on achieving a certain spend threshold within a
certain qualification period.

LCC's are mostly profitable for example; 1999-2008 collective operating profit for easyJet, Rynair and Southwest Airlines is $11.5 Billion. (Chris Tarry, 2010) Table 1 shows the biggest LCC's in the world (by revenue), with their fleet size, passenger number and loyalty programs name. They all of them offering some sort of loyalty programs.

Table 1. The Top Biggest 10 LCC's by Revenue in the World 2009

	Country	Fleet	Passenger	Revenue Bil. $	Loyalty Programs Name
Southwest Airlines	USA	542	86.3	10.4	Rapid Rewards
Air Berlin	Germany	99	27.9	4.6	Top bonus
Ryanair	Ireland	230	65.3	4.1	CC
easyJet	England	169	46.1	4.1	easyJet plus
JetBlue	USA	151	22.5	3.3	TrueBlue
Gol	Brazil	96	28.4	3.1	Smiles
AirTran	USA	138	24.0	2.3	A+ Rewards
WestJet	USA	88	14.0	2.0	Frequent Guest Program
Virgin Blue	Australia	71	18.2	1.9	Velocity
Air Lingus	Ireland	44	10.7	1.7	Gold Circle Club

Graham Dunn, Airline Business, May 2010, Coming of Age, s.51

Ryanair are offering UK and Irish customers the ryanair.com Visa credit card. Ryanair Credit Card with no annual fee, if you buy 10 Ryanair tickets on the card within 12 months and get a 'free' ticket. Within this card you can earn up to 5 Bonus flights in your first year, if you spend £100 on your card in the first 90 days and get 1 bonus flight, if you spend £3000 on your card in the first 6 month period and get 2 bonus flights and if you spend £3000 on your card in the second 6 month period and get 2 bonus flights.

JetBlue Airlines FFP name is TrueBlue and this program advantages is; Ability to use points for any seat on any JetBlue operated flight, No blackout dates, Points that don't expire, Bonus points the more you travel, Oneway Award Flights starting at just 5,000 points, 6 points for every dollar spent when you purchase a flight at jetblue.com, Earn an additional 2 points for every eligible dollar spent on JetBlue flights when you use your JetBlue Card from American Express for a total of 8 TrueBlue points for every eligible dollar spent on jetblue.com.

AirLingus, The Gold Circle Club is the Aer Lingus Frequent Flyer Programme. It entitles members to earn and spend frequent flyer points on AerLingus flights and partner member airline flights. Members can also use their points earned on a range of quality services provided by our programs partners.

4. LCC's Loyalty Programs in Turkey

In Turkey 9 scheduled and 5 non-scheduled passenger airlines, and 3 cargo airlines operates in June 2010. Passenger airlines have around 300 aircraft and 3 cargo airlines have 24 aircraft. (www.shgm.gov.tr) Turkish airline industry generates around 10 billion $ revenue in 2009. (http://www.dunyagazetesi.com.tr) 41.2 million domestic and 44.3 million international passenger's total 85.5 million passengers use 45 airport in Turkey in 2009. It shows increase of 15% domestic passenger number and international passenger numbers increase 1.6%. (www.dhmi.gov.tr) There are 3 LCC's in Turkey. These airline names are Onurair, Pegasus and Anadolujet (Turkish Airlines). Table 22 shows some details about these airlines.

Table 2. LCC's Loyalty Programs in Turkey

Carriers	Launch	Base	Fleet	Loyalty Programs Name	Passengers (mil)
Pegasus	1990	Istanbul SAW	28	Pegasus Card	5.9
Onurair	1992	Istanbul IST	26	On Air	6.0
AnadoluJet (THY)	2008	Ankara ESB	16	JetGenc	2.9

In 2009 Onurair 23th, Pegasus 24th and AnadoluJet are 44th biggest low cost carriers by the number of passengers in the world. (Dunn, 2010) Onurair and Pegasus are later transformed in to a low cost carrier. Before, they both operated as charter airlines. AnadoluJet is operated as a low cost business model by Turkish Airlines. AnadoluJet was founded by Turkish Airlines as a separate brand with a new business model to provide masses of people with the transportation services. All flights operate for Turkish Airlines. They both have some loyalty program. The details of these programs below;

- Pegasus "Pegasus Card"

Pegasus brand a loyalty card with HSBC, it is a credit card same time. When you take this card this card gives 20 TL (10 Euro) flight point. You can gain flight point your flights with Pegasus and your shopping, the flight points can use like money in Pegasus flight, no space limits for free tickets, you can use flight points even you do not have enough points, annual fee 60 TL (30 Euro), no extra luggage weigh right, no check in priorities. (www.flypgs.com)

- Onurair "On-Air Card"

Onurair brand a card with Finansbank, same time this card a credit card with Onurair logo. This card annual fee is 50 TL (25Euro). Gives passenger some advantages like the points (money) in your credit card multiply 2 if you buy a domestic air ticket, special check-in facilities at airport, 5 kg more in domestic flight baggage, priorities with in Onurair passengers. (www.cardfinans.com.tr)

- AnadoluJet "JetGenc"

Turkish Airlines passengers can spent THY Smiles & Miles points with Anadolujet flights but cannot get points for these flights. AnadoluJet has another loyalty program call "JetGenc". With this program below 25 years old or university student can member of this program. After member of this program anybody who gives this membership account and make 10 flights, the owner of this account win 1 free flight. And some period 25% discounts for all routes. (www.jetgenc.net)

Conclusion

Faced with growing competition, FSCs have attempted to fight back by adopting some of the LCCs' characteristics – with increasing online sales, more rapid turnaround times and reduced use of travel agents or lower commission rates. LCCs' also attempted to adopt some the FSCs like entering strategic alliances, flying long haul, offering frills, codesharing and interlining and loyalty programs. LCC's in Turkey like the LCC's in the world apply some sort of loyalty programs. They imply the suitable programs for their market. In Turkey LCC's do not have FFP's but mostly give some advantage for their customer with some card (with banks) and after number of flights give free flights. LCC's in Turkey just start their loyalty program and give priority to develop these loyalty programs.

References

1. Beemer, C. Britt and Shook, Robert L., "The Customer Rules", Mc Graw Hill, 2009, USA, s.205.
2. Bhagwanani, R., "Making Loyalty Pay", Airline Business*;* Nov 2009; 25, 11; pg. 50
3. Dunn, G. "COMING OF AGE**",** Airline Business, May 2010; 26, 5;
4. Hunter, L., "Low Cost Airlines: Business Model and Employment Relations", European Management Journal Volume 24, Issue 5, October 2006, Pages 315-321
5. Klophaus, R., Frequent flyer programs for European low-cost airlines: Prospects, risks and implementation guidelines, Journal of Air Transport Management 11 (2005) 348–353
6. Kumar, V. and Shah, D., "Building and sustaining *profitable* customer loyalty for the 21st century" Journal of Retailing 80 (2004) 317–330

7. Park, Jin-Woo., The effect of frequent flyer programs: A case study of the Korean airline industry Journal of Air Transport Management 16 (2010) 287e288)
8. Pels, E., Airline network competition: Full-service airlines, low-cost airlines and long-haul markets, Research in Transportation Economics Volume 24, Issue 1, 2008, Pages 68-74
9. Sharp, B. and Sharp, A., Loyalty programs and their impact on repeat-purchase loyalty patterns Intern. J. of Research in Marketing 14 (1997) 473-486
10. Suzuki, Y., Airline frequent flyer programs: equity and attractiveness. Transportation Research Part E 39 (2003) 289–304)
11. Tarry, C., "Low-Cost Commodity" *Airline Business;* Feb 2010; 26, 2; pg. 28
12. www.airsafe.com/paxinfo/miles.htm
13. www.cardfinans.com.tr
14. www.carlsonmarketing (Low Cost Carrierrs &Loyalty, Carlson Marketing)
15. www.dhmi.gov.tr
16. www.dunyagazetesi.com.tr/havacilikta-yuksek-ucus_92710_haber.html
17. www.eflighttickets.com/airline-tickets/frequent-flyer-programs.php)
18. www.flypgs.com
19. www.jetgenc.net
20. www.infosys.com (Pankaj Narayan Pandit, Win in the Flat world Airline Loyalty Programs, June 2009)
21. www.online.wsj.com/article/SB10001424052748704222704574501453001798692.html
22. www.servinghistory.com/topics/Frequent-flyer_program::sub::History
23. www.shgm.gov.tr
24. www.yakima-herald.com/stories/2010/05/23/fly-fly-away-with-frequent-flier-miles
25. www.wisegeek.com

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CHARTER AIRLINES IN TURKEY

Abstract
Charter airlines play important role word tourism and economy. Charter airlines are back bone of Turkish air transport industry. Charter airlines give fast and safe travel services for tourism industry. Tourism is one of the biggest and important industries in the world. For Turkish economy tourism is crucial. This paper examines the importance of charter airlines for Turkish tourism and economy.
Keywords: *charter airlines, tourism, Turkey*

Introduction
Air transport has contributed to the development of tourism markets, which are not accessible via road or sea. There are two types of airlines when concerning passenger transport; scheduled and charter airlines (non-scheduled). Scheduled airlines fly on agreed and published routes. The advantage of charter airlines resides the fact that they fly on routes where they can generate high load factors, between 85% and 90%. Because of the way they operate, charter airlines are well adapted to fluctuations of demand in time of crises. (www.fhiser.org.za) Charter Airlines has been Turkish economy since beginning of 1980's when the government give permission for private airlines. After that charter airlines in Turkey grow up by day. At that time charter airlines play important status for toursim and Turkish economy.

1. Charter Airlines

Charter airlines predominantly serve leisure routes on weekly bases, carrying clients for tour operators. The seasonal, locational and event-specific nature of leisure tourism enables charter air services and travel companies to achieve economic of density and reduce passenger unit costs. (Buck and Lei, 2004) Although charter airlines typically carry passengers who have booked individually or as small groups to beach resorts, historic towns, or cities where a cruise ship is awaiting them, sometimes an aircraft will be chartered by a single group such as members of a company, a sports team, or the military. The economics of charter flights demand that the flights operate on the basis of near 100% seat occupancy. While in the past a charter flight could only be secured through a tour company, in recent year's charter airlines have opened up their ticket sales to the general public. Because of the discounted rate, a charter flight must constantly strive for maximum occupancy, more so than traditional scheduled airlines. There is some general belief that service on a charter flight might be of a lesser quality than standard flight service, though this is by no means absolute. Charter airlines were the 'original' low-cost airlines, and were developed to offer leisure travelers (tourists) low fares to holiday destinations which were not served by network carriers. Because charter airlines had no schedule, they were treated differently from conventional airlines in bilateral agreements. Charter airlines carried about 13% of international travel in 2000 (Doganis, 2006). Charter flights are contrasted with scheduled flights, but they do in fact operate to regular, published schedules. However, tickets are not sold directly by the charter airline to the passengers, but by holiday companies who have chartered the flight.
Charter carriers were the primary air service provider of leisure travel in world until the early 1990s. The seasonal and/or occasional character of such flights matched well the pattern of leisure travellers. (http://steconomice.uoradea.ro)These airlines acted as the original low cost ones by emphasising cost reduction: dense seat configuration and high passenger load factors allowed economies of density and low unit costs; irregular and sometimes inconvenient schedules plus the choice of somewhat secondary airports reduced airport fees; basic inflight servicing cut operation expenses; and the explicit linkage with the travel distribution system in the context of an integrated tourist package led to very low publicity and distribution outlays. As a result of these low costs, charter carriers were able to offer low prices and satisfy the conscious leisure travellers. (Papatheodorou and Lei, 2006)
Charter airlines, increasingly because of competition from LCC on short-haul routes, operate on medium- and longhaul routes. The nature of their product often leads to quantitatively large, but relatively

inflexible, traffic streams. The emergence of new quality classes on charter planes can be explained as an attractive new segment to their type of service. (Biegera and Wittmer, 2006) Charter Airlines have a lower cost per seat than LCCs. This difference, in particular, can be explained by a load factor even higher than those of LCCs and the use of greater capacity aeroplanes over a longer distance. (Dobruszkes, 2006) Charter airlines adapt to changes in holiday habits, forexample in 1987 any charter airlines make only booking for flight but nowadays they are. And in 1987 charter airlines use single class seat for long haul routes but nowadays many of them use two class cabins which increased legroom. (www.ascendworldwide.com)
Specifications of charter airlines; (Pels, 2008)

- Aircraft utilisation is relatively high compared to conventional airlines. Charter airlines do not offer flights on very short routes, so that less time is spent on the ground. Furthermore, charter airlines offer night flights, whereas conventional airlines target passengers that prefer day flights, and/or operate from (hub) airports with night restrictions that do not allow conventional airlines to fully utilize the hub-spoke strategy during the night.

- Charter airlines have low station costs compared to conventional airlines due to extensive outsourcing of aircraft, baggage and passenger handling. Furthermore, there is no need for out of season station staff and facilities.

- Charter airlines have relatively low expenditures on passenger services because there are fewer cabin staff (and no overnight expense for cabin staff) and no business class.

- Charter airlines have relatively low expenditures, saving on ticketing, sales and promotion. There is no extensive yield management, which saves expenditure on expensive staff. Tour operators print their own tickets, and because the bulk of tickets sold to tour operators, sales cost are low, no retail sales office is necessary, and no commission is paid.

- Seating density is relatively high, so that the cost per seat is relatively low.

- Next to the high seating density, load factors were also high, leading to a low-cost per passenger. (If a conventional airline has a cost index of 100 on the route London–Athens, a charter airline has a cost index of only 31.) The main factors explaining this difference are the seat occupancy, the seat density and the sales and promotion strategies.

2. Charter Airlines in Turkey

Turkish Civil Aviation Authority (TCAA) classifies airlines as scheduled, non-scheduled and cargo airlines. In Turkey 9 scheduled and 5 non-scheduled passenger airlines, and 3 cargo airlines operates in June 2010. But some airlines who take right to TCAA for scheduled flights right operate as a non-scheduled. Passenger airlines have 302 aircraft and 3 cargo airlines have 24 aircraft. (www.shgm.gov.tr) Turkish airline industry generates around 10 billion $ revenue in 2009. (http://www.dunyagazetesi.com.tr) 41.2 million domestic and 44.3 million international passenger's total 85.5 million passengers use 45 airports in Turkey in 2009. (www.dhmi.gov.tr)

Table 1. Charter Airlines in Turkey 2010

Charter Airlines	Type of Aircraft	Number	Seat	Total Aircraft	Total Seat Number
CORENDON	B737-300	1	148	7	1198
	B737-400	4	672		
	B737-800	2	378		
FREEBIRD	A320	5	900	7	1340
	A321	2	440		
IZAIR*	A319	3	432	5	792
	A320	2	360		
SAGA	A310-304	2	450	9	1800
	A330-300	1	318		
	B737-400	2	336		
	B737-800	4	696		
SKY AIRLINES	A320-211	3	536	17	3168
	A321-231	2	438		
	B737-400	6	1014		
	B737-800	4	750		
	B737-900ER	2	430		
TAILWIND	B737-400	5	840	5	840
TURKUAZ	A320-211	3	360	6	1020
	A321	3	660		
Total				**56**	**10158**

*Izair operated for Pegasus.

Table 1 shows the charter airlines in Turkey. Also Sunexpress (25), Pegasus (27), Onurair (28) and Atlasjet (13) important part of their operations charter flight but same time they operate scheduled domestic and international flights. (www.toshid.org) Charter airlines enable a few thousands of employee and billions of $ revenue for Turkish economy and play important role Turkish airline industry. Most of the Turkish Charter Airlines have their own tour operators, hotel chains, etc. Only Corendon Airlines members of the International Air Carrier Association (IACA) with the aim of promoting leisure travel. (www.iaca.be) Figure 1 shows the five big airports charter traffic in 2000-2009. Tourism income and tourist number increase accordingly charter flights.

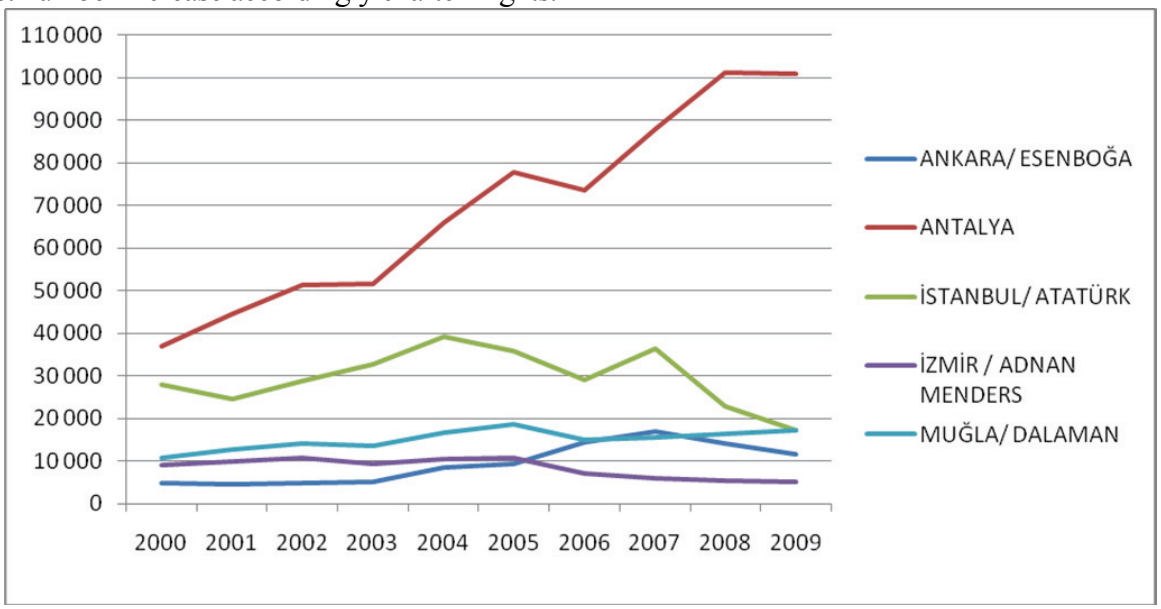

Figure 1. Five Big Airport Charter Traffic in Turkey 2000-2009 (www.dhmi.gov.tr)

3. Importance of Charter Airlines in Turkey

We can summariese the importance of charter airlines below;

- Charter airlines provide thousands of direct and hundred thousands of indirect job opportunities in Turkey.
- Charter Airlines provide foreigh exchange input which is very important for emerging economies like Turkey.
- Provide direct, cheap, reliable flights to Turkey, this allows the full potential of tourism facilities.
- Charter airlines provide tourism which is one of the largest revenue items for Turkish economy, which is related cheap, fast and safe air transportation. 40% of tourists come Turkey by air. Its increases 80% after daily or short term stay Turkey's neighbour countries from Turkey. In 2009 more than 25 million tourist spend more than 21 billion $ in Turkey. (www.tuik.gov.tr) The Associaiton of Hotels in Turkey Presedent denote that one of the most important reason of development in tourism in turkey is present of strong "national charter airlines". (www.turizmgazetesi.com)
- Charter airlines the backbone of the Turkish private aviation industry. Because, after 1983 allow to start private airlines in Turkey, charter airlines start operate and later some of them transform LCC or domestic airlines.
- Because of the nature of the industry charter airlines make vertical integration buy hotels, agents, tour operators etc. and than now operate all over the region (Europe, Asia, Africa) for all tourist inbound and outbond tourism facilities.
- After tourism season end or weak in Turkey, charter airlines rent their aircraft Far East, Africa, etc., and stil make money for Turkish economy.
- Charter airlines give service the tourists who especially come for shoping from especially Russia, Iran, and Arabic etc. this develop the commercial life in Turkey.
- Charter airlines often use the airport the off-peak hours, and this increase capacity utilization rates of airports and balance distribution of traffic density.

Conclusion

Charter airlines are very importand for Turkish tourism and economy. Without air transportation Toursim can not be massive as today in Turkey. Charter airlines give safe, fast and economic access to tourist destinations (Europe, Asia and Africa). Charter airlines are the back bone of Turkish airline industry and fantastic economic affects. Tourism is one of the most important areas for Turkey and without charter airlines it is not possible to achieve the numbers today. Charter airlines importance is bigger day by day in Turkish economy and tourism. It is expected that growth of charter airlines accordingly tourism facilities in Turkey and region.

References

1. *Buck, S. and Lei, Z.* "Charter Airlines: They Have a Future?" Tourism and Hospitalty Research, March 2004, 5, 1.
2. *Pels, E.* "Airline Network Competition: Full-service airlines, low-cost airlines and long-haul markets", Research in Transportation Economics, 24, 2008.
3. *Biegera, T. and Wittmer, A.* "Air transport and tourism—Perspectives and challenges for destinations, airlines and governments" Journal of Air Transport Management 12, 2006.
4. *Papatheodorou, A. and Lei, Z.* "Leisure travel in Europe and airline business models: A study of regional airports in Great Britain", Journal of Air Transport Management 12, 2006.
5. *Dobruszkes, F.* "An Analysis of European Low-cost Airlines and Their Networks" Journal of Transport Geography, 14, 2006.
6. *Doganis, R.* "Flying off Course the Economics of International Airlines", Routledge, 2006.
7. www.ascendworldwide.com/easier-16-08-07.pdf)
8. www.atag.org/files/ATAG%20brochure-124015A.pdf
9. www.dhmi.gov.tr
10. www.dunyagazetesi.com.tr
11. www.fhiser.org.za/Workingpapers/13MiMihailescu1.pdf Radu Mihailescu, CHARTER AIRLINE ECONOMIC ANALYSIS FOR NELSON MANDELA METROPOLITAN AREA – PRELIMINARY ANALYSIS
12. www.iaca.be
13. http://steconomice.uoradea.ro/anale/volume/2007/v1-economics-and-business-administration/66.pdf "AIRLINE BUSINESS MODELS AND LEISURE TRAVEL IN EUROPE" Firoiu Daniela, Gheorghe Camelia Monica.
14. www.shgm.gov.tr
15. www.toshid.org
16. www.tursab.org.tr/content/turkish/istatistikler/gostergeler/63TSTG.asp
17. www.turizmgazetesi.com/articles/article.aspx?id=18355
18. www.tuik.gov.tr

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PROBLEMS OF UKRAINIAN AIRLINES IN THE MARKET OF AIR TRANSPORT

The object of this article is to determine the present problematic issues concerning rise in competitiveness of the native air carriers in the international market of air transport. Taking into consideration the orientation of Ukraine on the fundamental incorporating of its economy in the system of the world economy the Ukrainian civil aviation has to take part in this process. For this reason Ukraine should enter dynamically all the structures of the international civil aviation as well as find the ways for the equal-right cooperation with foreign airlines.

During the last ten years in the Ukrainian air service major modifications have been done. Earlier it was fully a state sector and the air service was regarded as a sort of the public service. Now on the contrary the state plays a role of the dealer in the market oriented transport sector and controls an abidance by rules including those rules established by the international controlling organizations.

Close by ten of the native airlines work in the market of international carriage. Herewith the most of them, UIA and Aerosvit as well, in the inland flights cater for a transit passenger. Their aim is to bring a passenger to Kiev for the further transferring to the European and Asian countries.

Many native airlines provide maintenance and repair servicing and the service of the overhaul-period renewal of aircrafts (AC) and of the aircraft engines (mostly made in the USSR and CIS). Also they render services of the operating and financial leasing of AC and train the aviation staff for AC operating. UIA has received the certificate JAR-145 for maintenance of airplanes "Boeing 737" which confirms that the airline has reached the European standards in this sphere. Moreover it gives a possibility to reduce an insurance payment on aircrafts.

There are some possibilities of the air carriers' services: servicing of the postal and cargo air transport and forwarding service of cargos on the air transport; POL supplying of an airport and the airlines served at this airport; representation of the interests of airlines at the airports and in the work with enterprises occupied with the issues of aviation activity; service organization of the carrier flights at the Ukrainian airports; organization of the full service of flights and passengers; organization of catering for the flight staff and passengers, settling of the staff and passengers in the hotels of Kiev and other cities of Ukraine; pickup traffic servicing; organization of charter and business flights all over Ukraine and abroad.

The most popular practice among the national air carriers is to receive an AC on operating leasing. On average its term makes five years. For example, the cost of an operating leasing of "Boeing 737" makes about 300 thousand dollars per month, Airbus - 320 – about 200 thousand dollars, etc. Moreover "Aerosvit" and UIA took on leasing the AC on a security of the state. There is a positive experience of receiving AC on leasing by the native airlines from the foreign companies (as in the case of AC leasing "Boeing 737" by UIA from international leasing company GECAS). "An – 148" may be given on leasing by the National leasing company "Leasingtechtrans".

The financing sources of the flying stock of the national airlines can be sufficiently different. For example, one of the possible sources of finances for renewal of a flying stock and for development of the new flight directions of UIA is considered an additional emission of shares.

In the case of financing on the expense of a banking credit the native airlines should remember the story of AC "Ruslan", the first owner of which was CC "Ajax" that applied to the bank "Imperial" for credit. In time credit indebtedness of CC "Ajax" before the bank "Imperial" and also before the National reserve bank made up 29 million US dollars. Since the subject of deposit was an AC, it was arrested in the Dutch airport Maastricht where it was lying idle for three years (of course, it was not gratis – the sum charged was big enough). The Russian LLC "Center-Capital" bought the airplane having sunk the debt mentioned.

The initiative of the Ministry of Economy of Ukraine (2005) as for the abolition of all the VAT privilege for AC bought on leasing programs abroad was significant. The airlines those were taking on leasing foreign AC, imported AC drawing a tax anticipation bill with the payback period of 360 days. If a leasing contract was prolonged, the AC was exported and then was imported back drawing a new bill. Such a scheme was forced because AC were not bought and remained in the possession of the foreign lessor. Naturally the airline could not receive the compensation of VAT.

At this point let us note that for the development of the lowcosters (in particular, the airline "Wizz Air Ukraine" that has become a powerful competitor of the native airlines in the market of the inland traffic) in Ukraine practically there are no peripheral airports those have a technical service of appropriate level and runways those can receive the middle main AC.

In 2008 in Ukraine it was started the program "An Open Sky" that stipulates equal conditions of competition for all of the airlines of the countries joined. As a result any airline can make flights to Ukraine only after it has given a notice to the airport. It can create two problems for the Ukrainian airlines ("Aerosvit", "Donbasaero", UIA, UM Air and "Dniproavia"): 1) the market of long-haul traffic can be taken by the big international airlines with the wide rout network (British Airways, Lufthansa, KLM-Air France, Austrian Airlines), and from the middle main routs they can be pressed by the foreign discounters (the Irish Ryanair, the British EasyJet, the Hungarian Wizz Air, the Slovakian SkyEurope); 2) engineering constraints the Ukrainian air carriers are faced to at the West European airports when they can not receive slots. At the same time the West European competitors do have such slots and can receive them for free operation, consequently the conditions for competition are not fair.

The Ukrainian airlines have sufficiently restricted choice as for the purchase of an aviation fuel, a board catering, a baggage service for passengers, and the whole spectrum of the transport service. A monopolism has an effect on the quality as well as on the prices for service that considerably restricts the competitiveness in the international market.

Harmonization of the native legislation with the European one could help to destroy these monopolies and to open an access to the native markets of the foreign suppliers of this service. By negotiations our native air carriers hope to fix in the text of the treatment the safeguards of access of the Ukrainian airlines to the foreign airports. However the European commission explains that this is an issue of the contractual relations between airlines and airports those have almost all the slots occupied by the European companies.

The liberalization of the market of the air transport after all will eliminate the problem of flights quoting that was a burning issue with Germany, but there are still many problems of bilateral agreements of Ukraine with the Russian Federation and the USA.

In 2005 by results of the audit of the State Air Service that was done in October, 2004, US Federal Aviation Administration (FAA) initiated the sanctions of the development of the air communication between Ukraine and the USA. FAA decided that "Ukraine did not follow the international safety standards established by the International Civil Aviation Organization (ICAO)" according to some of criteria. As a result our country was lowered by FAA in the safety rate from the first category to the second one.

The principal claims of FAA were related to the non-compliance with the international norms of the organizational structure and to the commissions of the national authorities of the civil aviation. Moreover the American specialists qualified the legislative control ensuring of the air carriers as an insufficient one, especially in the issues of the breaking of the flight safety norms. However inspectors did not have any claims to the Ukrainian carriers. In the final report FAA underlined that the qualification did not concern any concrete airline.

The international airport "Boryspil" is serviced by "Kiev-Catering" and "Aero-Catering Services Ukraine". There is more or less developed board catering in Odesa, Dnipropetrovs'k, Donetsk and Kharkiv. Herewith the service given by the Ukrainian catering companies are practically limited by the supplying dinners, spirits and refreshing drinks to the board, as well as the little service articles. At the same time in Europe and America the catering companies offer a broad service range, in particular, a compartment cleaning and supplying different goods on the board, from portable medicine chests to

plaids, newspapers and ear-phones. The Ukrainian catering companies provide their clients with the full range of different menus taking into consideration religious, dietary and other reasons.

In January, 2007, Aerosvit and Donbasaero signed a treaty about a foundation of the alliance "Ukrainian Aviation Group" having united their resources within its scope (there was conducted the uniting of the flying stocks, there was created a common rout network and they began to use a common technological basis). After the foundation of LLC "Airline "Donbasaero" the main founder of which became "Aerosvit" we can speak about the actual merging of two air carriers. It seems to be logical taking into consideration the liberalization of the airspace of Ukraine that should tentatively take place in 2010 after the signing of a corresponding treaty between Ukraine and European Union. "Ukrainian Aviation Group" (UAG) that unites "Aerosvit" and "Donbasaero" companies, was given on leasing an AC Airbus 320 for six years by the company BBAM (the USA). By the end of 2008 the united flying stock will be reinforced by the remote main AC Boeing 767 – 300 ER and before the end of year will contains 18 AC of Boeing production (14 Boeing 737 and 4 Boeing 767), four Airbus 320 and six Yak-42.

The volume of additional expenses for the airline "Aerosvit" insurance taking into consideration the international aviation market modification after the acts of terror on the 11th of September in the USA was priced minimum at 700 thousand dollars per year.

There is one more problem as for the VAT of a fuel: for inland traffic it is collected, for international traffic – it is not. To fight with the rise in prices for fuel the Ukrainian airlines establish the fuel dues and use tankering (maximum fuelling of an AC at that airport where the prices are lower).

There was a conflict between airlines and suppliers of the aviation fuel that happened in winter 2006-2007 and could lead to cancellation of flights from "Boryspil", starting from the 1st of February. The point of this conflict was that suppliers of the aviation fuel (CC JE "CREBO" and LLC "LUC-Avia Oil") offered to air carriers new and absolutely unacceptable conditions of fuel supplying: the augmentation of prices for fuel by the level which was higher than a world one for 15-20%; suppliers illegally demanded from carriers the payment of VAT for fuel, assigned for international flights, while the law prescribed a zero-rate VAT. In this situation the final price of fuel can grow for almost 35-40%. The managers of airlines also say that in Ukraine there is no market forming of the fuel price at all, while it depends on the world price of oil.

Before this conflict the volume of fuelling in Boryspil of Aerosvit accounted for 60% and UIA – about 45%. The point is in the specific character the rout network: UIA is specialized in flights to Western Europe. That's why it is much easier for it to work according to the system of tankering. Aerosvit has a whole set of the remote main flights. From 1995 to 2002 the market of the aviation fuel was almost totally controlled by CC "Joint Ukrainian - Dutch Enterprise "Crebo" (Kremenchuk). In 2001 one more enterprise which was occupied with supplying of aviation fuel to the Ukrainian market appeared. That was Odesa Oil Refinery that belonged to "LUCOIL". LLC "LUC-Avia Oil" built its own fuelling complex in Boryspil. In 2002 Lysychans'k Oil Refinery that passed into the ownership of "TNK" came back to the market. Now a specific gravity of the fuel price in the transaction costs makes up to 30-40%.

There was one more positive moment. The scheme of customs clearance of transit cargo in Boryspil was simplified. It facilitated the acceleration of the cargo clearance procedure.

The law constrained to leave a half of value at risk in Ukraine. This led to the fact that air carriers were forced to insure their AC directly with the help of foreign insurer. It caused a material damage. For instance, UIA valued its additional costs of its AC up to 0,5 million dollars. Consequently the airline was to introduce an insurance fee.

The rise of insurance tariffs practically of all the big risks became impartial after changes in the Law "About taxation of enterprises" had been adopted. According to this law the insurance companies was obliged to pay 3% tax for the reinsurance commissions to non-residents. Furthermore any insurer who placed his risks abroad through the brokers had to pay 3% more of the tax. Thereafter it caused a great rise in prices for 6% at least for insurance of big risks for airlines.

Conclusions

To the problematic issues those already have been a reason of deceleration of the growth rate of the transport volume before the beginning of the world financial crisis and now slows down the efforts of transportation field of Ukraine to gain a full-fledged membership in JAA (Joint Aviation Authorities) we can refer too rapid liberalization of the air transport market in Ukraine and absence of the defense mechanism in the native airlines' activities.

The mainstreams of resolving the problems of the augmentation of competitiveness of the national aircrafts should be as follows: 1) EU integration, discharge of obligations of entry to WTO, bilateral and multilateral cooperation with other countries and organizations; 2) strengthening the image of Ukraine as an aviation transit country by means of concentration of transit transport of passengers and cargos via the State international airport "Boryspil"; 3) rising of the air transport safety level.

References

1. *Жаворонкова Г.В., Матвєєв В.В., Мирончук В.О.* Світовий досвід управління парком повітряних суден авіакомпанії // Залізничний транспорт України. - №6(78) – 2009. – С. 31-34.

2. *Myronyuk V.* Aircraft fleet management of an airline. – Manuscript. Te dissertation in partial fulfillment of the requirements for the scientific degree of Candidate of Economics by specialty 08.00.04 - Economics and management of enterprises (economics of air transport).

3. *Жаворонкова Г.В., Кам'янецька О.В., Янчук М.Б.* Формування парку сучасних повітряних суден авіаційного транспорту України // Залізничний транспорт України. - №4(77) – 2009. – С. 31-34.

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MEASURES OF LIBERALIZATION IN DEVELOPMENT OF AVIATION INDUSTRY OF UKRAINE

A market of aviation industry condition is analysed within the framework of policy of liberalization from the side of the state and world organizations. The basic aspects of influence of liberalization are certain to the aviation market and basic tasks which it is possible to decide from application of measures of liberalization.

In the conditions of difficult world economic processes to Ukraine an effective state transport policy is needed including at the market of air transportations, which would take into account geopolitical aspects in the state, features of industry and her role in the processes of economic and social transformations and would give possibility to development of industry, provided her competitiveness. Having the ramified transport infrastructure and being on crossing of major directions of world trade between Europe, Asia and other continents, Ukraine has all pre-conditions for steady development of this industry within the framework of the dttermined state policy. A world civil aviation steadily moves in direction of liberalization and deregulation of markets, the concepts of primary possession and effective control are looked over in any case, the global system of delivery of slots is developed, national limitations are taken off from many aspects of activity of airlines. The measures of liberalization are sent to the removal of limitations results in the increase of competition from the side of foreign companies. Therefore already it is today necessary to take measures, which allow airlines to be competitive, that an inevitable removal did not find them suddenly. It is not possible to forget about circumstance that the competitiveness of airline is impossible in the conditions of uncompetitive industry, but and, in turn, determined by the competitiveness of separate airlines, airports, infrastructure and is component part of competitiveness of country. However the general level of liberalization in Ukraine substantially goes down through the presence of limitations of untariff character, main from which are for today numerous opaque and in many cases arbitrary bureaucratic procedures related to the external economic adjusting, burdensome system of internal taxes and tax collections, imperfection of the antimonopoly adjusting which distorts the terms of competition at the internal market of Ukraine. Actually these limitations present one of displays of general institutional inadequacy of the Ukrainian economy from the point of view of criteria of the effective participating in the system of world connections and international integration groupments.

It follows to consider that greater openness of the economic system, and thus and active and economically effective inclusion in the processes of globalization, it is possible to reach methods of consecutive approach to the standards of more liberal economy at possible temporal application of methods of defence of national producers; and on the other hand, radical and economically not reasonable liberalization can be reason of spontaneous degradational economic trends which substantially narrow possibilities of effective integration in a global economy.

Undoubtedly, the considerable acceleration of process of globalization of economy in 1990th lays on a substantial imprint on forming of strategy of development of transitional economies on the whole and their external economic strategy in particular. It is directly related to the considerable breach, attained in industry of liberalization and international adjusting of world trade which is the consequence of multilateral agreements within the framework of the Uruguayan round of negotiations of GATT and next agreements within the framework of the created Worldwide trade organisation (WTO). At the same time it is necessary to establish, that these processes created not only new possibilities for more effective increase but also new sharp problems of global scale, which are able to blow up neogenic potential of development. To it growing opposition testifies to the present paradigm of globalization from the side of different international government (foremost systems UNO) and ungovernmental agencies. It, in particular, small by the practical consequence actual failure of the Ministerial conference of countries -

members of WTO in Seattle (THE USA) at the end of 1999 year, where the important problems of grant of new impulse to development of globalization came into question on the basis of liberalization.

The noted circumstances require the careful revision of correlation of two parties of process of globalization - liberalization and adjusting objectively, including those his aspects which behave to defence of national air carriers.

It should be noted that universalization and expansion of scales of liberalization in the primary phase foresee the asynchronous flowing of processes of liberalization and, accordingly, unsimultaneous distribution on them of norms of GATT/of WTO. Thus grace period, which certain exceptions and indulgences, temporal mechanisms, can operate during, has for an object conditioning for adaptation of economies in relation to the groups of countries which develop, and also countries, with a transitional economy to the terms of more hard international competition, which must come as a result of tacking to the system of the global adjusting and free international moving of resources.

In turn providing of competitiveness of aviation industry of Ukraine possible at terms decision of next tasks :

- it is an analysis of the state and estimation of activity of aviation industry, in particular infrastructures of international transport corridors;
- it is perfection of state mechanism of acceptance of administrative decisions by the central organ of executive power in industry of transport and improvement of operationability of this process;
- it is creation of the proper transparent conditions for attraction of investors and work private to the sector in industry;
- it is an effective and economic-reasonable order by state property, optimization of privatization processes;
- it is development of flexible competitive tariff policy in aviation industry;
- it is an improvement of normatively-legal base of aviation industry, her adaptation to the requirements of the European legislation;
- it is realization of the government program of reconstruction of airports;
it is an acceptance of the "Air code of Ukraine" with differentiation of functions of management in aviation industry and investigation of aviation events;
- it is passing an Act of Ukraine "About the airports of Ukraine" with providing of the grace use of earth under basic aviation activity;
- it is passing an Act of Ukraine "About a zero rate of import duty and zero rate of VAT for the import of air ships and surface aerotechics for their service, analogues after the class of which not produced in Ukraine;
- it is creation of the modern system training of aviation (especially flying) personnels, which in a complete measure answer international requirements;
- it is providing of confession of the Ukrainian diplomas, certificates, licenses in the sphere of aviation activity European aviation structure;.
- it is building of modern terminals in the Ukrainian airports and air strips with the aim of increase of carrying capacity and creation of comfort terms for passengers; providing of the having a special purpose use of earth is for further development of airports and building of objects of their infrastructure;
- it is support of national air carriers and development of home aircraft building;
it is realization of certification of the Ukrainian airlines on the European standards.

All of it determines the necessity of realization of complex of the organisation-legal, economic and technological measures, counted both on a short-term and on long-term prospect, what would provide development of aviation industry in close combination with processes which take place in a world and home economy, assisted to development of productive forces of country, social mobility of population.

Taking into account it, the increase of efficiency and quality of work of any transport, including aviation, requires deployment of achievements of scientific and technical progress, introduction of leading and discovering of new, more progressive forms and methods of management and organization of a transport process.

Among progress of modern world economy of such trends as revivifying and integration qualificatory also is and repeatedly the higher mentioned measures of liberalization which finds the

display and in an economy, and in ideology, and in a policy. Liberalization overcame both regional and global levels.

Liberalization in modern international economic relations plays a double role. From one side, she is important as a process which accompanies globalization, clearing to her a road from superfluous obstacles. From other - liberalization is basis of economic integration. At the same time integration and liberalization - the qualitatively different phenomena. Liberalization is the mechanical opening of national market by a decline or removal of tariff and untariff trade obstacles, standardization of custom procedures, perfection of trade infrastructure. Integration not always leans against the removal of obstacles on the way of commodities and services.

The market adjusting of transitional economy of Ukraine comes true by forming of the mixed economic system which is based both on the private and on public (state) pattern of ownership, both on market and state methods of her adjusting. Main direction of passing to the mixed economic system is liberalization (as expansion of economic freedoms).

The primary purpose of research of influence of processes of liberalization is an exposure of the most general principles of forming and change of economic parameters of liberalization and exposure at methodological level of degree of influence of liberalization on economic development.

Economic efficiency is formed under act of two groups of factors of functioning of the economic systems : liberalization and not-liberalization (all other, except liberalization). For the exposure of clean influence of liberalization on economic development it is needed to disengage oneself from the factors of not-liberalization. Elimination influence of the last, the processes of liberalization it is expedient to investigate in the conditions of so-called clean extensional.

The socio-economic consequences (effects) of liberalization can prove in two ways: suddenly, in the moment of realization of certain procedures of liberalization and with a certain delay in time, with a certain delay. In last case gnosiological pre-conditions are created for the incorrect estimation of processes of liberalization.

After character of forming and functionally-system her level liberalization can be dual: internal and external. Is the last in turn closely associated with membership of Ukraine in world, regional and national government and ungovernmental agencies which influence on the measures of liberalization in aviation industry from the side of the state.

Within the framework of regional trade agreements and WTO two main going was formed near liberalization of trade and investments in the field of services:
1. A list of concrete obligations of liberalization of the trade mode (positive list approach) is national lists, in which a country marks sectors, subsectors and methods of supply of services, that liberalizations are subject. This approach inherent GATT.

2. List of exceptions in the field of liberalization (negative list approach), in which a country marks sectors, subsectors and methods of supply services, that liberalizations are not subject.

According to the list of concrete obligations of liberalization of the trade mode (positive list approach) within the framework GATT, countries consent to guarantee the national mode and free access to the market, specifying (through an exception from the list of obligations) an application of the national mode and access domain to the market for foreign services or foreign service providers. The alternative going near liberalization of trade and investments in the field of services, so-called list of exceptions of spheres of liberalization (negative list approach), is based on conception of negative list, at which all sectors and methods grants of services, not represented in the list of obligations and given in appendixes to the agreement, must be liberalized. The basic distinguishing features of model of liberalization of service business on the basis of list of exceptions (negative list approach) can be systematized thus:

- at first, such approach keeps and confirms the previous consent of countries to undertake the complete set of general obligations;
- secondly, the most practical personal touch of this approach consists in his ability to provide stability of the trade modes, not accept new normative acts which limit trade (position of "stand still"), that is to create the strong to founding for liberalization of trade by fixing status quo in the legislative or instructional order.
- thirdly, a distinguishing feature which extends imperious plenary powers of list of exceptions of spheres

of liberalization (negative list approach) at the same time foresees the higher level of transparency of the trade modes, which is arrived at due to him. In turn, the transparent trade mode is more suitable for effective liberalization, for example, by encouragement of states-members on a concordance to shorten or gradually stop applications of the forbidden measures, which can kennels similar in different countries, as, say, quantitative limitations and part of foreign proprietors in a capital of airlines.

As a result of study of basic models of liberalization of trading in services on the basis of list of exceptions of spheres of liberalization two lacks of this approach were educed. At first, he can be burdensome in the administrative providing, especially for countries which develop. These difficulties can be overcame however, if to allow a gradual stowage the countries-members of obligations, which are not regulated by a trade agreement. Secondly, application of list of exceptions of spheres of liberalization means in the future complete abandonment of governments from application of discriminatory measures or such which limit access to the markets, including those industries which in the moment of entering into contracts did not exist or not fell under the action of such agreement even.

Conclusions. As a result of insufficient development normatively-legal base and subzero investment potential of aviation industry the wear of hardwares increases, their structure gets worse, the proper safety of motion is not provided, negative influence of activity of transport grows on a natural environment and health of man. All of it in the conditions of world financial crisis and hard competition results in forcing of the Ukrainian ferrymen out of international markets of transport services, reduces quality of maintenance of domestic enterprises and population, creates the real threat to economic security of the state.

The self-weighted measures of liberalization, which can be determined by the factor of time, scales of liberalization and participation of Ukraine in world concords, must become basic principles of new policy of activity of aviation industry.

References

1. *Барі Л.* СОТ: Проблеми членства України та його наслідки (Регіональні багатосторонні торговельні домовленості: взаємне доповнення чи заміна?) // Книгозбірня державного управління. – К., 2004.

2. *Ніколаєв Є., Волощенко В.* Торговельна лібералізація: конкуренція інститутів // Політичний менеджмент. - 2005. - № 4 (13). - С.148-160

3. *Жалило Я.* ВТО и неравное равенство его членов. // Економіка і держава. – 2003. – №11. – С. 2 – 4.

4. *Шишков Ю.В.* Интеграционные процессы на пороге XXI века. Почему не интегрируются страны СНГ. – М.: III тысячелетие, 2001.

5. *Мокринська В.* Глобалізація авіатранспортної галузі // Науковий вісник Волинського національного університету імені Лесі Українки 74

6. Автореф. дис... канд. екон. наук: 08.02.03 / Ю.І. Турянський; Львів. нац. ун-т ім. І.Франка. — Л., 2005. — 21 с. — укр.// Державне регулювання господарських систем в умовах лібералізації та капіталізації економічного розвитку

7. http://www.br.com.ua/referats/Mighnarod_econom_vidnos/28312-14.html // Україна в європейських інтеграційних процессах.

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CONDUCT OF PASSENGERS IN THE MARKET AS A COMPONENT AVIATION SERVICES TRASPORTNYH MARKET SERVICE

An approach to study the behavior of potential passengers on air transport services market, which consists of two stages. The first phase should be analyzed the behavior of potential passengers on the transport market in general. Principles and main components of behavior potential market for passenger air transport services.

The purpose of the report is to develop an approach to study the behavior of potential passengers, taking into account the specific features of air transport services market.

As a result, modern transformation in the context of a dynamic, global economic changes, the formation of information society has changed significantly in the social organization of the Ukrainian society. This leads to what the main characteristics of present and future society related to the predominant influence of social relations on all sides of human activity, affect values, way of life the citizens of Ukraine, and accordingly change their consumer behavior.

At the same time increasing the intensity of competitive markets for air transport services regularly rotates the interests of all stakeholders to study the mechanisms of air consumer behavior (potential air passengers) and opportunities to use these mechanisms to achieve their goals. Obviously the consumer behavior of potential passengers is a special reality, which reflectes and partially constructed social structure of society. It should be noted is the growing socially oriented consumer behavior of potential passengers, its complications and dependency status attributes.

The development of modern production is impossible without transport, financial, information and other services. The emergence of new kinds of service transformation in this sector, the flow of financial, material resources and human capital in the services sector, a permanent increase of the employment and production volume in the sectors orientention services speak about the changing role of service sectors in society.

This reality must be overcome related to inadequate service sector as the secondary sector, which develops due to material production, science and comparing them virtually untenable. Because each type of material production requires a range of services and production services facing material components. And the new information technology generally can not be split.

In matters of this kind of market formation, including the market for air transport services as an independent, open economy subsystem that performs the function of resource efficiency to meet the needs of society, extremely important for the Ukrainian economy today.

At the same time the needs for development of air transport services go beyond economic needs: the process of economic growth accompanied expanding range of services aimed at the same potential air passenger and his intelligence and physical capabilities, his appreciation of cultural, spiritual and social needs. The need for solving scientific problems in this sphere is determined by the fact that the formation and functioning of the market of air transport services, especially potential passengers consumer behavior have become the object of attention of local novadays economists and sociologists. So far no stable definitions, there is ambiguity in the interpretation of some categories, many phenomena remain subject to debate.

Currently, the definition of consumer behavior presented R. D. Blackwell, P. W. Miniard, J. F. Engel [1]. According to these authors, the behavior of consumers is defined as actions that people make when purchasing, consumption of goods and services, and exemption from them

A great contribution to the solution of this problem, introduced Michael R. Solomon [2]. Noteworthy E. Holubkov point of view , which divides the purchasing behavior as one of the factors that influence purchasing decisions and their own purchasing decisions on the implementation of a purchase.

E. Kostromina raised and studied the problem in the civil aviation [4].

In our opinion, none of these two basic points of view can not be used in the market for air transport services in the following two reasons. Firstly, is not clear on services that there is consumption, as consumers may choose not to use any vehicle, and release.

Secondly, as it is by shown V. Mova and Y. Kolbushkin [5], standard stages of purchasing behavior are reduced only to these four.

In this regard, the following approach to study the behavior of potential passengers on air transport services market, which consists of two stages.

The first phase should be analyzed the behavior of potential passengers on the transport market in general, it where together with air transport is the analyzed choice of other modes.

At the second phase should be analyzed the behavior of potential direct passenger air transport services market.

Consider the main components of the first phase behavior of potential passengers on the transport market as a whole.

The first, most important component is the need to identify the problem of displacement. Only the presence of this problem is necessary to exit not only the market of transport services in general but also and the market of air transport services in particular.

After entering the market of transport services potential passenger has alternative – to use aircraft or other transport. To compare, these alternatives three components should be implement .

As part of the first component - assessment of the volume of information required for air transport and its collection - a potential air travelers, depending on their degree of awareness, should determine what additional information he needs in case ofusing air transport. These statements may include, for example, the possibility of raising prices on airticets, airport taxes changes, the level of safety, ets. Gathering this information can be made by using the Internet, periodicals, etc..

Similarly the simultaneous component is implemented - assessment of volume information required for other types of transport and its fee.

As part of the second component - assessment of alternatives to air transport - a potential air travelers, depending on the level of education, intellectual abilities, awareness, taking into account the interests, needs, motives, values and preferences should form the criteria and restrictions on further evaluation of alternative to air transport.

Similarly the parallel component is realized - rating options using the other types of transport.

As part of the third component - assessment of the impact of air transport - a potential air travelers, depending on the level of education, intellectual abilities, awareness, taking into account the interests, needs, motives, values and preferences should form the criteria and assess the actual impact of possible alternative to air transport.

Similarly and simultaneously implemented component - estimate the impact of other types of transport modes.

Further evaluation of options and assess of the results are compared with each other on specific criteria. The need to develop criteria for comparison is because of the evaluation of options and consequences of their realization in turn can be conducted by various criteria. On the basis of this comparison is mode a decision to use (or not to use) the air transport.

If it is decided to use air transport, the potential air traveler enters the market of air transport services. The peculiarity of this market is that not only the possibility of traveling via air travel should be included , but the aggregate of all factors and elements, as he followed and related actions after landing the aircraft. The main components of the first phase are presented in fig. 1. Let`s take a took at these components.

In this case, potential passengers who had already taken some decision needs to solve the problem of moving air, for which he goes on the market for air transport services.

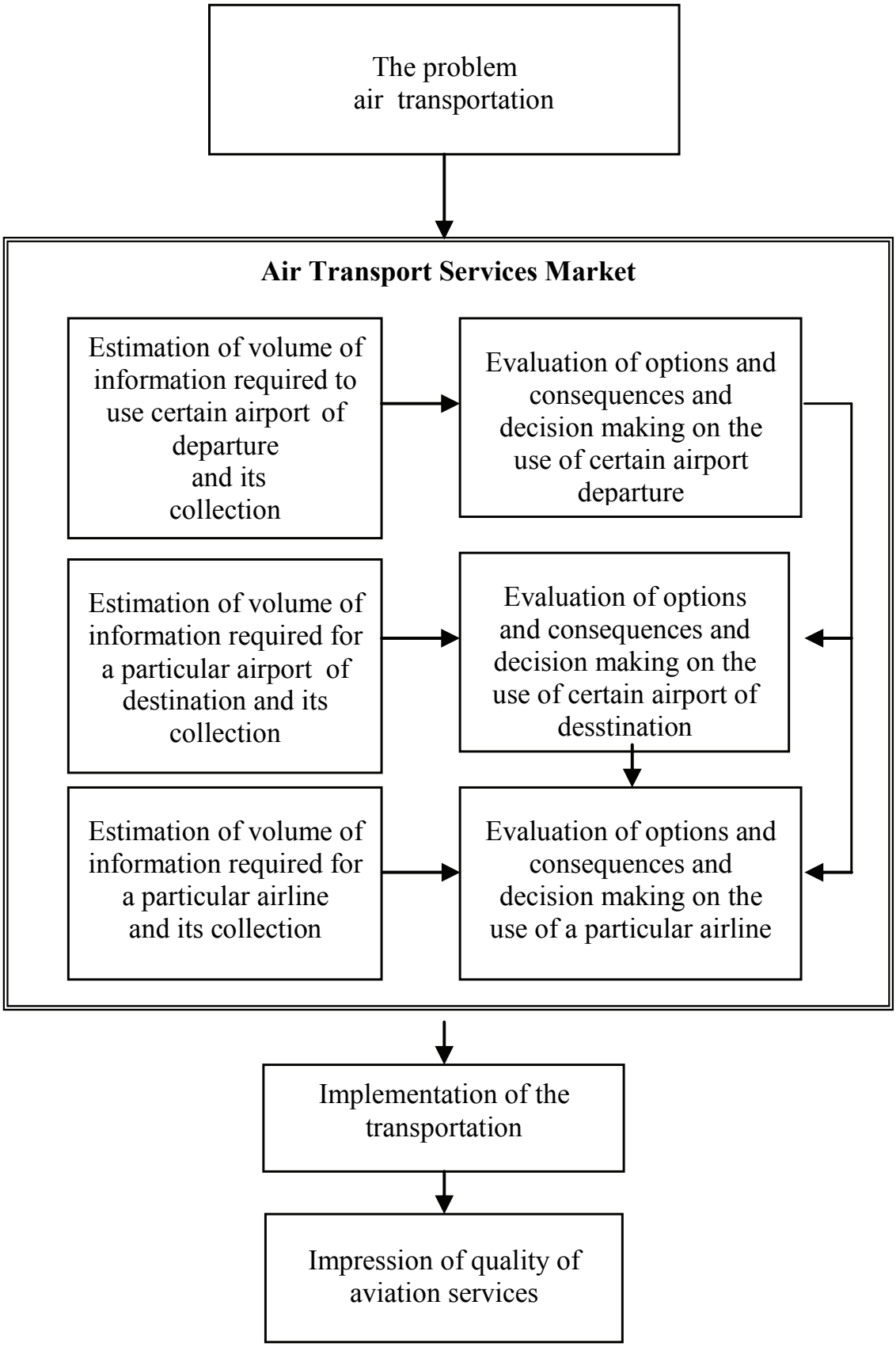

Fig. 1. Basic components of a potential passenger behavior market for air transport services

On the basis of component - assessment of the volume of information required to use certain airport of departure and its assembly - potential air traveler evaluate options and consequences and decide on the use of certain airport of departure.

On the basis of component - assessment of the volume of information required for a particular destination and its airport fees - and the results of a decision on airport air passenger evaluates potential options and implications and decide on the use of certain airport arrivals.

On the basis of component - assessment of the volume of information required for a particular airline and its collection - and the results of a decision on airport and air passenger arrivals evaluates potential options and implications and decide on the use of a particular airline.

Later is realized sold the process of moving air, which gives some impression (positive or negative) on quality of air transport services.

For each phase author applied fuzzy set theory For example: $X = \{x_1,x_2,...,x,,\}$ set of customers, $Z = \{z_1,z_2,...,z_m\}$ - set of types of services, $Y = \{y_1, y_2,\ldots,y_p\}$ - set the parameters for each type; $\Phi(x,y) \rightarrow [0,1]$ -membership function, fuzzy binary relation $R=(x, y)$ that determines the degree of importance of attributes in the client's possible future; $\pi(y,z) \rightarrow [0,1]$ - membership function, fuzzy binary relation $S=(y, z)$, which defines how the sign is in the type of services z.

Additive membership function is defined as:

$$\mu_{A_i}(x_k, z_i) = \sum_j \Phi(x_k, y_j) \times \pi(y_j, z_i) / \sum_j \Phi(x_k, y_j); \quad (x_k \in X, y_j \in Y, i = \overline{1, M})$$

is one of the possible functions that determine the degree of superiority type of services by the client.

Cited helps to establish the following.

1) Requirements in the development of air transport services beyond the purely economic: the process of economic growth accompanied by expansion of services, aimed at potential passengers himself, his intellectual and physical abilities, his appreciation of cultural, spiritual and social needs. The formation and functioning of the market for air transport services, especially consumer behavior of potential passengers, has been the object of national attention of economists and sociologists only recently and not fully resolved.

2) Proved that none of the existing two main viewpoints concerning consumer behavior can not be used in the market for air transport services.

3) Proposed and implemented an approach to study the behavior of potential passengers on air transport services market, which consists of two stages. At the first phase was perfomed the research and formed the behavior of the potential market for passenger transport services in general, where together with air transport is analyzed the choice of other types of transport. At the second phase was carried out the research and formed a potential passenger's behavior directly in the market of air transport services.

References

1. *Roger D.Blackwell, Paul W.Miniard, James F.Engel,* Consumer Behavior, 9E, 10 th. Edition. (Thomson, 2007). Harvard Business School Publishing.

2. *Michael R. Solomon,* Consumer behavior 5. ed. Upper Saddle River: Prentice Hall, 2002

3. *Голубков Е.П.,* Маркетинг: Словарь – справочник [Текст] / *Е.П. Голубков.* – М.: Дело, 2000 – 440 с.

4. *Кострома Е.В*. Авиатранспортный маркетинг [Текст] / *Е.В. Кострома.* - М.: НОУ ВКШ "Авиабизнес", 2003. – 383с.

5. *Мова В.В.* Системный подход в экономике [Текст] / *В.В. Мова, Ю.П. Колбушкин*. – К.: НАУ, 2004. – 204 с.

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INFLUENCE OF MACROSTRUCTURAL BIASES OF DOMESTIC ECONOMICS ON AVIATION INDUSTRY GROWTH

In the article trends of keeping misbalance between development of foreign trade and internal Ukrainian market resulting in structural disproportions of economics are observed. Live issues of role of aviation industry in providing high pace of long-term economic development are analyzed. Considerations concerning development and state support of aviation industry for gaining competitiveness on perspective high technology markets are given.

From the moment of Ukrainian state independence economics of the country has suffered drastic changes aimed at formation of market economics. But in many aspects such as increase of economic potential, growth of international competitiveness, resolving of main social problems, happened a crush of previously developed potential. Extremely complex way of Ukrainian reforms is defined to a large extent by mistakes in strategy of market transformations that led to substantial structural disproportions curbing development of the country in future.

In course of market reforms in Ukraine a model of economic development with extremely high level of openness to external trade has formed: in recent years volume of export to country's GDP varies in range 54—62%. Openness of Ukrainian economics is two times higher than average and is substantially higher than openness of economics of developed European countries-EU members. Having export quota of GDP two times higher than average in EU Ukraine has only 5 % from average level of export per capita in EU, and level of direct foreign investments (DFI) per capita in Ukraine remains low enough comparing with average in EU. According to 2009 statistics DFI per capita are estimates in $ 872,6 that is 16 times lower that in EU.

Analysis of statistics of 2009 shows that net increase of gross foreign capital in economics of Ukraine make up $ 4,41 billion that is minus 27,4 % of 2008 level. In 2009 foreign investors have invested into Ukrainian economics $5,635 billion of direct investments but have withdrawn concurrently $0,941 billions. For comparison during 2009 Ukraine has sent to economics of other countries of the world $69,8 mln. of direct investments mainly in the form of money payments. Foreign investors see as the most attractive fields finance, real estate, and also reclamation industry in particular food and beverages production, chemical and petrochemical industry, machinery construction. Thus increase of foreign capital was observed firstly on enterprises conducting financial activity (on $1813,7 mln.), trade, car service, home appliances and consumer goods repair (on $537,6 mln.), operations with real estate, lease, engineering and offering services for entrepreneurs (on $451,2 mln.), and also on industrial enterprises (on $969,3 mln.) including reclamation (on $885,1 mln.). Industrial enterprises account for $9021,9 mln. (22,5 %) of gross volume of foreign investments to Ukraine, including reclamation industry with $7740,8 mln. and extractive industry with $1128,1 mln.

Sum of credits and loans obtained from foreign investors on 1 January 2010 equaled to $6615,2 mln., and volume of direct Ukrainian investments to the economics of other countries with reevaluation, losses, exchange rate difference, on 1 January 2010 totaled almost the same sum $6223,3 mln., including to EU countries - $5908,3 mln. (95% of gross volume), to CIS countries $ 220,1 mln. (3,5% of gross volume), and in other countries of the world - $94,9 mln. (1,5%). Direct foreign investments from Ukraine were made to the 51 of the world, major part of them – to Cyprus.

High rate of offshore zones is kept in volume of DFI (Cyprus, Virgin Islands) that testifies for positive trend of capital's return to the country, and from the other side that offshore investments are not connected largely with new technologies and management that lowers their value for Ukrainian economics. To this connection increasing level of high technologies development and inclusion of country's economy to the global high-tech interchange is extremely essential. Within

framework of global economy Ukraine is characterized by low indexes of high-technological goods and services conditioned by formation during 1990s such type of international competitiveness that is based mainly on price factors and comparative advantages in cost of natural resources and labor force. At the same time preconditions to formation of high-technological type of competitiveness are not used in a proper way [2].

Paradigm of economic development should be oriented to the priority of internal market development that doesn't contradict to the course of open character of external trade after joining to WTO. But weak development of Ukrainian internal market due to drop in solvent demand of population, unfavorable investment climate, underdevelopment of market infrastructure stimulate outflow of capital from the country.

According to conclusion of experts the process of integration of Ukraine into global economy is accompanied by the formation of unfavorable export structure, therefore, offering little for model of international specialization. Ukraine is concentrated on supplying low-dynamic international markets of goods and services (foods, ores, metals, primarily black, transport services), with fierce price competition. The share of these markets in the global sale of goods and services decreases, and price advantages can very quickly move to other countries, especially when restrictive, discriminatory trade measures are applied to any country. Ukraine is characterized by low levels of exports of high-tech goods and services, and major exporters need radical restructuring of production. Very small supply to high dynamic markets with increased stability of competitive advantages that determine the global economic outlook (office and telecommunications equipment, airlines and other commercial services) characterize the structure of Ukrainian export as not very promising. These structural features of Ukrainian foreign trade are strategically losing for the country. They should be changed in the process of further market reforms.

The essential condition for the functioning of post-industrial economy is the application of scientific knowledge, usage of significant resources and funds for technical, scientific and technological development. Significant increase in the level of development of high technology and integration into the global high-tech exchange is extremely important in this regard. For technologizing of economy a purposeful state scientific and industrial policy is required involving investing considerable amounts of capital to raise the necessary level of capacity of most existing companies. Investing funds in new enterprises is constrained by the high level of risk and lack of real confidence in the possibility to obtain adequate returns on invested capital in the near future because of the narrowness of the domestic market. Work for export requires a significant investment and effort to overcome the high competition and significant domestic protectionism by developed countries.

Among the highest priorities of technologizing economy, such as information technology, biotechnology, medicine, nanotechnology, environment, nuclear research and several others, aviation and space are always present. The aviation industry in the broad sense includes the whole range of areas of design, production, operation, maintenance and repair of aircraft and is characterized by high innovation activity and susceptibility. In this context, we consider the depth of the problems of reforming the aviation field and, in particular, the aviation industry (AI) as the most representative for scale, prospects, technology content complexity, relevance and effectiveness.

Aircraft production is not only a major consumer of scientific, technical and technological innovations, but at the same time is owner of powerful innovation potential for their creation. In terms of innovative technological development base for the Ukrainian economy importance of the aviation industry can not be overstated - so large are scale and range of its scientific, technical and technological achievements and interests. Existing international system of regulation of aviation activities and constantly rising requirements for civil aircrafts because of their cross-border usage, for reliability, safety, economy, ecological compatibility initiate numerous innovations and basic and applied research and development that go prior to them.

In Soviet times state conducted in relation to the AI coherent scientific and industrial policy that ensured the forefront positions in scientific and technical level of aircraft construction and in

production. Industry was one of the world leaders in development and manufacturing of civil (the first jet and the first supersonic airliners - domestic) and military aircraft and helicopters of almost all types. Achieving good results was provided by several factors: industry had a centralized system of administration, enjoyed the privilege of priority resourcing (financial, personnel, logistics), developed by balanced current and future plans and targeted programs, within industry by specific (not economic) methods competition between different scientific and engineering schools and plants was maintained, scientific-technical policy of uniform rules requirements, state and industry standards, regulations, certification systems was conducted etc.

With the beginning of market economic reforms, with closing of a large-scale policy of state support AI was found in deep crisis. It should be noted that efficiency of the enterprises of the domestic aviation industry is strictly determined by amount of public funding which lacked due to adoption of the budgets of debt that caused that catastrophic decline of the industry. Inefficient use and more costly loss of the capacity of various sectors of aviation field (aviation industry, civil aviation and aviation infrastructure) seem particularly pointless. Critically important were the factors of domestic demand and public financing which have fallen sharply. Among the consequences of policy of radical reforms, which caused a rapid and unprecedented decline in GDP and welfare of the population, added effects of past economic autarky system, its militaristic orientation, weakness of the position in the global high-tech markets, the lack of mechanisms for self-development and self-organization of companies.

Currently aircraft industry mainly exists at the expense of past scientific, technical, engineering and technological basis, the reserve of which is steadily dwindling. Chronic lack of financial resources limited by narrow limits of state orders and state programs leads to a delay or suspension of promising research and development, their higher prices. In the absence of serious investment in innovation it is increasingly difficult to compete with Western corporations. Sharp decline, and in some areas - and complete elimination of the state order have led to a fragmented operation of sub-fields of AI. Financial and economic situation in the military and civil aircraft construction, engine and helicopter construction varies greatly. Military aeronautics of Ukraine is in better state because of its foreign trade contracts.

Sluggishness of industry going out from crisis lies not only in its lack of demand but in a weak adaptive ability to respond to the specifics of market relations and interactions - this requires a fundamental change and improvement in the economic environment and in all levels of economic and sector management.

Conclusions

Reforming of industry should be held in the context of enhancing its competitiveness, satisfying domestic needs of the country in view of global trends in the international market of aviation equipment and air traffic.

First, the priority of reforming the AI should be self-organization of business entities in a vertically-integrated business groups, including the same global TNC, their structural-technological and organizational transformation, selection of the profile (diversified profiles) activity. As dramatic results of decade changes in science-intensive sector of economy show the art of strategic choice and its practical implementation in the Ukrainian context by industry and state management in the not yet fully mastered. Prolonged crisis of AI is largely a consequence of the lack of crisis management teams with strategic level thinking and organizational abilities.

Secondly, it’s necessary to raise companies producing civil aircraft to the level of competitiveness not only domestically but also worldwide. Domestic liners should not be pushed from international airlines because of their lack of technical proficiency. Only market development, commercial activity and its results can provide enterprises with financial sources of self-development including through high credit rating.

Thirdly, one of the main mechanisms for financing of civil aircraft construction should be created - a full leasing system. Without starting financial capital it is not possible to begin upgrade of scientific and industrial machinery industry which during the long periods of inactivity has

largely obsolete and outdated. To start serial production enterprises need investments that usually lack. Initial risks must take the state.

The fourth principle significant condition for market functioning of AI – is institutional changes and creation of a full-fledged stock market - another powerful source of investment in modern industry.

The fifth condition - restoration of human potential. The average age of employees approached retirement threshold. If continuity of generations would be interrupted, science and engineering, production and technological schools will be destroyed. Forced flow of large part of qualified personnel in other areas destroys the continuity of experience.

References

1. Державна комплексна програма розвитку авіаційного транспорту України на період до 2010р. [Електронний ресурс].- Режим доступу: http://www.asavia.org/avia/zakonodatelstvo

2. Прямі іноземні інвестиції в Україну на 1січня 2010 [Електронний ресурс].- Режим доступу: рокуhttp://www.ukrstat.gov.ua

3. *Крючкова И., Сиденко В.* Макроструктурные сдвиги в украинской экономике в контексте интеграционных процессов [Електронний ресурс].- Режим доступу: http://www.zn.ua/

4. Мезоэкономика переходного периода: рынки, отрасли, предприятия. / Под ред. д.э.н. Клейнера./ Клейнер Г.Б. [Текст] — М.: Наука, 2001.

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FINANCE MANAGEMENT OF AIRPORT DEVELOPMENT IN UKRAINE

The results presented in this article are based on a review of existing studies, comprehensive collection of new data and analysis of same. This article takes an overview of the strategies which Ukrainian airports should develop and seeks to assess the relevance of general competitive strategy to the Ukrainian airport industry.

Traditionally, airports have been regarded as integrated and important part of the national air transport system. Airports are a key component of local, national and regional infrastructure of Ukraine.

At the same time, airports are much more than regulated public service providers. They are complex commercial entities that must meet well-defined business objectives in terms of day-to-day operations, financial performance and planning for future growth.

Airports are complex and multi-product enterprises. Each airport comprises one or several runways, a set of aprons and taxiways, a terminal building through which passengers and freight are separately processed, and a control tower. Each of these parts develop specific activities that once combined, allow the interchange between air and land transport modes.

With the growth of air traffic, airport operations have become increasingly complex. More and larger aircraft, an increase in ground support equipment and faster turnaround times all contribute to the challenge.

There are 32 airports in Ukraine. There are points of admission through the state border in 23 airports. 5 airports provide freight transport. 9 airports are centrally administered. These airports are usually called "strategic": Government enterprise „"Boryspil" international airport", Utility enterprise „Donetsk international airport", Utility enterprise „Odesa international airport", Government enterprise „Lviv international airport", Republican enterprise „Simferopol international airport", Aviation utility enterprise „Kharkiv international airport", International airport "Dnipropetrovsk", Utility enterprise „Kyiv (Zhuliany) international airport".

The rapid growth in demand for air transportation service has not been matched by an equivalent growth in capacity leading to increased delay and congestion in the air transportation system [5].

A shortage of capacity at airports translates into increasing congestion and delays. The immediate consequences for users are increasing costs, and decreasing quality of services and safety. However, providing additional capacity in order to meet demand requirements has important implications for the airport costs structure.

Capital costs consist of the component costs (e.g., labor, component costs (e.g., labor, materials and equipment) of construction of the airport and its component parts [4].

Sources of capital for airport development include:

- governmental or international organization loans and grants,
- commercial loans from financial institutions,
- equity or debt (typically, bonds) from commercial capital markets, including private investors, banks investment houses, or fund pools,
- the extension of credit from contractors and suppliers.

Airports must also evaluate the amount of foreign capital needed.

Commercial loans typically incur the highest interest rates, though such rates maybe reduced by governmental loan guarantees. Existing airports also may have retained earnings building in a capital development account.

Foreign governments may be willing to provide capital to airport projects in less developed nations, out of a sense of altruism or with the purpose of promoting trade and commercial relations between the two nations, or exporting technology and equipment from firms domiciled in the lender nation. Some nations have developed economic and social development programs in various parts of the world, providing loans on preferential terms, or supplies, equipment and technology.

Several international bank and fund organizations have been established to aid developing nations by assisting in financing and execution of projects, particularly air infrastructure projects, which foster economic development.

Once built, an airport must earn sufficient revenue to pay its operating expenses and retire its dept. Such operating costs include expense items as interest and depreciation or amortization on debt, taxes and maintenance and administrative costs, including salaries, salaries and repairs.

When an airport is operating, it must generate sufficient revenue to retire generate sufficient revenue to retire debt and cover operating expenses.

Airport income costs may fall into two categories: those related to the terminal building and those associated with the runways system [2]. The first group depends on passenger flows at the terminal building, while the second is determined by the number of processed aircraft.

In covering operating costs, airports tend to use one of three approaches:
The most popular is the Residual Cost, or "cash register," approach, which seeks to balance total costs with total revenue. Once the airport's costs have been determined non-airline revenue is subtracted from total expenditures to determine what additional revenue is needed to break even. Airline specific fees are then set to make up the remaining deficit.

A second approach is the Cost Service, or a "multiple cost center" method. The airport is divided into cost centers, and fees and charges for each cost center is set at a level to cover the costs allocated to it.

A third method is the Public Subsidy approach, under which the difference between cost and revenue is subsidized by the airport or the government.

Activities carried out at an airport may be classified into three distinct groups: operational services and facilities, handling services and commercial activities (see Table 1). Alternatively, the first two are commonly referred to as aeronautical services, while the later are considered non-aeronautical.

Table 1 Activities carried out at an airport

Aeronautical services		Non aeronautical services
Operational	Handling	Commercial
• Air traffic control • Meteorological services • Telecommunication • Police and security • Fire, ambulance and first aid services • Runway, apron and taxiway maintenance	• Aircraft cleaning • Provision of power and fuel • Luggage and freight loading and unloading • Processing of passengers, baggage and freight	• Duty free shops • Other retailing shopping • Restaurants and bars • Leisure services • Hotel accommodation • Banks • Car rental and parking • Conference and communication facilities

Figure 1 shows the structure of the largest Ukrainian airport “Boryspil” income [3]. Demand for basic airport services such as aircraft landings is directly influenced by the air transport market.

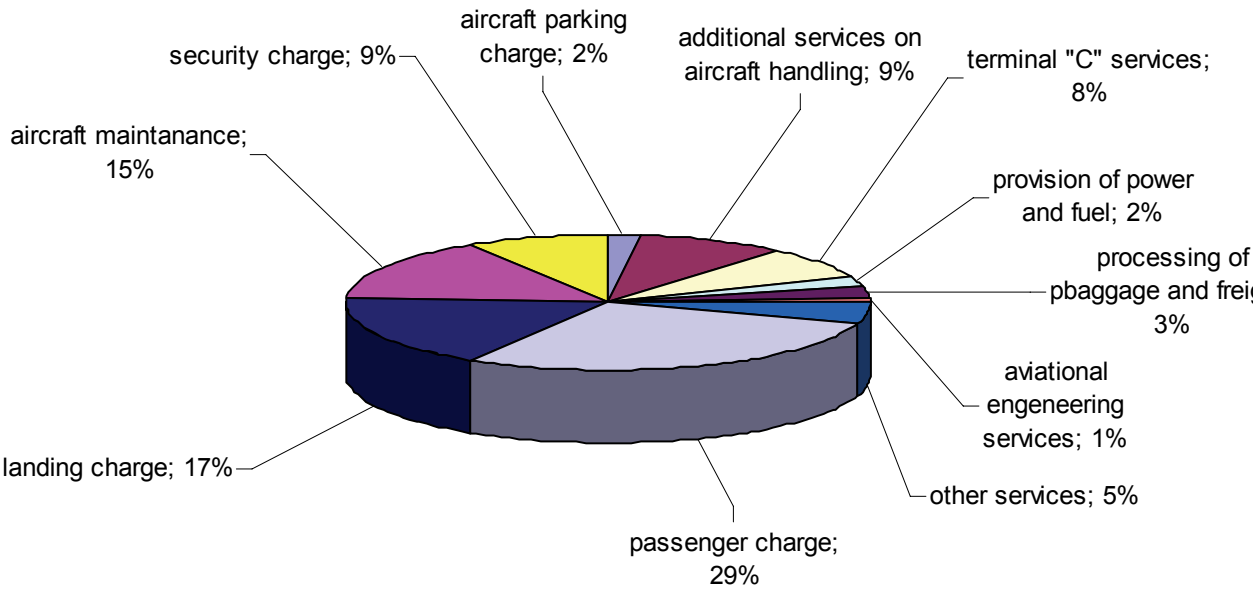

Figure 1. The structure of the "Boryspil" airport income.

Figure 2 shows the development of air passengers' movements and airport income of the "Boryspil" airport [3]. The airport has shown a particularly significant increase in air passengers' movements.

Figure 2. the development of air passengers' movements and airport income ("Boryspil" airport)

Traditionally, airports have been owned and operated by central or local governments. Airport infrastructure was commonly believed to be a public utility.

Assume an investor, which can be the Government or a public/private joint venture, interested in investing in the construction of a new airport. This type of investment requires huge amounts of capital, which is, in a large scale, sunk once spent.

There are several sources of uncertainty in this type of project, namely the number of passengers and the net cash flow per passenger.

The arrival of the private sector into airport operations has led to the airport commercialization. In this case the infrastructure is regarded as a business opportunity, and as such, something beyond a traditional airport. Meetings, visitors, employees, local residents, and local businesses and industries would also be important potential customers for airport commercial services. From this point of view, the greater the involvements of the private sector in airport activities, the greater the importance of non-aeronautical sources of revenue.

At the same time many of the services which make up the composite airport product, such as air traffic control, security, ground handling and commercial facilities, can be provided either by the airport operator or by a third party. The way in which they are offered, and whether there are competing services, can have an impact on an airport's competitive situation. An extreme case is the management of entire terminals by different operators or suppliers.

The market share of the European airports seems to be affected by a concentration trend that is due to the value asymmetries that enable larger airports to grow more rapidly than smaller airports [1].

Conclusion Growth restrictions may be natural reasons for the airport to seek cooperation with other airports. A cooperation strategy might involve strengthening the position of domestic regional airports, or it might mean becoming part of an international network.

The value of airport infrastructure derives from enhancement of the airport's strategic position. Such investments increase an airport's future ability to capture growth opportunities in the industry. Therefore, infrastructure and network investments require careful competitive analysis.

The decision to invest in an airport demands, usually, a huge amount of money. This, combined with the fact that this type of investment is, in a large scale, irreversible, becomes a very important timing problem.

References

1. *Dr Anne Graham* Airport strategies to gain competitive advantage - Bremen, 2004. – 16 p.
2. *Richard K. Green* A Note on Airports and Economic Development - University of Wisconsin-Madison, 2002 – 23 p.
3. www.kbp.kiev.ua
4. *Zaporojetz V.V., Shmatko M.P.* Airport: organization, technology, safety – K.: Dnipro, 2002. – 168 p.
5. *Alessandro F. D`Amico* Airport development, plans and processes: a case study of Dorval international airport - University of Manitoba, 2000 – 172 p.

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FRANCHISING AS A TOOL OF THE IMPLEMENTATION OF VERTICALLY INTEGRATED SYSTEMS IN AVIATION

Vertically integrated systems based on the methods and principles of franchising make it possible to activate the Ukrainian market of the local air transportation and increase the effectiveness of the air carriers that operate on the internal directions. The aim of this paper is to study the opportunity of the Ukrainian market to use franchising as a tool for the vertical integration of the air carriers corporate systems to increase the effectiveness of the internal local air transportation.

Complex institutional and structural reformations in Ukrainian economy have caused changes in a paradigm of the social and economic management process. New operation principles for branches of the national economy update and make it necessary the goal seeking of the appropriate methods, models and approaches to the improvement of the corporate structure management system, particularly in basic industries, including the civil aviation, that operate in the dynamically developing business environment conditioned by the rivalry intension, business globalization and a number of other factors.

The market of air transportation being in the direct interrelation with the macroeconomic tendencies determines the vector of development and direction of activity for particular airlines and to a large degree explains the main problems of this industry under the conditions of transformation economy. This defines the need to research the economic aspects of operation of air transport in the scope of its "backbone" role for particular regions and the state in whole.

Vertically integrated corporate systems become a gear for subjects of economic management to activate and effectively realize their potential in the national and world scale due to both the synergic advantages of integration and the ability to implement the most advanced and flexible management systems into the corporate structure.

The relevance of study of the management process in the national civil aviation including the complex research of the vertical integration in the air carrier companies, has the following background:

- ... tougher requirements to the quality of the air navigation and ecological data of aircrafts,
- ... aggravated obsolescense and functional depreciation of the aircraft fleet on conditions of low level of investment to the civil aircraft construction,
- ... growing rivalry among the air carriers on the international priority-driven directions,
- ... increasing level of competition among the Ukrainian air carriers at the market of domestic operations,
- ... the potential of growing requirements to the level and quality of passengers' service according to the changes in the social structure of air transportation demand.

The above mentioned factors exert an unfavorable influence on aircraft business which as a rule is not characterized with the high level of efficiency.

The sales opportunities of the Ukrainian market of air transportation dictate the necessity of merger or capture. The focus on airlines agglomeration due to merger or creation of regional air carriers is more viable. This is stipulated by the development of the civil aviation as an important part of the economic system of the country and an element of the state unified transportation system directly depending on the process that takes place in macroeconomic environment from one side. From the other side the tendencies in the branch development do not encourage the stable positions of the air carriers in the market due to tougher international requirements to the quality of the air navigation and ecological data of aircrafts as well as the growth of the rivalry among air carriers inside the market. Besides, the major features that characterized the Ukrainian market of air transportation are the following: high assets capacity under low investments level and insufficient usage of the results of innovation activity because of the finance reduction of R&D and purchase of new equipment.

Franchising is considered by the founders of the marketing theory as one of the types of vertically integrated distribution systems which is called to increase the effectiveness of company's performance.

The air carriers could be such companies that can improve their performance due to implementation of the franchising schemes into their operational structures. In the world practice in the majority cases the franchising is mentioned as a method to create the own business for those who own the initial capital, have the experience of entrepreneurial activity and management of the small scale enterprise, but do not tend to seek the personal style in the market, develop marketing strategies and promote own brand or trade mark. The obvious advantage of franchising scheme for a franchiser company is to capture new markets and enlarge activity with no measurement investments.

Experts evaluation states that franchising is developed in about 80 branches of economy and it is considered in the world as the most advanced form of business conducting. The growth rates of number of franchisers and correspondingly franchising networks are significant. On the International Association of Franchising data today in the world there are 16,5 thousands of franchisers with more than 12 million franchisee; the volume of sale of franchising networks is about 2 billion USD; about 12 million people are employed by franchising networks. The recognized leaders are USA, Korea, Canada, Brazil, Japan. In Ukraine the first franchising project "American cleaner" was realized in 1998. The lack of sufficient awareness level of the essence of franchising in the entrepreneur environment slowed down the development of franchising for several years.

Franchising in aviation is not the widely-spread and observable phenomenon. The experts in franchising consider its occurrence in the air transportation more as some exotic and special event. Despite this such method of the vertical integration could facilitate and encourage the growth of effectiveness of the airlines in the local market. The air carriers discuss the extension of operation using franchising schemes as an application of the common business development patterns to the air transportation. Such schemes are viable because the aviation business widely uses the different forms of alliances and partnership.

The United States is a franchising pioneer in aviation – the franchise is used to be sold by American airlines during twenty years. The franchisers are the largest air carriers that operate on the international directions, franchisee are the regional airlines that cover with their services only the territory of the USA. Probably, the development of this practice is encouraged not only by the significant volume of the local air market, but also the integration tendency among its leading operators.

A carriers-franchisee possess all attributes of franchiser, i.e. the relevant symbols on the aircrafts, stewardess uniform, ticket form, check-in counters design, etc. On their side they pay fixed payment (royalty) for the trade airline mark employment and in accordance with the agreement one or another percent from the activity turnover under the trade mark of a franchiser. Besides the direct receipt of funds (sometimes insignificant) for large airlines franchising provides the ability to develop the network of regional flights without substantial investments to form the special regional small capacity aircraft fleet, flights licensing, infrastructure creation and development in the local airport. But the main advantage for a franchiser is that a franchisee replenishes franchiser's hubs bringing passengers to the connection flights. Additionally the activity based on the franchising scheme can assist a franchiser to avoid conflicts with antimonopoly committee in the issue of the airport slots due to the independency of the company-franchisee.

In a number of cases the franchising becomes the consistent continuation of the cooperation of large and small airlines that assists to improve the company's image and to increase the passenger flow. A franchisee safes its own independence regarding the organizational structure and management and actually never is the ownership of a franchiser.

Using the franchising scheme is a creative method to make the company reorganization in the case of occurring the necessity to remove particular departments from the main structure because of the financial problems, ownership conflicts and other, without disturbing neither the outside image nor the tailored functional scheme of a air transportation company.

The situation when the "young" airline that does not have sufficient funds for the development of the own trade mark and marketing policy or the regional air carrier that has temporary production and financial difficulties resorts to the international famous air carrier for franchise is considered closer to the classical franchising relations. It is necessary to mention that franchise is not the yoke for life: For one thing; franchising relations could be canceled on the both sides agreement, secondly, franchise is not

spread to all flights of the regional air carrier. Many regional air carriers using the franchise of the national airlines can conclude a partner agreement with other airlines.

As any theory and its practical application the usage of the methods and principles of franchising in aviation has supporters and opponents though for the Ukrainian air transportation market franchising is a quite perspective functional scheme.

Due to the European Association of Air Carriers data the air transportation is an only market segment in aviation business that is distinguished with the growth rate and naturally it is a subject for the high level of rivalry. One of the ways to breathe life into the regional airlines market is to collect the most decent aircrafts and crews and integrate them into the distribution system of the large air carrier providing with the needed connections. Taking into consideration today's crisis economic and financial situation such regional airline can not insure the significant earnings to its central colleagues, but it will provide with the additional passenger inflow to their flights. Therefore the regional small companies can flight under the flag of the leading Ukrainian air carriers.

The airline company can sell franchise not only to air carriers but also to transport companies which collect passengers to its flights or transfer them from one airport to other, as well as other enterprises of the ground services.

The foreign airlines could also take the Ukrainian franchise to create the own routes at the Ukrainian air transportation market. In this case the local company – carrier does not need the advanced aircraft fleet, while the foreign airline decides the issue of licensing flights on the territory of Ukraine. Unfortunately, the foreign airlines do not actively interested in such forms of activity in Ukraine so far and do not place their franchisee to the Ukrainian internal regional flights.

Franchising in aviation like in other branches of economy has an additional advantage as a management system that speaks for benefit of franchising – it's rather simple to obtain credit against the well promoted trade mark, particularly foreign, than against unknown regional airline.

The integration based on the franchising methods is successful when the franchiser possesses the exceptional patented technology or well known brand, which it is rather difficult to duplicate by competitors. There is no reason for franchisee to purchase a new business if it does not obtain profit for at least several years. Therewith new markets will successfully develop and grow if a new product is differentiated and has evident advantages against the similar products that either have been already offered or can appear in the market soon.

The choice of the integration strategy is conditioned by the analysis of its weak and strong sides. The selection of the integration direction and scale depends on the answers to the following questions:

- ... Is the integration able to improve the strategically important sectors of the company's operations in direction of costs reducing and differentiation increasing?
- ... How does the integration influence the flexibility and responsiveness of feed back, as well as administration expenses connected with coordination of the work of all links of the integrated chain?
- ... Is the integration able to create the competitive advantage?

The integration can provide airlines with the strategic benefits such as economy on integration, economy in the sphere of internal control and coordination, economy in the sphere of information, economy due to stability of connections, economy due to influence of the technological factor.

The economy on integration is the benefit connected with the reduction of different kinds of costs by mean of joint execution of production functions, sales, purchase functions, management and others.

The economy in the sphere of internal control and coordination due to the integration assumes the decrease of the expenses on scheduling, coordination of operations, elimination of consequences of emergency situations.

The economy in the sphere of information can cut the need to collect the market information or reduce expenses for its acquisition due to the integration of operations.

The economy due to stability of connections is based on the awareness that the sale and purchase links are defensive, steady and firm that allow structural department to develop more effective and special procedures of interrelationship.

The efficiency of integration due to influence of the technological factor is conditioned by enlarging of technological capability. The integration intensifies the technological knowledge that has the significant value for the success of the main business and good company's performance.

Conclusions.

As a conclusion it should be mentioned that the Ukrainian market of local air transportation needs to be restructured and reorganized by large national and/or foreign airlines probably by mean of construction of the vertically integrated system with the franchising schemes application.

The forming of the integrated aviation networks on the base of airlines of the national level with involving the Ukrainian airlines of the regional level can effectively assist to solve the topical problem of existing underdevelopment of the market of internal local air transportation.

The integration possesses the definite benefits that can provide airlines of different levels with significant competitive advantages and strong market position.

References

1. *Erwin J. Keup* Franchise Bible: How to Buy a Franchise or Franchise Your Own Business. The Oasis Press/PSI Researche Grants Pass, Oregon, Second edition, 1994. - 272 p.
2. *Joseph P. Guiltinan, Gordon W.* Paul Marketing management. Strategies and Programs. Mcgraw-Hill Book Company, USA, Third edition, 1988. – 426 p.
3. *Kole S. and Lehn K.* Workforce integration and the dissipation of value in mergers: the case ot the U.S. Airline industry, FR Working Paper Series, University of Rochester, 1997.
4. *Дементьев В.Е.* Интеграция предприятий и экономическое развитие. ПредпринтЦЭМИ,М., 1998.
5. *Ф. Котлер* Маркетинг менеджмент. Питер, Санкт-Петербург, 2005. – 797 с.
6. *Мендельсон М.* Руководство по франчайзингу. Пер. с англ. - М., 1995. - 176 с.
7. *Цірат Г.* Виникнення та розвиток франчайзингу // Підприємництво, господарство і право. – 2002. - № 10. – С. 127-129.
8. Формування франчайзингових відносин в Україні // Звіт по дослідженню, проведеному на замовлення проекту BIZPRO (USAID).

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TRENDS OF AVIATION SECTOR DEVELOPMENT

In the article main trends in aviation industry are defined, latest data on volumes of world air traffic is analyzed; activity of domestic aviation companies with regard to development priorities is studied.

Aviation industry is represented by all types of businesses, organizations and institutions that are aimed at creating conditions for utilization of airspace by the man with the aircraft. Air transport is an innovative industry that promotes economic and social development and strengthens connections between developed countries and developing countries. It brings together people, countries and cultures, provides access to global markets and is a factor of development in trade and tourism. Aviation is able to provide business and tourism with characteristic global network of high-speed traffic; it plays a significant role in promoting economic growth in developing countries.

Global world trends that shape the look of air transport at this time and in the future which is impossible without taking into account the success of any airline need to be outlined. In the last two decades such trends as liberalization of air transport, privatization of state airlines, appearance of mega-carriers, and intensification of competition are determined. Among other trends in global air transport market should be noted following:

- Active implementation in many countries deregulation and liberalization policies in domestic and foreign airlines;
- Consolidation and integration of companies;
- Development of computer reservation systems;
- Creation of new principles of financing aircraft deliveries;
- Privatization of airlines;
- Introduction of strict regulations on the noise of aircraft engines;
- Increase the role of IATA and change of its strategy;
- Rapid growth of express freight transportation of small shipments.

Trend towards active creating of strategic alliances is observed in development of aviation in the global market. With alliances airlines try to secure more stable and foreseeable conditions in airline market that are primarily in more effective use of aircraft, route network expansion, transfer of technology, knowledge and know-how, holding joint research, personnel training.

Significant progress in the development of civil aviation in the EU in recent years is associated with the development of accident prevention and its prerequisites. This is primarily founding of European Aviation Safety Agency (EASA) and introducing of uniform rules in civil aviation sector.

But now unfortunately air transportation industry is experiencing worldwide the worst times. The global financial crisis has touched all spheres of social production and aviation sector is undergoing through appreciable losses in two directions at once: passenger and freight transportation. The scale of decline world aviation is experiencing now for the recognition of experts can not be compared with anything in the past. It reflects an unprecedented reduction in global production and trade at the end of 2008. Reduction of economic activity in most countries by 15-30 % is in the last 40 years is the highest and recalls the 1930's decline [2]. Losses of carriers at the beginning of 2009 reached 4.7 billion dollars instead of projected 2.5 billions at the end of 2008.

The volume of international and domestic traffic in 2009 decreased by 3.9% and 1.8% respectively. General domestic and international air travel suffered in all regions, except Middle East where carriers announced 10 % growth. The double-digit domestic passenger traffic growth in the emerging markets of Asia and Latin America, and the relative strong performance of Low Cost Carriers (LCCs) in North America, Europe and Asia Pacific, helped curtail the severity of the

decline in total traffic. Capacity offered by airlines, expressed in available seat kilometres (ASKs), declined by 3.1%, in response to the declining traffic.

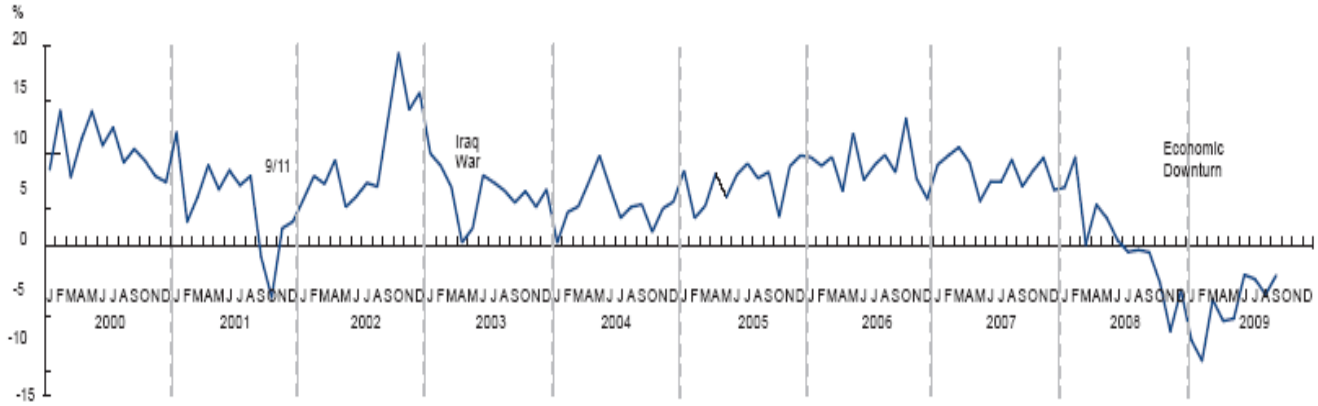

Fig. 1. Airline scheduled passenger growth 2000-2009

(Source: ERA)

In line with the improving economic situation in many parts of the world, a moderate recovery is expected for 2010 with a 3.3 percent traffic growth forecast. The momentum is expected to continue in 2011, on the way to full recovery and traditional growth trends of 5.5 percent per year.

The effect of the worldwide recession is again evident from the third quarter of 2008 continuing throughout 2009 where growths in scheduled passenger numbers have significantly slowed. Scheduled passenger growth was reported to be -6.1 percent for the first nine months of 2009. Scheduled hours and landings decreased by 9.8% and 8.6% respectively for first 9 months of 2009.

In 2009, cargo traffic plummeted by 15 percent in terms of total freight tonne-kilometres (FTK) compared to 2008, significantly worse than the 6.2 percent drop in 2001. The magnitude of the change is also indicative of the huge decrease in world trade volumes in 2009 due to the global economic downturn. The cargo traffic of Asia Pacific carriers, which accounts for some 36% of global FTKs, declined by around 14 percent, while traffic of European and North American carriers that each account for 25% share of global FTKs dropped by some 18% and 17% respectively.

As for Ukrainian air transportation market by the end 2009 it has fallen by 16.99% to 5.13 million passengers. The greatest economic impact on the market situation was made namely by such factors as fall of income of population, rising dollar, increased lending rates and devaluation of hryvna, at the end of the year there added difficult weather conditions and complex epidemiological situation. During January-April 2010 passenger transport services used 1.3 million of passengers, passenger work in the amount of 2445.7 mln. passenger-km was made that accounts for 107.6% and 108.0% of the volume in January-April 2009. Statistics from the first quarter of 2010 demonstrates keeping of air transportation market at the level of previous year.

Processes of economic liberalization and globalization have caused drastic changes in activity of commercial air transport. Privatization and commercialization of airlines, airports and suppliers of air navigation services is part of a broader trend connected with globalization and liberalization in all economic sectors by reducing or termination of state participation in ownership and management of state businesses. State's role in regulation of airlines is changing.

Overall as of 2009 the work of the aviation industry is provided by 74 airlines of different patterns of ownership, 41 airport and aerodrome, PE SAT "Ukraerorukh" that manages ir traffic in the area under Ukraine responsibility, and also range of several other specialized companies.

As a product offered by airlines in the market is serving production made in the process of air transportation of passengers and cargo. Along with this airlines offer a wide range of services that accompany air transportation process. Due to this amount of supply can be estimated as a carrying capacity of aircraft park operated by airlines on a commercial basis.

Market leaders in passenger traffic during long term remain Aerosvit Airlines, Ukraine International Airlines, Donbassaero, DniproAvia - they perform about 90% of the national transportation.

Ukraine presently has the largest network of airports that are located throughout its territory according to the existing structure of the productive forces and regional needs of strengthening international connections with other countries. Operation strategy of airports of Ukraine is aimed at achieving five key strategic objectives: quality, profitability, self-financing, marketing, airport's powerful place in the economy. The basis of marketing policy is attraction of new airlines, essential extension and activation of operations in non-aviation area, creation of high international image and prestige. Special features of process of preparing aircraft flights are their performing in a limited time with maximum safety and quality. Selective forecast of departures for 2010, 2015 and 2020 years as is represented in chart 1.

Chart 1.

Take offs and landings for period 2004-2007 and forecast till 2020 for main strategic airports of Ukraine (selectively)

Airport	Type of activity	Years						
		2004	2005	2006	2007	2010	2015	2020
Boryspil	Take off -landind amount per year	58379	67146	79084	78600	113385	179303	259990
Kharkov	Take off -landind amount per year	4596	4834	7070	8563	10870	27024	54499
Lviv	Take off -landind amount per year	5513	6643	7640	8625	11778	23778	38222

Now preparation of airports included in State program of preparation and holding in Ukraine the final part championship Euro 2012 is going on. In the Stabilization Fund in 2009 for building, reconstruction and repairing of airports in state and municipal property under the state target program was provided 978.2 million hrn. At a time works were actually financed on 253.9 million hrn. In Kharkiv project title and summary of aerodrome Kharkiv (Basis) was approved, construction and installation of new roof is already made, works of developing the interior design of terminal are going on. By arrangement of Cabinet of Ministers of Ukraine projects and reconstruction titles of aerodrome and new air terminal complex PE "International Airport "Lviv" were approved. Runway of airport Kyiv is reconstructed for taking aircraft type Aerobus A-320 and Boeing 737. In March 2009 for the first time in the history of the airport multi-seat plane Airbus A-320 performed landing.

Boryspil International Airport is the largest airport in Ukraine having priority importance for the city as it is capital of Ukraine is the most optimal air transport hub. Airport Boryspil offers different economic sectors an opportunity to develop, in-sample such as tourism. Strategic objectives of airport are: keeping of international leading position of the main international airport of Ukraine, constant increase of transit through airport, stable growth of range and quality of services for passengers. In the public enterprise "International Airport Boryspil" are implemented measures for reconstruction of Terminal B, construction with means of Japanese credit of a new passenger terminal "D", expansion of existing platforms, construction of parking lots, and extension of driveway. Construction works on the platform "Hall of official delegations" are completed. By arrangement of the Government from 24.06.2009 № 718-p project and the title of the passenger terminal building "F" are approved, works of building the upper layer of concrete covering the PC-1 PC-2 are held. Realization of joint project with the Bank for "Development of Public international airport Boryspil" is made. Total cost of the project is $380 millions, including loan of JBIC reaching $171.74 million. Customer (PE "Boryspil International Airport") held a tender and identified the general contractor of works - Turkish company (DAY-SP) with which in September 2008 a contract for construction work in the amount of $380 millions was signed. Customer received permission for the construction, signed act of transfer of building platform; further works on its resettlement and making utilities are going on. Works on arranging building foundations are made by contractor. At the 01.10.2009 loan funds in the amount of $67.6 million were already used.

Ukraine has complete and exclusive sovereignty over the airspace of Ukraine. Airspace system is one of the systems or air traffic control. Ukraerorukh is responsible for authorizing entry of aircraft in the area of its responsibility. On basis of intensity of air traffic on the track and air conditions in the airport area, time interval for the aircraft coming can be set. In this case not only coordination between interacting bodies is needed but also coordination with relevant airport complex. Functioning of PE Ukraerorukh is based on next main principles of air traffic services processes:

- Continuity of controlling of each aircraft;
- Creating the most simple scheme of interaction between the control room managing aviation of various departments;
- Listing manager's opportunities in performing functional tasks;
- Rational use of radio navigation facilities.

Enterprise Ukraerorukh enabled receiving and transmitting radio aviation center in Simferopol. New facilities will improve significantly reliability and quality of air traffic services.

In June 2009 at first in Ukraine Centralized meteorological support system of air navigation was set on the run. With the introduction of this system differences between national and international practice of meteorological support are minimized. With the introduction of system problem of operative delivery of true and accurate meteorological information at working places of air traffic controllers in all regional centers of Ukraine in real time and standard formats and protocols that are used worldwide is resolved.

Conclusions

Ukraine's integration to Europe without development of the aviation industry is impossible. Worldwide air transport is becoming increasingly important in development of foreign economic relations. It is expected that passenger transport decreased in 2009 for 2.9% will increase in 2010 to 5.6% and the overall number of passengers will grow to 2.33 billion people. Recently IATA has twice lowered losses forecast for year 2010: instead $5.6 billion forecasted in December 2009 losses must account for $2.8 billions. Total income of airlines is expected to rise to $522 billions in 2010 – it is $43 billion more than in 2009.

On the background of this trends work towards standardization and unification of the Ukrainian aviation industry standards according to European legislation continues. To harmonize norms with modern standards of normative-legal acts of the European Union changes are made to the Regulation of use of Ukrainian airspace. Transport Ministry developed and Government approved Program of development of state system of airspace usage of Ukraine for 2010 - 2014 years. In aviation sub-sector under the concept of a State program of airport development in 2020 works of developing this program are continuing.

To increase flights safety by arrangement of Cabinet of Ministers of Ukraine from 05.03.09 № 273-r concept of State target program of flights safety for 2009-2015 years was approved.

Measures aimed at improving environmental performance are ongoing, permanent work on improving aviation engines is continued, strict control over harmful emission and noise level is set, especially at takeoff and landing modes.

References

1. ERA Yearbook – 2010 [Electronic recourse]. – Access mode: http://www.eraa.org/publications/yearbook
2. IATA annual report 2009 [Electronic recourse]. – Access mode: http://www.iata.org/pressroom/Documents/IATAAnnualReport2009.pdf
3. The economic and social benefits of air transport 2008 [Electronic recourse]. – Access mode: www.atag.com
4. Ukrainian aviation portal – the official web-site: http://aviation.com.ua/
5. The State Aviation Administration of the Ministry of Transport and Communications of Ukraine – the official web-site: http://www.avia.gov.ua/eng/index.htm

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MARKETING RESEARCH IN THE MARKET OF REPAIR AIRPORTS INTRODUCTION

This article describes a study on the reconstruction of airports market to the Euro - 2012. The above problems and proposals take into account logistical, historical and geographical and politico-economic characteristic of Ukraine. Marketing strategies, best adapted for use in the field of air transport.

In 2010, in preparation for the transport industry for the Euro-2012 from the state budget at airports will be allocated 5 billion 101 million 500 thousand UAH. Such costs are defined in the new edition of State program of preparation and holding in Ukraine the final part of the European Championship-2012, approved 14 April 2010.

"Infrastructure development leading domestic airports and increase their capacity - one of the main tasks of the Ministry of Transport and Communications, and a strong incentive to do so is to hold the championship Euro-2012 in Ukraine.

The growing commercial progress increase in demand for air transport. Higher commercial activity country, the greater the volume of air traffic. Increased international tourism feeds demand for international air transport. The higher the tourist activity, the greater the demand for air travel and air transport.

The devaluation of local currency means increase the value of foreign currency. Thus, lower prices for foreign countries, and it attracts tourists from abroad. The rise in prices in foreign countries has contributed to growth in domestic tourism and reduce foreign tourism.

Problem definition. A fundamental element of marketing is market research - in order that organizations can have a thorough understanding of the characteristics and needs of their market. Most research will cover two areas, namely market characteristics in terms of market size, share, segmentation, and trends, and the more subjective area of passenger satisfaction. The quality of service paper has already considered passenger satisfaction and so the emphasis of the discussion here is very much on the first area.

Solving of problem. Information about passengers can be collected from a number of different sources. Passenger surveys at the airport arc the most common but surveys or group interviews at home or at work arc also possible. Views about current services and particularly any underserved destinations can be gleaned from organizations such as travel agents, local businesses, and freight forwarders. Most major airports will carry out periodic surveys of their passengers to find out details such as origin and destination, age, sex. socio-economic group, flying frequency, and so on. These surveys may be tied in with the quality surveys so that correlations between passenger profile* and levels of satisfaction can he made. In some countries, surveys may be undertaken by the national civil aviation authorities or government transport departments instead of, or in addition, to those earned out by the airport operators. For example, in the United Kingdom, the CAA regularly surveys passengers at all main airports. This has the advantage in producing survey data that are directly comparable for different

The process of airport planning requires a large number of forecasts to be made. Most attention is given to the prediction of passenger and freight traffic It is, however, also necessary to attempt to predict likely changes in aircraft and airport technology, productivity in passenger and freight handing, choice of access modes, number of airport workers, and the number of meters and greeters' per passenger. Also the airport planer is not alone within the air transport system in needing forecasts. The airlines, the manufacturers, the sub-system suppliers and the national transport planning authorities all need forecasts of air transport activity.

The most fundamental forecasts are those for the gross annual throughout of passengers and freight for the system under consideration. This estimates to be made of the necessary scale of the system, its impact and, in gross terms, its financial viability.

For the detailed planning and design purposes, the most crucial parameters are the flows of passenger, cargo and aircraft in the design hour, where the latter will normally be somewhat below peak hour flows, reflecting some acceptable level of delay or congestion in the system during the worst peaks. The passengers terminal layout and scale, and the revenue generation from load factors. A similar method with definition parameters is usually adopted for cargo terminals, a most important parameters here being the proportion of belly hold to all-freight cargo.

The market for airport services. The focal point of any marketing system is always the consumer of the services. For the airport product, demand comes from a variety of markets each with (heir own specific requirements. From a marketing perspective, it is useful to divide this demand into two, namely the trade such as airlines who buy the airport facilities direct and the general public or travelers who merely consume or utilize the airport product. The marketing techniques used for these two types are very different. Most airports would probably agree that both airlines and passengers are key customers, whereas airlines tend to think of passengers as their customers and them-selves as customer* of the airports.

In addition, there arc the other market segments such as local residents and businesses whose needs must also be met Obviously these types of demand do not impact directly on the amount of aeronautical revenue and traffic throughput m an airport but their presence at the airport can have a significant impact on the level of no n-aeronautical revenue. They con also help airports in acting as a catalyst for economic development. Concessionaires, tenants, and other organizations such as handling agents can also be considered customers of the airport. Table 7.3 shows some of the major market segments at an airport. Each of these needs to be further subdivided into much smaller discreet segments in order that they can be targeted appropriately and so that the airport's marketing efforts can be the most effective. A common way lo segment demand is by airline product type. For example, with passenger travel this would include a full-cost traditional service, a low-cost service. And a charter service. Airline alliances could well be given special consideration. In the cargo area, the market may be segmented into integrators, cargo airlines, passenger airlines, and other freight companies.

It is difficult to apply this marketing concept to the airport sector because of the composite nature of the airport product. From a passenger viewpoint, the airport product includes the airline product as well as the product of the concessionaire, handling agent, and so on. Another way of looking at the airport product is by considering its 'raw[1] and 'refined* features The raw product consists of both physical tangible elements (such as the runway, buildings, apron, lighting, navigation aids, fire, and rescue) and intangible service elements provided by the airport operator's own staff and those: of the customs, immigration, and security agencies. To produce the refined product involves adding the services provided by concession-aires and other tenants and the air travel elements, both tangible and intangible, provided by the airlines

A Creative Marketing Approach for the Airport Enterprise

Turbulent competitive dynamics in the airport business are forcing all players to reengineer their strategies as the only way to maintain long-term viability- Start-up of greenfield airports or the conversion of former military ones; deregulation processes in former monopoly 'cash-cows', like ground handling; growing competitive pressures from the likes of high-speed trains as well as videoconferencing; all of these combined elements mean that today market-based ingenuity has become crucial for airport enterprises. The adoption of a 'customer-centred' approach is capable of creating more satisfied customers which may be considered an effective basis to counteract both intra-industry and inter-value chain attacks.

This, however, does not mean that airports on a widespread basis are actually adopting a full-scale, marketing-based approach to manage their intermediate and final relationships. Most of the time, in fact, airports remain passive in both negotiations and market interactions with their target audiences, this position being a direct consequence of the historic lack of managerial know-how. What airports need today, is a cultural change in management practices, to move airport managers away from the pure exploitation of natural-monopoly rents towards a proactive view able to construct a solid competitive advantage in a turbulent scenario.

One of the main pillars of this new approach lies naturally in the planning of all strategic and operational duties to be implemented. Dealing specifically with marketing, the definition of an airport marketing plan is a fundamental step for establishing new rules of conduct and later implementing them in a consistent way.

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FOREIGN INVESTMENTS IN UKRAINE: PROBLEMS AND SOLUTIONS

The article provides a complex research of the main problems of foreign investments in Ukraine and is devoted to give the suggestions how to solve the problems involved in attracting investment to Ukraine. The authors were trying to represent the investment climate in Ukraine, investigate the role of the government and define the forms of key solutions.

Introduction. Ukraine possesses a strong potential for attracting essential amounts of foreign investments due to its advantageous geographical location, large market with numerous free 'niches', rich natural resources, powerful manufacturing base, cheap and well-educated labor force, and other important factors.

Ukraine's outstanding potential and its positive political image in the world make it one of the most attractive targets in the region, and many potential foreign investors express their readiness to start co-operation with Ukrainian partners as soon as favorable conditions are created for this.

However, the amounts of foreign investment in Ukraine remain at a very low level and are inadequate to facilitate the country's vigorous economic development. Such a situation has been caused by a number of factors that not only defer the investment processes in Ukraine, but also affect its general economic development.

Today, the quality of investment policy affects many things: industrial output, the condition and technical level of fixed assets at Ukrainian enterprises, the options for restructuring the economy, and the solutions to social and environmental problems. Investment is the basis for developing individual businesses, specific sectors and the economy as a whole. The modern economic environment demands an active policy for attracting foreign direct investment.

The aims of the article is to focus on the problems involved in attracting investment to Ukraine and give some suggestions for how to solve them.

Results. In broad terms, investment is the foundation of a modern economy: it brings together the interests and resources of private individuals, legal entities and the state to generate real socio-economic development. Global experience shows that transition economies are not capable of developing their economies properly without attracting and effectively using investment, including foreign investment. By accumulating business, public and mixed capital and providing access to modern technologies and management, investments not only help form national investment markets, but also bring new life to markets for goods and services. In addition, investments generally support efforts at macroeconomic stabilization and make it possible to ease social pressures during the transformation period.

Ukraine could potentially become one of the leading countries in terms of direct and portfolio foreign investment. This is supported by Ukraine's large domestic market, comparatively skilled yet inexpensive labor, major scientific and technological potential, abundant natural resources, and its available, if underdeveloped, infrastructure. Yet, private domestic and foreign capital investment is hampered by political instability, inflation, ambiguous legislation, under developed industrial and social infrastructure, and inadequate information flows. The interconnectedness of these problems reinforces their negative impact on the country's investment appeal.

The Government's immediate objective must be to stimulate investment and to spur significant growth in investment volumes. Increasing investment flows was and continues to be a priority for executive bodies.

To spur investment, including foreign investment, a number of measures need to be taken at the national level:

- Reduce the level of state regulation of commercial activity and ensure the stability of relevant legislation;

- Eliminate ambiguities in legislation and regulations and finish judicial reform;
- Improve regulations regarding the exercise of property rights;
- Complete administrative reform, make the policy-making process both public and transparent, and, hence, eliminate red tape and corruption;
- Institute effective corporate governance;
- Foster the development of capital markets, first of all the banking sector and the stock and insurance markets;
- Reduce tax pressure;
- Ensure a stable political environment;
- Increase efforts to establish a positive image for Ukraine.

The key policy objective regarding investment is to establish equal conditions for doing business and investing in Ukraine's economy for business entities of various forms of ownership, to ensure that investment happens in a transparent and civilized manner, and to improve the distribution of investment sources. Government policy should concentrate on:

- Instituting open consultations between executive bodies and business, and disseminating information about the real economic situation, domestic and foreign markets, market prices, and regulations;
- Significantly reducing the share of the shadow economy;
- Establishing equal conditions for the activities of business regardless of their form of ownership or the origin of their capital;
- Forming a working competitive environment;
- Strengthening the stock market, developing vehicles for joint investment, insurance and pension funds, establishing a market for corporate securities and integrating it into international capital markets;
- Providing additional economic incentives to attract investment to priority sectors;
- Setting up an effective system for protecting intellectual property;
- Establishing conditions for the development of high technologies and the infrastructure for innovation;
- Developing and utilizing the country's investment potential;
- Establishing cooperation with key non-government and community organizations and institutions that are prepared to participate in formulating and implementing investment and innovation policy in Ukraine.

The key solutions to investment the problems are:

- Deregulating and liberalizing business activity and establishing a proper competitive environment: The country's economic policy must aim at establishing a favorable environment for the development of business, eliminating red tape and corruption, and reducing the shadow economy. This would, in turn, establish the conditions for: implementing a unified business regulation policy to achieve the optimal level of state regulation of commercial activity, defining the legal principles for state support for small enterprises, and regulating licensing procedures, revising legislation regulating business activity in specific sectors of the economy with the aim of increasing the effectiveness and competitiveness of businesses, improving and simplifying the system for registering a business, improving the procedure for launching investment projects, establishing a system for regulating inspections of commercial activity, introducing a mechanism for the seizure of property for violating contractual terms in the process of carrying out investment projects, agreeing trade and competition policy to ensure domestic businesses equal conditions when competing on external markets, expanding international cooperation in competition policy to prevent restrictions due to actions taken outside of the country's territory.
- Forming a legal base: One of the most important factors for improving Ukraine's investment climate is to establish a legal environment suitable to a market economy. This requires the state to take two key steps: conclude interstate agreements providing incentives, protecting investments and avoiding double taxation, exchange information about regulations and legislation

Definition of Goals

This second phase asks airport managers to explore, and later adopt, one of (he main available strategic marketing options, like:

- the Tight option*, that promises to increase an airport's market share;
- The 'retrench option', that works to protect the current market share in a highly turbulent environment;
- The 'streamlining option', that looks at divesting unprofitable **SBUs;**
- The 'abandon option', that sees a company exiting a current business.

1. This is always the preferred option by both airport managers and political stakeholders, as it is linked to positive and rather successful policies. This option seems, however, to require a high level of stability in both macro and micro scenario drivers. In fact, an airport's market growth is due not only to successful internal KPI (Key Performance Indicator), but also to both a growing primary demand and a stable competitive environment as well.

An airport management can determine the secondary task of reconstruction of airports through the bundle of operational activities::

- by fostering the effectiveness of actual market relationships with served customers. Improving their loyalty indexes will provide a good chance to make these players concentrate a larger slice of their activity on a single airport platform;
- by maximizing the quality of business development processes through the use of dedicated intelligence and IT supports. This could be the result of an excellent aviation-related marketing campaign, where the airport succeeds in attracting new airlines thanks to the scope of its value proposition in terms of information and marketing support packages;
- by diversifying the range of services offered and targeting both current and potential customers. In the case of current customers, providing extra retailing corners in the terminal building will be a good trick to improve both customer satisfaction and the length of time spent in the terminal building, with an associated effect on the average expenditure level. In the case of potential customers, a more radical innovation in the non-aviation activity, like the launch of discotheques and supermarkets, will attract new non-passenger cluster targets and extend the power of commercial influence.

Conclusions. A negative economic climate may require airports to take much more drastic decisions. One of these is the need to cut unprofitable business units as a means to rationalize the portfolio of offer and improve overall efficiency.

This activity is frequently implemented by giving away a slice of the current business to a third party concessionaire- In the case of aviation-related activities, this could involve the practice of outsourcing handling services and dismantling the internal production, while conserving the marketing-related activities concerning scouting for new carriers.

In the non-aviation business, airport managers could instead decide to give away to a third-party specialized concessionaire the management of properties to improve the market performance that may be gained from this business.

Airport passenger terminals have grown to be complex functional systems and monuments to modern technology and community pride. When it works well, the terminal is an efficient element of the local economy and the national transportation network. When it works badly, the terminal becomes a purgatory for its users and a disruption well beyond its boundaries. With commercial air travel in its second half-century, the future airport passenger terminal will be more than ever a vital link in one of the nation's most vital systems. This link must be kept strong as the nation builds and expands its future airport passenger terminals.

References

1. David Jarach, Airport Marketing (strategies to cope with the new millennium enviroment).

2. IATA, Airline marketing Handbook.

3. Air transportation , organization & market.

governing investment activity, and establish stable legislation and other conditions and expand cooperation with the International Monetary Fund, the World Bank and the EBRD regarding financial assistance to Ukraine and carry out the necessary measures to complete accession to the World Trade Organization.

- Reforming the tax system: The strategic goal of tax policy should be to form a stable tax system that brings in tax revenues sufficient for budgets at all levels, ensures the effective operation of the economy, and establishes the conditions for further integration into the global economy. This means that the main objectives of tax reform should be to: reduce tax pressure by cutting the number of taxes, mandatory fees, reducing payroll, tax pressure to enable the establishment of pay-as-you-go social funds and the switch to individualized programs, expand the tax base by canceling exemptions that are not directly related to innovation and investment, instituting a mechanism for taxpayers to declare tax deductions and exemptions, and introducing property tax, provide incentives for commercial innovation and investment and improve the terms of taxation to provide incentives for upgrading production facilities and developing small enterprises, raise the level of tax and fee collection, avoid double taxation of non-residents.
- Establishing transparent executive decision-making: The institution of transparent government procedures for making decisions related to investment projects financed by State and local Budgets and those investment projects that have vital significance for the general population must include: making decisions to hold public debate on draft regulations regarding developing business activity, setting up community councils and business councils under executive bodies, consulting with businesses, community organizations, academics, and other specialists to evaluate the effectiveness of existing regulations and participating in international events to promote Ukraine's investment potential, showcasing priority investment projects through the international media and the internet, holding exhibitions and similar events more frequently.
- Developing corporate governance: Corporate governance must be developed to improve the investment climate and make the operation of joint-stock company effective.
- Developing the stock market.
- Improving the privatization investment climate: Privatization policy should aim at: replacing the fiscal model of privatization with an investment and innovation model and privatizing large companies and monopolies based on individual plans by selling controlling stakes to industrial investors and re-equipping enterprises technically and technologically using part of the proceeds from privatization.
- Providing incentives for long-term lending: Improving the investment climate in Ukraine depends considerably on resolving problems with the way the banking system operates: increasing the concentration of banking capital, expanding long-term lending to the real sector of the economy, and attracting personal deposits.

Conclusions

As a country in transition, Ukraine is still in the process of creating a working enforcement system to support the investment legislation, and, in the course of carrying out this objective, faces a number of difficulties that are mainly inherited from the time when Ukraine was a part of the Soviet Union such as: unclear division of powers between legislative, executive and judicial branches, over centralized economy, bureaucracy, abuse of power by the governmental authorities, fear of foreign penetration into the country, etc.

All these, and other problems that slow down economic transformations in the country and deter foreign individuals and companies from investing into Ukraine show all the controversies the country experiences when switching to another economic system. On the example of Ukraine, it could be perfectly seen how ambiguous and unaccorded actions of different branches of power could completely block positive initiatives, if not reverse them.

Currently, the top priority of Ukraine's policy is to integrate all its forces and to elaborate a single strategy of reforms implementation on all levels and in all spheres of the country's life. Without a uniform approach towards the improvement of current economic, social and political

situation, it would be impossible for Ukraine to meet the challenges existing in the global environment, and to integrate into the international economic community.

Ukraine should become more open to an international business, since the penetration of foreign capital and intellectual property would not only revive the paralyzed industrial sector of the country and, thus, decrease the level of unemployment, but would rather help to create new resource saving industries based on the latest technological developments which would facilitate Ukraine's new birth as a technologically advanced state.

Foreign investors are waiting for the possibility to start exploring Ukraine's rich resources, and creating a favorable climate for that would give a rise to Ukraine's future prosperity.

Investment resources should grow with the effective use of public investment and increased long-term lending volumes for the real economy, at the same time as the possibilities of foreign investment are used in more traditional ways.

The institution of concessions should help attract investors to upgrading infrastructure, while investment in science, technology and innovations should generate new jobs.

Government support for high technologies and the development of an innovation infrastructure in the country should help attract investment into innovations and bring the treasury revenues from the use of this know-how. By implementing the strategy for long-term economic development, Ukraine should see State Budget and local budgets investments on industrial and social projects grow, while the specific volumes are determined at the appropriate level of government.

References

1. *State Agency for Investment and Innovation of Ukraine Main Department of the Civil Service of Ukraine* - Attracting Foreign Investment to Ukraine: Problems and solutions – international center for policy studies, 2001. – 24;

2. *Tegipko M.* Foreign Investments in Ukraine: Venture Factors and the Ways of Their Diminution - Financial Support of the North Atlantic Treaty Organisation, 1999. – 37;

3. *Губський Б.В.* Інвестиційні процеси в глобальному середовищі. К.: Видавництво „Наукова думка", 1998. – 390 с.;

4. *Майорова Т.В.* Інвестиційна діяльність: Навчальний посібник. – К.: „Центр навчальної літератури", 2004. – 376 с.;

5. *Пересада А.А.* Управління інвестиційним процесом. – К.: Лібра, 2002. – 472 с.

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TURKISH DOMESTIC AIRLINE MARKET OVERVIEW AND DYNAMICS

This paper aims to examine Turkish domestic airline market dynamics and transportation infrastructure. Short history of Turkish domestic market is identified and current market overview is analyzed. By following this analysis, threats and opportunities are pointed out for incumbents as well as new comers.

1. Introduction

Turkish domestic airline market was deregulated in 2003. This deregulation provided private airline companies to enter any domestic market. Prior to this, private airlines were doing only charter operations. Tax reduction was also provided and this caused a slight decrease at fares.

Since re-liberalization of domestic routes in 2003, Turkish domestic airline market has grown beyond expectations. This enormous growth reached nearly 80 million passenger traffic in 2009. Airlines operating in domestic routes have mixed operations (international, charter, and domestic) and fleets. They don't have unique airline model choices so far. Recent successes of LCCs and proven outcomes of regional airlines worldwide would attract new ones to enter the market or force incumbent airlines to look over their strategies.

2. Historical Background and Market Overview

After the first deregulation in 1983, a bunch of charter airlines appeared and most of them could not survive due to the numerous reasons. However, a few of them managed to survive until the second deregulation in 2003. There was a monopoly at domestic routes before re-deregulation. Turkish Airlines was flying in domestic routes originated from Istanbul and the capital city Ankara to Anatolian cities. Market was so weak and fares were high. After the re-deregulation two charter airlines entered the market and very early signals were very positive. Nevertheless, figures of 2004 and consecutive years were very promising and exciting. Nobody was expecting such a boost in domestic routes.

Today, there are six airlines operating in domestic routes and in addition a subsidiary company of Turkish Airlines. Each has different fleet and network structure. Some of them chose another base from Turkish Airlines. All airlines operating in domestic routes offer competitive fares including Turkish Airlines.

We cannot say that airlines operating in the Turkish domestic market compete directly with each other. Airlines have different network structures. To measure competition among these airlines we may simply look over the city pairs where they are operating between.

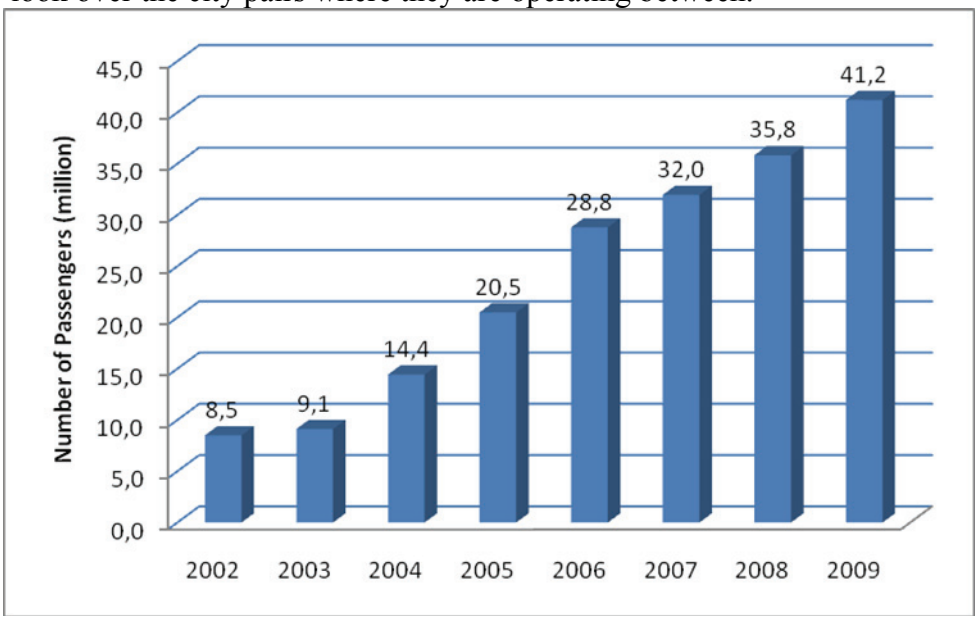

Figure 1. Turkish Domestic Passenger Market

Turkish Airlines

THY - Turkish Airlines, is the flag carrier of Turkey, It operates scheduled services to more than 120 international and 36 domestic cities, in Europe, Asia, Africa, and the Americas. Its hub is Istanbul Ataturk International Airport. The airline carries approximately 30 million passengers in a year. THY is planning to become the third largest airline in Europe in terms of total passengers carried. THY has been a member of the Star Alliance network since April 2008. It is also famous with the food service quality and one of the fastest growing airlines in the world.

THY enjoys becoming market leader at the most of the city pairs served at domestic routes. Other airlines has lots of difficulties entering THY's markets mainly because of Istanbul Ataturk Airport has full capacity and sharp competitiveness of THY. Thus, THY is very unique market position. Other strength stems from being the most reliable and well known airline by customer point of views and ease of international connections.

Anadolu Jet

AnadoluJet, as a trade mark of Turkish Airlines, has launched its first flight on April 23, 2008. Anadolujet flies from its hub Ankara, the capital city, to domestic and to some international destinations. Its philosophy is cutting extra costs and minimizing the return time between flights.

Lately, AnadoluJet added flights originated from Istanbul Sabiha Gokcen International Airport. Its fleet is growing with low-cost version of Boeing 737-800's and 737-700's. Mainly offers promotional low-fares. As a consequence, AnadoluJet created itself unique market and has become one of the most ambitious and mighty domestic carriers in Turkey.

SunExpress

SunExpress was founded in 1989 as a subsidiary company of Turkish Airlines and Lufthansa. SunExpress has charter, international and domestic scheduled operations.

All domestic flights originated from Istanbul Sabiha Gökcen Airport, Izmir and Antalya to certain cities of Turkey. SunExpress has a standardized fleet structure and do not have flights exactly the same city pairs whose Turkish Airlines and AnadoluJet serve. By doing so, it is a direct competitor with Pegasus Airlines.

Pegasus Airlines

Pegasus Airlines was established in 1990 as a private charter airline. Pegasus, after its ownership was exchanged, started its scheduled domestic flights on November 2005. Low-cost airline business model was adapted and chose a secondary airport as Istanbul Sabiha Gokcen International Airport. It has also scheduled international flights as well as some charter operations. It has also bought the shares of Izmir based small airline and added Izmir originated flights to its network. Leading tourism city Antalya is also added to its network coverage.

Pegasus offers promotional fares and considers quality and customer satisfaction with its high on-time performance. It is a popular airline and uses mass advertisement. It seems a tough competitor of domestic airlines and has a bright future with its growing figures and fleet as well as popularity.

Onur Airlines

Onur Air, has operated since 1992 as a charter airline and has been running domestic scheduled flights since 2003. It has flights to 72 destinations in 15 countries in international lines, and to 10 destinations in domestic lines.

Its domestic flights originated form Istanbul Ataturk Airport. This makes Onur Airlines directly competing with Turkish Airlines and with having no unique city-pairs served.

Atlas Jet

Atlasjet was established in 2001 as a charter airline. Today, it has international charter operations, scheduled services to Turkish Republic of Northern Cyprus and 5 domestic flights originated from Istanbul Ataturk Airport. Except Northern Cyprus flights it has no unique city-pairs served.

BoraJet

BoraJet was established on April 2010 as a first regional airline of Turkey. It has 4 ATR72 aircraft and started to connect small cities to main cities of Turkey. It has also point to point

services between certain cities. Its philosophy is performing short distance flights previously unattended routes with affordable prices.

Therefore, it has many unique city-pairs and becomes the only carrier serves certain cities. Especially cities that have small runways and weak demands are the target of this airline. It is a new airline and it is very early to talk about its success or failure.

3. Strategies of Domestic Carriers

Carriers operating in domestic routes have been some difficulties adopting operational and managerial strategies of scheduled airlines as they were charter airlines prior to re-deregulation. Some of them are still having charter operations. However, they have been pushing hard to transform as a scheduled domestic carrier. Most of them have been trying to offer best fares in order to be more competitive and to gain more market share. Hence, they have tried to adopt some low-cost strategies. They also invest information technologies to reach customers in the web environment and to implement some yield management strategies.

Routes and airports

Turkey is a big and roughly rectangular country; it extends east-west direction more than 1600 kilometers and from north to south approximately 800 kilometers. Half of its area is higher than 1000 meters and mountain ranges extend parallel to north and south coasts. These geographical factors show that available highways and railways do not provide fast traveling and clearly indicate the need for air transportation. Airlines connect mostly eastern cities to Istanbul, Ankara and Izmir. Also tourism regions at the southern costs attract domestic passengers from all around the country.

Other than main routes originated from Istanbul, Ankara, Izmir and Antalya recently some carriers started to fly between other city pairs those are not served before. They are trying to avoid direct competition and tend to create new markets.

Table 1. Domestic Operations Summary of Airlines

Name	Hub	Number of city pairs served	Number of unique city pairs served
Turkish Airlines	Istanbul Ataturk	36	26
Anadolu Jet	Ankara	31	21
SunExpress	Antalya-Izmir-Istanbul Sabiha Gokcen	33	14
Pegasus	Istanbul Sabiha Gokcen-Izmir-Antalya	34	12
Onur Air	Istanbul Ataturk	10	-
AtlasJet	Istanbul Ataturk	5	-
BoraJet	Ankara-Bursa-Istanbul Sabiha Gokcen	33	24

As it has seen at the table Turkish Airlines dominates the flights originated from Istanbul Ataturk airport. Thus, Onur Air and AtlasJet do not serve any unique city pairs and those carriers strongly face to Turkish Airlines' competition. When it is analyzed city pairs served by Pegasus and SunExpress it is clearly seen that these two carriers are competing each other. Almost one third of their flights are towards cities where others do not serve. AnadoluJet and BoraJet is the exceptional one here. Both have many unique city pairs. AnadoluJet enjoys having many unique city pairs because of choosing Ankara, the capital city, as its hub.

Fleet composition

They all have mixed fleet composition caused by having mixed type of operations. However, they tend to use same type of aircraft for domestic operations. For instance, Onur Air flies with its MD83/88's in domestic routes while Sunexpress flies its 737-800's. On the other hand, Pegasus Airlines tends to acquire only Boeing 737 series and tries to keep fleet uniformity.

Table 2. Fleet Composition of Airlines

Turkish Airlines	9 A-340 7 A-330 4 A-310 21 A-321 25 A-320

	4 A-319 4 B-777-300 52 B-737-800 13 B-737-700 4 B-737-400 **143 Total**
Anadolu Jet	10 B-737-800 10 B-737-700 **20 Total**
SunExpress	24 B-737-800 3 B-757-200 **27 Total**
Pegasus	22 B-737-800 2 B-737-400 3 B-737-500 2 A-320 3 A-319 **30 Total**
Onur Air	3 A-330 9 A-321 7 A-320 6 A-300 5 MD-83/88 **30 Total**
AtlasJet	3 A-330 6 A-321 2 A-320 4 B-757-200 **15 Total**
BoraJet	4 ATR72-500

Fares and marketing

All market players including Turkish Airlines have simple fare structures. However, they all use revenue management systems. They offer fairly low prices in order to attract airline passengers previously have not flied especially for new city pairs. In addition, for all city pair markets most of them offer promotional fares.

Domestic passengers seem to like FFP's and after a few successful trials almost all of them are using such programs. They have agreements with some credit card companies and banks. Card holders can earn miles when they purchase air tickets and in some conditions accommodation and car rentals even supermarket expenditures.

Online ticket sales are used by all airlines. Most of them have also online check-in systems. Almost all airlines use advertisement and city billboards to reach both existing and new customers.

4. Conclusion

As it is seen at the figures, Turkish domestic market has been growing enormously and this attracts newcomer airlines. The market continues growing and new flights are added steadily. Although new city-pair markets are created last years it seems there is still potential market for airlines and especially for regional newcomers.

Carriers such as AtlasJet, Onur, Pegasus and SunExpress have also international routes as well as charter operations at the same time. None of them are not exactly low-cost carriers. However, they all seem to use similar strategies of low-cost carriers. Generally speaking, they offer low prices compared to Turkish Airlines; they use internet distribution channel; they pay low wages to their employees; they use one class configuration aircraft; they offer no-frills or just a few snacks.

Until the beginning of this year there has not been a regional airline in Turkey. BoraJet is the only regional airline for last decades. BoraJet connects many cities previously having no air services by any airline.

As a consequence, Turkish Airlines with its subsidiaries AnadoluJet and SunExpress is very strong in domestic routes and replied to strongest competitor Pegasus with its successful subsidiary SunExpress. Onur Air and AtlasJet are relatively weak competitors. A very new-comer regional airline BoraJet entered many city-pair markets and it is difficult to say something about it before seeing first signals of its success or failure.

References

Lijesen Mark G., Nijkamp Peter and Rietveld Piet. "Measuring competition in civil aviation", Journal of Air Transport Management, 8, 2002.

Forsyth, Peter. "Low-cost carriers in Australia:experiences and impacts", Journal of Air Transport Management, 9, 2003.

http://www.shgm.gov.tr

http://www.dhmi.gov.tr

http://www.turkishairlines.com

http://www.flypgs.com

http://www.anadolujet.com

http://www.atlasjet.com

http://www.onurair.com.tr

http://www.borajet.com.tr

http://www.sunexpress.com

http://www.sabihagokcen.aero

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THE CONCEPT OF MANAGEMENT OF ECONOMIC SAFETY OF THE ENTERPRISE IN THE GLOBAL INFORMATION FIELD

In article questions of management by economic safety of the enterprise in the conditions of high dynamism and uncertainty of the surrounding social and economic environment are considered. The analysis of influence of globalisation, information and virtuality on economic safety of the enterprise is carried out

Problem statement. Activity of the modern enterprises passes in conditions of high dynamism and uncertainty of the surrounding social and economic environment. The majority of changes occurs at the expense of a new information technology with which help there is possible a processing of huge layers of the information and acceleration of changes.

With development of information-telecommunication technologies importance of resources of new type – on-line social networks – as means of distribution of a uniform information field which has unconditional influence on economic safety of the enterprise over the last ten years has essentially increased.

Studying of problems of operation of business in a global information field – are a subject of active researches, since second half of XX-th century. The practical demand and absence of methodical recommendations about formation and management of economic safety of the enterprise in a global information field have predetermined necessity of carrying out of research on studying, generalisation and structurization of scientifically-methodical toolkit for the purpose of its further practical use.

The analysis of researches and publications. Theoretical and methodical bases of studying of economic safety have been put by many domestic and foreign scientists that has provided base for research of problems of formation and management of economic safety of the enterprise in new conditions of high dynamism and uncertainty of the surrounding social and economic environment.

It is a lot of scientists both in Ukraine, and in the countries of near and far abroad prosecute the subjects connected with maintenance of economic safety of the enterprises of areas of economy. So, the powerful contribution at disclosing of a question of economic safety have brought L.Abalkin, V.Tambovtsev, A Illarionov, E.Olejnikov, A.Kolosov, V.Shlikov, O.Grunin, V.Senchagov, Z.Varnalij, G.Kozachenko, V.Geets, M. Ermoshenko, V.Muntijan, V.Shchelkunov, G.Zadorozhny, V.Ponomarov, V.Gusev, A.Ljashenko.

Unresolved part of a problem. However it is direct to questions of formation and management of economic safety of the enterprise in a global information field in the scientific literature the insufficient attention that causes necessity of carrying out of teoretiko-methodical researches for this direction is paid.

Article purpose consists in formation of the concept of management by economic safety of the enterprise in a global information field.

Statement of the basic material. Many organisations, for the sake of a survival and adaptation to continuously varying living conditions, are compelled to reconstruct constantly the structure and the work organisation, to alter strategy and tactics of the activity and behaviour in the business world. Carrying out of the innovations connected with change of the general organizational structure of the organisation and its divisions and that is especially difficult, the innovations mentioning psychology and behaviour of people, becomes necessity. [1,2]

At modelling of a control system of economic safety of the enterprise in a global information field there is a necessity of the deep analysis, including, as questions of influence of globalisation, information, and consequently virtual management and activity of the enterprise and the account of mutual influence of interested parties, dynamics of their opinions and influence on economic safety of the enterprise.

For the decision of tasks in view, it is offered to consider structurally functional model of management of economic safety of the enterprise which with development of an information technology, becomes more preferable to a traditional principle of functioning (fig. 1).

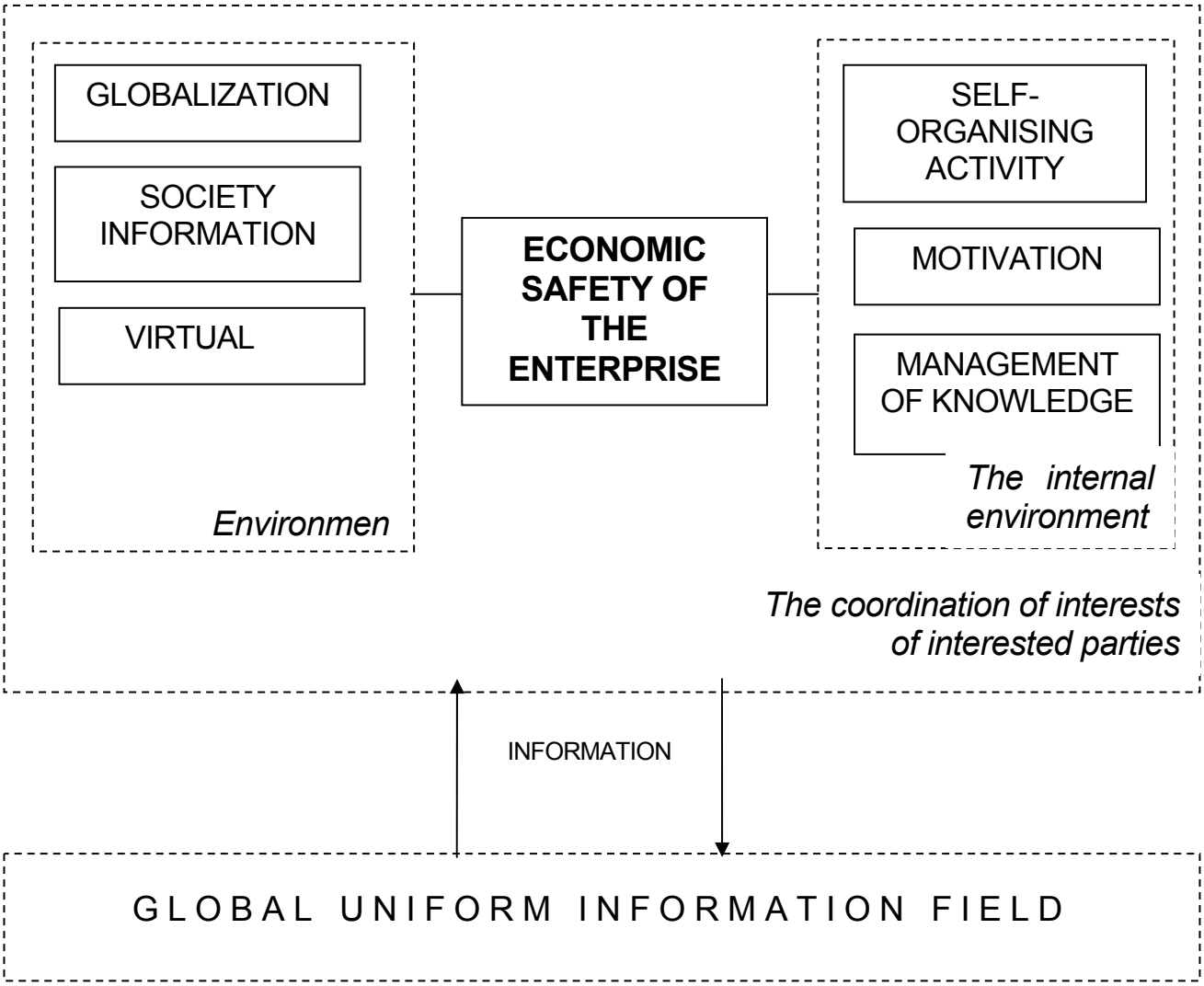

Fig. 1. Structurally – functional model of management of economic safety the enterprises in a global information field

Specificity of modern economic processes and the environment of functioning of the enterprises dictates necessity of working out of new principles of maintenance of economic safety.

Society information gives the chance not only fast and cheap access to millions potential buyers, but also allows to create essentially new business models, to accelerate all processes of creation and delivery to the end user of consumer value.

Globalisation, weakening influence between the countries borders, expands the markets of resources, technologies, production and essentially aggravates a competition. At the same time globalisation creates possibilities for fast attraction of the additional resources which effective utilisation of themes or other enterprise can deduce it in number of leaders.

On the other hand, in the conditions of globalisation of an information technology by object of information criminality there is all world information field and its each component. [2,3]

Thus, such processes as globalisation, information can bear potential threat of economic safety of the enterprise, owing to strengthening of a competition and development of information criminality.

Essential transformations to modern economy cause dynamical development of the automated information technology which is the basic goods in the markets of virtual economy. At the heart of idea virtuality manufactures not so much dialogue or interaction, how many the interrelation of the business processes directed on such organisation of the concrete mechanism of manufacture of the goods or granting of services at territorially carried enterprises at which are as much as possible shown key the competence of the organisations, collectives and people [1,8] lies.

Such organizational form allows to generate the flexible set of the companies - of the "agents" distributed in space, the most adapted for the prompt release of new production (service), increases of its competitiveness and operative delivery to the market on purpose as much as possible to satisfy requirements of the client - of the customer.

These technologies connected with paperless computer science, represent gathering, accumulation, storage, processing and advancement of an information product. They have the purpose, methods and implementers. The purpose of the automated information technology is creation from an information resource of the qualitative information product satisfying the requirements of the user.

Thus, at the decision of a problem of maintenance of economic safety of the enterprise as the complete system functioning in the global information environment, it is impossible to do without new tools of the strategic analysis and the planning, allowing is system to consider the enterprise both its business processes and the purposes of the enterprise not supposing substitution by the purposes of separate groups of interested parties.

In a similar channel, taking into account globalisation and information influence, should be developed and new tools of the theory of interested parties. As problems which dare with their help, also are connected with ordering of relations with all circle of interested parties, their coordination and integration in system of maintenance of economic safety of the enterprise. Thus, at the decision of a problem of maintenance of economic safety as complete system it is necessary to consider interests of all stakeholders, its components, though and in various degree.

At the same time, it is obvious that the number of interested parties of any organisation is close to the infinite. Thereupon in practice the choice of those groups and individuals from huge set stakeholders which are really important is necessary and with whose interests really it is necessary to be considered. This problem defines the first of three areas of research of the theory of interested parties.

The second area of researches is defined by necessity of revealing of interests stakeholders. Thus allocation of relevant groups of interested parties, but also an estimation of their comparative importance from the point of view of the enterprise and its safety is necessary not simply. Besides, it is not enough to reveal inquiries stakeholders. The quantitative estimations considering importance of inquiries and satisfaction stakeholders by their realisation, their importance for the enterprise are necessary. It will allow to raise quality of realised strategy of the organisation, objectivity of the strategic analysis and, accordingly, economic safety.

In a century of globalisation and information by essential factors there is also an intercultural understanding and experience.

In the conditions of complexity and globalisation employees of the enterprises face complexes of the interconnected problems. Therefore from them it is required not only competence in the field of decision-making, but also system thinking and understanding, Between disciplines and intercultural understanding, competence of the organisation of work of collective in the conditions of the limited rationality of its separate members.

At unstable and mobile conditions of balance it is necessary, except that, long-term valuable orientation. For this purpose operating difficult behaviour in the future should consider the person as the centre of nonlinear dynamics of the enterprises and to consider features of its nature. This problem can be realised only in the event that management will be under construction on achievements and system researches, on concepts of philosophy and ethics.

Therefore in modern administrative activity it is impossible to do without system knowledge and understanding, i.e. without ability to think taking into account features of difficult dynamic systems. The

modelling directed on the analysis of projects and applying on Between disciplines, assumes good knowledge of principles of system work. Such knowledge becomes advantage in an education system which will develop in the globalized society of knowledge.

As the major condition of economic safety of the enterprise manufacture and management intellectualization serves. For its achievement it is necessary to systematise corporate knowledge and experience, to create the distributed and big bases of industrial knowledge, to develop intellectual industrial systems in which subsystems are capable to independent estimations, reasonings and actions.

The effective decision of these problems demands working out of models and control systems of industrial knowledge. The dominant role of management of knowledge consists in their division between participants so that everyone could perceive and use corporate knowledge in processes of the distributed decision of problems.

If the enterprises and management systems are considered as trained difficult dynamic and self-organising knowledge systems there is a requirement for the employees who are meeting the requirements, differing radically from what were shown to the personnel dealing with fallen asleep mechanical devices with rigid the instruction to order of carried out functions. To reveal at employees their creative potential - a problem of personnel work in the future.

The main task of construction of system of an effective utilisation of knowledge consists in simultaneously to raise the consumer value created by business, to improve process of training and to optimise management of organizational changes.

Appropriate management of knowledge creates preconditions for creation of steady economic safety of the enterprise on a global scale.

Conclusions

Thus, processes of globalisation, information, virtuality societies make the demands practically before each enterprise, and each enterprise should find the answer, develop the system of use and accumulation of knowledge, the receptions of self-organising of activity and motivation of the personnel, to find ways of the coordination of interests of interested parties in the conditions of the globalized and transformed world.

The literature list

1. *Shamsetdinov A. D.* Formation and management of the virtual organisations (teoretiko-methodical aspect) Avtoref. dis. On degree reception. The house-keeper. Sciences: 08.00.05 / the State university of management. – Moscow, 2009. – 24.

2. *Klejner G. B*. Management of the corporate enterprises and economy of knowledge//the World of Russia. - 2005. - №4

3. The law of Ukraine «About main principles of an information society in Ukraine for 2007-2015»//www.rada.gov.ua

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STRATEGIC DIRECTIONS OF DEVELOPMENT AND FUNCTIONING OF AIRPORTS IN UKRAINE UNDER CURRENT CONDITIONS

This article deals with the peculiarities of airport position and function in the conditions of international transport system development. According to the formulated basic directions of airport function strategic plan, the elements of its realization were proposed. The present condition of Ukraine airports development were regarded at this lecture.

The peculiarity of airports functioning is conditioned by their importance both for the whole country and the region in particular. First and foremost, an airport is a place where the interests of various business partners, as well as various business activities concerning air transportation, intersect. The importance of an airport lies in: 1) combining the efforts of both partners and users with the purpose of creating a unique airport product, which makes an airport more than just a trans-shipment point; 2) making infrastructure; 3) its role as an economic factor. Since airports are considered to be commercial enterprises, to every particular region, they are even far more important than airlines. Airports are heavy investors in the infrastructure giving new jobs, raising taxes and investing capital, promoting tourism as well as business trips in case an airport is not a tourist-oriented one [1]. Airports function as consolidating centres of a particular region's activity.

An airport cannot alter its activities or its location; it has limited possibilities of production diversification. This situation limits a choice of strategies, which makes the stage of implementation of the chosen strategy still more important.

The choice of a strategy implies a number of policies of a production commercial organization. The main key factors to be taken into consideration first when choosing the strategy of an airport functioning are: the condition of a transport branch and the position of an airport in it, the objectives of an airport, the interests and attitudes of the top management, financial resources of an airport, airport staff qualification, airport's liabilities, the degree of an airport's dependence on the external environment, time factor.

The process of strategy implementation is particular since this process doesn't infer the strategy realization per se , while it only makes a base to realize the strategy as well as to attain the objectives. To implement the strategy, certain conditions for its realization should be met, which means that some necessary changes should be introduced.

Let us consider the most widely-used business development strategies [2,3]. As a rule, these strategies are called basis or standard. They present four different approaches to the firm growth and are connected with the change in a state in one or several elements: 1) product; 2) market; 3) branch; 4) position of the firm within this branch; 5) technology. Each of the five elements might be found in one of the states: old or new.

Concentrated growth strategies deal with product or market change, not affecting the other elements. The specific types of strategies are: the strategy of strengthening position in the market place (considerable marketing efforts are required); the strategy of market development; the strategy of product development.

The strategy of integrated growth includes such business strategies that are connected with expansion of a firm, introduction of new structures, with the firm's position within the branch being changed. There can be distinguished two main types of integrated growth strategies: the strategy of a converse vertical integration aimed at the firm's growth through taking or strengthening control over suppliers, the firm can expand its activities towards suppliers (back) and/or towards consumers (forward); the strategy of the forward vertical integration implies the firm's growth due to taking or strengthening

control over the structures in between the firm and the ultimate consumer, namely the systems of distribution and sale.

The strategies of diversified growth are pursued in case the firm cannot develop on with some particular product in the market place within some particular branch. The main strategies of diversified growth are as follows: the strategy of centred diversification based on search and use of extra opportunities to produce new products which can be found in the existing business; the strategy of horizontal diversification which assumes search for opportunities to grow at the existing market due to some new product which requires some new technology, different from the one being used; the strategy of conglomerate diversification which lies in the fact that the firm expands due to production of some new products which are not technologically connected with the ones being produced, at the same time realizing the new products in the new market place.

The strategies of production cutback are pursued when the firm needs to regroup forces after a continuous period of growth, or in connection with the necessity to raise the efficiency, when economic recession or some cardinal changes in the economy are observed. In such cases, the strategies of purposeful and planned production cutback are pursued.

For the airport as well as its passenger terminal to function, the following strategies of development, surviving and liquidation can be suggested [4,5].

The strategy of development can be pursued by the airports in which the passenger flow is expected to grow. The strategies of development include the strategy of integrated growth, the strategy of diversification which is connected with the expansion of airport's activities (non-aviation), introduction of some new activities: leases, concessive agreements, franchising agreements, advertising; new construction, reconstruction – complete or partial re-equipment and readjustment of production carried out using one and the same project , with obsolete and depreciated equipment being changed, production process being mechanized and automated, disproportion in technological links and subsidiary facilities being eliminated.

Reconstruction meets the requirements in production volume growth on the basis of a new up-to-date technology as well as improvement of other technical-economic indices, with less expense incurred and within shorter time period, which is not possible in case of building new enterprises or expanding the existing ones.

The strategy of airports functioning in Ukraine cannot be a single one, it should be developed in various directions. For instance, "Boryspil" airport pursues the following strategies of development: reconstruction of terminal "A": realization of this project will improve servicing passengers travelling within the territory of Ukraine; reconstruction of terminal "B", "C"; building of a terminal complex "D": a new terminal complex with the capacity of 3 000 passengers per hour, which is located 1250 metres away from the existing terminals; building a terminal of light constructions (terminal "F"); reconstruction of platform "S"; reconstruction of platform "F"; building of a multistory parking lot for passengers' vehicles; building vehicle parking areas; moreover, IA "Boryspil" suggested the following objects to be included in the investment propositions of the branch: 1) a hotel at 280 rooms; 2) a hotel at 500 rooms; 3) organization of passenger railway link between the city of Kyyiv and "Boryspil" airport; 4) a parking lot that can accommodate 3 000 vehicles; 5) a department of on-board catering servicel; 6) building a sewer pumping station; 7) facilities to purify sewage disposal; 8) out-of-area discharge collector and reconstruction with purifying facilities for shower sewers [6].

The new terminal of the international airport "Kharkiv" is supposed to open by August 23, which is the Day of the place. "DCH" group represented by "New Systems AM" company is the operator of reconstruction of the international airport "Kharkiv" and the only investor in reconstruction of a terminal complex which envisages building of a new terminal, modernization of an old terminal, reconstruction of a terminal area, building of a temporary terminal, which is to be used during football matches of Euro-2012, modernization of infrastructure, buying special technical equipment and vehicles. Reconstruction of an aerodrome complex, which includes reconstruction of aprons, a runway, installation of a lamp signaling system, building of an emergency station, building of an air control tower is funded from the state budget [7].

Lviv airport will have been reconstructed by the beginning of Euro-2012. In particular, the runway is expected to be lengthened as well as a parking lot and two new terminals to be built. One of the two terminals, that will be located at the entrance to the functioning airport, is planned to be built in 2010.

To reconstruct an aerodrome "International airport "Kyyiv" (Zhulyany) in 2008-2009 the state budget allocated in the neighborhood of 140 mln hrns, with the airport now being able to handle such planes as A-3230 and Boeing-737.

To reconstruct the seven airports in Ukraine that are supposed to welcome participants of Euro-2012, the state budget allocated 1, 008 bln hrns. These airports are located in such places as Kyyiv, Dnipropetrivsk, Kharkiv, Lviv, Donetsk and Odesa.

"Airport Consulting Partner" (a German company) has worked out the program of development for nine airports of national importance up to 2020. Among these airports are international airports "Boryspil", "Donetsk", "Odesa", "Lviv", "Simferopol", "Kharkiv", "Dnipropetrivsk", "Kyyiv" (Zhulyany) and "Zaporizhzhya". This was reported by the press-service of Mintranszvyazok [7].

To work out the strategic plan of airports functioning, the strategy of air transportation development should be pursued as a basis. When choosing a particular strategy, one should take into consideration the potential importance as well as the opportunities of a specific airport concerning providing passenger and cargo transportations, rapid mail delivery, handling charter flights. The airport strategy should be worked out with the airport's peculiarities being taken into account. Such peculiarities should reflect: national and regional importance of an airport, its monopoly position, a necessity for considerable and, as a rule, non-current capital investments, airport's location. Choosing a functioning strategy for a specific airport is quite a difficult and important task. This task cannot be solved when just considering an airport from the standpoint of its being profitable or unprofitable.

Some scientists think, and we can agree here, that the strategic plan for airports functioning, should have, at least, three strategies: development of the most important airports, surviving and liquidation [5].

According to the basic directions of the strategic plan for airports functioning mentioned above, the main elements of its implementation can be singled out (Fig. 1).

For an offensive strategy, marketing policy includes a market analysis and a constant research of demands. In accordance with the basic types of air transportation, there can be distinguished passenger transportation market and cargo transportation market. Thus, the market of services that an airport renders can be divided into the following parts: passenger servicing, visitor servicing, handling of planes, cargo handling. The market of passenger transportation, in its turn, includes transportation of business passengers and private purpose transportations. Passenger non-business transportations are tourist trips and holiday trips as well as trips with the purpose of visiting relatives or friends. Airport visitors can be viewed as so called potential passengers i. e. visitors might want to purchase an air ticket or might inquire some information on flight routes as well as tours in the travel agency. People coming to the airport can also do some shopping, go to the drug store, currency exchange, restaurant, café, bar, entertainment places, etc. Airlines, concessioners, tenants are also consumers of the services an airport provides. Marketing policy should on a constant basis research the demands of passengers and visitors, as well as airlines, concessioners and tenants.

Practice of the leading international airports shows that two directions of the maximum boost of profit as a result of advertizing should be kept to: opening small advertizing departments within the company, which will save the company's profits (appeals more to small airports); co-operation with advertizing agencies.

To encourage people to use some particular airport, giving incentive presents to passengers and visitors can be practiced; passengers are interested in convenient working hours of the airport; equipment used in the airport; Duty free souvenirs and goods; special booklet containing information on the airport; airlines basing in it; state control requirements including information on the services the airport renders. Airlines that co-operate with the airport on a constant basis are granted a system of discounts or privileges.

Fig. 1 Strategies and elements of implementing a strategic plan of airports functioning

Conclusion: The strategy of development is being completely pursued only by Boryspil. The airports of Kyiv, Dnipropetrovsk, Kharkov, Lviv, Donetsk and Odesa are planned to be reconstructed by Euro-2012. The strategy of surviving turns out to be most actual for most airports of Ukraine for some continuous period. Its main direction is expenditure reduction which is possible at the account of revising

the area of the airport as well as seeking new investors. This is the strategy that airports of Lutsk, Simferopil and Uzhgorod are trying to pursue. Cherkasy airport has concluded an agreement on co-operation with a Ukrainian airline "Urga", Vinnytsya airport began to handle scheduled flights in 2008, Sumy airport has repaid all its debts and its constructing will be completed. For some airports of Ukraine the strategy of liquidation is at the stage of factual realization, for example, in 2008 Rivne airport was put up for auction at Rivne commodity exchange at 72,7 mln hrns

In October 2009, in spite of a complicated economic situation in the country a construction of an international airport on the basis of the former military aerodrome in "Kanatovo" (Kirovograd) began.

Literature

1. *Рожок О.А., Загорулько В.М.* Обгрунтування джерел розвитку аеропортів в сучасних умовах// Проблеми підвищення ефективності інфраструктури: Зб. наук. праць.– К.: КМУЦА, 1998. – Вип. 3. – С. 147 – 149.

2. *Паламарчук Ю.А., Ложачевська О.М.* „Особенности деятельности аэропорта в условиях развития международной транспортной системы"// Бизнес Информ. – 2006.– № 12. – С. 31-36/

3. *І.О. Борисюк, Н.М. Чигасова та ін.* Корпоративне управління в Україні: стратегії, інновації, інвестиції. Монографія. – К.: Видавництво „Наукова думка" НАН України, 2008. – С. 366-376.

4. *Паламарчук Ю.А.* Стратегії функціонування пасажирського терміналу аеропорту// Економіка: проблеми теорії та практики: Зб. наук. пр. –Дніпропетровськ: ДНУ, 2006. – Т.1. – Вип. 214. – С. 11-17.

5. *Евстифеев В.С.* Особенности стратегии функционирования аэропортов Украины // Проблеми інформатизації та управління: Зб. наук. пр.: Вип. 5. – К.: НАУ, 2002. – С. 66 – 71.

6. http://2012ua.net/news/

7. http://www.mtu.gov.ua

SYMPOSIUM 7

HUMAN FACTOR IN AVIATION

UDC 656.7.086 (043.2)

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MINIMIZING HUMAN ERROR (LANGUAGE RELATED)

The study is about the role of human factor in aviation accidents and incidents. The human factor can be of different nature and a language related human error is considered to be one of the frequent causes of accidents and incidents in aviation. An automated system to minimize a language related human error could be a right solution to provide safety of flights and air navigation services.

Human factor still remains one of the main causes of accidents and incidents in aviation. It should be noted that the human factor means a human error, which may be of various nature. For example, according to PlaneCrashInfo.com database the table below represents causes of fatal accidents in the period between 1950s and 2000s:

Causes of Fatal Accidents by Decade (percentage)

Cause	1950s	1960s	1970s	1980s	1990s	2000s	All
Pilot Error	40	32	24	25	27	26	29
Pilot Error (weather related	11	18	14	17	21	17	16
Pilot Error (mechanical related)	7	5	4	2	4	3	5
Total Pilot Error	**58**	**57**	**42**	**44**	**53**	**46**	**50**
Other Human Error	0	8	9	6	8	8	6
Weather	16	10	13	15	9	9	12
Mechanical Failure	21	20	23	21	21	28	22
Sabotage	5	5	11	13	10	9	9
Other Cause	0	2	2	1	0	1	1

The table above is compiled from the PlaneCrashInfo.com accident database and represents 1,300 fatal accidents involving commercial aircraft, world-wide, from 1950 thru 2009 for which a specific cause is known. Aircraft with 10 or less people aboard, military aircraft, private aircraft and helicopters are not included.

"Pilot error (weather related)" represents accidents in which pilot error was the cause but brought about by weather related phenomena.

"Pilot error (mechanical related)" represents accidents in which pilot error was the cause but brought about by some type of mechanical failure.

"Other human error" includes air traffic controller errors, improper loading of aircraft, fuel contamination and improper maintenance procedures. Sabotage includes explosive devices, shoot downs and hijackings.

"Total pilot error" is the total of all three types of pilot error (in yellow). Where there were multiple causes, the most prominent cause was used.

There is a lack of “pilot error (language related)” category which may result due to poor English language performance. Therefore a human error (language related) includes both pilot and air traffic controller errors occurred within radiotelephony communication and related to English language performance.

According to data obtained by the Institute of Air Navigation for the decade of 1998-2008, 78% of breakdowns and accidents/incidents in air navigation services were caused by a human factor.

As the number of planes in our skies continues to grow, so the need for safety becomes even more important. An ICAO review of 28000 incident / accident reports has found that over 70% of the problems were caused by language.

ICAO standards now demand that all pilots flying internationally and all air traffic controllers providing services to international flights must have a minimum level of English.

This level of English is known as ICAO Operational Level 4. The above mentioned facts point out that there should be actions undertaken to minimize a human error (language related) in order to increase safety of flights.

The language related human error is a complex phenomenon. It may occur within phraseology exchange as well as within plain English usage in non routine situations when phraseology may not be sufficient.

In addition to language nature the human error may be brought by anxiety and nervousness of a pilot or an air traffic controller because of unexpected turn of events on the work place.

Therefore language related human error during radiotelephony "ground to air" communication might have twofold nature, namely linguistic and psychological.

Analysis of results obtained in human factor researches has revealed that mostly the key points under consideration focused on the following:

- Systemic approach to flight safety management in relation to failures within the system "aircraft – crew – environment";
- Basic theory of flight safety provision in the aviation transport system;
- Classification of events and incidents in aviation based on types of risks, causes and consequences;
- Quantitative approach to estimation of flight safety level, others.

It is obvious that most of the researches focused on local actions to predict, identify and manage risk factors disregarding negative influence of the language related factor. Therefore still there is no integrated solution to provide safety of both flights and air navigation services taking into account the language related human errors.

One of the suitable ways to find the solution could be an automated system of minimizing the language related human error within the radiotelephony exchanges between a pilot and an air traffic controller.

To develop the system it is necessary to find and analyze both quantitative and qualitative characteristics of human speech patterns specific for the English language performance in aviation and during radiotelephony communication in particular. The knowledge of the characteristics will make it possible to monitor the system in real time, to provide functioning of its elements with efficacy and effectiveness for safety of flight and air navigation service.

This automated system might include a few modules, e.g., the module of task input, the module of data processing, the module of data adapting, the module of data correction, etc.

The system will provide a crew and a controller with language support needed in radiotelephony communication "earth-to-air", and in this way will decrease the language related risks of human factor.

It should be mentioned that previously the main focus was on professional job related skills of a pilot or an air traffic controller. The English language competence was considered as an option and till now has tackled the standard phraseology. In other words, the language related interactions on the work place between a pilot and a controller might not have been taken as a serious risk factor for safety of flights.

The recent new ICAO language requirements implementation in Ukraine highlighted a gap between high professional level of the aviation personnel and low level of their English language performance in job related situations beyond the standard phraseology exchange.

Still the assessment of the professional qualification level is being provided separately from the English language performance. It might mean that the language performance is not being viewed as an integrated part of the professional knowledge and skills of aviation personnel.

At the same time it is a well known fact that the language related human error is one of the main reasons of accidents and incidents in aviation. In this respect the above mentioned automated system should be developed on the basis of statistics on negative impact of human factor (language

related) on flight safety. It might be possible to calculate the index of human error (language related) predictability in order to estimate the level of flight safety.

We have analyzed nearly 1000 speech samples of oral language performance of pilots and air traffic controllers within oral test setting. It tuned out that the speech behavioral patterns could be described by the following characteristics:

- Pauses of hesitation
- Pauses due to lack of language
- Influence by individual native language fluency
- Individual ability to native language extend and paraphrase
- Gestures and facial mimics as substitutes of words
- Individual oral speech productivity

The listed characteristics can be presented quantitatively using mathematical and statistical methods and qualitatively through discourse analysis.

It is important to notice that the above mentioned characteristics are not presented by descriptors of any oral speech rating scale because they are closely connected to the personal qualities of an individual candidate. On the other hand a language related human error is always individual and unpredictable due to its being individually unique.

Conclusions

The English language performance of a pilot and an air traffic controller might become a cause of a human error resulting in accident or incident in aviation. In this way it may become one of the risks for safety of flight and/or quality air navigation service.

Minimizing the language related human error could be provided through an automated system with various modules which might operate with data obtained through mathematics, statistics and discourse analysis. The data should represent individual characteristics of oral speech behavior of a pilot and an air traffic controller during radiotelephony communication from air to earth which might be one of the risk factors for safety of flights.

It should be concluded that minimizing of a language related human error is possible through a specially created automated system which could manage predictability of the language related errors in communication between a crew and a controller.

References

1. *Petrashchuk O.P.* English language requirements for aviation personnel to be used on the work place // Foreign Languages in Educational Establishments. - № 3. – 2006. – P.116-123;
2. *Alekseyev O.M.* Automatized management of flight safety in the system of air navigation / Dissertation Thesis, 2009 – 270 p.
3. Internet links: www.PlaneCrashInfo.com ; www.icao.org

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INTEGRATIVE COURSES AS A METHODOLOGICAL FOUNDATION IN THE SYSTEM OF CONTINUOUS EDUCATION OF THE TWENTY-FIRST CENTURY

Abstract *Considered are the theoretical and methodological bases for the development of integrative courses as a holistic process of shaping specialists, both personally and professionally, that puts in place the conditions necessary for developing further their creative personality; with a level of creative potential marking all the stages of activity of the person, that retains his / her creative essence – the tendency to search and transform.*

Introduction

The study of theoretical and methodological bases for designing integrative courses in a continuous system of education is determined by the social and practical significance of the problem of self-improvement of the creative personality and his / her professional self-actualization.

At the present-day stage of development of the society, under the conditions of Ukraine's higher education structural reform and content improvement, a necessity is emerging to actively search for new reserves in order to raise the quality of training of specialists, their competence and individual personal maturity.

The present-day socioeconomic conditions and contradictions present convincing arguments in favor of reforming the existing mass-reproduction concept of education into a concept of the individual-creative approach in the training of students – future specialists, who are capable of creative self-improvement. A transition to the pedagogical value of student self-development is the formula of new pedagogy of tertiary education. It is during student years that a person acquires the power of reflection – comprehension of limits to one's own individual knowledge and the ability to go beyond these limits.

Requirements that are now being set by the individual and society for educational outcomes have determined a necessity for cardinal changes in both content of education and pedagogical technologies. These requirements and goals are implemented in the creative approach, now being put in place in the system of professional education - in the system of continuous formation of creative thought and development of creativity in both secondary and higher school students. The basic mission of a creative system of education is to arouse one's creativity and boost the latent creative potential.

It is quite clear that implementing this mission, which is, undoubtedly, of national importance, could only be up to creative teachers possessing a sufficiently developed personal creative potential, who, themselves, are not only highly cultured and competent in psychology and pedagogy, but who can also use alternative approaches to resolving various psycho-pedagogical situations and organize their own activities on a creative basis.

In addition, the social significance of studying the patterns of designing integrative courses, as a methodological foundation of the system of continuous education, is determined by the fact that it:

- identifies the productive-creative trend in a person and constitutes the backbone of the person's social orientation in life;
- is the major determinant in professional creativity;
- facilitates creative professional development and social self-actualization of the specialist;
- conditions the adaptive ability of the human body, as a physiological system, to the specifics of professional activities.

Therefore, the topicality of this study is determined by the fact that the problem of providing rationale for the theoretical and methodological foundation of developing integrative courses in the system of continuous education has not been worked out sufficiently and is of crucial importance for further professional activities of the specialist under present-day market economy conditions.

The object of this study is the system of continuous education, and the subject is the theoretical and methodological foundation of developing integrative courses in the system of continuous education.

Essential Content of the Study

The system of the so-called "supportive" education, that took shape in the past, is clearly not in line with the demands of the post-industrial civilization now being formed. Radical change in educational practices can only be achieved by means of innovative education that is the main precondition for their theoretical review, as well as for Ukraine's Higher School integration into the world educational context.

The content of education in the twenty-first century is to be aimed at nurturing persons with a sense of personal sovereignty, free and creative, capable of continuous self-identification not only in relation to their professional activity goals, but also in relation to human values, "striving to be", self-realizing, self-actualizing in the totality of their human essence. Only such persons are capable of pursuing their aspirations, getting involved in social co-creativity, substantially influencing social renewal, its conscious forecasting and implementation.

Today creativity, as the process and result of the innovative process of education, is largely represented as a kind of personal adaptation mechanism to deal with the on-going social change. The dynamism of economic and political developments encompasses changes in the inner life of a person. In order to be internally compatible with present-day realities, specialists are not only to be able to get adapted to new situations but also to change them, while changing and developing themselves. Hence - the special interest in studies that deal with the shaping of the active creative personality, the mechanism of creative thinking throughout the period of continuous education.

Important pedagogical requirements for a creative educational process – continuity, succession and student inclusion in the active educational sphere, in independent management of the creative process, – allow every student at any educational level not only to develop the initial creative potential, but also develop a need for further self-actualization, creative self-improvement, developing one's own self-concept. This, in turn, requires a review of the content and technologies of education, as reflected in the works by Ukrainian and foreign authors [1-6].

Furthermore, the importance of the problem of developing personal creativity with the use of integrative courses in the system of continuous education is determined by a number of aspects:

- *social*, because we are not simply shaping a new person having a specific mode of thought capable of radical change and transformation, but a specialist of a new formation – an innovative specialist;
- *scientific*, because of it being the means of knowing creative abilities in the areas of intellectual and social creativity;
- *practical*, because it is possible to use new technologies to immediately develop creativity.

The above-mentioned aspects make it possible to establish the existence of a number of contradictions between the existing system of training specialists and present-day social and personal needs, caused by profound changes in all spheres of social life, in particular, between:

- society's objective need to make contemporary school more humane and attractive and retaining, the authoritarian mass-education school that, basically, does not provide conditions for both students and specialists to manifest their personal creativity;

- requirements put forward by the individual and society for educational outcomes and the concept of mass-reproduction education;

- the trend towards a continuous formation of creative thought, development of creative abilities – and the narrow-area concentrated specialist training in the higher technical school;

- the liberal arts component in the professional work of the future specialist pertaining to the subject-subject interaction, and the insufficient presence of the psychological and pedagogical component in higher school training.

All the above contradictions allow formulation of the main problem of this study: what are the theoretical and methodological foundations for the development of integrative courses in the system of continuous education, as the basis of the person's creativity, that provide his / her adequacy to

present-day and future professional requirements?

The major hypothesis of this study assumes that a system of training the creative personality in the continuous education system can only be effective if, when being designed and implemented, the following premises are taken into account:

- The chief goal in shaping an individual's creative personality in the continuous education system is to secure a level of the creative contemporary higher school graduate that corresponds to the needs of the person and dynamically changing professional activities; to train professional experts with a high level of general culture, well-developed communication skills, empathy and intuition, whose core trait is the creative orientation of his/her personality.
- The main methodological approaches in designing the shaping of creativity in higher school graduates are:

- *the system and functional approach*, according to which the shaping of higher school graduates' creativity is viewed as a flexible pedagogical sub-system of the system of re-training specialists in their professional activities that takes into consideration the dynamics, trends and prospects of their development;

- *the integrative approach*, that allows, on the level of an integral component, coordination of achievement of different objectives within the framework of a single process of education; and, on the level of content and procedural components, – designing of a system of interdisciplinary knowledge and skills that would secure a high level of competence and creativity in higher school graduates;

- *the personality-oriented approach,* that is directed at the development of professionally significant personality traits in students determining the effectiveness of their creative activities.

- Creativity, as a special multi-level personality category of creative pedagogy, characterized by dialectical three-dimensionality of its components (procedural, resultant and prognostic) - is a productive source of creative professional activities and the basis of professional adaptation.
- The design and implementation of the process of shaping creativity in the system of professional training rely on the totality of general pedagogic and specific principles:

- greater inclusion of the humanities element, that is expressed in orienting all components of the learning process towards the development of the student's personality potential;

- succession, that allows correlation of different stages of continuous education (school – lyceum – university – professional development courses – re-training – professional refinement) and bringing them together into a system that provides the person's professional development;

- comprehensiveness, that means the completeness of information relating to major problems in special, general professional psychological and pedagogic, natural science, social and philosophic disciplines that allow variation in the process of education;

- use of modules, that envisages educational content structuring in module-units that provide an optimum combination of invariable and variable components of the process of education.

In order to realize the theses we formulated in this study, the following objectives were established:

1. To provide rationale for theoretical and methodological bases of designing integrative courses in the Higher School, proceeding from their importance for the professional activities of future specialist.
2. To identify basic indicators of creativity and establish the correlation between specific personality traits - that have an immediate relation to creativity manifestations in future professional activities.

We find the first mention of the nature of scientific creativity in the works of ancient philosophers. Aristotle in his famous syllogistics attempted to establish the nature of generating new knowledge by building an algorithm of logical conclusions. In pre-scientific psychology new knowledge production was for a long time believed to be due to the mode of thought operations called deduction, later – it was induction, which meant a non-deterministic kind of approach to defining the nature of creativity. A notion of the nature of creativity that in part was in line with "deterministic ideals of science" about creative synthesis and creative associations appeared in

psychology only in the epoch of the reign of the association concept.

Analysis of approaches and views of philosophers, psychologists and educationalists relating to the problem of creativity allowed not only establishing the essence, mechanisms and criteria of creativity, but also identifying its applied aspects, in particular - the search for pedagogic conditions under which a successful shaping of the individual's creative personality is possible.

The first to notice this was J. Pestalozzi who understood studying as the student's own creativity - knowledge acquisition on the basis of independence and self-development. This point of view had marked a turn in didactics from the external nature of creativity to human nature itself. Furthermore, on the basis of experimental research it was established that creativity, which is an independent psychological entity, integrates itself into a range of the person's individual traits (distinctions) in the intellectual sphere, and, depending on the level of manifestation of these traits, the person projects an appropriate creative outcome phenomenologically. Even with minimum manifestations of creative abilities, under the conditions of an enriched environment of innovative education and the appropriate process of upbringing, i.e. contextualized education, - an individual can demonstrate positive dynamics in creativity: a stable tendency towards self-actualization and creative self-expression starts to emerge.

In addition, creativity characteristics are linked to a complex of psychic attributes that manifest themselves in a particular productive or professional activity. So, a number of authors [6-9] identify various abilities as elements of creativity, the basis of which, in their view, is expressed in the ability to project and generate new ideas.

We intend to consider creativity as a process and a complex of intellectual and personality traits of an individual that are instrumental in independent problem formulation, generating a large number of original ideas and non-standard approaches to tackling them, which allows studying creativity not only as a result, but also as a personality-wise meaningful new quality based on reflection and subjective self-concept.

In order to find out how future graduates of the Higher School, who study at different faculties and higher educational establishments of Ukraine, correlate their future profession with the notion of creativity and creative work, we carried out a study of the phenomenon by means of a specifically tailored questionnaire.

Responding to the question: "Do you see your future specialty as a creative one?" - 85 percent of graduate students said they believed their professional activities were indeed creative. For the sake of comparison - only 70 percent of final year lyceum and college students were in the affirmative as regards the creativity of their future profession. In response to the question: "Do you see yourself as a creative person?" – 57.7 percent of higher school and 42.6 percent of secondary school students said "yes".

Proceeding from the logic of our study, the creative personality, creative process and creative environment are the necessary conditions for demonstrating creativity. Creativity can be viewed as intellectual creativity and social creativity. Intellectual creativity includes the cognitive sphere, which, in turn, comprises analysis (abstraction) and synthesis (generalization); at the same time, the abilities to perform analysis and synthesis are components of general intellect. Social creativity, in its turn, includes professional creativity, one form of which is pedagogical creativity that includes the perception of intellectual values, as well as the ability to be innovative.

Therefore, it could be assumed that innovative activity is a three-level structure where the foundation (the basis) is reflection – being a person's comprehension of his/her own search and creative activities, creating and transforming activities, mutual creative work with other people.

Of great importance for a reflection on the structure of innovative activities is the consideration of relation between creativity and professionalism that has a latent contradiction: on the one hand, differentiating traits that make every profession distinct from all other professions condition a system of requirements, which, if not met, strips a person of the image of professionalism, on the other hand, the greater the complexity of knowledge, that is close to the heights of mastery, the more tangible become the signs of innovation, the aspiration to disregard the conventions, the development of products and tool-kits that are in contrast with the generally

accepted ones. A trend towards innovation is clearly manifested in creative self-expression that goes beyond the ordinary. The closer the peak of achievement the creative innovator is about to conquer, the greater the number of "violations" of the conventions and of the people involved in ignoring the conventions. Productivity and success in professional activities serve as the criteria of acceptability for the "departures from the mainstream".

If development is life's strategy, then - adaptation is the tactics that allows all living to hold to a certain evolutionary framework, thus securing progress.

The most recent problem in the study of man is the problem of professional adaptation. It has recently emerged in the modern production environment where certain types of activity are highly demanding. It should be mentioned that one of the important aspects of professional adaptation is the development in the student of professionally significant qualities - because changes in them, in the process of study, can be seen as certain identified regularities that reflect the stages in the professional development of a person. Flexibility and originality of thought can realistically be considered as factors of a person's survival in society at the present stage of its development, as necessary qualities for considering vital problems - including the problem of one's own place in real life, in the first place.

In order to establish the impact of creativity of the educational environment on the effectiveness of adaptation, we introduced a psychological diagnostic methodology - "Adaptability" [10]. The responses drawn on the question "Do you consider the educational environment in which you study as creative?" showed low appraisal of creativity in the educational socium by students of non-pedagogical higher educational establishments (45.6 %) and collage and lyceum teachers (46.7%).

By comparing the responses obtained to the questions on methodology with the results that demonstrated the level of adaptability of the human organism, as a biological and psycho-physiological system, we saw a vivid confirmation of our assumption concerning the fact that in a creative environment (if that is the perception of the individual) the process of adaptation is more efficient, it requires smaller mental exertion and takes less time. Hence, a conclusion can be drawn that in shaping and demonstrating the creative personality, a special role is played by an environment that has "a creative charge" to it, the environment that creates a need for creative work and is supportive of creative behavior. However, in practical professional activities and in the educational socium, students' creative abilities are often suppressed by teachers and administrators, because the socium is interested in its internal stability and in a continuous reproduction of existing relationship patterns. The conclusion made is that for creativity to be shaped as a profound (personal) quality, and not only a behavioral (situational) quality, the process of education is to take place under specially designed conditions – a systemic indirect creativity shaping influence exercised through a complex of conditions of a microenvironment that must have a high degree of uncertainty and potential poly-variance (a multitude of opportunities). At the same time, uncertainty would stimulate a search for personal reference points and vital resources, while poly-variance would provide opportunities to find them. Furthermore, the educational environment should keep samples of the teacher's creative behavior and outcomes of that behavior.

Thus, we can distinguish three directions in the study of creativity in higher school professional training: the general theoretic (methodological), epistemological and empirical (related to the use of methodological principles of research) directions. The epistemological idea concerning a possible source of activating creativity lies in the fact that a creative personality - that is constantly in extreme conditions, in a state of psychological uncertainty, surrounded by paradoxes of life and generally accepted views of problems, that experiences feelings of frustration - always exhibits flexibility and inventiveness in decision making that goes beyond stereotypes and original views of problems, which allows quick adaptation and efficient actions; that is, creativity is a holistic, dialectic and value dimension.

Since the creative approach to the problem of education does not assume meeting ready-made didactic challenges, but rather the generation, creative formulation and development of ideas, concepts and projects in the broad social aspect of life, a creative technology of education is to

constitute a means of measuring the initial and major purpose of professional education; that is, the dominating function of education in relation to the student should be replaced by the servicing function.

The difference between creative technologies and conventional pedagogic technologies lies in:

1. The partnership of students and teachers in the process of education, the teacher playing the role of a director, manager of educational services.

2. The chief condition of conventional education is removed – the use of ready-made, systematized knowledge to be interiorized. In project-oriented education, knowledge may be non-systematic in nature, contradictory and "incorrect". The student works on his/her own project by making choices based on a multitude of knowledge, notions and concepts; the student has his/her own vision of the world.

3. Knowledge ceases to be the main element of education being replaced by information - that is data of any nature, sometimes doubtful regarding their veracity, and, as a rule, poorly matching and contradictory.

Therefore, we come to the conclusion that creativity is a complicated phenomenon of complex organization that includes, along with divergent intellectual functions, a whole galaxy of personal qualities that facilitate the emergence and development of these qualities.

In order to arrange mutual creativity of the teacher and the students in the process of education, there should be a general heuristic direction in teaching and upbringing. This direction is secured by the use of a greater number of search and transformation problem tasks in the process of education and upbringing by putting in place an atmosphere of cooperation between the teacher and the student which provides creative co-work.

In technical higher educational establishments an approach had been formed over many years under which attention was focused on technical subjects, whereas social sciences and the humanities were regarded as secondary in significance. As a result, the system of technical education in the Higher School turned into a clearly expressed standardized "techno-centric" environment, the centre of which was the objective content of technical disciplines to be interiorized. It is in this context, that the optimal model of the higher school specialist-graduate was built. Despite the progressive nature of this approach to technical education, it did not provide the intellectual and moral development of a person. No notice was made of the fact that students of technical higher educational establishments were future leaders of production and the main problems facing them would be the problems of people management, in the first place, and in the second place – those of technical decision-making. Furthermore, it should be kept in mind that narrow specialization gets obsolete as fast as equipment, scientific methods and technologies, and for higher school graduates with insufficient training in the humanities it might be difficult to adapt to different types of professional activities [11].

At the same time, one cannot but take into account the fact that technical systems, the whole of techno-structure of modern society, are part of a certain eco-social system and, accordingly, influence the natural and social environment of a person. Essentially, the very nature of engineering work is such that it encompasses many socio-economic, socio-political, moral and aesthetic problems of teamwork functioning.

An engineer is required to be able to fully rely on himself/herself, learn, be more exacting towards himself/herself, his/her career and potential. In other words, the dominant qualities to be inculcated in a future engineer during professional training are: the ability to establish contacts, communication skills, the ability to accomplish established goals, competency, creativity, organizational skills, and analytical thought. The training of such specialists is a pressing task for the technical university that is to become an educator of the intellectual aristocracy – aristocracy of talent and intellect.

Therefore, the strategy of development of technical education in the third millennium is to be guided in the direction of securing humane attitudes towards man as integral personality: towards the person's natural features (health, ability to think, ability to act); the person's social

characteristics (being civic-conscious, a good family person, diligent), and towards the qualities of the person as the subject of culture (the inner world, liberty and humaneness). It is this aim that is to become a priority in the professional activities of a specialist at the technical university, because it is the one that materializes the encounter of "the teacher and the pupil" in three hypostases at the same time: Teacher (the instructor) and pupil (the student), Teacher (the university) and pupils (instructors and students), and Teacher (national and world culture, spirit) and pupils (university as a whole – instructors and students). Hence, the shaping of an intellectual at the technical university is to be a process of three components operating concurrently: special-professional, fundamental investigation and liberal education training, because the most important function of the sphere of education is the synthesis of Knowledge and Belief. It is these supreme values that are to form the foundation of mentality and personality in the socium, be the basis of purposefulness, content selection, methods and techniques of educational activities at all stages of instruction.

The defined problem can only be resolved on the basis of professional and creative training of the specialist, regarding this training as an integral process of personal and professional shaping of the specialist that creates the conditions for self-actualization in the learning-cognitive and educational activities and secures further development of personal and professional qualities that facilitate successful creative professional activity. Furthermore, the level of development of creative potential has an impact not only on the professional activities of the future specialist, but also on the very process of his/her life, because different kinds of a person's activities (cognitive, world outlook, working, communication and emotional) retain the person's creative essence – the tendency to search and transform. For this reason, in the situation of a single educational space a program should be put in place that integrates positive national educational programs and strategies in the context of universal human values on the basis of which mankind would be educated in the spirit of tolerance, mutual respect, dialogue of cultures and respective tolerance, open communication, belief in the rational beginning, pluralism of ideas, flexibility, and not in the spirit of forceful conflict resolution and crisis management strategies. Hence, the program "Global education: cosmic view of life", developed by the World Centre for Survival and Problems of the 21st Century under the United Nations, based on a new paradigm of education: from differentiation of knowledge to synthesis of knowledge, from reductionism to holism, which stresses the spiritual and world outlook function of modern education as an actual mechanism of inclusion of every person in the vivid and continuous process of understanding the world and one's place in it, is the corner-stone of future changes on the planet [12].

The understanding of these priorities should facilitate the formation of a modern system of technical education that includes humanistic and ethical parameters, and integrates fundamental science, special and liberal arts knowledge.

All these aspects require radical changes in the methodological framework of training the specialist in the higher technical school.

The new definition of education, as a condition for training individuals for active independent life, is linked to a more profound understanding of education: not simply as a process of imparting knowledge and skills, but as a process of a person's identification of his/her self and society, nature, space, his/her role in the preservation and beneficial transformation of the world - that is, to be a professional in the area chosen, to be a person who is able to function successfully in the ever changing world of many uncertainties, and to be a person of multi-faceted humanistic and liberal thought who is backed up by the cultural legacy of preceding generations.

Proceeding from the fact that education, as an open dynamic system, is to secure the ability to analyze change, anticipate the future, and be flexible in response, the role and goals of liberal training in the system of technical education is changing.

If we compare the main goal of technical university education with the goals of liberal arts training in the course of education, we will see that its main feature is the study of regularities in the harmony of interaction between nature and society and modern ways of making it possible to use them practically - which determines the functional nature of liberal arts training in the technical university. Therefore, in line with the nature of the subject, liberal arts training, in the process of

technical university education, has the following tactical and strategic goals:

- it reveals the essence of phenomena of interaction between nature, man and society, and studies the laws of this harmonic interaction (the tactical goal);
- it identifies and substantiates the possibility of practical use of regularities discovered (the strategic goal).

The goals and tasks formulated indicate the place of liberal arts education in technical university training – bringing together fundamental science training, the step-by-step nature of cognition, creative thought formation and the philosophic framework of the future specialist's world outlook.

Being guided by these priorities will facilitate the formation of modern philosophy of technical education, as an interdisciplinary area that includes values, liberal and ethical parameters which integrate natural science, general technical, special technical and liberal arts knowledge, and widely uses traditions of world and national culture.

Based on the role and functions of fundamental science training in modern society, ideas of promoting fundamental science and liberal arts education should serve the basis for the formation and content of the university education system, which means that fundamental science training at the classical university - should not be of narrow-area nature. Therefore, the chief element of educational process improvement at the technical university is to be the inclusion in the fundamental liberal education curriculum of natural-technical disciplines, and, accordingly, of a cycle of liberal arts disciplines in the fundamental natural-technical science training. At the same time, this process should not be seen as mere mixing of the well-known subjects that already exist. What is meant here is the creation of new generation problem-oriented integrative courses, which will require inter-disciplinary synthesis and broad systemic poly-subject vision of the teachers and students. Development of such courses, as the basis of "shaping personal integrative qualities", should become a priority in the psychological and pedagogical research of problems of higher education.

In addition, the process of university education, in our view, should include disciplines and courses, the content of which reflects the process of integration and differentiation in modern science. This cannot be achieved without the use of cybernetics, synergy and other areas of knowledge, which emerged at the interfaces between sciences, and allow reaching the systemic level of understanding reality.

Therefore, interdisciplinary integrative courses, that carry fundamental (philosophical and methodological) knowledge forming the basis for shaping general and professional culture, should play a priority role in the content of renovated education provided by the classical university. These courses are to become the basis for university graduates' ability to adapt to new professions and specializations, as well as the theoretical basis for applied research. Thus, the basis for improvement of the content of fundamental knowledge training in the technical university, in our view, should include a number of basic, fundamental moral and aesthetic imperatives:

- values common to all mankind (standards of human conduct);
- nationally-oriented values (the idea of national self-identification, national cultural tradition);
- modern world values (democracy, human rights, freedom of choice) that allow us to identify the cult of the harmoniously developed person – who is a well-educated, cultured, physically and morally healthy, socially-oriented creative personality with an active social position in the fast changing world - as the bearing support for the system of education in the technical university.

Furthermore, the above formulated principles of the creative process impose certain requirements on the organization of the process of education in the classical university, which is to provide high-quality basic knowledge and skills, envisage divergent thought development and its practical application skills that allow reassessing acquired knowledge and generating new ideas, focus attention on developing creative and professional performance. The formulated objectives are in line with the views held by the well-known psychologist B.G Afanasyev who points out that "one of the indicators of human individuality is the person's productive, creative activity, realization of

all great potentialities of man's historic nature" [13].

As mentioned above, the framework of innovative education lies in the fact that it is aimed at the shaping of world outlook based on the diversity of criteria for decision-making, tolerance for dissent and moral responsibility for one's own actions, competence, and systemic intellectual activities. Primarily, this means harmony of different kinds of thought: objective, operational, theoretical, constructive-heuristic and personal world outlook. V.I. Vernadsky, in his time, raised the problem of necessity to remove boundaries that "put a wall, not surmounted yet, between people who make investigations in sciences natural and mathematical, and those who are close to sciences historical, philosophical, psychological and philological" [14]. Taking this into account, the technical university is to reorient itself towards a qualitatively new technology of education that is of multi-objective nature, i.e. towards pedagogy of cooperation and pedagogy of free upbringing; new approaches in the organization of the process of education in the Higher School: differentiated, problem-oriented, game-based, dialogue-based approaches – the ones that are based on principles such as role perspective, pedagogic interaction, cooperation and creative co-work.

Therefore, the technical university, being a holistic research and educational, scientific and technological, and socio-cultural system, presents itself as a kind of incubator of breakthrough technologies, highly-qualified specialists, science-intensive business, and production facilities of the future. The lead in its activities is taken by research, fundamental research in the main directions of science and technology, interdisciplinary research, research into problems of the Higher School and methodology.

Based on the main functions of higher education, it is possible to formulate the main principles that may serve as the foundation of a university education system technology:

- methodological reorientation from informational aspects of learning liberal arts disciplines to individual personality development;
- giving a humanities angle to fundamental science training through unraveling the cultural potential of scientific knowledge of fundamental sciences, its direction towards humanistic ideals of shaping individual personality capable of harmony with nature, the environment and him/herself;
- implementation of the principles of continuous education, considering the cognitive ability and interests at different stages of the individual's personality development;
- "workability" of education that provides activity and an individual rate of complete student interiorization of the humanities cycle courses taught.

The above principles that have the concepts of utilitarian technologies of training as their basis, allow, when designing new education technologies, a departure from the subject-oriented system of education and embarking on the designed creative path characterized, in the first place, by the personal activity approach to study - when activity proper (the creation of the image of the world and its understanding in the context of image creation) and individual personality (as personal responsibility for one's own actions) go to the forefront. For this reason, under the new concept of education, knowledge and skills are no longer considered to be the goals of education, but rather the means of individual personality development in an educational environment.

Based on the fact that the content characteristic of principles and requirements for the classical university graduate is enlarged by adding on new components, all this calls for a structure and content adjustment in the existing system of technical education, which presupposes the development of a new concept of liberal arts training in the technical university, the foundations of which are to include principles that would serve as the basis for shaping a highly educated, intellectually developed and moral person, not only because of the needs of the socium, but also with due regard for individual inclinations, abilities and interests, considering the person as a holistic open dynamic system.

Conclusionc

1. Proceeding from the chief goal of higher education – to shape professional specialists and civic-minded creative personalities capable of global humanistic thought and acting, through creative work - we consider creativity as an integral quality that appears in the intellectual and social spheres.

2. The study outcomes allow us to achieve a conceptually new level of theoretical understanding of the problem of devising integrative courses in the system of continuous education, making for a transition from the descriptive category of "considering the creative pedagogic sphere" to the active category of "creating a creative pedagogic environment".

3. It has been proven that creativity, as a personal multi-level personality category of andragogy, is characterized by the dialectic tree-dimensional nature of its components: procedural, resultant and personality; it is the productive source of the higher school graduate's creative work and the basis of effective professional adaptation.

4. Development of creativity facilitates the specialist's achievement of a high level of professionalism, personality and intellectual heights, i.e. it makes for self-actualization.

References

1. *А.Маслоу.* Новые рубежи человеческой природы. –М., Смисл, 1999, -425с.
2. *А.Вербицкий.* Активные методы обучения в высшей школе: контекстный подход. –М., Высшая школа 1991, -207с.
3. *Б.Гершунский.* Философия образования для XX1 века. – М., "Интер Деалект +" 1997, -694с.
4. *В.Давыдов.* Проблема развивающего обучения. –М., Педагогика 1988, -240с.
5. *В.Леднев.* Непрерывное образование: структура и содержание. – М., Высшая школа,1990, -224с.
6. *Ф.Янушкевич.* Технология обучения в системе высшего образования. – М., Высшая школа,1986, 146с.
7. *С.Габрусевич, Г.Зорин.* От деловой игры – к профессиональному творчеству. – Минск: НАН Беларуси, 1989, -165с.
8. *И.Зимняя.* Педагогическая психология. –М., "Логос", 2000, -380с.
9. *Ю.Карпова.* Инновации, интеллект, образование. Монография. – М.: Издательство МГУЛ, 1998, -176с.
10. *А.Морозов.* Диагностика креативности в педагогической деятельности. Монография. – М.: ИГУМО, 2001, -253с.
11. Сучасні системи вищої освіти порівняння для України. – К.: Вид-во Дім "Km akademia", 1997, -197с.
12. *BotRin I. Elmandra M., Malitra M.* No limits to learning. – Oxford, 1999, p.23-38.
13. *Б.Ананьев.* Человек как предмет познания. – М, Педагогика, 1980, -231с.
14. *Г.Александров.* Психолого-педагогические основы разработки педагогических технологий в XX! Веке. – Минск: НАН Беларуси, 2000, -165с.
15. *Valerio Grementieri.* Innovation Technology and Higher Education. Higher Education in Europe, Vol.XXIII, # 2, 1998 – p.47-53.

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EVOLUTION OF VIEWS ON THE HUMAN FACTOR IN AVIATION

The author offers a human factor model which differs from the SHEL model by a greater specification of its constituent elements and emphasis on cross-cultural aspects. The aim of the proposed model is to give a more adequate consideration to the phenomena which constitute the basis of the human factor in aviation.

Timely identification and minimization of risks which can result in failure of or undesirable deviation in human activities calls for an adequate fundamental model of the human factor in aviation. Statistics of flight events and accidents involving human factor testify that it is vital not only to make human factor management more consistent and thorough in keeping with the current models and concepts, but also to critically revise and update standard views on human factor. It is quite likely that insufficient attention to certain relevant aspects of human factor in its basic concepts can result in such aspects being underestimated or even overlooked. This can refer even to things which themselves are quite obvious, the obvious character of a problem not always being a sufficient ground for implementation of corresponding prevention measures on a systemic basis.

It is evident that human factor requires comprehensive analysis. Four principal aspects of such analysis are reflected in the SHEL model. At the same time, the extreme generality of the SHEL model, which is its strong feature in terms of clarity and indisputably comprehensive identification of the segments which call for attention, can be regarded as its weakness.

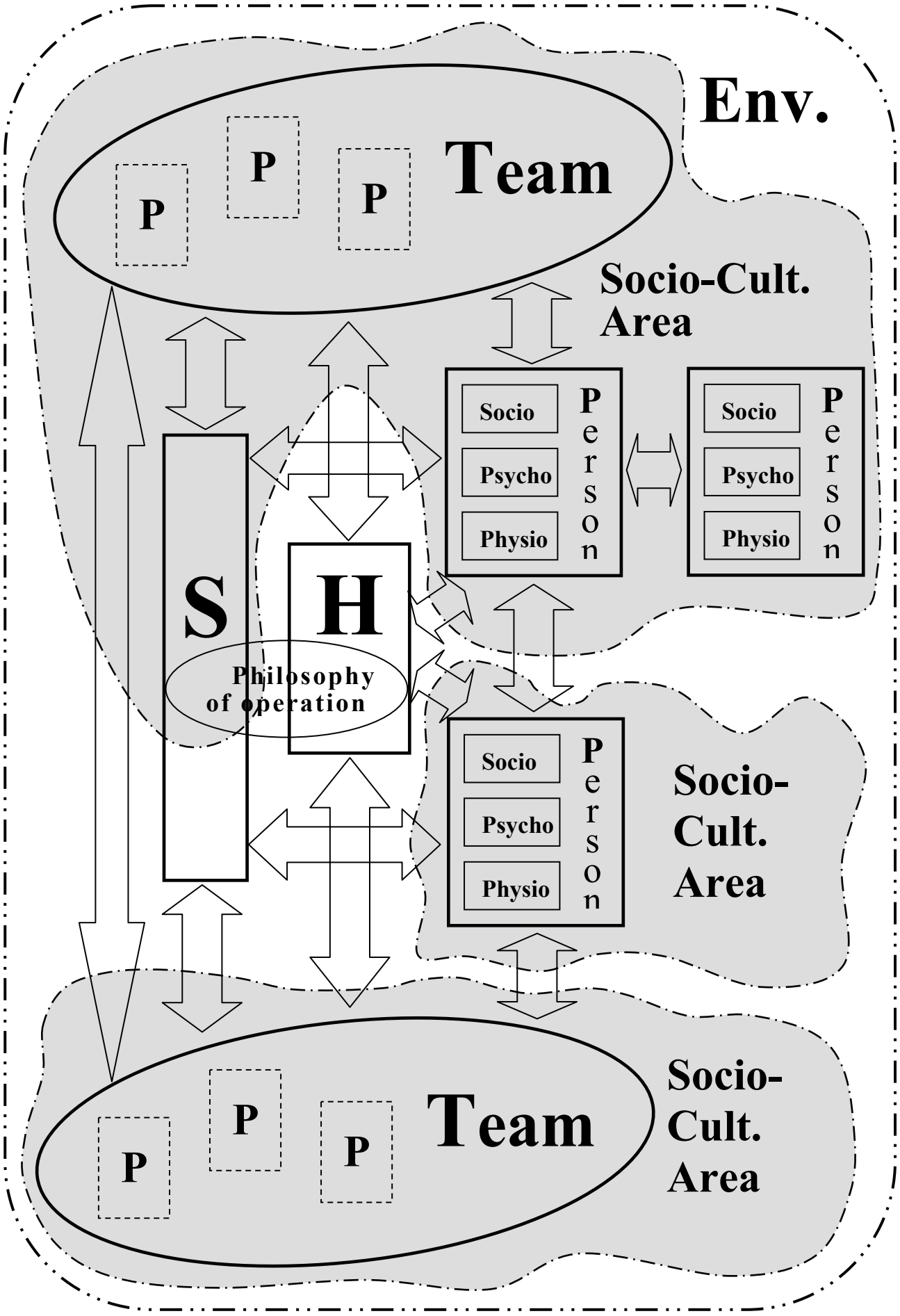
Emphasizing interrelationships on the fundamental level, the SHEL model inevitably goes beyond numerous issues relating to these interrelationships. Here are some arguments in favour of a more detailed specification of these issues.

The notion of *liveware* encompasses all forms of people's involvement in aviation ergatic systems. Thus, the SHEL model intends to incorporate all relevant aspects of *liveware*. But would not it be better to specify these aspects already on the level of the basic model? In our opinion, it is feasible due to the following. Staff comprises both professional teams and individual professionals. A professional team can act as a subject of activity in the same way as an individual. At the same time, characteristics of a team differ essentially from the characteristics of an individual. Forms of work with an individual differ from those with a team too.

A flight crew, even staffed for one single flight, is an integral unity both in functional and social-psychological meaning, and as such should be considered as a professional team with all its inherent characteristics. At the same time, each separate individual remains an important element of the whole system.

Possibilities of each individual are determined by a number of characteristics which relate to different levels of a complicated bio-psycho-social system, functioning as one single whole both subordinately and coordinately. This fact must be taken into consideration when analyzing various aspects of the human factor, which makes it possible to create optimal conditions for a multidisciplinary approach.

One more important thing is that staff functions in various sociocultural areas. These areas can be outlined by peculiarities of national mentality, corporate culture of airlines, some specific features of an airport staff or air traffic controlling staff, or even by sociocultural peculiarities of a separate subdivision. An up-to-date conceptual model of human factor inevitably has to include as an important object of analysis the sociocultural area in which people work.



Pict. 1. Detailed model of human factor

Another important issue connected with sociocultural factors lies in certain sociocultural determination of various procedures and rules. *Software* is a sociocultural product, even though at first sight some activity rules are determined by design features of technological systems. Any technological system is grounded on a certain philosophy which finds its further expression in operation rules and job management principles. Thus, a technology can attract potential operators by its performance, and at the same time put them off by its managerial- technological principles of operation. Naturally, the relevance of this issue can vary cross-culturally. In some parts of the world it can be of little importance, while in others it can be decisive while making decisions connected with technical modernization and purchase of new aircraft. It should be mentioned that if such circumstances arise, the situation can require not only adjustment of certain principles and operation rules (which often may appear impossible) but also development of corresponding principles and techniques of staff retraining in view of sociocultural peculiarities of each specific area.

Picture 1 shows a conceptual model of human factor as we see it in view of the considerations given above. Besides H (Hardware), S (Software), E (Environment), the model contains SCA element (Sociocultural Area), whereas Liveware is replaced by T (Team) and P (Person). Such view of the model serves for us the basis for defining the main directions of our further research aiming at building a modern paradigm of human factor management.

References

1. *Петренко О.В.* Соціокультурні регулятори ефективності льотного екіпажу (Sociocultural regulators of flight crew efficiency) // Актуальні проблеми психології діяльності в особливих умовах: Матеріали IV Міжнародної науково-практичної конференції. – К.: НАУ, 2009. – С. 85-90.
2. *Петренко О.В.* Методологічні особливості психологічних досліджень діяльності екіпажів повітряних суден як малих груп (Methodological features of psychological research of the work of aircraft crews as small groups) // Гуманітарні проблеми становлення сучасного фахівця: Матеріали VIII Міжнародної науково-практичної конференції – Т. 1. – К.: НАУ, 2007. – С. 164-166
3. Циркуляр ИКАО №216 - AN/131. Человеческий фактор: Сборник материалов №1. Фундаментальные концепции человеческого фактора. - Монреаль: ИКАО, 1989. - 34 с.

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PRINCIPLE OF THE SUBJECTIVE ENTROPY MAXIMUM AND SAFETY OF ACTIVE SYSTEMS

The possibility of using the method of entropy maximum with the analysis of the tasks of active systems safety is examined.

Introduction

The account of "the human factor» in problems of safety of flights is an obligatory component of research, and in case of concrete aviation events — an investigation component. Experts take away to "the human factor» from 60 to 80 % of special flight situations when this factor served as the reason of aviation incident.

In aircraft as «the human factor» usually understand set of personal, medical and biological factors which define optimum service conditions airplanes and an air traffic control. For today the human factor is difficult system for aircraft, but at the same time is a source of hopes and not used reserves [1].

Statement of research problems

Attraction of the subjective analysis for the decision of flight situations is offered. The Aviation-transport system is considered as active system. In the centre of such system always there is a person who makes the decision.

The concept «safety of active systems» essentially differs from concept of safety of technogenic, ecological, economic, and social and other systems. Though at all these systems there is a person, its role usually is represented under other point of view [2,3] how it becomes within the limits of the developed approach and use as the central element of subjective entropy. This entropy displays preferences of the subject and is a measure of its uncertainty. The device of functions of preference can be connected with some sections of psychology and, in particular, with psychometric methods.

The main aspects of problem

Safety of active system is a safety of the subject which is a kernel of active system.

Directly the active system joins the subject and an artificial component. Thus, the active system always is opened. The subject co-operates with external environment that leads to change of a problem-resource situation and in parallel to it occur internal processes. They are connected among themselves that in turn speaks about «safety of active system».

There is a formal analogy between distribution of preferences and to distributions of probabilities and there is a possibility to use many results of probability theory, the mathematical statistics, and also the information theory, giving them, however, each time interpretation in terms of the subjective analysis.

For reception of initial distributions of probabilities it is possible to use a variation principle of entropy maximum. [4]. Use of the similar approach leads to "initial" functions of distribution of preferences. The optimality principle is thus postulated.

In a general view the principle looks as follows: $P(\sigma_1) > P(\sigma_2)$ but if to make replacement by preferences we will receive the following: $\pi(\sigma_1) > \pi(\sigma_2)$. If to consider this replacement in functional it will be possible to receive result which will already numerically define alternative that is more attractive.

It is supposed that preferences of the subject are distributed on set of alternatives S_a in such a manner that some criterion containing functions of preference gets extreme value. The functional looks as follows:

$$\Phi_{\pi_i} = \sum_{k=1}^{N} \pi_i \cdot \ln \pi_i + \beta \cdot \sum_{k=1}^{N} \pi_i \cdot F(x, \dot{x}..) + \gamma \cdot \sum_{k=1}^{N} \pi_i \qquad (1.1)$$

Let's consider that the criterion is the weighed sum three component. A criterion body is entropy of distribution of preference H_π. The second additive component of criterion is function of efficiency ε which depends from both on subjective preferences, and from the certain objective characteristic of alternatives.

Let's assume that generally as such characteristic function can be used a function of utility $U(\sigma_i)$; $\sigma_i \in S_a$. In the special cases probabilities of $p(\sigma_i)$, can come forward as a function of utility, either some of resources or even some other functions, reflecting distributions of preferences in the past and allowing to take into account on the current stage a priori tastes, folded "points of view" and persuasion.

The third composed is caused by condition of standardize. Both function of efficiency and a condition of standardize in each specific case have the specific appearance answering to statements of the problem.

Structural parameters α, β, γ… will be defined as internal parameters that reflecting certain properties of mentality.

In the theory of the subjective analysis the concept entropy accidents is offered.

«Entropy accident» is such situation when on set of alternatives S_a entropy H_π exceeds critical level H^* and the subject cannot make the decision within had time (time resources)/

Let's consider the elementary example in the presence of two equivalent alternatives. In it cases entropy will be maximum $\mathbf{H_\pi = -2\pi ln\pi = H_{max}} = 0{,}693$ and, hence, there was no possibility to make decision having chosen one of the offered alternatives.

If had resources gradually are settled, and subjective entropy remains high "a rescue" condition is the inequality: $\mathbf{t^*_н < t^*_R}$, (1.2)

Where — $\mathbf{t^*_н}$ the moment of time, such that at $t \geq t^*_н$ for entropy takes place inequality $H_\pi \leq H^*_\pi$, t^*_R such that at $t \geq t^*_R$ inequality $R^{disp}(\sigma_k) \leq R^{req}(\sigma_k)$ for these conditions is carried out reflects fig. 1.1.

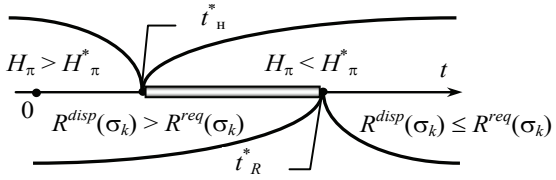

Fig. 1.1 Scheme of occurrence «entropy accidents»

If it is in advance known that the inequality (1.1) it is possible to set the task about additional quantity of resources and ways of their investment in system which are necessary for system "rescue" takes place. To negative consequences from the point of view of safety can make interference of two and more subjects at the permission of the extreme situation interfaced to a choice from a set of alternative strategy. Accident comes not necessarily as a result of exhaustion of active resources (intellectual, physical resources and the time) but also, for example, at occurrence of catastrophic changes in external environment when active resources are not settled yet, but catastrophically there are no passive resources (the finance, materials, energy, the information which the subject has) and, in a consequence of it, all alternatives become unattainable. In this case we can say that setS_a becomes empty: $S_a = \varnothing$, or contains only one (actual) condition σ_0, and the subject gets to "stalemate".

«Entropy jump» can serve one of stressful situation characteristics. Jump is characterised by depth and "direction". We name «entropy jump of I sort» sharp increase in entropy:

$$\delta H_\pi = H_\pi(t + \varepsilon) - H_\pi(t) > 0, \qquad (1.3)$$

«Entropy jump of II sort» — sharp reduction of entropy:

$$\delta H_\pi = H_\pi(t + \varepsilon) - H_\pi(t) < 0, \quad (1.4)$$

Entropy jump is connected with instant (an event during very short time) "allocation" or information "absorption". In case of jump of II sort there is a question on ability of the subject to perceive and master the information during small time ε. As to jump of I sort, we can come out with the assumption of the limited quantity entropy jumps which the mentality of concrete subject $N^*_н$ can sustain. Apparently, this number depends on absolute size of jump, type of jump, intervals between jumps. There should be a dependence similar to curve weariness $N^*_н = f(\delta H_\pi, \ldots)$.

It is offered to consider the alternative approach to the description of behavior of active system «the pilot – the plane». We will make construction of the combined "probability-subjective" model of situational dynamics. We will present air system in the form of active system which during each moment is in a certain problem-resource situation. The subject of system – its active element makes the decision on set of alternatives.

Character of alternative strategy and their quantity depend on an arising flight situation $\sigma_{mi}(t) \in S_{ai}(t), \quad (m \in \overline{1, L})$. Each time when there is an initiating event to the probability $q_i(t)\Delta t$, situations leading to change, the pilot analyzes a quantity of alternative strategy of parrying of adverse development, and one of strategy without fail gets out. The decision on a strategy choice $\sigma_{mi}(t)$ are accepted on the basis of the analysis of resources, knowledge and the skills received at training, and also such factors, as I.Q., education, level of the general culture. For possibility of the qualitative analysis of influence of these factors subjective preferences, a combination of the likelihood and subjective analysis are entered into consideration.

The events consisting in a choice of this or that strategy from $S_{ai}(t)$ are incompatible and make full group. Therefore transitive probability $Q_{i,j}(t)$ can be written down in a kind:

$$Q_{i,j}(t) = \sum_{m=1}^{L} P\left(\sigma_{m,i}(t) \mid i\right) Q_{i,j}\left(t \mid \sigma_{m,i}(t)\right), \quad (1.5)$$

$P(\sigma_{m,i}| i)$ — probability of that as a result of occurrence of initiating event with intensity $q_i(t)$ the pilot will choose strategy $\sigma_{m,i}(t) \in S_{ai}(t)$, $Q_{i,j}(t| \sigma_{m,i}(t))$ — probabilities of transition of system in a condition j from a condition i at use $\sigma_{m,i}(t)$. Probabilities $P(\sigma_{m,i}(t)| i)$ are normalized by a condition:

$$\sum_{m=1}^{L} P\left(\sigma_{m,i}(t) \middle| i\right) = 1, \ (\forall i) \quad (1.6)$$

If to assume that probabilities of a choice of alternatives $P(\sigma_{m,i}(t)| i)$ are directly proportional to corresponding preferences, which as well as probabilities normalized on unit it is possible to make informal substitution:

$$P(\sigma_{m,i}(t)| i) \to \pi(\sigma_{m,i}(t)| i) \quad (1.7)$$

And instead of a parity (1.6) to take advantage of a parity:

$$Q_{i,j}(t) = \sum_{m=1}^{L} \pi\left(\sigma_{m,i}(t) \mid t\right) Q_{i,j}\left(t \mid \sigma_{m,i}(t)\right). \quad (1.8)$$

In expression for the initiating density of probability which represent the total probability formula private probabilities of realization of those or other strategy are replaced with functions of preferences [5].

Let's consider some problems which are connected with safety of flights.

Formalization of concept of a flight situation is given in [6]. In the course of flight one flight situation replaces another. There are some alternative strategy of behavior of crew or all personnel when appears some situation. The exception is made, of course, by cases when on crew already depends nothing. But nevertheless in most cases, however, crews take measures to rescue of an aircraft and safe end of flight. We will designate alternative strategy through σ_k, and all set of admissible strategy through S_a. Preferences $\pi(\sigma_k)$ are formed on set S_a. Distribution of preferences changes in process of development of a flight situation. Set S_a included into the formal description of a flight situation and also is dynamic object: the structure of alternatives changes eventually.

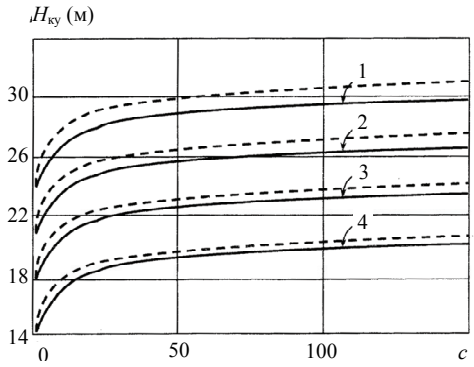

Fig.1.2. Dependence of $H_{ну}$ from c and τ

Let's consider results the decision of a problem on a choice of height of the beginning of departure on the second circle for plane Il-86. The basic result is presented on fig. 1.2 where values of the accepted height of the beginning of leaving of $H_{ну}$ depending on the relation of penalties are shown with and the most influencing parameter – delays of reaction to decision-making we "leave" τ. From drawing it is visible that at c = 50 and τ = 3.16s (according to requirements IKAO) it is necessary to accept in this case $H_{ну}$ = 30 m.

Conclusion

Results of the numerical decision of some modeling problems are presented: values of transitive probabilities on set of flight situations and their dependence from external and internal factors. There was a variant of mathematical model which considered mobility entropy thresholds. The point of intersection of curve entropy and «a threshold curve» is the decision-making moment.

Results of the decision of one of problems are presented on fig. 1.3. In the given model it is provided three alternatives which are normalized and their entry conditions are equal. To each of them there corresponds the speed of an expenditure of resources. In due course the subject is compelled to make the decision and it throws back one of alternatives that leads to spasmodic change remained two. It is obvious that it was accompanied by entropy change. It is possible to explain an event to that resources are settled and it is necessary to make a choice before there will be no time in a stock.

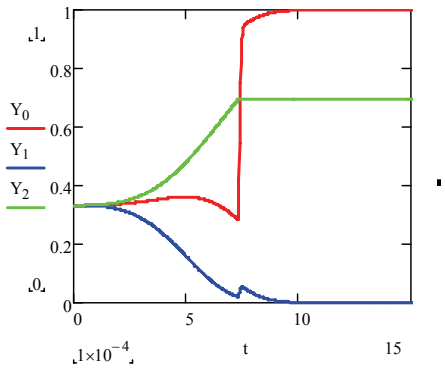

Fig. 1.3. Spasmodic change of alternatives.

The literature list:

1. *Кулик Н.С., Харченко В.П., Луцкий М.Г.,* Энциклопедия безопасности авиации. [Текст] / Н.С.Кулик, В.П.Харченко, М.Г.Луцкий – Киев: Техника, 2008. – 1000с.

2. *Волик Б.Г., Гладкова Г.А.* Математические модели человека-оператора, работающего в замкнутом контуре управления // Приборы и системы управления, № 2. — М. — С.9-12.

3. *Ефремов А.В., Оглобли А.В. Предтеченская А.И., Радченко В.В.* Летчик как динамическая система. — М.: Машиностроение, 1992. — 336 с.

4. *Стратонович Р.Л.* Теория информации. [Текст] / Р.Л. Стратонович — М.: Сов. радио, 1975. — 424 с

5. *Касьянов, В. А.*Субъективный анализ [Текст] / В. А. Касьянов. — К.: НАУ,2007. — 512с.

6. *Касьянов В.А.* Моделирование полета. [Текст] / В. А. Касьянов — К.: НАУ, 2004. — 400 с.

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TRANSFER OF TRAINING PROBLEM IN UKRAINIAN AIR COMPANIES

This review focused on the ways of overcoming proactive inhibition - the brain mechanism responsible for the proactive interference influenced by prior knowledge over new learning, which create "transfer of training problem" and slows adopting process of native flight staff for the modern operational standarts.

For about twenty years we have been looking for our own new way in Ukrainian skies. We changed almost everything: our fleet, rules, procedures and most of personnel. We tried to do our best selecting the best. Strict selection system was aimed to choose the most experienced, professionally skilled pilots. Best of the best were first to have a retraining for new machinery and technologies of work in various international certified centers. At the beginning there were a number of problems. But foreign instructors who have been watching over adoption process were deeply impressed by quick and permanent progress. Now we work on our own. The results are not bad. Not bad at all. But the progress is hardly gained. The situation became stable at some level and the further improvement comes very slowly. It is obvious for managers who watch over operation quality. What is the reason?

I spent years flying as a line instructor and flight safety inspector and now suspect that the method of selection and training of flight personnel is faulty. I often observed that being retrained pilots may appear to be able to adopt the desired skills during the training session, but when they get into the air much of what they apparently learned during training sometimes seems to disappear. This is especially noticeable in stressful or in emergency situations. It is evident in the absence of “call-outs”, “cross-check procedure” and other procedures, that were not present at the soviet planes. Under high work load and stressful conditions people invariably revert to their "own way" and forget their training. This is known as the "transfer of training problem". The transfer problem disturbs most training efforts. For example, it can take up to 1,000 hours for an experienced pilot to become fully competent and comfortable with the flight management system.

One of the main causes of the transfer problem and the associated slow rate of learning progress is interference associated with the learner's prior knowledge. The brain mechanism responsible for the proactive interference influenced by prior knowledge over new learning was called proactive inhibition. Proactive inhibition is best understood as the interference influenced by prior (old) knowledge over new knowledge. Proactive inhibition explains why old habits die hard and why trainees often appear to forget what they have just learned and return to their old ways of performing. In my opinion this mechanism lies in the basis of appearing of pilot’s aggression in stressful situations. This is what I wrote about in the article “The peculiarities of pilots’ aggressive reactions in stressful situations”.

But today I would like to point out the methods that will help to overcome transfer problem. I think the reason of failures in the process of experienced pilots retraining is wrong retraining method. As a rule our instructors use conventional training methods. Conventional training methods point out errors whenever they occur and then accentuate the correct answer. Because errors are believed to indicate the absence of learning or failed learning, trainers prefer not to keep on errors any more than necessary. This predisposition is also motivated by the mistaken belief that paying too much attention to a usual error will make it even more difficult to eliminate. What the trainer is basically saying to the trainee in all this is, "That's wrong; don't do it that way; do it this way; copy me; now go and practice the right way". This approach can be effective over an extended period of intensive correction but learning gains are typically slow. Transfer of learning to performance settings outside the remedial setting is usually poor because whenever the trainer is not directly attending to the trainee the cues to correct performance are removed and so the trainee typically reverts to his old wrong way.

For the means of overcoming the proactive inhibition and adapting new procedures by experienced pilots there exist absolutely different method of pilot training. Dr Paul Baxter (Brisbane, Australia) called this method Old Way/New Way. This method is very effective in changing actual human behaviour and misconceptions and improving conceptual understanding in many different performance settings. This method typically gives 80% or higher transfer of skill after one or two sessions. The learner is also able to apply self-correction after one session and since he or becomes 90% effective in detecting whenever they revert to their "old way", the rate of improvement is understandably rapid. Old Way/New Way can deliver these learning gains because it by-passes the proactive inhibition mechanism.

The Old Way/New Way process has a number of steps. Step one is error diagnosis. It is necessary to determine if we are dealing with a learned error or a simple transient "mistake" because the remedy is different in each case. Mistakes can be dealt with using conventional training or re-training or perhaps they are to be expected as part of the normal learning process. Learned errors, however, require Old Way/New Way because trying to correct them using conventional means does not work - it arouses proactive inhibition and causes interference with new learning so that the new learning suffers accelerated forgetting and the old inappropriate learning returns. Error diagnosis relies on expert input, e.g., from a flying instructor. His contribution is to help the person change over to the "new" way, once this has been identified. At this point you can probably see how this methodology would ideally be part of the instructor's own set of on-the-job training tools on which he could draw during normal day-to-day instruction. Step two involves teaching the person the difference between his "old" and "new" way, in other words, the way he normally or often do it, and the way he should be doing it. This difference is then reinforced until it is clear in their heads, before proceeding with the final step which is the practice of the "new" way. Old Way/New Way is not for everyone and it is certainly no quick fix. For the method to work we really do need someone who is able to identify exactly what is being done wrong, what should be done instead and what the differences are between these two ways. Not every pilot-instructor can be that analytical. Secondly, we need people who are willing to change or at least see a need to change. The methodology is able to sort out those people who are unwilling from those who appear to put up a resistant front because they believe, deep down, that it is impossible to change themselves. Thirdly, for the methodology to work we need someone who is prepared to practice the new way. Without practice, as we all know, what you learn is soon forgotten and this is no exception. Finally, self change is an intensely personal process and can be demanding. The person must be prepared to put in the effort and cooperate with the facilitator all the way through the process.

The problem is that we don’t have instructors skilled enough to prepare personnel using this method. Instructors themselves have an awful load of experience that’s why they teach in a wrong way and achieve wrong results. What we need is the change of instructors’ school. The question cannot be put off. There are already a lot of young and smart pilots in Ukrainian companies who avoided old machinery and procedural experience, and who were taught according to the modern western technologies. Our task is to pick up those of them who have necessary psychological and pedagogical qualities for the adoption of new methods of retraining. We should teach these young instructors the Old Way/New Way method in appropriate foreign centers. We should provide normal psychological environment in our flight team for them. It will help to avoid conflicts among different generations. If this is not realized the history would repeat itself again and again. The experience of my company shows that there are a lot of barriers on this way. But nevertheless we shall do our best to change the way the thing are.

References

1. Baxter EP et al. 1996. Skill Correction and Accelerated Learning in the Workplace.
2. Baxter EP. 1998. CRM Training Fails Because of What Trainees Already Know; Not Because of What They Don't Know.
3. Rowell JR et al. 1990. Changing misconceptions.

UDC 371.32 (043.2)

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HOW TO TEACH SPEAKING: A CRUCIAL METHODIC PROBLEM

The article is dedicated to an important problem of teaching speaking. Skills are presented in the form of communicative incorporation according to which the tasks for developing speaking skills are exemplified.

Teachers tend to talk about the way we use language in terms of four skills – reading, writing, speaking and listening. These are usually divided into two types: receptive and productive skills. Receptive skills is a term used for reading and listening, skills where meaning is extracted from the discourse. Productive skills is a term for speaking and writing, skills where students actually have to produce language themselves.

There is some concern about separation these skills in such a way, especially since they are seldom separated in real life. According to Eli Hinkel, there is little use in pointing out the skills in such a way, "in meaningful communication, people enjoy incremental language skills not in isolation, but in tandem". When we are engaged in conversation, we are bound to listen as well as speak otherwise we could not interact to a person we are speaking to. Lecturers frequently rely on notes they have written previously, and people listening to lectures often write their own notes. Even reading, which is generally considered as a private activity, often provokes conversation and comment. So, as we can see, usually all skills are more or less incorporated within one activity.

Clearly, therefore, if a skill is multi-layered in this way, it would make no sense to teach each skill in isolation. Our task, therefore, is to look how input and output are connected in the classroom, how skills can be integrated.

To help students develop communicative efficiency in speaking, instructors can use a balanced activities approach that combines language input, structured output, and communicative output.

Language input comes in the form of teacher talk, listening activities, reading passages, and the language heard and read outside of class. It gives learners the material they need to begin producing language themselves.

Language input may be content oriented or form oriented.

Content-oriented input focuses on information, whether it is a simple weather report or an extended lecture on an academic topic. Content-oriented input may also include descriptions of learning strategies and examples of their use.

Form-oriented input focuses on ways of using the language: guidance from the teacher or another source on vocabulary, pronunciation, and grammar (linguistic competence); appropriate things to say in specific contexts (discourse competence); expectations for rate of speech, pause length, turn-taking, and other social aspects of language use (sociolinguistic competence); and explicit instruction in phrases to use to ask for clarification and repair miscommunication (strategic competence).

In the presentation part of a lesson, an instructor combines content-oriented and form-oriented input. The amount of input that is actually provided in the target language depends on students' listening proficiency and also on the situation. For students at lower levels, or in situations where a quick explanation on a grammar topic is needed, an explanation in English may be more appropriate than one in the target language.

Structured output focuses on correct form. In structured output, students may have options for responses, but all of the options require them to use the specific form or structure that the teacher has just introduced.

Structured output is designed to make learners comfortable producing specific language items recently introduced, sometimes in combination with previously learned items. Instructors often use

structured output exercises as a transition between the presentation stage and the practice stage of a lesson plan, textbook exercises also often make good structured output practice activities.

In communicative output, the learners' main purpose is to complete a task, such as obtaining information, developing a travel plan, or creating a video. To complete the task, they may use the language that the instructor has just presented, but they also may draw on any other vocabulary, grammar, and communication strategies that they know. In communicative output activities, the criterion of success is whether the learner gets the message across. Accuracy is not a consideration unless the lack of it interferes with the message.

In everyday communication, spoken exchanges take place because there is some sort of information gap between the participants. Communicative output activities involve a similar real information gap. In order to complete the task, students must reduce or eliminate the information gap. In these activities, language is a tool, not an end in itself.

In a balanced activities approach, the teacher uses a variety of activities from these different categories of input and output. Learners at all proficiency levels, including beginners, benefit from this variety; it is more motivating, and it is also more likely to result in effective language learning.

Traditional classroom speaking practice often takes the form of drills in which one person asks a question and another gives an answer. The question and the answer are structured and predictable, and often there is only one correct, predetermined answer. The purpose of asking and answering the question is to demonstrate the ability to ask and answer the question.

In contrast, the purpose of real communication is to accomplish a task, such as conveying a telephone message, obtaining information, or expressing an opinion. In real communication, participants must manage uncertainty about what the other person will say. Authentic communication involves an information gap; each participant has information that the other does not have. In addition, to achieve their purpose, participants may have to clarify their meaning or ask for confirmation of their own understanding.

To create classroom speaking activities that will develop communicative competence, instructors need to incorporate a purpose and an information gap and allow for multiple forms of expression. However, quantity alone will not necessarily produce competent speakers. Instructors need to combine structured output activities, which allow for error correction and increased accuracy, with communicative output activities that give students opportunities to practice language use more freely.

Structured Output Activities

Two common kinds of structured output activities are information gap and jigsaw activities. In both these types of activities, students complete a task by obtaining missing information, a feature the activities have in common with real communication. However, information gap and jigsaw activities also set up practice on specific items of language. In this respect they are more like drills than like communication.

Information Gap Activities

Filling the gaps in a schedule or timetable: Partner A holds an airline timetable with some of the arrival and departure times missing. Partner B has the same timetable but with different blank spaces. The two partners are not permitted to see each other's timetables and must fill in the blanks by asking each other appropriate questions. The features of language that are practiced would include questions beginning with "when" or "at what time." Answers would be limited mostly to time expressions like "at 8:15" or "at ten in the evening."

Structured output activities can form an effective bridge between instructor modeling and communicative output because they are partly authentic and partly artificial. Like authentic communication, they feature information gaps that must be bridged for successful completion of the task. However, where authentic communication allows speakers to use all of the language they know, structured output activities lead students to practice specific features of language and to practice only in brief sentences, not in extended discourse. Also, structured output situations are contrived and more like games than real communication, and the participants' social roles are irrelevant to the performance of the activity. This structure controls the number of variables that

students must deal with when they are first exposed to new material. As they become comfortable, they can move on to true communicative output activities.

Communicative Output Activities

Communicative output activities allow students to practice using all of the language they know in situations that resemble real settings. In these activities, students must work together to develop a plan, resolve a problem, or complete a task. The most common types of communicative output activity are role plays and discussions.

In role plays, students are assigned roles and put into situations that they may eventually encounter outside the classroom. Because role plays imitate life, the range of language functions that may be used expands considerably. Also, the role relationships among the students as they play their parts call for them to practice and develop their sociolinguistic competence. They have to use language that is appropriate to the situation and to the characters.

Students usually find role playing enjoyable, but students who lack self-confidence or have lower proficiency levels may find them intimidating at first. To succeed with role plays:

Prepare carefully: Introduce the activity by describing the situation and making sure that all of the students understand it

Set a goal or outcome: Be sure the students understand what the product of the role play should be, whether a plan, a schedule, a group opinion, or some other product

Use role cards: Give each student a card that describes the person or role to be played. For lower-level students, the cards can include words or expressions that that person might use.

Brainstorm: Before you start the role play, have students brainstorm as a class to predict what vocabulary, grammar, and idiomatic expressions they might use.

Keep groups small: Less-confident students will feel more able to participate if they do not have to compete with many voices.

Give students time to prepare: Let them work individually to outline their ideas and the language they will need to express them.

Be present as a resource, not a monitor: Stay in communicative mode to answer students' questions. Do not correct their pronunciation or grammar unless they specifically ask you about it.

Allow students to work at their own levels: Each student has individual language skills, an individual approach to working in groups, and a specific role to play in the activity. Do not expect all students to contribute equally to the discussion, or to use every grammar point you have taught.

Do topical follow-up: Have students report to the class on the outcome of their role plays.

Do linguistic follow-up: After the role play is over, give feedback on grammar or pronunciation problems you have heard. This can wait until another class period when you plan to review pronunciation or grammar anyway.

Conclusion

Through well-prepared communicative output activities such as role plays and discussions, you can encourage students to experiment and innovate with the language, and create a supportive atmosphere that allows them to make mistakes without fear of embarrassment. This will contribute to their self-confidence as speakers and to their motivation to learn more.

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AVIATION ENGLISH TEACHING IN THE UKRAINIAN CONTEXT

"Aviation English" is designed as English for Specific Purposes (ESP) in the fields of aeronautics and/or aviation. Learners of ESP are supposed to become proficient in the specialty vocabulary concerned as well as English language skills. This paper states the importance of English in aviation industry and explores the methodology of teaching Aviation English in Non–English speaking countries, especially in the Ukrainian context, so that learners of ESP can learn the target language more effectively and meet the standards set by the International Civil Aviation Organization (ICAO).

With the recent advances in information and communication technologies, educators are rethinking how we teach all subjects including English for Specific Purposes. Today with the emergence of English as the prominent language in our increasingly technological and global society, the study of ESP has assumed a sense of urgency, especially in countries that are attempting to restructure the manner in which students learn and perform in English. Several of the issues and challenges that have surrounded English for Specific Purposes since the late 1960s and early 1970s still exist today as practitioners and researchers continue the discussion of needs assessment, discourse analysis, curriculum design, materials development, and delivery of instruction [3]. The challenges are largely due to the hybrid nature of ESP in its dual role of teaching field-specific content while simultaneously facilitating learners' development of the English language skills required to succeed in that field. First, ESP can be defined in terms of two basic goals for the learner: 1) the acquisition of content knowledge of a specific field, and 2) the development of English skills required to perform in the discipline. This combination requires expertise in English language teaching and content knowledge of a particular field such as aviation, science and technology, etc. in order to meet the specific needs of the learners; however, few individual instructors possess adequate knowledge of both a specific discipline and English language pedagogy. Success of international civil aviation depends upon standardization of aviation procedures, of which air communication is an important one. As history has repeatedly shown, a breakdown in the communication process often leads to less than desirable event below:

On March 27, 1977, the aircraft Pan Am Flight and KLM Flight 4805 - taking off in heavy fog on the airport's only runway, the KLM flight crashed into the top of the Pan Am aircraft back taxiing in the opposite direction. The Pan Am had followed the back taxiing of the KLM aircraft, under the direction of Air Traffic Control, and the KLM's flight crew had been aware of Pan Am back taxiing behind them on the same runway. Despite lack of visual confirmation (because of the fog) the KLM captain thought that Pan Am had cleared the runway and so attempted to take off without further clearance to do so. This case unanimously indicates the importance of English in the aviation industry as a prerequisite for safety and efficiency in aviation. However, the level of English training that pilots and controllers require is still a matter of some dispute. Goertz [4] feels that, because much of the critical information that is passed is based on numbers and letters (e.g. call–signs, altitudes, flight levels, radio frequencies, vectors, runways, wind speed), a controller with a good command of the International Civil Aviation Organization (ICAO) phonetic alphabet and a limited number of standard phrases can avoid many air traffic controller (ATC)/pilot miscommunication problems. But Uplinger [9] argues that the mastery of a specialized terminology is insufficient to avoid ambiguity. Developing functionality in a foreign language is a difficult task, she says, and a pilot or controller who knows 200–300 English ATC terms may have little functional ability. Uplinger cites the case of the crash of American Airlines in Columbia in December 1995. The controller complained that he did not have adequate English skills to resolve questions when the crew made illogical statements about the aircraft's position. The Boeing 757 killed 160 people when it flew into a mountain. Obviously the potential for serious

misunderstandings between controllers and pilots is high during international aviation communications. Safety experts and linguists are inclined to agree that phraseologies alone, no matter how extensive, are not sufficient to adequately cover all of the potential situations that can arise from human communication, particularly, in aviation, for urgent or emergency situations. No set of phraseologies, however extensive, can account for the breadth of human communicative need, even within the relatively constrained environment of air traffic control communications. In all those situations for which phraseologies cannot suffice, of urgency, emergency, or other non–routine but normal circumstances, controllers and pilots will use plain language. ESP teaching and research started late in Ukraine but has developed rapidly over the past years. This is because all trades and professions need composite talents who have not only a good grasp of English skills, but also a conscious command of professional knowledge. Researches in educational psychology show that learners may foster different interests due to various needs of their work [1]. Business English has long been an ESP course in Ukraine. It highlights the great achievement of ESP teaching in Ukraine and sets a good example for the development of ESP in aviation industry – a rich new field, which will be of interest to ESP theorists and practitioners both domestically and around the world. Grammar–translation method has been dominating the approach to ESP teaching in Ukraine. It is actually an extension of traditional ELT methodology, and its basic mode is like this: analyzing sentences from the grammatical point of view, comparing the usage of some words and expressions, and then translating sentence by sentence into Ukrainian. The benefit of the grammar–translation method is that ESP students can have a better understanding and memory of the text. The defect is that this method is teacher centered, and students' roles are rather passive. They have little opportunity to speak or communicate with others. Consequently, the English they learn is not meaningful and purposeful, and thus they are unable to discuss the work–related matters in English on which they spend plenty of time. They fail to acquire the normal English proficiency required to freely exchange their ideas on issues in their discipline. So this method is obsolete and is constantly rejected. Register analysis and discourse analysis are popular approaches to ESP teaching in the world. But they are more suitable for native English speakers or those who have long experience of working and studying in English language atmosphere. University students in Ukraine have the lack proficiency in English though most of them start to learn English in their primary schools. We find it hard for them to adapt to foreign ESP teaching methodologies. To teach ESP in Ukraine, we must take into consideration students' English proficiency, the learning backgrounds and proper teaching methods, and teach students in accordance with their aptitude. Contrastive approach plus linguistic analysis is now at its experimental stage. This is suitable for learners of ESP or other specialty in aviation industry. But ESP practitioners are faced with some challenges in implementing this approach.

The first challenge ESP practitioners face in designing ESP courses is a careful consideration of students' English level. It seems that an accomplishment of Ukrainian English program (is a prerequisite for ESP courses). The second challenge comes from the need of self–improvement of ELT instructors; they have to renew their knowledge of English language and try to associate their linguistic skills with a specific domain or field. Furthermore, they have to give up their dream of teaching a certain book or a certain course life long, and cast the conservative idea of immutability. The third challenge is the opening up policy that brings in chances of cooperation with our international counterparts as well. General English is not enough to communicate the world as far as technology is concerned, so developing ESP courses in the Ukrainian context is indeed necessary if we want to get involved in the international community. In Ukraine, there is a huge market for aviation industry. Being itself a part of globalization, the industry requires its pilots and air traffic controllers, cabin attendants and crew members, engineers and service staff to be able to communicate with their counterparts in the world on work–related issues in addition to the fact that English examination is almost a must if they want to get professional promotions. English is the right media of communication with the de facto of long time usage in this industry. This is especially true with international airports and airlines, at the time when Ukraine is carrying out the opening up policy and actively participating in international activities. ESP is closely related to the

work of pilots, ATCs, engineers and those in various trades and professions. Learners, therefore, are well motivated and greatly interested in ESP. The popularity of ESP teaching both in university education and continuing education is rightly the result of social demands on English language, rapid development of linguistics and educational psychology. With different objectives, different contents and targets, ESP teaching definitely needs its own methodology and curriculum in a different context. Such a situation requires the teaching of Aviation English on a large scale to university students as well as adults, either in long term for strategic programs or in short term for current operations. Thus the necessity of teaching Aviation English as ESP in the University context has come into being.

Aviation English can be defined as a comprehensive but specialized subset of English related broadly to aviation, including the 'plain' language used for radiotelephony communications when phraseologies do not suffice. Not restricted to controller and pilot communications, Aviation English can also include the use of English relating to any other aspect of aviation: the language needed by pilots for briefings, announcements, and flight deck communication; language used by maintenance technicians, flight attendants, dispatchers, or managers and officials within the aviation industry, for example. Radiotelephony English (RTFE) is a sub–category of Aviation English. RTFE is the language used in radiotelephony communications between air traffic controllers and pilots. It includes but is not limited to ICAO phraseology and can require the use of general English at times. Accordingly, Aviation English can be a subdivision of EST (English for Science and Technology), a part of ESP, while RTFE may be considered as a kind of special language. Although it is not mentioned and illustrated in the simplified Tree of ELT [5] this is much closer to Carter's [6] classification of ESP, namely English as a restricted language, English for Academic and Occupational Purposes, and English with specific topics. Thus the RTFE is an example of English as a restricted language. Mackay and Mountford [8] clearly illustrate the difference between restricted language and general language with this statement: ... the language of international air–traffic control could be regarded as "special", in the sense that the repertoire required by the controller is strictly limited and can be accurately determined situationally, as might be the linguistic needs of a dining–room waiter or air–hostess. However, such restricted repertoires are not languages, just as a tourist phrase book is not grammar. Knowing a restricted "language" would not allow the speaker to communicate effectively in novel situation, or in contexts outside the vocational environment (pp. 4–5). Although RTFE can be classified into the first type of ESP, we do not think it will stop there, as students in aviation or aeronautical universities grow more and more interested in Aviation English and are proud of learning Aviation English in a systematic way, we can further develop this subject by referring to the second type of classification which is further developed by Jordan [7] into the two main branches of ESP: EOP (English for Occupational Purpose) and EAP (English for Academic Purpose). RTFE falls into EOP as it is mainly targeted at pilots and ATC while aviation linguistics falls into EAP.

The research base on Aviation English for ESP is still in its infancy. One of the reasons for this is that, with the rapid development of aviation industry in the world, especially in developing countries like China, RTFE for EOP has started to be taught in aeronautical colleges and universities for the training of ATC and pilots. Meanwhile there has been a corresponding steady increase in the proportion of papers on EOP and development of EAP courses. The teaching of EAP falls within the framework of what is generally called ESP, taking place in essence, and as its name suggests, in an educational environment [14]. Then Aviation English courses taught in colleges and universities can generally be regarded as EOP and /or EAP, although it is hard to make a clear–cut distinction between the two. The RTFE for EOP is more suitable for adult training in the continuing education while Aviation linguistics for EAP is for college students of ESP major. It is more systematic and academic in comparison with EOP: Aviation English (specifically RTFE for EOP) = typical selections of language corpus in the field of air communication + register analysis and/or discourse analysis (with focus on aviation terminologies) for practical use Aviation English (specifically aviation linguistics for EAP) = linguistic processing of language corpus in the field of aviation industry + register analysis and/or discourse analysis (with focus on phonetics and English

language proficiency) for language study Aviation phonetics is part of the teaching in ESP. On the basis of learning international phonetics systematically, learners will focus on aviation phonetics. This includes the reading of numbers, alphabets, time, code of airport, air pressure and aircraft type, etc. In ICAO phonetic regulations, learners of Aviation English in the Ukrainian context could have a better understanding of phonetic knowledge. For example, in English air communication "3" is read as /TREE/ instead of /θri:/ as usual, "4" is read as /FOW–er/, "9" is read as /NIN–er/ instead of /nain/ as usual, because, to pronounce the sound /θ/, we have to put the tongue between the teeth; in addition, it is voiceless and this makes it difficult to be heard by the listener in communication, so the /θ/ sound is replaced by the alveolar plosive /t/ in air communication, and the word "thousand" is pronounced as /TOU–SAND/. Therefore /tr/ is likely to replace /_r/ in this case. The pronunciation of the number "4" gets easily confused with that of the preposition "for", so the vowel /er/ is added (/FOW–er/) to distinguish the two sounds. In pronouncing number "9", the second /n/ sound in /nain/ is a nasal and this makes it difficult to be heard too, so it would be safer and easier to be heard if we read it as /NIN–er/, with a vowel /er/ added to it.

The *de facto* use of English as the international language of air traffic control is proof that English has become the international language of aviation. Terminal buildings and airports are becoming the language center of hub spoke pattern of air transportation. This does not apply only to those directly involved in flying or air–traffic control, but virtually to all those personnel in aviation sectors who are required to communicate with international passengers and customers, pilots, dispatchers, operations center technicians and regulatory agencies. To facilitate the interchange of information among them, English has evolved to become the global language for all aviation needs, and a strong command of both general English and its specialized varieties, has become an essential prerequisite for safety, efficiency and effective communication.

Language–related misunderstandings of various kinds have been a critical contributing factor in aviation accidents, as often illustrated by the familiar fatal accident in Tenerife in 1977 where the death of 583 people resulted in part from misunderstanding of the phrase *at takeoff*, which was used by the flight crew to indicate that they were "in the process of taking off" but was understood by the tower controller as meaning "at the takeoff point". So the pilot was not warned that another Boeing 747, shrouded in fog, was already on the runway. It seems that the reason for the wrong usage on the part of
the Dutch pilot was his code switching between Dutch and English language, translating the Dutch idiom (preposition "at" + the infinitive) instead of using the present continuous tense of English language. Many of the occurrences of similar misunderstandings, according to Cushing (1994), can be attributed to a clash between individual cognitive and social interactive factors of language use.
This shows the importance and necessity of semantic study in Aviation English. As Hortas [5] points out, "we have entered a new millennium, the ability and the need to understand and communicate with each other has become increasingly important, at times even urgent. An international exchange of ideas – from environmental issues such as the thinning ozone layer and the warming of the planet, to medical topics such as genetic engineering, to political crises – is essential. To meet these communication needs, more and more individuals have highly specific academic and professional reasons for seeking to improve their language skills".

When learners of English language reach an intermediate level, they may find that collocation is something difficult to grasp. From a lexical and semantic point of view, collocation can be considered as the third step of mastering the English language: Basic words Phrases and idioms Collocations Complete sentences this is equally true with Aviation English (not just confined to RTFE). When students have learned quite a number of words and expressions, they are faced with the problem of collocation. Therefore, it is the teacher's responsibility to help them discover the rules and regularities of collocating words and phrases, especially with specialty vocabulary. Meanwhile we must bear in mind to explain them in ESP. For example:
(1) *Black box:* The flight recorder, as on a military or commercial aircraft, that documents preflight checks, in–flight procedures, and the landing.
(2) *Sniffer dog:* Dog whose work is to sniff the drugs, especially in Customs.

Conclusions

This paper has discussed the importance of English for safety and efficiency in aviation, addressed the development of ESP teaching in the Ukraine context, explored methodologies of teaching ESP in the Ukrainian context and illustrated some cases of contrastive approach to teaching Aviation English. By teaching the Aviation English course, I perceive a prosperous future of teaching Aviation English as an ESP both in Ukraine and in the world. A systematic and comprehensive curriculum of Aviation English will be perfected with the joint efforts of language practitioners. It is my sincerest hope that my efforts will lend insight into the challenges facing the ELT instructor acting as ESP curriculum developer.

References

1. *Cushing, S.* Fatal Words: Communication Clashes and Aircraft Crashes. Chicago: University of Chicago Press, 1994. – 162 p.
2. *David* C. Some Propositions about ESP. The ESP Journal. Vol. 2. 1983. – p. 131–137.
3. *Domimguez, G., and P. Rokowski.* Bridging the Gap Between English for Academic and Occupational Purposes. Hawaii University Press. 2002. – p. 57 - 63.
4. *Goertz, H.* New Approach to ATC English Proficiency. Journal of Air Traffic Control. July–Sept., 1997. – p. 46–50.
5. *Hortas, J. D.* English for Specific Purposes. TESL – Teaching English as a Second Language. 2002. – p. 87 – 95.
6. *Hutchinson, T., and A. Waters*. English for Specific Purposes: A Learner–Centered Approach. Cambridge University Press. 1987. - p. 19.
7. *Jordan, R.* English for Academic Purposes: A Guide and Resources Book for Teachers. Cambridge: Cambridge University Press. 1997. - 464 p.
8. *Mackay, R., and A. Mountford.* English for Specific Purposes: A Case Study Approach. London: Longman. 1978. – p. 4–5.
9. *Uplinger S.* English–Language Training for Air Traffic Controllers must Go Beyond Basic ATC Vocabulary. Airport Operations (Flight Safety Foundation) 23/5. 1997. – p. 1 – 5.

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ENGLISH FOR SPECIFIC PURPOSES AND CONTENT TEACHER COLLABORATION

This article is dedicated to the rationale for English for specific/academic purposes courses (ESP/EAP) in Higher Education (HE) implementation language instruction taking into account specific educational needs (Dudley-Evans, 2001).

At university level, and in English as foreign Language (EFL) contexts, this integration increases language proficiency as CBI makes students realize how the discourses pertaining to their field of specialization are organized in the target foreign language. This approach highly motivates EFL learners since it can draw on knowledge already acquired in subject disciplines (Widdowson, 1978; 1979; 1983) and applies even to freshmen because they do not reach higher education totally blank. On the contrary, bring with them both content and foreign language expertise (Widdowson, 1979: 44).

Although the matching of language and content has a high face value in motivating students, CBI implementation opens the way to what has been defined "the ESP teachers' subject knowledge dilemma" (Wu and Badger, 2009) since CBI implies that ESP professionals have to tread specialistic paths. Such areas are often outside the remit of language teachers as their training usually revolves around English language teaching (ELT) practices (Čepon, 2005:50). This bias can have a two-fold solution: either the ESP practitioner consults a colleague expert in the field, or asks the same for a deeper collaboration.

As concerns the latter issue, Dudley-Evans and St. Johns (1998:43-48) acknowledge the importance of such an engagement and recognize three different stages upon which this joint work can take place: *cooperation*, *collaboration* and *team-teaching*.

The first stage, or *cooperation*, witnesses the ESP teacher to take the initiative and to enquire about the students' fields of specialism to design an appropriate program of study.

The second step, that of? *collaboration*, plans for a more direct involvement of the subject teacher to validate the syllabus content by devising common materials, whereas the third stage, *team-teaching*, implies a stricter conjoined work in the classroom, where each educator provides his/her own expertise in the field.

How is **English for Specific Purposes (ESP)** different from **English as a Second Language (ESL)**, also known as general English?

The most important difference lies in the learners and their purposes for learning English. ESP students are usually adults who already have some acquaintance with English and are learning the language in order to communicate a set of professional skills and to perform particular job-related functions. An ESP program is therefore built on an assessment of purposes and needs and the functions for which English is required.

ESP concentrates more on a language in context than on teaching grammar and language structures. It covers subjects varying from accounting or computer science to tourism and business management. The ESP focal point is that English is not taught as a subject separated from the students' real world (or wishes); instead, it is integrated into a subject matter area important to the learners.

However, ESL and ESP diverge not only in the nature of the learner, but also in the aim of instruction. In fact, as a general rule, while in ESL all four language skills; listening, reading, speaking, and writing, are stressed equally, in ESP it is a needs analysis that determines which language skills are most needed by the students, and the syllabus is designed accordingly. An ESP program, might, for example, emphasize the development of reading skills in students who are

preparing for graduate work in business administration; or it might promote the development of spoken skills in students who are studying English in order to become tourist guides.

As a matter of fact, ESP combines subject matter and English language teaching. Such a combination is highly motivating because students are able to apply what they learn in their English classes to their main field of study, whether it be accounting, business management, economics, computer science or tourism. Being able to use the vocabulary and structures that they learn in a meaningful context reinforces what is taught and increases their motivation.

The students' abilities in their subject-matter fields, in turn, improve their ability to acquire English. Subject-matter knowledge gives them the context they need to understand the English of the classroom. In the ESP class, students are shown how the subject-matter content is expressed in English. The teacher can make the most of the students' knowledge of the subject matter, thus helping them learn English faster.

The term "specific" in ESP refers to the specific purpose for learning English. Students approach the study of English through a field that is already known and relevant to them. This means that they are able to use what they learn in the ESP classroom right away in their work and studies. The ESP approach enhances the relevance of what the students are learning and enables them to use the English they know to learn even more English, since their interest in their field will motivate them to interact with speakers and texts.

ESP assesses needs and integrates motivation, subject matter and content for the teaching of relevant skills.

A teacher that already has experience in teaching English as a Second Language (ESL), can exploit her background in language teaching. She should recognize the ways in which her teaching skills can be adapted for the teaching of English for Specific Purposes. Moreover, she will need to look for content specialists for help in designing appropriate lessons in the subject matter field she is teaching.

As an ESP teacher, you must play many roles. You may be asked to organize courses, to set learning objectives, to establish a positive learning environment in the classroom, and to evaluate student s progress.

You have to set learning goals and then transform them into an instructional program with the timing of activities. One of your main tasks will be selecting, designing and organizing course materials, supporting the students in their efforts, and providing them with feedback on their progress.

You arrange the conditions for learning in the classroom and set long-term goals and short-term objectives for students’ achievement. Your knowledge of students' potential is central in designing a syllabus with realistic goals that takes into account the students' concern in the learning situation.

Your skills for communication and mediation create the classroom atmosphere. Students acquire language when they have opportunities to use the language in interaction with other speakers. Being their teacher, you may be the only English speaking person available to students, and although your time with any of them is limited, you can structure effective communication skills in the classroom. In order to do so, in your interactions with students try to listen carefully to what they are saying and give your understanding or misunderstanding back at them through your replies. Good language learners are also great risk-takers, since they must make many errors in order to succeed: however, in ESP classes, they are handicapped because they are unable to use their native language competence to present themselves as well-informed adults. That’s why the teacher should create an atmosphere in the language classroom which supports the students. The learners must be confident in order to communicate, and you have the responsibility to help build the learners’ confidence.

The teacher is a resource that helps students identify their language learning problems and find solutions to them, find out the skills they need to focus on, and take responsibility for making choices which determine what and how to learn. You will serve as a source of information to the students about how they are progressing in their language learning.

What is the role of the learner and what is the task he/she faces? The learners come to the ESP class with a specific interest for learning, subject matter knowledge, and well-built adult learning strategies. They are in charge of developing English language skills to reflect their native-language knowledge and skills.

People learn languages when they have opportunities to understand and work with language in a context that they comprehend and find interesting. In this view, ESP is a powerful means for such opportunities. Students will acquire English as they work with materials which they find interesting and relevant and which they can use in their professional work or further studies. The more learners pay attention to the meaning of the language they hear or read, the more they are successful; the more they have to focus on the linguistic input or isolated language structures, the less they are motivated to attend their classes.

The ESP student is particularly well disposed to focus on meaning in the subject-matter field. In ESP, English should be presented not as a subject to be learned in isolation from real use, nor as a mechanical skill or habit to be developed. On the contrary, English should be presented in authentic contexts to make the learners acquainted with the particular ways in which the language is used in functions that they will need to perform in their fields of specialty or jobs.

Learners in the ESP classes are generally aware of the purposes for which they will need to use English. Having already oriented their education toward a specific field, they see their English training as complementing this orientation. Knowledge of the subject area enables the students to identify a real context for the vocabulary and structures of the ESP classroom. In such way, the learners can take advantage of what they already know about the subject matter to learn English.

Adults must work harder than children in order to learn a new language, but the learning skills they bring to the task permit them to learn faster and more efficiently. The skills they have already developed in using their native languages will make learning English easier. Although you will be working with students whose English will probably be quite limited, the language learning abilities of the adult in the ESP classroom are potentially immense. Educated adults are continually learning new language behavior in their native languages, since language learning continues naturally throughout our lives. They are constantly expanding vocabulary, becoming more fluent in their fields, and adjusting their linguistic behavior to new situations or new roles. ESP students can exploit these innate competencies in learning English.

Conclusion

Such didactic aims the rationale for(ESP/EAP) in Higher Education can be fostered by content-based instruction (CBI), a valuable approach which enhances both language acquisition and academic success (Kasper, 1997; Song, 2006) by the “incorporation of content material into language classes” (Kavaliauskienė, 2004). This matching of language and content also broadens cross-curricular awareness and specific knowledge (Stryker and Stoller, 1997:5) to be spent both to improve academic studies or for the world of work.

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PSYCHOLOGICAL COMPONENT IN THE PROFESSIONAL SELECTION OF ATM SPECIALISTS

The article looks at issues relating to professional selection of applicants for the degree in flight navigation. It presents results of assessment of the prognostic value of some psychophysiological and psychological characteristics of candidates at the stage of the primary professional selection. Prospects of further research aiming at specifying ATM specialist selection criteria are discussed.

The recognition of the human agency as a key one in ensuring flight safety and security arouses no doubts today. The development and introduction of new computerized systems in aviation don't reduce the significance of the specialists' professionalism, and vice versa raise the standards of conformity of their level of professionalisms to the up-to-date specifications.

Thereby the problem of quality of experts' professional training in civil aviation sphere acquires exceptional actuality. Recently the psychological support is considered as one of the priority ones among the factors which ensure high efficiency of experts' professional training for work under difficult conditions. In this article I focus on some aspects of the psychological component in the professional selection of air traffic controllers for ATM. The choice of the current object for the study is prearranged by the specific character of the air traffic controller activities which includes many difficult tasks, the settlement of which expects a high level of professionalism.

The ATM air traffic controller is one of the key figures in the flight safety and security system. It is a well-known fact that character and content of his activities are connected with considerable intellectual and emotional stresses, and the work schedule and working conditions create the background for the development of undesirable functionary states, which affect adversely the productivity, the effectiveness and the activity safety [2].

It's obvious that under such conditions the requirements for the air traffic controller psychophysiological and psychological parameters are very strict. It concerns especially the group of biologically determined psychophysiological indexes which are stable by their character. Thus it's impossible to ensure their active development or compensation in the process of professional training [4]. That's why high effectiveness of the ATM air traffic controller work cannot be provided only by high-quality education which gives deep knowledge and establishes the appropriate professional skills. Therefore the prof-selection on the current specialty is justified from the point of view of rationality of the state financial expenses for the ATM specialists professional training as well as taking into consideration the providing of candidates' successful adaptation to the chosen profession requirements. This allows optimizing the process of ATM specialists' professional training, eases psychophysiological value of their activity, facilitates professional longevity and health preservation.

Today the ATM specialists' prof-selection procedure is multilateral and includes enlarged parameter diagnostics of psychophysiological, psychological, socially-psychological levels, and of course, the medical examination too. Hereby the tendency for constant search and improvement of diagnostic set of instruments is observed.

I consider the question about tests' content urgent at different stages of ATM air traffic controllers' prof-selection. The determination of diagnostic criteria during the conducting of the initial prof-selection asks especial attention.

To my mind, only those parameters, forming the basis for necessary professional skills development and the absence of which can't be compensated in the process of training, must be put into the criteria of the initial selection [4]. First of all, I mean here the neurodynamic peculiarities (characteristics of nerve processes), and also the medical contraindications (the existence of somatic and mental disorders, the inclination to deviations).

In order to specify the prognostic value of some individual characteristics for the initial prof-selection The Department of Aviation Psychology of NAU developed a study model, the aim of

which was to determine the character of influence of the main psychophysiological parameters of the ATM air traffic controllers-students over their success in carrying out the professional tasks. The study was held within the qualification projects (O. Istrat, V. Riabchenko) under the supervision of the assistant professor O. Secheyko. The selection was done among the students of NAU from the specialty "Aeronavigation".

Among the individual psychophysiological characteristics I examined the indicators of the main peculiarities of the nervous system, the structural elements of temperament, and also the most significant for the operator's activity formally-dynamic parameters of the cognitive sphere.

The degree of success in mastering the professional skills was determined by the group of experts, among members of which were the lecturers of the main disciplines, who had the direct relation to the theoretical as well as the practical training of future specialists. I should point out that the studying in the direction "Aeronavigation" is engrained with the elements of professional activity as much as possible and the number of practical courses is much lager that the number of theoretical ones. At the time of conducting a study the students had already passed the industrial practice, during which the level of their readiness to solving of professional tasks was assessed. This is liable to speak about the objectivity of facts, which underlay the expert evaluation of students' progress.

According to the expert evaluation, 38% of those under study got good marks over the level of progress; the rest got average and bad marks.

The analysis of the study results showed the presence of significant correlative relations between the level of progress in mastering the professional skills by the students and their psychophysiological parameters. The dependence of progress in mastering the professional skills on the indicators of the nervous system main peculiarities is shown at the Table 1.

Table 1

Distribution of the Nervous System Main Characteristics according to the ATM Air Traffic Controllers-Students' Progress

Nervous System Characteristics	Strength			Mobility			Equanimity		
	high indices	average indices	low indices	high indices	average indices	low indices	high indices	average indices	low indices
High Level of Progress	**69%**	**31%**	**0%**	**85%**	**15%**	**0%**	**46%**	**54%**	**0%**
Mean Level of Progress	**6%**	**12%**	**83%**	**18%**	**82%**	**0%**	**12%**	**18%**	**70%**

As we can see from the table above the study results confirmed that these are the indices of the neurodynamic level, which have high prognostic value for the success of execution of operator's activity. Thus the students with the high level of progress in professional training are characterized by integrity of a strong, highly mobile nervous system of equable and excitable types. Most students with the average level of progress have a weak nervous system of inhibitory type.

Also the relation between the level of progress and some temperament structural elements was determined clearly (IS, industry standard of Rusalov). In the group of prosperous students all of them have the highest level of objective ergic, objective and social plasticity, objective and social

tempo. The emotional indices for all students in this group are minimal. In the group with average level of progress the objective ergic, plasticity and tempo have average and bad marks and emotionality has average and good marks.

Therefore it became apparent which the ATM air traffic controllers-students' individual-typological features are those supporting and those preventing the quick and effective process of mastering theoretical knowledge and practical skills during their professional training. Among the parameters of positive impact the most significant is the nervous system strength; then – the equanimity of excitation and inhibition processes, plasticity, high psychic tempo, high objectivity ergic, low degree of emotionality.

The parameters of bad impact: weak nervous system, inhibition type of the balance of nervous processes, rigidity, low psychic tempo and high degree of emotionality [3].

The study results highlighted the formal-dynamic parameters of cognitive style which are the most significant and help the students' successful mastering professional required skills: cognitive supervision flexibility and low indices of verbal-color interference level. Thereafter the cognitive supervision rigidity and marked verbal-color interference are in inversely proportional relation with the progress of mastering professional skills [5]. But I should point out, that the results obtained don't allow drawing an explicit conclusion about the relation of cognitive peculiarities to the effectiveness of professional training.

An interesting fact, for example, is that the quantitative indices of Random Access Memory (RAM) don't determine alone the success in carrying out the professional tasks: thus there are students in a group of unsuccessful ones who have the maximum possible indices of a given parameter. The data about other cognitive indices are also divergent enough. The absence of strictly determined correlations between most cognitive style parameters and successful establishing of operator's activity practical skills gives reasons to expect, that the high effectiveness of information processing can be provided by the selection of effective cognitive style in the training process, considering student's individual features.

Today in our laboratory I conduct a series of studies concerning the impact of formal-dynamic parameters of cognitive sphere on the ATM air traffic controllers' activity progress involving equipment diagnostics. And as the cognitive style parameters are specified mostly by the peculiarities of the large cerebral hemispheres interaction, I think, that the scientific search in the direction of establishing links between the interhemisphere interaction peculiarities and the air traffic controllers operator's activity progress.

The results also displayed a specific regularity concerning the ratio of boys and girls in groups with a certain level of progress: among the prosperous ones – 62% of boys and 38% of girls; in a group with low level of progress – 35% of boys and 65% of girls. The insufficiency of sample so far doesn't allow to draw explicit conclusions about the tendency discovered. I consider further study in this direction promising, however, and of scientific interest. I suppose that there might be the link between the psychological sex (femininity-masculinity) and the effectiveness of operator's activity. If this hypothesis is true, the peculiarities of biochemical rate (especially hormonal profile) can be regarded an extra parameter of prognostic value.

To sum up I consider it's necessary to accentuate that at the first stage of prof-selection the conclusion concerning suitability for a profession must be based, first of all, on the stable naturally determined indices, which exert essential influence on the success in mastering the ATM air traffic controller profession. The development of the professionally required features in psychological and socially-psychological levels, and also the establishment and fixing of important professional skills are liable to occur in the process of professional training [1].

The results introduced above made us conduct more extensive studies: extension of students' sample, organization of longitudinal projects with the assistance of ATM experts, who have different record of service, and also with approbation of new equipment diagnostics methods.

Nevertheless, now we can talk about the necessity to review the principles of filling the test sets in the initial prof-selection at the specialty "Aeronavigation".

There are reasons to suppose, that at this stage it can be to no purpose to use the tasks, including the elements of real professional activity and expecting the existence of theoretical knowledge and practical skills. Within this approach there is high possibility of the fact, that in the result of the initial prof-selection the group of unfit for a profession can embody also those candidates, who have all the premises for quick and successful development of appropriate abilities and for efficient mastering of appropriate skills in the process of professional training.

References

1. *Holubeva E.A.* Abilities and Individuality. – M.: Prometheus Press, 1994.
2. *Ilyin E.P.* Differential Psychophysiology. – P., 2001.
3. *Istrati O.Y.* Impact of the Air Traffic Controllers-Students' Individual-Typological Features on the Success in Mastering Professional Skills // Materials of the 5th International Theoretical and Practical Conference "Urgent Problems of Activity Psychology under Special Conditions". April 20-21. – K., 2010. – P. 42 – 43.
4. Bases of the Psychophysiological Professional Selection/ *Makarenko N.V., Pukhov B.A.* – K.: Naukove Dumka Publishers, 1987. – 243 p.
5. *Riabchenko V.S.* Cognitive Style as the Factor of the Success in Mastering Professional Skills by the Air Traffic Controllers-Students // Materials of the 5th International Theoretical and Practical Conference "Urgent Problems of Activity Psychology under Special Conditions". April 20-21. – K., 2010. – P. 87–89.

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AVIATION ENGLISH IN COMMUNICATION SAFETY

Aviation English stands out in the list of disciplines studied in higher educational institutions along with other technical subjects for those who works in aviation industry .Aviation English is defined as a comprehensive but specialized subset of English related broadly to aviation, including the "plain" language used for radiotelephony communications when phraseologies do not suffice. Not restricted to controller and pilot communications, aviation English can also include the use of English relating to any other aspect of aviation: for example, the language needed by pilots for briefings, announcements, and flight deck communication; or the language used by maintenance technicians, flight attendants, air traffic controllers, or managers and officials with in the aviation industry.

The matter is that studying any subject, not only humanitarian one, is usually aimed at learning some amount of material that is getting knowledge about a subject of studying. Meanwhile the subject of studying aviation English is not a language in itself but integral unity of knowledge, habits and skills for specific purposes which allow not only to know language, but to use it as means of the communication in various professionally-oriented situations.

Thus, aviation English for anyone who studies it, is not only a subject of studying but also means of information reception and interchange. It's a complex of developing system that gives unlimited opportunities for its studying, using and mastering a language. On the other hand it is reasonable to keep in mind that specialized aviation English is built upon proficiency in general English and that individuals entering the aviation environment with a high level of proficiency in "general" English (native speakers and/or expert users of the language) readily acquire the specialized English vocabulary and phraseologies needed for efficient and safe radiotelephony communication. It is expected that "general" English programs and courses may be an at the lower levels. This is to say that "general" English programs and learning activities can play a valuable role and are a legitimate language learning activity for flight crews and controllers.

Viewing aviation English studying as a special kind of activity it's considered that the most acceptable approach in its studying is activity-oriented approach. In accordance with this point of view, the language usage, including its studying, embraces all actions, carried out by objects that during this process acquire and advance a row of competences, first of all, communicative speech competences which are in various speech situations for realization of specific language activities (reception, production, interaction and mediation).

A more narrowly focused, learner-centered approach to teaching aviation English for specific purposes aims to help learners establish partial competence in a given, work-specific domain, such as aviation. Aviation English learning and teaching activities focus on the language needed to function in various aviation contexts.

As any other subject, aviation English has its own vocabulary. It can cause problems for both learner and teacher. There are sets of highly technical terms, semi-technical words and subtechnical vocabulary that must be implemented into practice as well. Thereby, the teacher's role here is to teach both language and content, with or without the cooperation of specialist subject teachers.

The implementation of content-based language programs for flight crews and air traffic controllers can be accomplished through collaboration between ESL-certified language specialists and aviation specialists. Such classes may be co-developed, and even co-taught, with the ESL specialists providing linguistic support to the aviation content. Appropriate classroom activities of an aviation content based language programs will be familiar to Crew Resource Management trainers: a focus on task-based activities, problem-solving, team-building exercises, role play and simulations.

During the process of studying the strategies which are the most favorable for realization of the objectives put in each separate situation (routine, urgent or emergency situation) are used. Strategy is a task-oriented line of behavior organized in a specified way which is chosen by an individual for realization of any specific objective.

As the accident investigators usually uncover a chain of event lining up in an unfortunate order to finally cause an accident, the language simply becomes one link in the chain of events. In some instances, the use (or misuse) of language has contributed directly or indirectly to an accident. At other times, language is a link which exacerbates the problem. The purpose of the ICAO language proficiency requirements is to ensure that the language proficiency of flight crews and air traffic controllers is sufficient to reduce miscommunications as much as possible and to allow pilots and controllers to recognize and solve potential miscommunications when they do occur. In short, language should be a tool to identify and help solve a potential problem before it becomes a disaster, rather than being one more attention-demanding obstacle.

Language has three distinct roles in accidents and incidents:

a) in the use of phraseologies;

b) in the use of plain language;

c) in the use of more than one language in the same environment.

The purpose of using phraseologies is to promote clarity and brevity; standardized phraseologies are developed to avoid ambiguity. For phraseologies to have the most significant safety impact, all parties need to use the same, ICAO phraseologies. While incorrect application of phraseologies has been determined to be a contributing factor in some accidents, a lack of general proficiency in the language used for radiotelephony communications is more often cited as having played a contributing role. The controller last in contact with the English-only speaking crew which strayed off course and crashed into a mountainside acknowledged to accident investigators that the flight's position reports were incongruent with where he understood their position to be. However, by his own admission, he lacked plain English proficiency to clarify his doubts or to notify the crew that they may have been off course.

While it is widely recognized that a need for plain language may quickly arise during emergency or unusual situations, the critical role of plain language in more or less routine situations is less recognized outside the relatively small circle of applied linguists who specialize in aviation communications. In fact, in addition to the need for plain language which is readily acknowledged to occur during unusual or emergency situations, plain language is a requirement in many everyday situations. Pilots and controllers frequently need to share information or to negotiate a variety of matters.

As important as plain language proficiency is, it must be equally clear that according to ICAO Standards, plain language is an option only when ICAO phraseologies are not available, with a clear emphasis on the requirement to adhere to ICAO phraseologies whenever applicable. In fact, with increased pressure for non-native English users to demonstrate adequate levels of English language proficiency, proficient speakers of English, in awareness of the special challenges faced by non-native English speakers, can accommodate this challenge by re-committing to ICAO phraseologies and disciplined radiotelephony techniques and by developing an awareness of cross-cultural communication difficulties.

Conclusion

The use of two languages in the same environment can lead to a lack of situational awareness for flight crews who do not understand all the languages used for radiotelephony in that airspace. It has been cited as a contributing factor in several accident reports; however, the establishment of a single language radiotelephony environment that would rely only on the English language faces several challenges. It would require all users of airspace to have sufficient knowledge (ICAO Operational Level 4) proficiency among pilots and air traffic controllers worldwide would permit the implementation of such a policy without excluding a large number of currently active pilots. It must also be recognized that there are significant national, cultural, economic, and organizational impediments that make such a move impractical. Because language use is so closely tied to a community's sense of national and cultural identity, language policies always require sensitive management. While the implementation of a single-language radiotelephony environment on worldwide basis is not realistic in the short and mid-term, a number of non-native English-speaking ICAO Contracting States, free to set policies more stringent than ICAO Standards, have implemented measures that either require or encourage the use of English only, at least in busy international sectors.

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PSYCHOLOGICAL ASPECTS OF COMMUNICATION IN AIRPLANE CREWS

The author of the article determines main aspects of psychological analysis of communication among airplane crews.

The problem of communication has always been timely on different stages of development of the Humanities, with only approaches to its analysis changing, a number of trends and branches of the science increasing, which in tern initiated new aspects, including interdisciplinary approaches.

Theoretical and practical studying of the problem of communication is especially significant for those activities where it has crucial character in final and irreversible decision-taking. Civil aviation can be rightly referred to such kind of activity.

Analysis of communication process is mostly based on studying the following components: motive and aim of the communicative interaction; a common for interlocutors sense image; the inner scheme of an utterance; outer program for forming an utterance; acoustic control of the verbal expressing of one's utterance and control of perceiving the interlocutor's utterance; the correlation of perceived from the interlocutor matter with one's sense image concerning the communication topic. These components are often investigated separately, without considering their interrelation, which leads to only partial analyzing the problem of professional communication.

The active usage of such a phenomenon as discourse is very timely for the modern stage of studies in the sphere of airplane crew communicating.

The scientific category of discourse is being actively investigated by foreign (E. Benveniste, B. Borbotko, T. Van Dike, V. Maroshi) and domestic scientists (F. Batsevych, A. Kudlayeva, O. Kucherova, V. Rizun, H. Yavorska) [2; 3; 4; 6].

This scientific category of discourse is perspective in analyzing communication in civil aviation, which can be explained by its content. There is no doubt, this kind of communication is impossible to study without considering peculiarities of the social context, psychological peculiarities of the communicants, perception mechanisms, production and interpretation of language units.

The discourse in the civil aviation means double-directed exchange of information with the help of radio communication devices between the airplane crew and air traffic controllers and other airplanes, as well as radio communication between the crew members of the same aircraft [5].

The connection with air traffic controllers is made by the aircraft commander or by one of crew members by the aircraft commander's order. The connection by ground communication channels is made by air traffic controllers (fly crew – air controller "ground") in accordance with the established rules and demands aiming at ensuring safe flight.

The following levels of discourse process are necessary in analyzing crew members' communication: phonological, i.e. phonosemantic contents of the utterance; prosodic which includes such characteristics as sonority, tempo, pauses, articulation; lexico-semantic level which characterizes peculiarities of the speaker's vocabulary; morphological and syntactical levels which are determined by links between grammar of the utterance and syntactical peculiarities of its forming and the recipient's guideline; extralinguistic level which is determined by peculiarities of the speaker producing an utterance.

It is necessary to investigate organizational conditions of the air communication, to determine main types of radio discourses, to clarify discourse peculiarities in the context of psychological peculiarities of communication interaction participants, types of communication situations.

We share the opinion of O.V. Akimova and M.I. Solnyshkina who suggest analyzing radio communication on the basis of the following characteristics: working environment (standard and non standard), subject of activity and their interrelation [1].

According to the above-mentioned characteristics the discourse can be of four types: AI (standard situations and vertical relations), AII (non standard situations and horizontal relations), BI (standard situations and horizontal relations) and BII (non standard situations and vertical relations).

Moreover one should take into account the peculiarities typical for the aviation discourse:

- oral form is stipulated by the acoustic communication channel;
- synchronism of producing, transmitting, perceiving, interpreting communicative elements;
- comparison standards, patterns and spontaneity in semantic and formal aspects of communicative interrelation;
- remoteness of the partners of the communicative interrelation.

Besides, analysis of the peculiarities of aviation communication of post Soviet professionals will be incomplete without considering the problem of bilingualism.

The phenomenon of bilingualism can be defined as the capacity of an individual to use two language systems in communication. The main problem of bilingualism in communication process is interrelation of structures of the contacting languages. Let us note that the communication in native tongue is integral as it gradually passes all stages from the motive to the self-correction, if the communication product does not correspond to the model. In case with two language the communication does not have the stage of self-correction, as very often the respondent does not have inner language models and the correction is of exclusively outer form.

Taking into consideration peculiarities of pilots' activities, it is necessary to determine specific features of the bilingualism for the people of this profession. In our opinion, while analyzing the problem it is reasonable to use bilingualism classification by D. Winerihe, based on the peculiarities of learning the language: complex bilingualism (every notion has two ways of language realization: coordinative (every language realization is connected with its certain system of notions), subordinate (the system of the other language is wholly built on the system of the first language).

Determining types of bilingualism for each of pilots and air traffic controllers will help clarify those specific peculiarities which will determine effectiveness of the communication in two language environment and clarify typical psychological and linguistic problems which may complicate and even cast doubt on the possibility of the communication interrelation.

So, the prospective aspects of analyzing problems on communication in aircraft crews are the following ones:

- adequacy, informativeness and timeliness of the radio discourse;
- dialogue in radio communication or its absence;
- peculiarities of producing, perceiving, interpretation and back transmitting of information in the macrofield 'radio exchange in civil aviation' ;
- type of discourse and its correspondence to the certain flight conditions;
- type of the communicative situations and their interrelation with psychological peculiarities of the participants and conditions of professional communication;
- specifics of the pilot's communicative activity or air traffic controller, depending on the type of bilingualism;
- widespread stereotypes, mistakes in the process of professional communication and possibilities of their evasion, correction and prevention;
- components of the communicative competence of the specialists in civil aviation.

The mentioned aspects allow to determine psychological components of the problem of efficient professional activity, design training, retraining, control, estimation and correction programs for professional activity of aircraft crews.

References

1. Акимова О. В., Солнышкина М. И. Типология дискурса в профессиональной коммуникации // Актуальные проблемы теории коммуникации. – С.Пб.: С.Пб. ГПУ, 2004. – С. 253–270.
2. Кудлаева А. Н. Типы текстов в структуре дискурса // Автореф. дис… к. филол. н., спец. 10.02.19 – теория языка. – Пермь, 2006. – 20 с.
3. Кучерова О. Комунікативно орієнтована типологія дискурсу: проблеми та підходи // Іноземні мови в навчальних закладах. – 2003. – № 2. – С. 172–181.
4. Макаров М. Л. Основы теории дискурса. – М.: ИТДГК "Гнозис", 2003. – 280 с.
5. Олянюк П.В.. Астафьев Г.П., Грачев В.В. Радионавигационные устройства и системы ГА. -М.: Наука, 1983.
6. Різун В. В. Природа й структура комунікативного процесу // Наукові записки Інституту журналістики. – К., 2001. – Т. 5. – С. 17–37.

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PSYCHOLOGICAL APPROACHES TO THE PROFESSIONAL VALUES SYSTEMS OF THE AVIATION PERSONNEL-TO-BE GENERATING

The article pays attention on that fact the professional activity is stipulated by the values system. The paper looks at major problems related to the professional values system of the students generating. The author proposes some approaches to initiation of the conscious gaining of the professional values for their functioning on the actual performance level.

The personality and professional values system makes a grate contribution to the effective professional activity of the aviation personnel. The universal values system contains the professional values subsystem which is formed later then the previous one. That is why the problems related to the professional values system of the aviation personnel-to-be generating might be investigated and solved in the wider value space in consideration of its evolution, involution and deformation.

Exceeded value expansion of western culture in Ukraine and all over the world caused the extreme individualization and economic liberties priorities generating which have brought to the deformation of local cultural values of other societies with the lower development level. Scientific and technological progress has decreased dramatically the importance of former firm religious values. Wide spread of the alcoholism, smoking habit, drug addiction etc. at individual level leads to weakening of the criticality, self-control and value-based behavior. The collision of two value systems disorganizes the individual behavior in decision-making and problem-solving circumstances. Essential changes in composition and structure of the personality values systems cause partly socially undesirable results. Internet and mass media have played the decisive role in decrease and even total destruction of the value orientation due to free access to the disruptive information.

Civilization progress in the universal values system affected the strictly specialized professional values. Professional occupation has become a reason of exchange of personal labour (goods and services) for money equivalent which gives freedom of excess to any human resources. Professional mastership used to be a subjective worth, a base of people's social rank and exceeded other forms of social exchange. Now profession is an instrument of excess to freedom through the money. Under given conditions the values become professional when they serve social exchange but clear mastership, self-improvement, creativity are smoothed over. We firmly believe that the process of professional values changing is the result of "successful export" of western culture and economic-political system to other social frameworks and their predominance over the traditional cultural values.

Low intensity of the economic side of the profession during study at higher educational institution enables concentrated generating of the strictly specialized professional values system of the aviation personnel-to-be.

Professional values are emotionally polarized and evaluated personality constructs which influence the situational decision-making. Professional values are key points for occupational election, training, activity, mastership, effectiveness. They are characterized by the domination degree, defined sign (positive/negative), awareness degree, variability degree.

The first parameter of value is the degree of domination. Dominant values have the decisive importance during decision-making in the professional choice conditions.

The second parameter of value is the sign. There are values which have an adverse effect on work. The communicative value for the majority of air traffic controllers is not of great importance, because the quality of operation does not expect excess of conversation.

The third parameter of value is its awareness. For example, a man without any frequent flight experience wants to become a pilot, but he does not know how it operates in reality. He is not aware of this value.

The fourth parameter of value is its variability degree. The often changing of value orientations is the characteristic feature of young people due to the beginning of generating their system of values. Psychologist Kurt Levin has put to use the term "quasinecessity", which means the need in definite circumstances. "Quasivalues" appear under the influence of conversation, film, moment. The choice made on the base of quasivalue will not be stable.

There is a considerable amount of specific values in professional culture. The experts' generations has detected and selected typical sets, patterns of behavior, ideas, priorities, strategies and tactics which ensure individual professional success. The part of these values is integrated to the code of professional conduct, organization standards and systems of punishment, encouragement and stimulation. The other part of values implicitly exists as universal standards of interaction.

Professional values generating at higher educational establishment should not be spontaneous but purposeful process, organizationally, economically and methodically managed. We have to start professional values generating from the entering and continue till graduating from the university.

E.F.Zeer marks out the following stages of professionalization: *option* – the professional intention formation, professional self-determination, conscious election of the occupation on the individual-psychological characteristics base; *vocational training* – the formation of professional knowledge, skills, proficiency needed for typical tasks solution in a profession; *occupational adaptation* – new professional role, technologies, experience of self-reliant professional activity adoption; *internal stage* – the stage of professional quality and professional mentality generation; *workmanship* – professional creative self-actualization [5].

We firmly believe that each stage should be accompanied by different pedagogical means of value guidance to develop professional values system with the features of pragmatic approach, precision, efficiency, consciousness, automatism, integrity aimed at workmanship achievement.

One of the key problems of professional values system generating of the aviation personnel-to-be is that their practical adoption can be reached through repeated individual behavior submission to professional values during functioning in the actual working conditions. But it is impossible at higher educational establishment due to lack of work situations. The only declaration during lectures, practices and seminars does not provide neither pace nor profoundness of the professional values gaining for their functioning on the actual performance level. There is a disagreement between educational process, conditions, methods and goals of efficiently operated professional values system of the aviation personnel-to-be.

The important problem of the professional values generating at the higher educational establishment is the inadequate tutors' repertoire of methods of influence which does not provide professional values achievement on the subconscious level.

From the position of systems sets of values provided for the aviation personnel-to-be achievement are the elements of future professional values system of the aviation personnel. Value generating might be enforced by polarization method, gathering values into groups, establishing value hierarchy structure.

The conscious gaining of the professional values for their functioning on the actual performance level: 1) relying on value informant – teacher, tutor, expert; 2) through the interaction with the professional (imitation); 3) during discussions (dialog actuates the value reconsideration, search for the self-improvement ways); 4) negative experience examining; 5) under the influence of important environment; 6) through the system of training; 7) through the conscious self-development in the individual interaction with the professional information sources.

Life demand for changes in the professional values system is stipulated by the social progress. Nowadays professionals are inclined to stereotype their personal constructs, values and professional conduct and operate in such a way till the end of their professional career. It is very important to

form the positive psychological attitude in students to new value changing especially in new organization adaptation conditions.

In search of problems solution we have conducted scientific research of the universal values system containing sets of the professionally oriented value components. 1027 value elements were investigated in 200 students to detect implicit backbone constructs which are the basis of the personality values structure of the aviation personnel-to-be. Actual backbone factors knowledge of the operating values system gives the real pragmatic tool for simultaneous enforcement of a great amount values gathered into single construct on the subconscious level.

Conclusions

1. There is a special students values system, which might be investigated in the context of the universal values system, to detect the conditions of value domination in the social circumstances at the higher educational establishment and on this base to solve the problem of the professional values systems of the aviation personnel-to-be generating and development.

2. The research might be based on the pragmatic criterion: professional development – key criterion for value components defining. Through psychological research, value orientation correlation and connection analysis with the main personality features to get the information for understanding psychological mechanisms of professional value system functioning to effect the professional development of the aviation personnel-to-be.

3. It is necessary to change the psychological and pedagogical means for personal professional values system generating, development, self-development initialization during educational process. The training work might be greatly enforced.

4. The methods of the professional values generating should be based on the personal backbone constructs which are the basis of the personality values structure of the aviation personnel-to-be.

5. The key psychological method of professional value components initialization is their polarization, disagreement problem solution, simultaneous values operation providing.

6. The special psychological and pedagogical task is development of the openness to new value constructs needed for successful occupational adaptation, workmanship achievement, correspondence between the personality and professional values systems.

References

1. *Бондаренко О.Ф.* Психологічні особливості сучасної студентської молоді // Практична психологія та соціальна робота. – 2003. – №4. – С.8-11.
2. *Братусь Б.С.* Психологические аспекты нравственного развития личности. – М., 1977.
3. *Леонтьев Д.А.* От социальных ценностей к личностным: социогенез и феноменология ценностной регуляции деятельности // Вестник. Моск. ун-та. – Сер. 14. Психология. – 1996. – №4. – С. 35-44.
4. *Р.Н. Макаров, С.Н. Неделько, А.П. Бамбуркин, В.А. Григорецкий.* Авиационная педагогика: Учебник. – Москва – Кировоград: МНАПЧАК, ГЛАУ, 2005. – 433 с.
5. *Р.Н. Макаров, М.И. Рубец, С.Н. Неделько, А.П. Бамбуркин.* Авиационная психология: Учебник. – Москва – Кировоград: МНАПЧАК, ГЛАУ, 2003. – 312 с.
6. *Rokeach M.* Beliefs, attitudes and values. - San Francisco, 1969. – 317 p.

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COMMUNICATIVE BASE FORMATION OF AVIATION EXPERTS WITHIN THE CONTEXT OF HUMAN FACTOR

The article reveals the issue of the vitality of human factor in Aviation English teaching.

Aviation today is going through rapid and dynamic alterations, thus demanding a drastic change in aviation-related human activity.

Over the last decade, air traffic has grown by more than 50%. Europe now has close to 8.5 million flights per year and up to 28,000 flights on busiest days. Even so, airspace capacity has been increased by 80% since 1990.

These results are good but the growth of traffic is set to continue. EUROCONTROL expects that today's traffic will have doubled by 2020. Current systems, with ongoing improvements, should be able to handle this increased load until the middle of the next decade, consequently imposing a greater responsibility upon aviation experts. So, not only more radical measures are called for in order to avoid serious congestion but also drastic changes in proficiency levels of humans involved.

The Single European Sky initiative is confidently expected to lay the foundations of a unified system which will be able to cater for the anticipated growth. Any unification is tightly associated with common professional language and its provision will be impossible without **Aviation English upgrading techniques** introduction. Since inadequate language proficiency has played a role in accidents and incidents, it's led to review of ICAO language requirements. ICAO has adopted strengthened language proficiency requirements for radiotelephony communications. All states and organizations have a role to play in improving communications.

At the same time, we cannot view language proficiency separately from human factor. The affect of human factor on flight safety is the vital issue of international aviation. Emergency and urgency expert investigations has shown Human Factor as the utmost reason for catastrophes and accentuated the fact that 80 % of Flight Safety depend on that crucial truth.

Accident investigators usually uncover a chain of events lining up in an unfortunate order to finally cause an accident, and language simply becomes one link in the chain of events. In many instances, the misuse of language has contributed directly to an accident. At other times, language is a link which exacerbates the problem. It has three distinct roles in accidents and incidents: the use of phraseologies, the use of plain language, the use of more than one language in the same environment.

As a matter of fact – the major part of Aviation expert proficiency is his linguistic skills. The linguistic skills determine the quality of aviation expert knowledge, but, at the same time, it's impossible to view them as a separate domain – we consider it to be a part of more overwhelming, integral human characteristics – his communicative skills.

Despite the fact ICAO has set forward uniform English proficiency requirements (there exist 6 operational levels and the level not less than the 4^{th} determines ATC or pilot job validity), there is still a gap concerning communicative skills that fall under the concept of human integral individuality. Thus, it becomes clear that the mentioned above problem decreases the quality of aviation expert training as far as the ATC profession makes a great emphasis on the communicative skills of a person.

The communicative approach to language teaching involves learning language by being involved in the tasks that require its use. One way of organizing a communicative language teaching curriculum is not only through a focus on the communicative functions of language but also on personal communicative skills which are a part of integral personality.

The communicative focus is associated with the peculiarities of aviation expert profile that features distance communication format. The ATC job environment is unique in the way that a

controller experiences a continuous 8 hour alert and responsible interaction with multiple aircraft crews, where interlocutors (controller - pilot) are out of visual contact, that, in case of unexpected turn of events will definitely aggravate mutual understanding.

The fact that a controller establishes communication with a number of aircraft simultaneously is complicated by multi-language interaction. Suchlike interaction is utterly dependant on communication plasticity, a tempo adequate enough for different language transition and also the ability to assess linguistic and communicative characteristics of a partner (speech clarity, tempo and accent). A controller with a number of communicative problems (inability to discern emotional state of a partner, reserve, autism, elevation, egotism or negative prejudices towards other people) will obviously pose a potential hazard that may result in safety disruption.

With air traffic growing at an unprecedented rate throughout the world, and a dramatic shortage of qualified air traffic controllers, quality ATC training with Aviation English domination is imperative. Simulation has to go beyond a simple computer game consisting of a few conflicting aircraft. Complete simulation needs to include all of the factors, which are present in actual ATC facilities. It is now essential to teach potential controllers how to manage airspace, communicate which other aircraft and agencies, use his flight strips and work on a team, and all that - within the framework of Aviation English.

Conclusion

Therefore, we state that the primary task in Aviation English for professionals teaching is the formation of the integral communicative – linguistic base for professional communication in English in the format of distance learning with communication environment simulation opportunities. We suggest that communicative skills formation of aviation experts will be based on inter-subject (dialogic) scientific approach.

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HUMAN FACTORS TRAINING DEVELOPMENT IN TRANSAERO AIRLINES

The strategic goal of human factors training development is formation of Company Resource Management in the Airline. Human Factors Policy is the main document of strategic development TRANSAERO AIRLINES. Human Factors Training in Airlines is conducted by CRM Instructors and analysis of the effectiveness is conducted by CRM Assessors. The modern system of Human Factors Training is the basis for effective preventive strategies of safety management.

Development of the Airline as the aviation business is determined by increased safety levels while maintaining efficient operating activities.

International Safety Standards pay great attention to the development of "Human Factors". Human Factors Training in the Airlines is a necessary element for the crews (pilots and flight attendants), as well as technical staff training.

TRANSAERO AIRLINES has the Human Factors Policy (2008) that determines the organization of human factors training and its impact on safety improvement.

The Human Factors Training provides skills-building of individual and collaborative professional activity (teambuilding for Airlines). Human Factors Group has built organization structure to the level of Company Resource Management.

General content of the Human Factors Training consists of the following stages:

a) Theoretical study

b) Psychological training

c) Assessment of knowledge and non-technical skills

In accordance with international requirements for airlines there is necessity to realize the following special human factors training courses for flight crews (CRM Training):

- ✓ Initial CRM Training.
- ✓ Conversion CRM Course when changing type.
- ✓ Conversion CRM Course when changing Operator.
- ✓ Command CRM Course.
- ✓ Recurrent CRM Training.

At the present stage TRANSAERO AIRLINES, together with experts of Lund University School of Aviation (L.U.S.A) adapts the international system of special human factors training for flight crews (CRM Training: Ground School).

During training pilots and flight attendants pass 12 modules:

1. Introduction.
2. Basic Aviation Psychology.
3. Attitude and Behavior.
4. Culture Awareness.
5. Communication.
6. Workload.
7. Situation Awareness.
8. Leadership and Group Dynamic.
9. Decision Making.
10. Human Error.
11. Treat and Error Management.
12. Automation.

Human Factors Training is conducted by certified professionals – CRM Instructors, who modify the content of training programs. During the Human Factors Training CRM Instructors use the leading research results and aviation accident reports.

Following the ICAO recommendations, Airlines CRM Instructors are classified into 3 categories:

a) CRM Instructor: Ground School

b) CRM Instructor: Simulators / Base

c) CRM Instructor: Line.

Flight Instructors TRANSAERO AIRLINES are trained as CRM Trainers (CRM Instructor: Ground School). This Course includes 14 modules:

1. Introduction
2. Basics about learning and teaching
3. Group dynamics
4. Objective of facilitation
5. Facilitation techniques
6. Push-pull techniques
7. Questioning techniques (open, closed, leading, judgmental, etc)
8. Different types of feedback (positive, negative, constructive, destructive)
9. Managing question from trainees
10. Evaluation and assessment
11. Working with case studies
12. CRM module structure (introduction, objectives, lecture, group work, team discussion questions, facilitation, etc)
13. Standardization
14. Practical application – facilitation performed by the candidates

Flight Instructors as CRM Assessors (CRM Instructors: Line) trained on the modern program. It is NOTECHS for CRM Assessment Course which includes 6 modules.

1. Airline system in general
2. The NOTECHS (Non Technical Skills) system
3. NOTECHS forms
4. Customization to the airline, discussions
5. Practical exercises in the assessment, using video scenarios
6. Requirements for an efficient assessment system

Only training for CRM Instructors: Simulators / Base have two parts (theoretical and practical). Theoretical part includes:

- Review of NOTECHS CRM assessment system,
- LOFT definition: Background, intentions and contents, design principles, debriefings, role and responsibilities of the instructor.

A practical part includes:

- Designing a LOFT session in class under the guidance of an experienced instructor,
- Designing individual LOFT sessions and conducting them as instructor in an FTD with class mates as crew members and under the supervision of an experienced instructor,
- Assessment exercises with video scenarios.

Effectiveness of the Human Factors Training implementation is provided by the Human Factors Report System.

The modern human factors training system is aimed at developing institutional responses to human error and is the basis for effective preventive strategies for managing Airline safety.

Conclusions

1. Human Factors Training development TRANSAERO AIRLINES is adapted to the international standards requirements. Human Factors Policy is the document of Human Factors Training strategic development.

2. TRANSAERO AIRLINES realizes the modern programs for flight and cabin crews, such as:

- Initial CRM Training.
- Conversion CRM Course when changing type.
- Conversion CRM Course when changing Operator.
- Command CRM Course.
- Recurrent CRM Training.

3. The Human Factors Training is conducted Airlines CRM Instructors. They are classified into three categories:

a) CRM Instructor: Ground School

b) CRM Instructor: Simulators / Base

c) CRM Instructor: Line.

4. TRANSAERO AIRLINES trains CRM Instructors of the Basic and Refresher Courses

5. The Human Factors Training Airlines System is the base of Safety Management System preventive strategy.

References

1. CAP 719 Fundamental Human Factors Concepts. – UK Civil Aviation Authority, 2002.

2. CAP 720 Flight Crew Training: Cockpit Resource Management (CRM) and Line-Oriented Flight Training (LOFT). – UK Civil Aviation Authority, 2002.

3. CAP 737 Crew Resource Management (CRM) Training. – UK Civil Aviation Authority, 2006.

4. Guidance Notes for Accreditation Standards for CRM Instructors and CRM Instructor Examiners, Standards Document 29. – UK Civil Aviation Authority, 2006.

5. Human Factors Training Manual, 1st Edition (Doc 9683-AN/950). – Montreal, Canada: International Civil Aviation Organization, 1998.

6. IOSA Standards Manual, 3rd Edition. – International Air Transport Association: Montreal-Geneva, 2010.

7. Safety Management Manual, 1st Edition (Doc 9859-AN/460). – Montreal, Canada: International Civil Aviation Organization, 2006.

SYMPOSIUM 8

AIR AND SPACE LAW: INTERNATIONAL AND NATIONAL ISSUES OF SECURITY

UDC 340.111.5 (045)

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LEGAL REGULATION OF TRANSNATIONAL INDUSTRIAL AND FINANCIAL GROUPS OPERATION IN THE FIELD OF AVIATION TECHNOLOGY PRODUCTION AND EXPLOITATION WITHIN THE CIS

In this article author researches some aspects of legal regulation of transnational industrial and financial groups operating within the CIS in the field of aviation technology production and exploitation as the most important integration and investment component

Legal regulation of creation and operation of transnational industrial and financial groups (hereinafter – TIFG) within the CIS is based on their considering as the most important integration and investment component. Cooperation of CIS member states in the field of aviation technology production and exploitation is governed in conformity with the bilateral and multilateral documents, among which are: the Agreement on Assistance in Creation and Development of Industrial, Commercial, Credit and Financial and Mixed Transnational Associations (1994), Convention on Transnational Corporations (1998), Agreement on Civil Aviation and Airspace Use (1991), Agreement on Creation of Transnational Financial and Industrial Group on Providing of Exploitation and Repair of the CIS Member States Civil Aviation Equipment (1996), Agreement on Creation of Intergovernmental Financial and Industrial Group "Internavigatsiya" (1998) [1; 2; 3; 4].

On April 15, 1994 the governments of Azerbaijan, Armenia, Byelorussia, Georgia, Kazakhstan, Kirghizia, Moldova, Russia, Tadzhikistan, Turkmenistan, Uzbekistan and Ukraine signed the Agreement on Assistance in Creation and Development of Industrial, Commercial, Credit and Financial and Mixed Transnational Associations. This document defines general characteristics of transnational associations and its provisions became the basis for governmental adoption of other documents which regulate procedure of transnational association creation and operation within the CIS. The above mentioned Agreement has not entered into force for Azerbaijan, Georgia, Turkmenistan and Ukraine and is temporarily applied to those states [1; 5].

On March 6, 1998 in Moscow the governments of CIS states signed the Convention on Transnational Corporations, which entered into force on January 14, 2000 (ratified by Ukraine on July 13, 1999) with the aim to develop provisions of the Agreement on Assistance in Creation and Development of Industrial, Commercial, Credit and Financial and Mixed Transnational Associations [2].

TFIG "Aerofin" is one of the first groups which received the official transnational status in the field of aviation technology production and exploitation on the territory of CIS. On October 18, 1996 in Moscow the CIS member states signed the Agreement on Creation of Transnational Financial and Industrial Group on Providing of Exploitation and Repair of the CIS Member States Civil Aviation Equipment – group "Aerofin" (hereinafter – the Agreement on Creation of TFIG "Aerofin"). The main purpose of this group is reestablishment of cooperation between aircraft builders, aircraft repair factories and airlines of CIS member states, increasing of their competitiveness on the global market of aviation services and transportation, as well as ensuring of high safety level of flights. The TFIG "Aerofin" incorporation and registration were executed in Russia. After its creation and registration it remains open for accession of other entities of the CIS member states and other countries which accept its aims and principles in accordance with their national legislation. The group may include entities of all ownership forms.

The parties of the Agreement on Creation of TFIG "Aerofin" perform the following functions:

- participation in realization of the Agreement on Creation of TFIG "Aerofin" in accordance with their national legislation;
- adoption of necessary national legal documents to contribute to the TFIG "Aerofin" activity on their territories;

- providing of relevant government guarantees, customs, tax and other benefits to the group members, determined by their national legislation etc.

The above mentioned Agreement is concluded on indefinite term. Note that this Agreement contains separate exceptions for Ukraine and Uzbekistan [6].

The TFIG "Aerofin" includes such entities: "Aviaprom", "Aviatekhsnab", Main Agency of Air Connections, "MiG", Airlines "Sakha-Avia", "Bykovo-Avia", "Omskavia", "Baikal", "Ukrainian Airlines", Byelorussian "Belavia" and "Minskavia", different joint-stock commercial banks and insurance companies etc. [7]

The Intergovernmental Financial and Industrial Group "Internavigatsiya" (hereinafter – IFIG "Internavigatsiya") is other TIFG which operates in the field of aviation technology production and exploitation within the CIS. It was founded according to the interstate Agreement on Creation of Intergovernmental Financial and Industrial Group "Internavigatsiya" from November 25, 1998, signed by the heads of six CIS governments (Armenia, Byelorussia, Kirghizia, Russia, Tadzhikistan and Ukraine). Its membership includes 14 enterprises and organizations of various ownership forms in Russia, Byelorussia, Kirghizia, Ukraine and Intergovernmental Bank. Its formation and creation were realized on the terms of voluntary association and mutually beneficial financial and economic activity. IFIG "Internavigatsiya" is the production and economic activity subject which operates as legal entity. It passed state registration in the authorized organs of Russia and has been included in the financial and industrial groups register.

The IFIG "Internavigatsiya" has the following purposes:

- coordination and using of their scientific and technical and industrial potential to create navigation systems, means and apparatus;
- profit-making and conducting of agreed investment policy, including search and attraction of financial resources within the CIS and other states;
- creating of their own investment structures for scientific research financing, implementation of their developments, programs and projects in the navigation field;
- conducting of sales markets marketing research, active advancement of their products to the CIS market and world market;
- creation of new jobs and implementation of social programs for IFIG "Internavigatsiya" members etc.

The IFIG "Internavigatsiya" activity focuses primarily on the implementation of the Interstate Radio Navigation Program of CIS member states and national radio navigation programs (plans) of CIS countries. The main activities of the group are:

- providing of navigation services for air, sea and land consumers;
- development and production of navigation systems and means, as well as GLONASS/gps integrated equipment ("Chaika"/ "Loran-C") for all consumer groups;
- development and manufacture of equipment for differential subsystem GLONASS/gps;
- development and implementation of automated radio navigation management systems and safe operating of different transport;
- conducting of scientific marketing research depending from IFIG activity and advertising;
- creation of certified centres and making of certification of navigation systems and means;
- conducting of foreign economic activity etc.

The IFIG "Internavigatsiya" members created its Central company as a limited liability company, approved its Charter, signed the constituent agreement and elected the Board of directors. The IFIG "Internavigatsiya" is open for accession of enterprises, organizations and other entities regardless of their form of ownership on conditions required by its constituent documents. Its participating companies developed a chain of projects and implement them in practice to ensure road safety of different transport (air, sea, automobile and rail) [8].

Conclusions

Today in the conditions of strict competition in the foreign markets and global financial crisis the ascertainment of cooperation between the CIS countries is one of the most important issues, which can be realized particularly through the creation of transnational industrial and financial groups as the most important integration and investment component. Creation of TIFG through integration of CIS countries financial capabilities in aviation industry will help to create competitive interstate market and form strong corporate entities in this field which will be able to compete with foreign leading aircraft corporations.

References

1. Угода про сприяння в створенні і розвитку виробничих, комерційних, кредитно-фінансових, страхових і змішаних транснаціональних об'єднань [Електронний ресурс] // Офіційний сайт Верховної Ради України. – Режим доступу: http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=997_013. – Назва з екрана.

2. Конвенция о транснациональных корпорациях [Електронний ресурс] // Офіційний сайт Верховної Ради України. – Режим доступу : http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=997_193. – Назва з екрана.

3. Соглашение о гражданской авиации и об использовании воздушного пространства [Електронний ресурс] // Офіційний сайт Верховної Ради України. – Режим доступу : http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=997_405. – Назва з екрана.

4. Соглашение о создании межгосударственной финансово-промышленной группы «Интернавигация» [Електронний ресурс] // Офіційний сайт Верховної Ради України. – Режим доступу http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=997224.– Назва з екрана.

5. Справка о ратификации документов и выполнении внутригосударственных процедур по документам, принятым Советом глав государств, Советом глав правительств и Экономическим советом Содружества Независимых Государств : за состоянием на 1 сентяб. 2004 г. [Електронний ресурс] // Офіційний сайт Верховної Ради України. – Режим доступу : http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=997_747. – Назва з екрана.

6. Угода про створення транснаціональної фінансово-промислової групи по забезпеченню експлуатації та ремонту авіаційної техніки цивільної авіації держав-учасниць Співдружності Незалежних Держав [Електронний ресурс] // Офіційний сайт Верховної Ради України. – Режим доступу : http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=997_073. – Назва з екрана.

7. Владимир Кривошеев: «Авиационные проблемы – забота общая» [Електронний ресурс] / *Шитов В.* // Гражданская авиация. – № 7. – 1999. – Режим доступу до журналу : http://www.avia.ru/inter/4/. – Назва з екрана.

8. Межгосударственная финансово-промышленная группа «Интернавигация» [Електронний ресурс] // Офіційний сайт Міждержавної фінансово-промислової групи «Інтернавігація». – Режим доступу: http://mfpg.narod.ru/main.htm. – Назва з екрана.

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EFFICIENCY OF FUNCTIONS OF LAW IN MODERN UKRAINE

In the article the author researches efficiency of functions of law in Ukraine, legal consciousness and legal culture.

Adaptation of the national legislation to the legislation of European Union in a sphere of civil aviation depends on efficiency of functions of law in modern Ukraine. Such efficiency depends on many factors. For example, a high level of legal consciousness and legal culture of nation is the guarantee of high efficiency of law functioning in the state.

There are different definitions of legal consciousness. "Legal consciousness is an aggregate of opinions, ideas, which express attitude of people, task forces, classes to law, legality, justice, their presentation about what is legitimate or illegal. The concentrate form of legal consciousness as forms of public consciousness is legal ideology – the system of legal opinions, which are based on certain social and scientific positions. The psychological side of legal consciousness is made by habits, senses, emotions of people in relation to the legal phenomena. The legal consciousness includes knowledge of operating law, its basic principles and requirements. It comes forward as a specific reflection of economic, political and other relations of certain society, position of classes and individuals in the system of public production and political structure. Legal consciousness influences on other forms of public consciousness, foremost on political consciousness and moral, and also public psychology, historical traditions, way of life, which was folded, and others" [1, p.521].

Farber I.E. marks that "legal consciousness represents all legal phenomena of society in ideas, presentations and senses, exists both in workaday and in theoretical consciousness" [2, p.204-205].

Legal consciousness is one of varieties of ideological and psychological perception of operating and desired law. The personal picture of operating law enables a person to perceive justice of legal orders, and also make sure in it. Perception of law will be realized through understanding of legal norms, which are basis of choice of the proper type of legal conduct. Legal knowledge are base of legal ideology. The level of such knowledge determines the degree of legal ideology and legal culture of man. Exactly the level of legal culture of society is closely related to development of the state.

"Legal culture of person (man, citizen) – is not it mental condition only. There are such components of legal culture: political and legal consciousness, which is based on scientific knowledge and understanding of nature of legal phenomena; legal positions (orientations, settings, persuasions, presentations, about legal relations and others like that); legal conduct (presence of motivation of political and legal action, legal hopes, abilities and legal skills, direct realization of rights, freedoms and duties); a display of activity is in legal spheres; legal emotions (sense of legality, necessity, in the observance of norms of law, aspiration, to realization of the rights and freedoms, respect to other people, their rights and freedoms, and other qualities)" [3, p.39].

Scientists come to the conclusion about existence of such types of deformation of legal consciousness, for example: "legal infantilism, legal nihilizm, legal idealism (fetishism), legal diletantizm, legal demagogy and "regeneration" of legal consciousness" [4].

"Functions of law are sending or types of influence of law to the relations public. A role and setting of law in society and state, its social value and major lines expresses in functions of law" [5, p.313]. "A function is a display of specific qualities of law. Functions of law have an economic orientation, carry political and ideological character. It is necessary to specify on some signs, which characterize the function of law as basic direction of its influence on public relations, which is determined its social setting. The function of law follows from its essence and determined setting of law in society on the certain stage of its development.

The function of law is such direction of its influence to public relations, a necessity for realization of which generates the necessity of existence of law as the social phenomenon. It expresses the most substantial, main lines of law, follows from his nature and directed on realization of the special role, which stands before a law as social phenomenon. The function of law characterizes by itself direction of influence of law on the whole, but not its separate part (a sphere, an institute and others like that) [6, p.26-27]. The functional efficiency of law depends on professionalism of laws, perfection of normative acts and process of their realization [7, p.124]. "Functions of law are processes of decision of dynamics of public relations by law [8, p.20].

"Functions of law are divided into two basic groups: commonsocial and special. Political, economic, social, ideological functions belong to commonsocial functions of law. Special functions of law are: regulative, protective, constituent and informative" [5, p.313].

Commonsocial functions of law are researched in scientific circles. Skakun O.F. takes to the commonsocial functions of law: informative, orientation, educate.

Oliynik A.Y. complements the noted list. Tere are: the function of humanism, organizational-administrative, evaluation-orientation and gnosiological (cognitive) functions of law. The scientist calls ideological-educational and communicative fuctions.

The Russian scientist Sinyukov V.N. extends commonsocial functions of law, including cultural-historical and the function of social control. He marks as one function informatively-orientation, and also supports opinion of other scientists of existence of educational function of law.

Radko T.N. divides the social functions of law into basic and unbasic. He takes to the basic social functions of law economic, political and educational. Informative, ecological and social functions are unbasic functions of law.

In the system of commonsocial functions of law in modern Ukraine informative, orientation and educational functions occupy a very important place. In opinion of Oliynik A.Y., by the informative (communicative) function of law "law informs people about will of legislator" [9, p.77].

"Law absorbs for itself, and then gives out information about the most various phenomena of public life. There is plenty of scientific definition, legal formulas, historical and vital certificates, political and legal estimations, legal recommendations, prohibitions, permissions, and others. Law is one of major facilities of social information, which the state uses, taking certain information to all legal subjects. Informative function can be considered element of ideological (educational) function. Informative ability of law is one of substantial factors, which allows to the elements of spiritual culture of society. Law above all things arises up not as informer, but as regulator of public relations. Arising up as a regulator of public relations, law begins to carry out the role of informer of their subjects. A legislator, concentrating certain vital information, through legal orders takes it to the participants of public relations, which are regulated. Objectively law acquires informative qualities also. Its social nature, ability to influence on will, consciousness and psyche of man, realized through its perception by people shows up" [10, p.243-244].

The orientation or evaluation-orientation function of law shows up that "conduct of people is estimated taking into account the laws of the state, specifies on solved by mutual agreement, socially possible methods and facilities of satisfaction of necessities of man within the limits of good behaviour" [9, p.77]. "Law comes forward the powerful source of moral orientation of subjects – organizations, physical persons in this concrete society. In this sense function of law must form the socially useful, positive orientation of subjective side of good behaviour" [11, p.157].

By the ideological-educational function "law forms functions for a man certain world view, educates the standards of good behaviour for it" [9, p.77]. "The educational function of law shows by itself the result of ability of law to express ideology of certain classes and social forces and its ability to carry out influence on opinions and senses of people. One of major tasks of the educational function of law is education of high legal consciousness, forming of stimuli of good behaviour, for citizens. At the same time legal requirements which do not represent desires and influenced of the people get negative estimation for them. In such cases the educational function of law does not arrive its purpose" [10, p.240].

Conclusions

The adaptation of the national legislation to the legislation of European Union in the sphere of civil aviation depends on the efficiency of functions of law in modern Ukraine. Improvement of efficiency of action of commonsocial functions of law, in particular, orientation, educational and informative, depends on the level of legal consciousness and legal culture of society. Exactly deformation processes of legal consciousness can destroy the nation and the state on the whole. It is need to increase the level of all forms of consciousness, including legal consciousness, and also legal culture. "Considering reasons of origin of different types of deformation of legal consciousness, it is possible to select the basic ways of its overcoming, among which most essential are: increase of general and legal culture of citizens, their legal and moral consciousness; perfection of legislation; prophylaxis of offences, and foremost crimes; strengthening of legality and law and order; defence of rights and freedoms of person; perfection of legal formation of population; training of highly skilled lawyers. It needs to create directions of development of legal consciousness for citizens of Ukraine" [4].

References

1. Философский энциклопедический словарь. Гл. редакция: *Л.Ф. Ильичев, .Н. Федосеев, С.М. Ковалев, В.Г. Панов.* — М.: Сов. Энциклопедия, 1983. — 840 с.

2. *Фарбер И.Е.* Правосознание как форма общественного сознания. — М.: Иридическая література, 1963. — 206 с.

3. *Менюк О.* Правова культура в умовах розбудови незалежної України: поняття, структура // Право України. — 2001. — № 4. — С. 21-23, 39.

4. *Требін М.П.* Правосвідомість громадян України: стан та види деформації. http://www.nbuv.gov.ua/Portal/natural/vkhnu/Soc_dos/2009_844/articles/Trebin.pdf

5. Юридична енциклопедія: В 6 т. /Редкол.: *Ю.С. Шемшученко* (голова редкол.) та ін. – К.: „Українська енциклопедія", 1998. – 756 с.

6. *Радько Т.Н.* Основные функции социалистического права: Учеб. пособ. – Волгоград, 1970. – 143 с.

7. *Коростей В.* Про функції права // Право України. – 2004. – № 9. – С. 124-127.

8. *Спаський А.* Функціонування права // Право України. – 2008. – № 1. – С. 18-20.

9. Правознавство: Підручник/ За ред. *В.В. Копєйчикова.* – К.: Юрінком Інтер, 2003. – 736 с.

10. *Радько Т.Н.* Теория государства и права: Учебник для вузов – М.: ЮНИТИ-ДАНА, Закон и право, 2004. – 576 с.

11. Теория государства и права. Курс лекций/ Под ред. *Н.И. Матузова и А.В. Малько.* – М.: Юристь, 1997. – 672 с.

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ON LIBERALIZATION OF RUSSIAN LEGISLATION

The article deals with the ways of liberalization of Russian air legislation. Some proposals on the economic use of Russia's air space for restoring regional and local air communications and for solving other problems of Russia's air transport are given.

Air space above the territory of any state has been considered and recognized by international law as a constituent part of the territory of the state. First in the Paris Convention of 1919, and then in the Chicago Convention of 1944 is recognized, that any state enjoys full and exclusive power over its air space located above its land and water territory, including territorial waters. This power is based on sovereignty – universally recognized principle of international law.

It is high time to see how the Russian State which is the owner of its air space, disposes of this "treasure", to see if it can derive evident and rather large benefits from this natural wealth for itself and its people. And the question of using this property is put point-blank - provision of intensive development of Russian transport communications throughout Russia is connected not only with roads and railroads but also with the development of aviation which provides transportation on regional and local air routes.

When the question arises how to find money for the restoration of local airlines, everybody's eyes are turned to the purse of the State. All the plans are based on the belief that if the State loosens its purse-strings and then regional and local airlines will revive, in our opinion, one will have to wait long for such benefits from the State. A great amount of money is needed to restore the local airlines. As a scientist and lawyer I propose my vision of solving this problem. We believe that in order to find such great amount of money for the restoration of local air communications and for solving other problems of Russian air transport, the owner of the sky, that is the State should give up the stereotyped ideas that, being the public owner of its air space, it can do nothing for using this space in economy, confining itself to the role of supreme sovereign of its air space. But the fact is that the air space where there is a network of air transport communications served by ATC management, is supported by the State which spends a lot of money on such support. The question arises: where to get money? Is it possible, figuratively speaking, to find ways of self-repayment, that is the ways of deriving profits by the State from such self-repayment, the owner of the air space.

Many states, not forgetting to ensure their security and not weakening their lines of defence in the air, have taken steps for their national air space to become accessible not only for transportation but for flights of general-task, business, amateur, sport and other aviation.

The USA, Canada, India, Cambodia, Vietnam and Laos, The European Union countries opened their national markets for international transportation on the principles of liberalization and "open sky". For example, it took the European Union countries about thirty years to create the European "open sky". Now, due to the "open sky", we witness a transportation boom in Europe. Because of the increased competition air transportation has become cheaper. European air companies, together with companies from the countries which chose the way of liberalization and "open sky" practically determine the economic situation on the world market of air transportation.

At present neither the Air Code of Russia nor any other statutes of air law contain provisions dealing with said issues. All the history of the development of the Russian air legislation testifies to the reverse. During the Soviet period all the legislation was aimed at strengthening the exclusive and unlimited power of the state over the situation in the air space and over those flying in it and using it. Effective Russian air legislation does not differ very much from the Soviet one. Legal prohibitions and restrictions, often presented as ensuring the safety for those using the airspace,

ensure, in fact the safety for beaurocrats. Legal orientation of our laws making the air space less accessible hinders the development of general-task aviation, prevents the development of the fleet of private planes, hinders flight clubs operation. It is evident that if the State continues to adhere to prohibitive- restricting policy in the use of the air space, the process of stagnation in the sphere of aviation activities is ensured. That is why the Russian legislation must undergo a fundamental reform, otherwise the transition to the market is impossible.

At present neither economically, nor legally the Russian market of international air transportation belongs to the liberal market and hence it is doomed to be a periphery of the world market of air transportation. No better is the situation on the domestic market. That is why, we believe, it is necessary to develop a new Air Code which wouldn't hinder the development of the market and would be a legal stimulant and regulator of market relations in using the air space for Civil Aviation flight activities.

From the legal point of view the State having the air space at its disposal, can well extend the possibilities of economic use of its air space because of the right to use which forms the legal triad of the State's property right to this constituent part of the state territory.

Not forfeiting its rights to this property, the State can, via the right to use, grant on lease or concession some objects of its air space use for a definite period of time and on its terms and conditions to potential lease-holders or concessionaires. Such objects may include federal, regional and local air routes and some other objects of air space use. Extending lease relations to air routes can considerably facilitate the search by the State of new sources of income for the restoration and development of regional and local airlines. Moreover, if the State makes inventory of its natural wealth, having in mind the economic use of the wealth, it is quite possible that some other interesting objects for leasing will be found. Such objects may include some parts of the air space which do not fall under the category of uncontrolled air space and can be used for the needs of general-task aviation and business aviation on the terms of lease and concession agreements. Figuratively speaking, the State may offer for lease on the air transport market peculiar goods – air routes, air zones in the vicinity of airports and other objects. As a result, the air space as a public sphere of ruling acquires the status of an economic object from the use of which the State will learn to derive profits for financing the adequate support and settlement of regional and local adequate reliable aeronavigation management on these routes.

It is quite possible that lease relations in this sphere will make it attractive for investments, further development of state-private partnership will become possible.

It cannot be ruled out that granting air routs on lease to foreign air companies, for instance, in the Far East, will help solve the problem of deficiency in the provision of its residents (inhabitants) with air transportation. In 2014 the compensational payments for flight on the Trans-Siberian air main paid by foreign air companies may cease. A question arises: What will we have to replace these incomes?

Lease of flight time, other uses of lease relating to the Trans-Siberian main will give us an opportunity to compensate for Russia's expenses on maintaining and ensuring safety of flight on this main.

It is quite natural that in order to do all this it is necessary to develop an adequate normative base and make it more liberal.

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FLEXIBLE USE OF AIRSPACE CONCEPT

Considered signs of Flexible Use of Airspace Concept with the characteristic of its structural levels and the necessity of its holding in Ukraine.

With the advent of aircraft heavier than air and capable flight over the territory of more than one State, there was a need for international legal regulation of such operations and the airspace regime. [8]

With the development of society and scientific technologies have started growing demands and needs of the airspace over. To enforce these requirements under constant movement in the air, Transport Ministers of the European Civil Aviation Conference (ECAC) April 24, 1990 accepted the concept called "on the way". This strategy was directed by the Office of the European Air Traffic Control (ATC) on the regulation of services should be provided from 1995 to 1998 in the context of those needs that are included in the XXI century. With this purpose in the early 90's of XX century under the auspices of the European Air Traffic management program was developed harmonization and integration of airspace use. The main aim of control was the introduction of flexible use of air transport (Flexible Use of Airspace (FUA) Concept). [10]

With Ukraine's accession in 2003 to Eurocontrol question using of this concept for our country become important. Cabinet of Ministers of Ukraine in 7 September 2002, the number 1328 was adopted a resolution "On approving of the Program of the building of the state system using of airspace of Ukraine for 2002-2006", where one of the objectives of the organization was given flexible use of airspace in the interest of its users in accordance with the Eurocontrol for the countries - members of the European Civil Aviation Conference. [5]

The Regulation of Cabinet of Ministers of Ukraine on 13.01.2010 № 44 "On approval of the state system of airspace of Ukraine for 2010-2014 years" proclaimed that the legislation of air navigation service requires harmonization with the regulations of the European community in the Single European Sky. [7]

In view of this it is possible to conclude that the Flexible Use of Airspace (FUA) Concept today requires special attention from legislators, practitioners and theorists.

At the first the notion of "flexible use of airspace" was used in March 1996. According to Eurocontrol Programme European concept of flexible use of airspace (FUA Concept) is that:

- Airspace is now not regarded as "civil" or "military" airspace, but as well as one (continuum), which exists for the needs of users;
- Any airspace segregation is temporary, based on use in real time within a time continuum;
- Adjacent lines of airspace are not limited by national boundaries.

Flexible structure airspace established:

- **Conditional Routes** - volatile Air Traffic Services (ATS) routes or parts of tracks;
- **Temporary Segregated Areas** (TSAs) and **Temporary Reserved Areas** (TRAs) - areas of temporary reservation for the exclusive use of individual users
- **Cross-Border Areas** (CBAs) - TSAs or TRAs, established by international borders
- **Reduce Co-ordination Airspace** (RCA) and **Prior Co-ordination Airspace** (PCA) - procedures that allow for General Air Traffic (GAT) is outside the ATS route structure. [8]

The Flexible Use of Airspace (FUA) Concept was developed on three levels of airspace management, appropriate civil and / or military coordination of objectives. Each level of airspace management affects the other and they are closely interrelated:

Level 1 - Strategic. Its content is that the states, within which there is a need for this, create a permanent body for Strategic Airspace Management (ASM) to undertake policy coordination and planning of airspace usage. Through this national body, states:

- Formulate the national police for airspace management taking into account national and international airspace users and Air Traffic Services (ATS) providers requirements;
- Reassess the national airspace structure and ATS route network with the aim of planning, as far as possible, for flexible airspace structures and procedures;
- Periodically review the national airspace needs and, where applicable, cross-border airspace utilization;
- Establish negotiation procedures and priority rules for airspace allocation at Level 2;
- Review the procedures and efficiency of Level 2 and level 3 operations;
- Provide a continuum and transparency of operational handling at national boundaries through collaborative airspace planning and harmonized airspace management with neighboring States.

Level 2 – Pre-tactical. At this level:

States establish, whenever required, joint civil/military Airspace Management Cells (AMCs) to conduct day-to-day airspace allocation and management in close cooperation with the Central Flow Management Unit (CFMU).

The National High-Level Policy Body determines the degree of discretion and authority of the AMC in order to minimize the need for referrals to higher authority.

Sub-regional AMCs, could be established by two or more States, with the responsibility for pre-tactical airspace management on both sides of an international manners.

Airspace Management Cells (AMCs):

- Allocate the required airspace on a day-to-day basis to the users in a decisive, timely and efficient manner;
- Promulgate each day to all parties concerned the airspace allocation decision for the following day by transmitting an Airspace Use Plan (AUP).

In order to implement the FUA Concept with efficiency, the ECAC States have recognized the need for a central pre-tactical Level 2 airspace management function, the Contralised Airspace Data Function (CADF).

The Centralised Airspace Data Function (CADF) has been established within the Central Flow management Unit (CFMU) to:

- Collect the information from Airspace management Cells (AMCs) and detect lack of continuity in Conditional Routs (CDRs) arising from the different Airspace Use Plans (AUPs);
- Compile a consolidated message on Conditional Routs (CDRs) availability within the ECAC area, Conditional Rout Availability Message (CRAM), to be issued to operators for flight planning purpose.

Level 3 - Tactical. States establish enhanced supporting coordination equipment and real-time civil/military coordination procedures in order to:

- activate, deactivate or reallocate in real-time the airspace allocated at Level 2;
- permit the maximum joint use of airspace by civil and military traffic in safety which reduces segregation needs;
- resolve specific airspace problems and traffic situations between civil and military ATS units and controllers;
- access to all necessary flight data including controller's intentions;
- fully exploit the FUA Concept at Levels 1 and 2.

The implementation of the Concept of the Flexible Use of Airspace has already benefited both civil and military aviation with:

- Flight economy offered through a reduction in distance, time and fuel;
- The establishment of enhanced Air traffic Services (ATS) rout network and associated sectorisation providing:
  - an increase in Air Traffic Control (ATC) capacity;

- a reduction in delays to General Air Traffic;
- more efficient ways to separate Operational and General Air Traffic;
- enhanced real-time civil/military coordination;
- a reduction in airspace segregation needs;
- the definition and use of Temporary Segregated Areas that are more closely in line with military operational requirements and more generally that better respond to specific military requirements
- in tactical phase. [10]

The Flexible Use of Airspace Concept is one of the basic elements in creating a Single European Sky of European Union and the security of the airspace within EU. At EU level legislative procedural enactment Flexible Use of Airspace (FUA) Concept passed through adoption of EC Regulation № 549/2004 of the European Parliament and the Council of 10 March 2004 establishing a framework to create a Single European Sky.

Article 1 of the Regulation provides that the purpose of the Single European Sky initiative is to increase the current standards of safety and overall performance for general purpose air traffic in Europe, to optimize bandwidth that meets the requirements of all airspace users, and minimize delays. In pursuing this goal, the purpose of this Regulation is to create a coordinated regulatory framework for the establishment of a Single European Sky by 31 December 2004. [1]

This Regulation creates a harmonized regulatory framework to create a single European sky in combination with:

(A) Regulation (EU) № 551/2004 of the European Parliament and the Council of 10 March 2004 on organization and use of airspace in the Single European Sky (the airspace Regulation)[2]

(B) Regulation (EU) № 550/2004 of the European Parliament and the Council of 10 March 2004 on the provision of air navigation services in the Single European Sky (Regulation of Service) [3]

(C) Regulation (EU) № 552/2004 of the European Parliament and the Council of 10 March 2004 on cooperation between the European network of air traffic control (Regulation of interaction). [4]

To manage to create special bodies at the national level to ensure they complete execution and compliance with EU Regulation № 549/2004. [1]

National supervisors organs must ensure independence from suppliers aero navigation air services. This independence should be achieved through adequate distribution, at least at the functional level, between national supervisors and such suppliers.

So, it can follow that, through the establishment of the Single European Sky regulations underlying Concept of Flexible Use of Airspace.

If you refer to Regulation (EU) № 551/2004 of the European Parliament and the Council of 10 March 2004 on organization and use of airspace in the Single European Sky (Regulation of airspace) Chapter III which defines the conditions for flexible use of airspace in the single European sky it is possible to see that Article 7 stipulates that Member States should provide same kind of application of the Concept of Flexible Use of Air transport within the Single European Sky, as described by ICAO and Eurocontrol developed to facilitate airspace management and air traffic control in the common transport policy. Member States shall report annually to the Commission on the application, in the common transport policy, the Concept of Flexible Use of Airspace in relation to airspace that is within their responsibility. If, in particular, after receiving reports submitted by Member States, it is necessary to strengthen and harmonize the Concept of Flexible Use of Airspace within the Single European Sky, implementing rules within the common transport policy should be adopted under the procedure established in Article 8 of the Regulation.

Article 8 (temporary suspension) states that:

1. in cases where the application of Article 7 leads to significant operational difficulties, Member States may temporarily suspend such use, provided that they immediately inform the Commission and its other Member States;

2. after the introduction of temporary suspension, according to the procedure in Article 8 of the Regulation for the structure of the airspace for which the corresponding (and) state (s) Member

(s) may be developed for changes to the rules adopted under Article 7.

Implementation of the rules of air traffic flow management must be based according to the procedure in Article 8 of Regulation structure to optimize existing capacity in the use of air space and improving air traffic flow control. These rules should be based on the principles of transparency and efficiency, ensuring that power flight provided a flexible and timely manner in accordance with the recommendations of the regional ICAO Air Navigation Plan, European Region.

Rules of implementation should support operational solutions of air navigation service providers, airport operators and airspace users, and should cover the following areas:

(A) flight planning;

(B) use of available airspace capacity during all stages of flight, including the allocation of time slots, and

(C) use of air traffic routing, general purpose, including

- Creation of a single publication for route guidance and traffic

- Possibilities for deviation of air traffic from general-purpose zones of intense air traffic, and

- Priority rules on access to airspace for general purpose air traffic, especially during periods of congestion and crisis. [2]

October 19, 2007 adopted a decree of by the President of Ukraine N 981/2007 «On delegation of Ukraine for talks with the European Union of Agreement with the European Union Common Aviation Area", which became one of the first steps towards putting into operation a mechanism for cooperation between the European Union and Ukraine. EU creating a Single European Sky has created a single air space without boundaries and borders, but preserve the sovereignty and independence of each state. Regulations adopted by the EU can be taken as a basis for the law on integration and implementation of this concept within the airspace of our state. Therefore, for Ukraine is a very urgent and necessary to introduce concept of flexible use of airspace, which will create a Common Aviation Area with the EU member states that, in my opinion, could be impetus to Ukraine's accession to the EU enlargement and border cooperation.

References

1. EU Regulation number 549/2004 of the European Parliament and the Council of 10 March 2004, which sets the framework for a Single European Sky – www.zakon.rada.gov.ua

2. Regulation (EC) № 551/2004 of the European Parliament and the Council of 10 March 2004 on organization and use of airspace in the Single European Sky (the airspace Regulation) – www.zakon.rada.gov.ua

3. Regulation (EC) № 550/2004 of the European Parliament and the Council of 10 March 2004 on the provision of air navigation services in the single European sky (Regulation Service) – www.zakon.rada.gov.ua

4. Regulation (EC) № 552/2004 of the European Parliament and the Council of 10 March 2004 on cooperation between the European network of air traffic control (Regulation of interaction) – www.zakon.rada.gov.ua

5. The Cabinet of Ministers of Ukraine of 7 September 2002 № 1328 "On approving of Program of the building the state system using of airspace of Ukraine for 2002-2006"– www.zakon.rada.gov.ua

6. Decree of the President of Ukraine from October 19, 2007 N 981/2007 «On delegation of Ukraine for talks with the European Union of Agreement with the European Union Common Aviation Area" – www.zakon.rada.gov.ua

7. The Regulation of Cabinet of Ministers of Ukraine on 13.01.2010 № 44 "On approval of the state system of airspace of Ukraine for 2010-2014 years"// Official Bulletin of Ukraine from 29.01.2010 - 2010, № 3, pp. 1933, Article 106

8. International law: Main industries: The textbook, edited by. VG Boutkevitch. - K.: Lybid, 2004. - S. 428

9. The EUROCONTROL Concept of the Flexible Use of Airspace (Brochure)

10.http://www.eurocontrol.int/airspace/public/standard_page/1482_Concept.html

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PROBLEMS OF TRANSFORMATION OF THE ARTICLE OF LABOUR RIGHT ON MODERN STAGE OF DEVELOPMENT OF SOCIETY

The article is devoted to research of problems of the transformation of the article of labour right, conditioned by high-quality changes in technology, information, science and intellectual base of society, characteristic for a modern labour-market

During history of existence of industry the article of labour right tested certain modifications, but in a given period of development of society the problem of his transformation acquired yet greater actuality. It is explained by that a modern labour-market has a number of the features, conditioned by new high-quality changes in technology, information, science and intellectual base of society.

Traditionally by the article of adjusting of labour right is hired labour, dependent, collective (cooperative) was acknowledged. By a criterion, on the basis of which relations, that arise up in the process of realization by the citizens of right to work it is possible to attribute to the labour relations, in science of labour right the lack of initiative of labour which is examined in two aspects is acknowledged: economic, which consists in alienation of worker from capital goods, and organizatsiyno-pravovomou, which consists in a presence between the sides of relations of power-submission. Except for it, such labour is public, organized and payment. For modern science of labour right for Ukraine position about that the labour relations of wage labour, which arise up on the basis of labour contract, base of the article of labour right is a doctrine. That is when the question is labour relations, the process of labour protracted and systematic is had in a kind, systematic payment of labour, application of living labour, implementation of certain labour function.

In a period the existence of soviet doctrine of labour right in science two basic conceptions of object were formed: one - traditional, pursuant to which the labour relations and relations interlinked with labours (conception of multiplicity (breaking up) of labour legal relationship) are an object, second - conception of unique labour legal relationship.

First the idea of differentiation of labour relations and other relations related to labours was expressed by A. E. Pasherstnik [1, p. 39-42]. Presently divides this point of view, in particular, Ukrainian scientific by D. O. Carpenco, in opinion of which the article of labour right, - the phenomenon difficult and many-sided, to maintenance of which enter, except for actually the labour relations, and such, that are interlinked with labours, one of which precede to the labour relations, second - accompany them, and third - swim out from the labour relations [2, p. 22]. Thus general for all derivative relations their conditionality is acknowledged by the labour relations.

At the same time, in science of the Russian labour right the suggestions about «cleaning» of the article of labour right from the relations unusual to him, and, under which those or other relations interlinked with labours are usually had in a kind, took place [3, p. 5, 33].

At one time offered a new interpretation of the article of labour right Russian scientific by S. A. Ivanov, R.Z Livshits, J. P. Orlovsky. So, R. Z. Livshits expressed opinion about that public relations which are regulated by a labour right, it is necessary to distinguish as individual and collective. Participation of citizens in the operations management is the table of contents of collective relations, organization and establishment of terms of labour. Such relations arise up between a labour collective, his organs and administration [4, p. 87]. In opinion of advocates of conception of collective labour relations, the collective-labour relations next to the individual-labour relations dip out all article of labour right [5, p. 87; 4, p. 9-13], the same the unique universal labour relation is constructed as though.

The selection of collective labour relations was stipulated to those, that socialistic organization of labour impossible without participation of workers in the operations management, and Constitution of USSR (in 1977) first fastened legal status of labour collective as an independent

legal subject. At the same time, this conception met serious criticism from the side of row of scientists in the field of labour law [6, p. 20-21].

Given conception, pursuant to which the article of labour right is made by the labour relations which include the relations individual and collective, the Ukrainian scientist divided by A. R. Matsuk [7, p. 49-56]. In a modern period this idea in the dissertation was inculcated by G. A. Chanisheva, in opinion of which, the individual labour relations do not represent all communications which arise up in the process of labour. As a result of conclusion of labour treaty (contract) a worker acquires labour rights both individual, and collective, becomes the participant of concrete types of labour pravovidnosin individual and collective. By an author grounds indissoluble communication, unity and co-operation of labour relations individual and collective [8, p. 7]. In modern terms there is the system of public relations, that make the article of labour right, from the point of view by N.B. Bolotina, consists of individual labour relations, which arise up on the basis of labour contract, and collective labour relations [9, p. 50].

Basic contrargoument of opponents of the adopted conception consisted in that the collective labour relations after the nature are not labour, as the capacities for labour not connected with application, the transmitter of which always an individual is only (physical person). Therefore collective relations not what other, as derivative relations after participation of workers in the management by an enterprise (organizational-administrative).

Taking to account that a labour right was formed as organic combination of two large institutes: private low institute of labour contract, which was formed in the bowels of the earth of civil law, and public-legal institute of labour (factory acts) protection, that functioned within the framework of constabulary (administrative) right, Russian scientist A. V. Kuzmenko article of modern labour right for Russia in a general kind suggests to examine, selecting three constituents in him: individual relations, collective relations, adjuvant relations [11, p. 46]. Thus individual labour legal relationship which it is necessary to examine as a fundamental systemically important element of full industry are main and determining. The collective relations, in opinion of author, include at itself the relations organizational-administrative and social-partner in the traditional understanding. The group of adjuvant relations is made by the relationships with participation of the state, called to be instrumental in realization of mutual right and duties main labour legal subjects - workers and employers.

S. M. Troshina comes forward for expansion of the article of adjusting of labour relations due to the inclusion of relations of social defence [11, p. 7, 11].

In the theory of labour right developed seven criterion signs of individual labour legal relationship, that allow them to select as the article of labour right and allow to distinguish from other relations maintenance of which labour is also, but which are regulated by other fields of law [12, p. 64]:

1. The process of labour, instead of its concrete result, is the article of adjusting, as in the civil legal relations; the labour relations carry a proceeding character.

2. A worker executes work personally.

3. A worker joins in the frame of society of organization, in which works.

4. A worker executes the not individual task, and any work incumbent to him, and that behaves to his profession, speciality, positions.

5. From a worker the implementation of certain measure of labour is required.

6. For a worker obligatory pointing and order of employer in relation to work which he executes.

7. The property risk always lies on to the employer, unlike the civil legal relations, for example, subcontract, where the property risk is distributed differently.

In legal literature of countries of the West thought has distribution, that subsequent expansion of labour right in these countries and other changes in legal building on in the conditions of postindustrial society will lead in the eventual account to the substantial change of the article of labour right, to distribution of him on all kinds publicly useful professional activity, that labour both dependent, and independent is included. Notion «labour activity» as an object of labour right will

be replaced by more wide notion «professional activity», that includes all kinds socially useful activity [13, p. 296].

On the whole it is possible to establish that modification of structure of the article of labour right in course of time was complicated and represented the changes in the system of legislation and in the system of public relations in the field of labour. In some period of history the change of theoretical conceptions was determined by mainly ideological factors at invariability of actual relations, that represented subjective (pursuant to ideological looks) vision of aims and tasks of the legal adjusting of sphere of wage labour.

Unfortunately, it is had to establish absence of unique conception of the article of labour right in the project of the Labour code (LC) of Ukraine. Going out with an item 2 of project of LC Ukraine, it is possible to do a conclusion, that his authors laid down in a basis the conception of labour relations and relations interlinked with labours. But the structural selection of separate book testifies the «Collective labour relations» to conception of labour relations individual and collective. Therefore the adopted item 2 with the structure of project of LC Ukraine needs the concordance. We consider on the whole, that an item 2 of project of LC Ukraine must reproduce the article of labour right. How is given out, today there is no necessity to renounce dominating in the theory of labour right for the soviet period of conception of difficult structure of the article of industry, that includes the public relations labour and derivative, and which are related to labours and conditioned by their existence. Operating Labour Code the Ukraine was repeatedly criticized in literature for absence of clear determination of circle of public relations, that by him are regulated (item 1), and sphere of action of legislation about labour (item 3). It is given out, that the developers of project of LC Ukraine not fully succeeded to avoid the errors of the predecessors, without regard to that a project contains a separate item 2, which the circle of public relations, that are regulated LC Ukraine is determined by. A list from nine types of public relations is not exhaustive, as in the noted article the question is relations in relation to «other questions certain by this Code». With the last position scarcely it is possible to consent. The Labour code of Ukraine is to become the basis of national labour legislation, for this purpose in him it is necessary expressly and exhaustively to define the circle of relations, that by him are regulated, and which make the article of labour right.

Conclusions

Consequently, it is possible to establish that relations, that arise up on the basis of labour contract concerning application of wage labour which is characterized by such signs, as a collectivity, lack (subordination) of initiative and internal legal regulation, is the article of labour right for Ukraine. The labour provided with the indicated signs is exactly hired, is that fundamental category, which comes forward the generalized expression of all system of public relations, that make the article of labour right multilateral and difficult. But unity of opinions of scientists from explored problematic is limited to confessedly approach to the difficult structure of the article of industry. As for a rich side in content - types of relations labour and derivative, these questions were and remain for the given time the object of discussions.

Before science of labour right the task gets up on the basis of present conceptions to form the unique theory of the article of labour right, which would respond to the modern conditions of development of society. The native changes of the socio-political system of society were reflected by a critical period in science of labour right. A theoretical basis which would respond to request the present is therefore needed. For postindustrial science of labour right development of a new theory of labour right on the basis of analysis and generalization of scientific conceptions is the actual practical task. In a modern period the state executes the row of social functions, is concentrated on guaranteeing and defence of human rights and citizen, that predetermines the changes in the article of labour right. Thus by an unchanging kernel, the labour relations are the bar of the article of the legal adjusting of labour right, they are his exceptional sphere, while other relations are contiguous, unbasic. Sparing lately of attention of personal data protection of worker allows to pull out supposition about subsequent development of the legal adjusting and increase of role of the personal no property relations in the field of labour and necessity of consideration of

these relations also within the framework of individual labour relations. The analysis of positions of project of the Labour code of Ukraine testifies to absence of unique whole conceptual basis. Such state of affairs testifies to the presence of methodological problems in science of labour right, which need the decision.

References

1. *Пашерстник А. Е.* Теоретические вопросы кодификации общесоюзного законодательства о труде. – М.: Изд-во АН СССР, 1955. – 228 с.

2. Трудове право України: Академічний курс: Підручник / А. Ю. Бабаскін, Ю. В. Баранюк, С. В. Дріжчана та ін..; За заг. ред. Н. М. Хуторян. – К.: Видавництво А.С.К., 2004. – 608 с.

3. *Лебедев В. М.* Трудовое право: проблемы общей части. – Томск: Томский государственный педагогический университет, 1998. – 184 с.

4. *Иванов С. А., Лившиц Р. З., Орловский Ю. П.* Советское трудовое право: вопросы теории. – М.: Наука, 1978. – 368 с.

5. *Мацюк А. Р.* Трудовые правоотношения развитого социалистического общества. – К.: Наукова думка, 1984. – 280 с.

6. *Андреев В. С., Пашков А. С., Смирнов О. В., Смолярчук В. И.* Проблемы общей части советского трудового права // Правоведение. – 1980. – № 6. – С. 20-21.

7. *Мацюк А. Р.* Структура предмета советского трудового права // Советское государство и право. – 1979. – № 11. – С. 49-56.

8. *Чанишева Г. І.* Колективні відносини у сфері праці: теоретичні та практичні проблеми правового регулювання. Автореф. дис. ... докт. юрид. наук. – Харків, 2002. – 38 с.

9. *Болотіна Н. Б.* Трудове право України: Підручник. – 2-ге вид., стер. – К.: Вікар, 2004. – 564 с.

10. *Кузьменко А. В.* Предмет трудового права России: опыт системно-юридического исследования. – СПб.: Издательство Р. Асланова «Юридический центр Пресс», 2005. – 274 с.

11. *Трошина С. М.* Совершенствование системы юридических источников регулирования трудовых отношений в Российской Федерации. Автореф. дисс. … канд. юрид. наук. – Екатеринбург, 1993. – 23 с.

12. *Лушников А. М., Лушникова М. В.* Курс трудового права: Учебник: В 2 т. Т. 1. Сущность трудового права и история его развития. Трудовые права в системе прав человека. Общая часть. – 2-е изд., перераб. и доп. – М.: Статут, 2009. – 879 с.

13. *Киселев И. Я.* Трудовое право России и зарубежных стран. Международные нормы труда: Учебник. – Изд. 2-е, испр. и доп. – М.: Эксмо, 2006. – 608 с.

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QUESTION OF ADMINISTRATIVE AND LEGAL STATUS OF THE AIRCRAFT COMMANDER OF UKRAINE

In this article the author investigational and systematized the feature of administrative and legal status of the aircraft commander of Ukraine. Author also gives the changes of legislative norms which regulate legal status of the aircraft commander of Ukraine.

The decision of administrative and legal status of the aircraft commander is presented by the special interest, as other crew members execute the limited functions and are inferiors exactly to the aircraft commander.

The aircraft commander (or pilot-in-commander, or PIC) has status of main leading person on an air ship during all flight time. As set the Air code of Ukraine (article 37), the aircraft commander can be a person, which has speciality of pilot, and also preparation and experience, necessary for an independent management a type the air ship of it and by guidance of crew of air ship [1].

The aircraft commander is a pilot, which is appointed for exploitation by the proprietor of air ship to carry out the duties of the aircraft commander and responsible for safe realization of flight during flight time.

The aircraft commander is under an obligation to own the technique of flight at level, which provides safe implementation of flight. The aircraft commander is under an obligation to be capable quickly and right to estimate a situation which is folded. The aircraft commander must to organize fully works of members of crew of air ship (on earth and on wing) also to manage pre-flight preparation of the air teaching, to watch by a situation at the feasance of flight an air ship and others like that.

For that, to take title to execute the functions of the aircraft commander, a candidate, at first, must to satisfy to all general requirements, by the foreseen aviation legislation of Ukraine, which all pilots must satisfy.

Secondly, a candidate must to satisfy and to the row of additional requirements, which include the presence of corresponding preparation and experience, necessary for the personal aviating and management of air ships.

One of these additional requirements there is establishment for the aircraft commander of certain age-old limitations. It is marked and in Rules on delivery of Certificates aviation personnel in Ukraine [2]. In these Rules it is said, that proprietors of certificates of pilots after achievement of 63-years-old age shut out to implementation of functions of the aircraft commander in flights which are executed for a pay, including in irregular international air reports.

Thus, one of features of administrative and legal status of the aircraft commander of Ukraine is the presence of additional, comparatively with other pilots, requirements and limitations.

Ensuing from the features of administrative and legal status of the aircraft commander of Ukraine, we consider, there is that, in comparing to other members of crew of air ship, the aircraft commander owns the considerably anymore volume of rights and plenary powers, both in relation to other members of crew of air ship and in relation to the passengers of this ship.

Really the aircraft commander has the large rights, including such rights as:

- to accept a final decision about flight;
- to accept a final decision about flight and landing of air ship;
- to be the trusted of owner of air ship;
- to enter owner's contracts and agreements in interests of the job processing on flight;
- to providing of safety of flight;
- to save normal activity of all air ship during flight time;
- to support health and life of passengers during flight time and others rights.

In an extreme situation the aircraft commander has such rights:

- to unite a fuel in flight;
- to throw down luggage, load, mail;
- to change a plan and a route of flight;
- to make the decision about stopping of flight and landing of air ship on the dispersal field or emergency landing off-aerodrome;
- to carry out flight of state boundary and/or, to execute landing of air ship on the air field which is not certain a task on flight;
- to give up rules and requirements of normative documents which regulate safety of flight.

The aircraft commander, in connection with implementation of the position requirements, mostly enters into legal relationships with public organs, and also with legal and natural persons.

To the number of features of administrative and legal status of the aircraft commander of Ukraine we take a presence for the aircraft commander of functions in relation to support of functions of legality and order aboard an air ship. The aircraft commander manages all activity of crew of air ship and provides hard discipline and order on an air ship, the aircraft commander watches and manages after the observance of all rules of exploitation of flight of ship, after providing of safety of passengers, after safeguarding property of owner of air ship. And, in the cases of the emergency landing, the aircraft commander manages the actions of all persons which are/were onboard air ship, up to delegation of the powers to the competent organs.

In this connection, the aircraft commander, if, certainly, has the opportunity:

- provides inviolability of checking information about flight, all carriers of data, recorders and other objects which were placed aboard an air ship;
- the plum of combustible materials and other liquids shuts out;
- closes and stops all doors, hatches, hoods;
- organizes the guard of air ship and place of event, and also accepts all possible measures as possible quicker to report about an aviation event in any aviation enterprise or local organ of executive power (except for a case, when the aircraft commander on the state a health can not carry out the duties) [3].

The analysis of normatively-legal base certifies that an aircraft commander is a person, which by virtue of the responsibility for safe realization of flight is provided the special imperious rights and plenary powers in relation to all persons, who are onboard this air ship.

At first, it touches other members of crew of air ship. The aircraft commander has large rights in relation to any member of command of air ship. For example, if the aircraft commander considers that the level of preparation of member of air ship does not answer a task on flight, and actions threaten to safety of flight, the aircraft commander can to require replacement this member of air ship. The aircraft commander haves the right to control the level of professional knowledge, abilities and skills of persons of flight crew, and also quality of work of persons of auxiliary personnel or check up the certificates (certificates) of members of crew of air ship and presence for them of necessary records and marks.

Secondly, the aircraft commander is a person, which is provided with the special imperious rights and plenary powers and in relation to the passengers of air ship, which are onboard, this air ship. In this connection, the aircraft commander has a right, within the limits of the competence, to accept all necessary measures and action for prevention of threat to the persons which create the threat of safety of flight and does not execute the order of the aircraft commander.

Thus, in certain cases, the aircraft commander comes forward not simply as a servant, but he gets the functions of the state public agent. Really, the grant of such powers to the aircraft commander is dictated by the specific of flight of air ship, its insulativity, by the necessity of acceptance of urgent measures for providing of safety of flight and for stopping of actions, able to result in heavy consequences and others like that [4].

Consider, fully justified are norms of the article 73 the Air code of Ukraine, which assumed, in decision of the aircraft commander, in the case of necessity, possibility of realization of control on safety, regardless of consent of passenger.

However, the irrefutable is circumstance that for exceeding of plenary powers which are

given to the aircraft commander, responsibility is foreseen, in accordance with a current legislation.

Also in obedience to the article 228 of Administrative Code of Ukraine (ACU) the aircraft commander within the limits of the powers given to him has the rights of organs of air transport to take shipping about administrative crimes, which are foreseen by the articles 111, 137, by part first of the article 112, part second of the article 120, part second of the article 135 of ACU [5].

Except for the above-mentioned, to the functions of an aircraft commander the grant of help to the air ships, marine and river ships and people which got in a danger in the case of receipt of red lamp (usually, if it does not present a danger for the air ship trusted to him passengers and crew of the air ship).

As flights of any air ship are determined by a complete insulativity, consider that the aircraft commander as representative of the state, during flight time must be allotted and by a right to execute some functions of notarial character. Foremost it touches a grant to the aircraft commander of right to certify testaments and commissions of passengers and members of crew of air ship onboard air ship during flight time.

Conclusions

Consequently, it is possible to establish that features of administrative and legal status of the aircraft commander of Ukraine:

1) the aircraft commander has status of main leading person on an air ship, - he is a pilot, accountable for a management and his safety an air ship during flight time;

2) to the aircraft commander is pulled out both general requirements, which must to satisfy all pilots and additional requirements and limitations what set exceptionally for candidates on taking title to execute the functions of the aircraft commander;

3) the aircraft commander are provided the special imperious rights and plenary powers in relation to all persons, which are onboard this air ship (other members of crew and passengers);

4) the aircraft commander, in connection with implementation of the position requirements, mostly enters into legal relationships with public organs and also with legal and natural persons;

5) in certain cases the aircraft commander gets the functions of the state public agent;

6) in an extreme situation which threatens death of people, for the rescue of their life the aircraft commander has a right to retreat from the set rules and requirements of normative documents;

7) in the cases of the emergency landing on the aircraft commander the laid duties in relation to a management the actions of all persons what are/were onboard air ship not only during flight time, and to the moment of delegation of the powers to the competent organs;

8) to the Administrative Code of Ukraine the aircraft commander within the limits of the powers given to him has the rights of organs of air transport to take shipping about administrative crimes;

9) the aircraft commander personally bears the responsibility for safety of flight and job processing on flight regardless of whether he pilots by an air ship personally or transferred control by an air ship to other person.

References

1. Повітряний кодекс України, введений в дію Постановою ВРУ № 3168-XII від 4 травня 1993 р. // ВВР. – 1993. – № 25. – Ст. 274.

2. Правила видачі свідоцтв авіаційному персоналу в Україні, затверджені наказом Міністерства транспорту України від 07.12.1998 № 486 // ВРУ. Управління комп'ютеризованих систем. Том 2. Законодавча база. – 2003 р.

3. Правила розслідування авіаційних подій та інцидентів з цивільними повітряними суднами в Україні, затверджені наказом Державіаслужби від 13.12.2005 № 943.

4. Монография «Международное воздушное право». Книга 2. Отв. Ред. А. П. Мовчан, О. Н. Садиков. М.: «Наука», 1981. – С. 45.

5. Кодекс України про адміністративні правопорушення, введений в дію Постановою ВР УРСР № 8074-10 від 07.12.84 // ВВР УРСР. – 1984, додаток до № 51. – Ст. 1122.

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AN AGREEMENT ON IMPLEMENTATION OF RESEARCH OR RESEARCH-DESIGN AND TECHNOLOGICAL WORKS AS MEAN OF INTRODUCTION OF INNOVATIVE TECHNOLOGIES IN CIVIL AVIATION

In the article legal nature of agreement is investigated on implementation of research or research-design and technological works and it is done the conclusion that overcoming of lacks of forming of modern and scale market of innovative products is possible through the improvement of the contractual adjusting of scientific and technical activity.

According to the Law of Ukraine "About scientific and scientific and technical activity" development of science and technique is the determinative of progress of society, increase of welfare, their spiritual and intellectual increase [1]. By it the predefined necessity of priority state support of development of science as sources of economic increase and inalienable constituent of national culture and education, conditioning for realization of intellectual potential of citizens in the field of scientific and scientific and technical activity, purposeful policy in providing of drawing on accomplishments of domestic and world science and technique for satisfaction of social, economic, cultural and other necessities.

Not having regard to considerable scientific and technical potential, which was inherited by Ukraine from the USSR, perceptible achievements in the field of shipbuilding, scientific and technical potential is needed for creation of aerospace technique, innovative processes in Ukraine did not purchase sufficient scales and did not become the substantial factor of increase of gross internal product, and scientific and technical potential of Ukraine is practically excluded from the economic process of the state.

The basic defects in forming of the national innovative system, except others, there is disparity of corporate structure, which is formed in Ukraine, to the requirements of innovative development and slow forming of modern and scale market of innovative products, infrastructure of innovative activity [2]. Overcoming of these defects the improvement of the legal adjusting of scientific and technical activity can be assisted.

Development of science and technique must be examined only in combination with productive activity. Productive process, as O. A. Pidoprygora said, together with development of science and technique form an only dialectical cycle, spiral coil on ascending [3, p. 17]. Into the main place in this loop a production must go out and other useful activity, which are inferior to the public necessities.

An urgent economic necessity is perfection and continuous increase of production on the base of the newest achievements of science and technique. In the conditions of market economy scientific and technical information becomes all more valuable commodity. Without the proper providing of subjects of economic production optimal development of public relations, related to the production, motion of commodities is impossible scientific and technical information, by the grant of services and others like that. Therefore non-random intellectual, creative activity is examined as a major factor of socio-economic development of Ukraine. One of types of this activity there is scientific and technical creation.

Essence of scientific and technical progress, on the determination by professor O. A. Pidoprygora, it is possible to define as continuous and forward, that is constantly perfected, conditioned process of cognition of conformities to law, phenomena and properties of the material world, their transformation and use in purposeful activity of man [4, p. 19].

The original source of scientific and technical progress is science. The progress of technique in general is impossible without science. Its basis is presented by technical creation, that creation, mastering and introduction of new technique, which is impossible without such stage, as research

work. An important role here belongs to adjusting of relations which are folded in the process of research, research-design and technological works. In this context the problem of determination of legal nature of agreements appears on implementations of research or research-design and technological works and also their places in the system of all agreements. Thus it is needed to notice that an agreement as an universal legal mean of arrangement of public relations has the common legal nature. Therefore agreements on implementation of research, research-design and technological works will be investigated by us as the common legal phenomenon.

An agreement on the nature is the variety of legal transactions, as legal transactions in which participates anymore one side acquire the type of agreement. In this connection an agreement is a commutative legal contract, in which an origin, change or stopping of civil laws and duties, comes on the basis of agreement two or more parties.

An agreement is sent to adjusting of market relations, that is why in most cases he is the legal form of property relations. But agreements are also used and in a non-material sphere - for adjusting of unproperty relations.

Requirements, set by a current civil legislation to the contractual relations, touch agreements which consist in an unproperty sphere. They must consist only by capable persons in the form set by a law, the article of their adjusting must be relations which are based on legal foundation.

Will make attempt outline an application of agreement domain on implementation of research or research-design and technological works.

According to article 626 the Civil Code of Ukraine (farther is CC of Ukraine)[5] an agreement is an agreement two or more parties, sent to establishment, change or stopping of civil laws and duties. The Economic Code of Ukraine (farther – EC of Ukraine) does not contain determination of concept of economic agreement, that, as registered in literature it is the lack of EC of Ukraine and needs revision [6, p. 297]. The authors of the Science-Practical comment of EC of Ukraine determine an economic agreement as founded on the agreements of parties and obligation legal relationship fixed in the form set by a law between the subjects of manage and unmanaging subjects – by legal entities, maintenance of which are mutual right and duties parties in the field of manage [7, p. 303]. Interpretation over of concept "sphere of manage" is brought by authors in a comment to article 1 of EC of Ukraine, from which it is possible to draw conclusion, that the sphere of manage is a certain sphere of vital, material relations in society, where a subject carries on economic activity, runs house, manages at his discretion [8, p. 9]. So in article 1 of EC of Ukraine is outlined circle of relations which have the only having a special purpose setting, built on only principles and regulated by means of method of only economic order.

According to article 3 of EC of Ukraine the economic activity means activity of subjects of manage in the field of public production, sent to making and realization of products, implementation of works or grant of services of cost character, which have price definiteness [9]. The major signs of economic activity, according to L.Znamensky are: 1) it is carried out in the field of public production (and in any way not in the field of the personal consumption); 2) being in the field of public production what, in turn, is based on market principles, this activity is sent to satisfaction of private interests of subjects of manage on condition of observance by them certain public interests (to economic activity inherent objective combination of private and public interests); 3) it is first of all related to that side of public production, the economic use of property is carried out in which; 4) it is the activity which will organize a production and use of property; 5) this activity is carried out in economic-industrial, organizationally-productive and inwardly-economic relations; 6) it is carried out both with the purpose of receipt of income and without the receipt of income [10, p. 572]. Thus, realization of economic activity generates the origin of two types of relations: a) relations from a direct manage; b) relations from organization of his realization.

In article 2 EC of Ukraine is marked, that the participants of relations in the field of manage are subjects of manage, consumers, public authorities and organs of local self-government, provided with an economic competence, and also citizens, public and other organizations, which come forward as founders of subjects of manage or carry out in relation to them organizationally-

economic plenary powers on the basis of relations of property. Public authorities, organs of local self-government, provided with an economic competence citizens, public and other organizations which come forward as founders of subjects of manage or carry out in relation to them organizationally-economic plenary powers on the basis of relations of property by O. P. Vikhrov and S. O. Vikhrov named the subjects of organizationally-economic plenary powers [11, p. 124]. Thus the characteristic sign of such subjects, in opinion of researchers, is that they carry out the noted plenary powers directly in relation to the subjects of manage and provided with a corresponding economic competence [12, p. 121].

By the subjects of manage in accordance with article 55 EC of Ukraine is the participants of economic relations, which carry out economic activity, realizing economic competence (aggregate of economic rights and duties), they have separate property and bear the responsibility after the obligations within the limits of this property, except for cases foreseen by a legislation (for example, part 1 article 8 EC of Ukraine).

Thus, a term "participants of relations in the field of manage" is wider from a term "subject of manage", as to the participants of relations both the subjects of manage and subjects of organizationally-economic plenary powers belong in the field of manage. Therefore classification of agreement, as economic-law, it is necessary, that on a side even one side the subject of manage came forward by agreement.

At that time a civil legal agreement is unreserved neither the sphere of action nor acts of legislation, except for cases, foreseen in article 6 EC of Ukraine, by neither subject composition nor other circumstances, on what article s 627 ECK of Ukraine specifies, where marked, that parties are free in the conclusion of treaty, choice of contractor and determination of conditions of the agreement taking into account the requirements of EC of Ukraine, other acts of civil legislation, customs of business work, requirements of cleverness and justice. By Economic Code an agreement will be acknowledged what, at first, celled between the subjects of manage or between the subjects of manage and unmanaging subjects – by legal entities (the special subject of obligation legal relationships is set) and, secondly, maintenance of which will be the mutual right and duties parties in the field of manage.

In addition, in accordance with part 2 article 175 EC of Ukraine property obligations, which arise up between the participants of economic relations, are regulate by EC of Ukraine taking into account features foreseen EC of Ukraine. It provides a basis for adjusting of economic relations the same civil norms which are used to any civil legal relationships.

The aforesaid enables to draw conclusion, that an economic agreement is correlated with civil legal as a specific and family concept, on what it registers in scientific literature [13, p. 160].

Conclusions

In this connection an agreement on implementation of research, research-design and technological works is a civil legal agreement as its parties can be any subjects and right and duties, unreserved a sphere manages parties.

Next to that, if a concrete agreement on implementation of research, research-design and technological works answers the signs of economic agreement, it costs to apply to such legal relationships position of EC of Ukraine on the basis of part 2 article 9 CC of Ukraine. Such approach will allow effectively regulating legal relations which arise up between parties in the process of implementation of research, research-design and technological works.

References

1. Про наукову і науково-технічну діяльність. Закон України від 13.12.1991 р. // Відомості Верховної Ради України. – 1992. – № 12 . – Ст. 165.

2. Про Рекомендації парламентських слухань на тему: „Національна інноваційна система України: проблеми формування та реалізації”. Постанова Верховної Ради України № 1244-V від 27.06.2007 р. // Відомості Верховної Ради України. – 2007 – № 46 – Ст. 525.

3. *Підопригора О. А.* Науково-технічний прогрес і право / О. А. Підопригора. – К.: Т-во "Знання" УРСР, 1988. – 48 с. (Сер. 11 "Правове виховання". – № 3).

4. *Підопригора О. А.* Науково-технічний прогрес і право / О. А. Підопригора. – К.: Т-во "Знання" УРСР, 1988. – 48 с. (Сер. 11 "Правове виховання". – № 3).

5. Цивільний кодекс України від 16 січня 2003 р. // Відомості Верховної Ради України. – 2003. – № № 40–44. – Ст. 356.

6. *Мілаш В. С.* Теоретичні засади становлення поняття підприємницький комерційний договір / В. С. Мілаш // Актуальні питання реформування правової системи України: ІІІ Міжнар. наук.-практ. конф., м. Луцьк, 2–3 черв. 2006 р. – Луцьк: РВВ «Вежа» Волин. держ. ун-ту ім Лесі Українки, 2006. – Т. 1. – С. 296–300.

7. Науково-практичний коментар Господарського кодексу України / [*В. І. Андрейцев, В. Е. Беляневич, О. А. Беляневич та ін.*]; за заг. ред. *В. К. Мамутова*. – К.: Юрінком Інтер, 2004. – 688 с.

8. Науково-практичний коментар Господарського кодексу України / [*В. І. Андрейцев, В. Е. Беляневич, О. А. Беляневич та ін*.]; за заг. ред. *В. К. Мамутова*. – К.: Юрінком Інтер, 2004. – 688 с.

9. Господарський кодекс України від 16 січня 2003 р. // Офіційний вісник України. – 2003. – № 11. – Ст. 462.

10. *Знаменський Г.* Ще раз про предмет господарського права / Г.Знаменський // Вісник Академії правових наук України. – Х. – 2003. – № 2 (33) – № 3 (34). – С. 567-580.

11. *Віхров О.* Суб'єкти організаційно-господарських повноважень як учасники відносин у сфері господарювання / Олександр Віхров, Сергій Віхров // Підприємництво, господарство і право. – 2006. – № 12. – С. 120-124.

12. *Віхров О.* Суб'єкти організаційно-господарських повноважень як учасники відносин у сфері господарювання / Олександр Віхров, Сергій Віхров // Підприємництво, господарство і право. – 2006. – № 12. – С. 120-124.

13. *Потопальський С. С.* Проблеми правового регулювання недійсності договорів за законодавством України / С. С. Потопальський // Вісник господарського судочинства. – 2005. – № 6. – С. 160-168.

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LEGAL THEORETICAL APPROACHES TO THE CONCEPTION OF INTELLECTUAL PROPERTY

The article deals with the conception of intellectual property, its regulation by legislation and legal theoretical approaches to its understanding

In recent years the accent of social and economic development of the countries all over the world has moved from production to intellectual activities. The experience of the developed countries shows a firm and purposeful tendency to the priority of such social activities as science, technique, culture, creative work. The new priorities of social activities stipulate for due legal protection of all types of creative work. Therefore, at the end of the last century many countries started to renew intellectual property legislation, especially the issue of its legal protection. The new laws on intellectual property protection were adopted and international organizations revived their activities concerning legal protection of creative results in many countries.

The conclusion of the Parliamentary deliberation on the issue "Protection of intellectual property rights in Ukraine: problems of legal protection" was the following: nowadays the system of legal protection of intellectual property in Ukraine is about to be formed. In 1990^{s} the basis of national regulation of this important sphere was formed. At the same time there arose serious drawbacks resulting in stagnation of the development of national scientific and creative activities and innovation model of the country. This situation complicated relations of Ukraine with the leading countries of the world, so it was necessary to seek new forms of cooperation and interaction in the sphere of intellectual property protection.

It is really difficult to solve above-mentioned problems as intellectual property relations are highly dynamic and versatile. The meaning of the term "intellectual property" and its structure is constantly extended and renewed.

The problem of the intellectual property protection in the modern world is solved when the system of regulation of intellectual property protection has already been formed. The World Intellectual Property Organization plays a leading role in this process. In international acts the term "intellectual property" was used at first in the Convention 1967 that established the World Intellectual Property Organization.

There was no intellectual property legislation in Ukraine, but applying international experience Ukrainian lawmakers succeeded to create legislative basis for protection of intellectual property in the early 90s of the last century.

In the Soviet legislation the term "intellectual property" appeared in the early 90s of the XX century. The Law of the USSR of the 6 of March 1990 "On property in the USSR" determined that relations concerning creating and using intellectual property are governed by the special legislation of the USSR, republics and autonomies of the USSR and other acts.

However, the final definition of intellectual property was given in the Constitution of Ukraine of the 28 of June 1996. Article 41 defines that every person has the right to possess, use and dispose of his property, the results of his intellectual and creative activities. Later some other legislative acts and the Civil code of Ukraine were adopted that regulated legal regime of the intellectual property objects in the modern way. Special laws regulating intellectual property in Ukraine are the following: the Civil code of Ukraine, the Law of Ukraine "On copyright and allied rights", the Law

of Ukraine “On cinematography”, “On television and broadcasting”, “On distribution of copies of audio works and phonograms”, “On publishing”, “On peculiarities of state regulation of economic agents activities connected with production, export and import of laser disks”.

The basic laws regulating industrial property in Ukraine are the following: “On the protection of rights on inventions and useful models”, “On the protection of rights to industrial models”, “On the protection of rights to trade and service marks”, “On the protection of rights to species of plants”, “On protection of rights to the topography of integrated circuit”, “On protection of economical competition” and others.

Ukraine is a member of the majority of the multilateral international conventions and treaties in the spheres that regulate the process of creation and use of intellectual property. It is also a member of 18 multilateral international treaties that are the part of the national legislation. However, Ukraine does not take an active part in the intellectual property protection as not all results of intellectual activities have necessary legal protection in our legislation. Especially this concerns the commercial secret, the topography of integrated circuit, discoveries and rationalization proposals.

In modern legal systems the phenomenon “intellectual property” covers different spheres of social relations and is regulated by various fields of legislation – civil, criminal, and administrative. Intellectual property investigations within the frameworks of any scientific branch are characterized by the specific number of features of this legal phenomenon. It is stupulated by the subject and tasks of the relevant science.

The term “intellectual property” had a great importance not only in political and economical, but also in legal life of the society:

- firstly, the category “intellectual property” consolidated the range of separate legal phenomena in order to systematize legislation. It allowed to examine intellectual activities results and consider the means of individualization as independent objects of legal relations;
- secondly, the creators of intellectual products have exclusive and absolute right to results of intellectual activities and means of individualization equated to them. The functions of this right were similar to the functions of property right to tangible objects;
- thirdly, the social importance of the results of intellectual activities and means of individualization equated to them, commercial and other interests of their creators and rightholders were officially recognized.

Thus, appearance of the category “intellectual property” provided a new attitude of the state and law to intellectual activities and their results based on the respect to creative persons and their interests.

There are different ways of understanding the phenomenon “intellectual property” in jurisprudence.

A number of legislators and the current legislation of Ukraine sometimes identify intellectual property and intellectual property right. But the others distinguish these two institutions. Pidiprygora O.A. says that the term “intellectual property” has two basic meanings: civil and legal institution and a set of subjective rights of creators to the result of their creative work.

The last approach restricts the meaning of intellectual property to subjective rights of intellectual property and that is why it is not correct. More appropriate approach is that one where intellectual property is relations of intellectual property subjects with the results of intellectual activities and means of individualization recognized and protected by the state. Intellectual property law is a body of legal norms that regulate intellectual property relations, or a set of subjective rights of the creator to the results of his creative work.

Article 418 of the Civil code of Ukraine defines that “intellectual property is a right of a person to the results of intellectual, creative work or other object of intellectual property”.

Intellectual property right covers personal material and intangible rights of intellectual property unlike the right of property where a person possesses, uses and disposes the property of his

own. Intellectual property right is inviolable. Nobody can be deprived of intellectual property right or restricted of its realization unless the law provided for otherwise.

Legal protection of intellectual property is impossible without the state protection system of intellectual property that has two components: current regulatory and legal base in the sphere of intellectual property and appropriate infrastructure for carrying out the above-mentioned legislation.

Traditionally the structure of intellectual property is divided into: copyright and allied rights, industrial property right. This division is specified in two conventions: Paris Convention for the protection of industrial property and Bern Convention for the protection of literary and artistic works.

Copyright law is a body of law that gives the authors exclusive right for reproduction, distribution or performance of their creative works. The Law of Ukraine "On copyright and allied rights" is a legal protection basis for works of many important industries including book printing, creation of art works, music recording and software.

Copyright protects works which are the result of the creative work of the author. They are traditionally divided into: literary and art works. According to Article 433 of the Civil code of Ukraine the objects of the copyright are: literary and art works, software, database if they are the result of intellectual activities. This protection does not cover the components of the mentioned objects.

According to the current legislation the works are the objects of copyright without any formalities and regardless of their completion, purpose and value and also the way and form of expression.

The objects of allied rights are very important part in the system of intellectual property objects. They are referred to reproduction, announcement of works. The allied rights are similar to copyright that are personal rights of legal protection.

Allied rights objects include: performance, phonograms, video grams, broadcasting.

The objects of industrial property right are the second group of intellectual property objects.

Industrial property right is the institution of civil law that regulates relations connected with technical creation. Unlike copyright industrial property right is realized in the other sphere of creative work dealing with natural laws of the material world. They do not reveal the individuality of their creators as copyright objects do. That is why objects of technical creation are reproducible. They may be created separately, by different persons, so they must be officially registered. Moreover, the results of technical creation are intended to solve practical tasks and have practical significance.

In the scientific literature there are two approaches to the industrial property objects: wide and narrow.

Paris convention for the protection of industrial property of the 6 of March 1883 includes the following objects of the industrial property: inventions, industrial models, trade marks, commercial (brand) and geographical names and also repression of unfair competition.

Ukrainian researchers refer to the objects of industrial property only those specified by the current legislation: inventions, useful and industrial models, topography of integrated circuit, rationalization proposals, species of plants, breeds of animals, commercial and geographical names, trade marks (for goods and services), commercial secrets, scientific discoveries.

Patent law objects which are the results of technical creation are the essential in the group of the industrial property objects. They include inventions, useful models and industrial models. First of all patent legislation must promote the development of scientific and technical creation and use its achievement in the national economy of Ukraine. Patent legislation is formed actively as such form of protection of creative results meets the requirements of market economy, though it is not perfect.

The second group of industrial property objects includes the means of individualization of goods and services: trade marks, commercial and geographical names.

The other group includes non-traditional objects of intellectual property. They are: commercial secrets, rationalization proposals, arrangement of integrated circuit, species of plants, breeds of animals, scientific discoveries.

International legal protection of intellectual property originated in 1873 in Austro-Hungary where the first international exhibition of inventions took place. That year the Viennese congress on patent reform took place where the leading principles of patenting were adopted. The next step in this direction was the Diplomatic conference which was held in Paris in 1880. There was agreed the project of international covenant which later became the basis of international covenant – Paris convention for the protection of industrial property which was adopted in 1883.

Another very important step in the creation of the world system of intellectual property protection was the signing of Berne convention for the protection of literary and artistic works. The above-mentioned conventions provided for the establishment of separate secretariats known as "International bureau". In 1893 these bodies were united and continued their work up to 1970, when the World Intellectual Property Organization began its activity.

The International protection of copyright and allied rights promotes the development of literature, art, science and use of literary and music works, works of art, phonograph works, software, execution etc. But it is impossible to establish modern system of intellectual property recognized by international community without harmonization of national legislation with international law norms. Ukraine does its best to coordinate the legislation with these norms. International exchange of scientific, technical, patent information and also technologies promotes the development of scientific and technical potential in Ukraine.

International protection of industrial property is aimed to create the single method for maintaining legal protection of industrial property objects (inventions, useful models, industrial designs).

In August 1991 Independent Ukraine declared about prolongation of Paris convention for the protection of industrial property, Patent law treaty, Madrid convention concerning international registration of marks, WIPO copyright treaty etc. in its territory.

International cooperation in the sphere of intellectual property protection influences deeply the development of the foreign trade, enterprise, investment and innovation processes in Ukraine.

References

1. Конституція України, прийнята Верховною Радою України 28 червня 1996 р. //Відомості Верховної Ради України. - 1996. - № 30. - Ст. 141

2. Бернская конвенция об охране литературных и художественных произведений // Интеллектуальная собственность в Украине: правовые основы и практика. - Том.1. Право интеллектуальной собственности. – К. -1999. - С. 184-226.

3. Всемирная конвенция об авторском праве. - Том. 1. Право интеллектуальной собственности. - К., 1999. - С. 246-267.

4. Закон України „Про авторське право і суміжні права" // Відомості Верховної Ради України. - 2001. - № 43. - Ст. 214.

5. *Філик Н.В.* Окремі питання правового регулювання судової експертизи об'єктів інтелектуальної власності // Бюлетень міністерства юстиції. – 2007. - №8. – С.37-45

6. *Філик Н.В*. Особливості правової природи ліцензійних договорів // Зовнішня торгівля: Право та економіка. – 2007. - № 3 (32).

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PARTICULARITIES OF LEGAL REGULATION OF INSURANCE CONTRACT IN CIVIL AVIATION

The article focuses on research of particularities of subjective structure of an insurance contract in civil aviation, types of insurance contracts in civil aviation, as well as content of insurance contract and order of its conclusion and termination.

Today insurance in the sphere of civil aviation in Ukraine is extremely important for financial system and aims at hedging against occasional but probable losses of citizens and organizations, therefore the research of legal regulation of insurance contract is vital in our country since it contains many problematic and controversial issues. The legal relationships between persons interested in insuring their life, property, liability and other property interests that do not contradict the current law of Ukraine (Insured), for one part, and persons fulfilling insurance (Insurer), for the other part, are covered by an insurance contract.

Let`s consider validity terms of an insurance contract in civil aviation, its content, subjective structure and procedure of conclusion.

But prior to considering this type of contracts it is worth while defining what is an insurance contract and by what regulations it is governed.

Legal regulation of an insurance contract is governed by the Civil Code of Ukraine [1], the Law of Ukraine "On insurance" [2] and other regulations. Official interpretation of this term in Ukraine is specified in the article 16 of the Law of Ukraine "On insurance" according to which insurance contract is a written agreement between insurer and insured under which the insurer undertakes in case of insurance event occurrence to pay the insurance indemnity to the insured or other person, specified in the contract as policyholder, to the benefit of which the insurance contract has been concluded (help provision, service rendering etc), and the insured undertakes to pay the insurance premium at set dates and to fulfill other terms of the contract [2]. The identical definition of the insurance contract is stated in the article 979 of the Civil Code of Ukraine.

After analyses of this definition some conclusions can be drawn. First, insurance contract in the sphere of civil aviation is a payment-based contract, since actions of the insured meet the obligation of the insurer to do the counteraction. Second, this contract can be bilateral or trilateral (agreement in favor of beneficiaries), since each of its parties have rights and responsibilities. Third, insurance contract is real since it comes in force upon payment of the insurance premium or the first insurance payment by the insured. Insurance contract belongs to aleatory (hazardous) contracts. According to the theory of civil law specifics of the aleatory agreements is that depending on whether certain circumstance occurs or not, one party wins and the other losses [3, C.318]. Insurance contract in civil aviation is concluded in writing. The fact of its conclusion can be confirmed by the insurance cover note (policy, certificate), which is a form of insurance.

Aviation insurance is a general name of the complex of property, life and liability insurance, arising from operation of air transport and protects property interests of entities and individuals in case of certain events specified by the insurance contract or law [4, C.109].

There is obligatory and voluntary aviation insurance. Certain types of aviation insurance are obligatory due to international conventions in civil aviation, to which Ukraine has joined, and internal legislative acts. It applies to all air-operators of Ukraine within the territory of Ukraine and beyond its boundaries. Obligatory insurance covers: 1. air carrier liability insurance for damages caused to passengers, baggage, post, mail, cargo; 2. liability insurance of the aircraft operator for losses caused to third parties; 3. insurance of the aircraft crew and other aviation personnel; 4. insurance of employees of the aviation works customer, personnel involved in performing technological process maintenance during aviation works; 5. aircraft insurance.

Voluntary types of aviation insurance is a wide range of property insurance and liability insurance of various companies and organizations which participate in operation of civil aviation

and includes: 1. accident insurance; 2. air transport insurance; 3. liability insurance of the air transport owners (including air carrier liability).

The procedure and conditions of aviation insurance are specific and require detailed treatment. In particular, due to the following factors:

- aviation insurance deals with specific, different from other types property risks;
- significant insurance amounts require agreed coordination of insurers and re-insurers;
- aviation risks may imply devastating and cumulative losses;
- aviation insurance is closely linked with international insurance market;
- aviation insurance is controlled by both national and international law;
- for operations in aviation insurance a developed specialized infrastructure is required;
- aviation risks have high requirements to professional training of the specialists fulfilling their insurance.

Thus, aviation insurance is quite complicated in its concept, and its realization requires a special approach from the insurer.

The following scholars dedicated their works to coverage of theoretical and practical framework of insurance and reinsurance in the filed of aviation: I.L. Morozava, O.Y. Shmatko, V.M. Furman, Y.V. Yevchenko, S.S. Osadetsj, V.D. Bazydevych etc.

The legal background of this type of insurance is very diverse. It implies norms of international treaties and conventions (Warsaw Convention, Guadalajara Convention, Rome Convention etc) to which our county has joined; regulations of civil aviation organizations, a member of which is Ukraine (IKAO, IATA; norms of internal legislation governing civil aviation and insurance (Air Code of Ukraine, Law of Ukraine "On insurance").

Subjective structure of the insurance legal relationships includes two groups of subjects. The first group consists of insurer and insured, i.e. persons that are parties of the insurance contract. The second group of insurance legal relationships is represented by insured persons and beneficiary – third parties.

According to art. 2 of the Law of Ukraine "On insurance" insurers are financial institutions established in form of joint-stock companies, full, limited partnerships or additional liability companies, which have duly obtained insurance license [2]. Insurer is a legal body (insurance company) which under insurance contract or according to rules of law undertakes for a certain fee to reimburse the insured or other insured person losses incurred as a result of certain events (insurance events) [4, C. 110].

In order for an insurance company to perform aviation insurance it must meet some obligatory requirements, namely: 1. It must have professional experts who have not only a good command of insurance economics but have profound knowledge of aircraft maintenance, certification in civil aviation, rules of flights, and, of course, international law; 2. Wide reinsurance system. Insurance amounts of aviation risks are one of the most high among all kinds of insurance (tens, hundreds of millions and sometimes even billions of dollars). Certainly, placement of such risks requires involvement of not only financial capacities of national insurance market but also resort to international insurance market. Such work cannot be performed without reinsurance contracts with national insurance companies and international insurance brokers; 3. Experts in international law and agreements with international law companies. In case of an insured accident occurrence in civil aviation laws of many countries are usually confronted: those of the country on the territory of which the accident happened, laws of the country where the air carrier is registered, country-owner of the plane and laws of the countries whose citizens were injured in aircraft accident. Therefore, settling of any serious insurance event in aviation insurance requires knowledge and correct application of all these laws; 4) Availability of accurate calculations of risks accumulation. Calculation of the insurer`s own retention due to considerable risks accumulation is an essential condition for acceptance of any risks from aviation insurance. Usually insurers differentiate between total or accumulated quota – clearly defined percentage of financial assets (100%) for all types of aviation insurance. Assessment of the insurer`s own retention quota for each type requires calculations. At calculation of risk accumulation it is taken into account that in case of plane disaster (crash) it is necessary to pay for a plane itself – damaged property (e.g. 50% of the accumulated quota) and for the dead crew members (5-7 persons, 10% of the accumulated quota)

and for the dead passengers (An-24 – 46/48 passenger seats, Tu 154 – 168 passenger seats, e.g. 20% of the quota), cargo taken for carriage and damaged by aircraft wrecks property on the ground (20% of the quota).

According to art. 3 of the Law of Ukraine "On insurance", insured is a legal body or a competent citizen who has concluded the insurance contract with insurer or is insured under the law of Ukraine. L.L. Kinashchuk believes that this definition is too narrow and offers to recognize insured as legal or physical body which has an insurable interest and enters into relations with the insurer as prescribed by law, participates in creation of insurance fund by paying fees and has a right for indemnity in case of insurance event [5, p. 72]. Definition of A.L. Khudyakov seems to be justified – he considers insured as a subject of insurance law relations, who has clear insurable interest and has a right to demand insurance coverage of this interest from the insurer [6, p. 251].

As determined in the article. 4 of the Law of Ukraine "On insurance", the objects of insurance may be the property interests that do not contradict legislation of Ukraine related to - life, health, ability to work and additional pension of the insured or the insured person; - possession, use and disposal of property; - compensation by the insured for damages out of his fault to the person or his property as well damages caused to legal entity (liability insurance).

The content of the insurance contract in civil aviation, as of mutual legal act of volition, is framed by conditions on which the relevant agreement was concluded. Definition of the contract`s content is of great practical importance since depending on it, specific formation of rights and liabilities and possibility of proper obligations fulfillment are defined. The law specifies conditions that must be covered in the insurance contract (art. 16 of the Law "On Insurance"), it is also stated that the insurance contracts are to be concluded according to insurance rules. Rules of insurance are local regulations of the insurer, which contain provisions as to specific type of insurance contract and are subject to registration with the State Commission for Regulation of Financial Services Market at issuing license for the relevant type of insurance.

As stipulated by civil legislation, the contract is considered to be concluded if the parties have duly agreed on all its essential conditions. Essential condition are the subject of the contract, conditions determined by legislation as vital and necessary for agreements of this type, as well as all conditions on which, upon the request of one of the parties, consensus must be achieved. Such conditions of the insurance contract in civil aviation, apart from subject-matter of the insurance and insurance fee (premium), also include condition concerning insurance event. Events recognized as insured accidents involving payment of amount insured must be clearly stipulated in the contract and agreed by the parties.

The order of contract conclusion is set by the civil legislation of Ukraine, in particular, by the Law of Ukraine "On insurance". There are two stages of contract conclusion: 1. Proposal of one of the parties to enter into contractual relations (offer); 2. Proposal receipt and acceptance by the other party – acceptance that signals about consent of the latter to conclude agreement on terms suggested in the proposal. The issue regarding legal characteristics of the offer cannot be considered without reference to theoretical provisions developed by science and regulations of civil legislation. A proposal to conclude contract can be defined as an offer if it meets certain requirements, for example, the offer reveals willingness to conclude contract and not just provides information about possibility of contracting. The offer should be addressed to a specific person. Legal definition of offer and specification of characteristics with which it must comply is stipulated in civil legislation. According to it, a contract proposal to one or several particular persons is an offer if it is clearly defined and reflects intention of the person placing the proposal to consider it contractually bound in case of its acceptance. The proposal is clearly defined if it specifies essential conditions of the contract and procedure of its definition.

The legislation of Ukraine classifies the order of contracts conclusion depending on proposals, made by one party to the other with setting terms for reply or without their determination.

If the proposal to conclude contract includes term for reply, the contract is considered to be concluded if the person who has placed an offer received an answer about proposal acceptance within this term. If the proposal to conclude contract has no specified term for reply, the moment of contract conclusion is defined depending on proposal submission in oral or writing. In the first case the contract is considered to be concluded if the party informed the person making the proposal

about its acceptance immediately. In the second case the agreement is considered to be achieved and the contract concluded if the notification regarding proposal acceptance is received prior to day defined by law, and should such term not be defined – within the period required for it.

Therefore, the offer states certain legal consequences, i.e. the party by which the proposal was submitted. In case of contract conclusion with the third party (or refusal to conclude the contract) the offerer undertakes to compensate the losses to the party to which the offer was made earlier, provided that the latter accepted it and incurred losses while fulfilling the contract.

General rules set for contract form are applied to insurance contract in civil aviation. If under the law the contract must be concluded in writing, it can be concluded by document issuing and signing by both parties, correspondence exchange, teletype programs etc. and signed by the sending party. According to law the insured undertakes to submit an application of the set form or to inform about his intention to conclude insurance contract. Written acknowledgement of the insurance contract requires not only written statement of the insured but also written consent of the insurance organization as to conclusion of such contract, which is confirmed by the insurance certificate (insurance policy) issued by the insurer.

Validity term of an insurance contract in civil aviation is terminated by mutual agreement of the parties and in the following cases: 1. if it expires; 2. if the insurer's obligations towards the insured are completely fulfilled; 3. the insured failed to effect insurance payments at the stated in the contract date. However the contract is considered to be early terminated provided that the first (or next) insurance payment was not made upon written request of the insurer within ten working days from the day of such request to the insured, if not otherwise stipulated by the contract. 4. liquidation of the insured as a legal body or death of the insured as a citizen or his disablement except as stipulated in the articles 21-23 of the Law "On insurance"; 5. liquidation of insurer in accordance with the laws of Ukraine; 6. court decision according to which the insurance contract is declared invalid; 7. in other cases under the laws of Ukraine. Insurance contract can be early terminated upon request of the insured or insurer if it is foreseen by the terms of insurance contract.

Conclusions

Summarizing the research certain conclusions can be drawn. First, insurance contract in the sphere of civil aviation is an independent civil-law agreement which combines general features typical for any civil-law service provision agreements with the specific ones. Second, insurance policy is the main confirmation of the insurance contract conclusion. The latter cannot be recognized as security. The main types of aviation insurance are: 1. third parties liability insurance of the aircraft operator, passengers liability insurance, liability insurance for cargo and mail; insurance (CNC insurance) of the aircraft fuselage; insurance of the crew members. Third party liability insurance of the airports and liability insurance of aviation products manufacturers can be also referred to aviation insurance. Legal coverage of aviation insurance comprises norms of international treaties and conventions joined by Ukraine; regulations of the international civil aviation organizations, of which Ukraine is a member (IKAO, IATA); norms of internal legislative acts controlling civil aviation and insurance. Obligatory aviation insurance is set by International Civil Aviation Conventions joined by Ukraine, Air Code (article 103), Law of Ukraine "On insurance".

References

1. Цивільний кодекс України від 16 січня 2003 р. // Голос України. – 2003, 12.03.2003, № 45-47; 13.03.2003, № 47-48.
2. Закон України «Про страхування» в редакції Закону від 4.10.2001 р. // ВВР, 2002. – № 7. – Ст.50.
3. *Брагинский М.И., Витрянский В.В.* Договорное право: Общие положения. — М., 1997. - С.318.
4. Страхування: Підручник./ Керівник авт.кол. і наук. ред. *Осадець С.С.* – К.: КНЕУ, 1998. –528с.
5. *Кінащук Л. Л.* Страхове право : [підруч.] / Кінащук Л. Л. – К. : Атіка, 2007. – 256 с.
6. *Худяков А. И.* Страховое право / Худяков А. И. – СПб. : Издательство Р. Асланова „Юридический центр Пресс", 2004. – 691 с.

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APPLICATION OF THE CONVENTION ABOUT THE LAWS COLLISIONS, WHICH TOUCH THE TESTAMENTS FORM

In the article analysed the theoretical principles about application of the Convention about the laws collisions, which touch the testaments form. The forms of testament are investigated on the civil legislation of Ukraine and foreign countries.

Development of the Ukrainian civil legislation is marked as an important step in the direction of its harmonization with the European legislation. On 17 December, 2009 the Supreme Rada of Ukraine passed an Act of Ukraine "About tacking of Ukraine to the Convention about the laws collisions, which touch the testaments form". A far of norms of the indicated Convention are completely new for a native civil law, in connection with what become the necessity of theoretical researches of the positions, on which is based this Convention.

In accordance from the article 1247 of the Civil Code of Ukraine (next CC) which is named as "General requirements to the form of the testament" - the testament is folded in a writing form, with pointing of place and time of its stowage, the testament must be personally signed by a testator, the testament must be validated by a notary or other public, official servants, certain in articles 1251-1252 this code. With the certain warning, with the recognition that or other type of testament, similar requirements in relation of its form are contained also in the Civil code of law of Germany (farther - CC of Germany), Civil code of France (farther in text CC of France), civil legislations of other European countries [5, c. 1096-1147].

The construction elements of the testament form are the writing form and personal signature by the testator, pointing of time and place of the testament, attestation of will by the authorized public, official servant. In accordance with the article 5 of the Convention about the laws collisions, which touch the testament form: "For the aims of this convention any norm of right, which limits the forms of testaments taking into account age, citizenship or other personal internals of testator, it is considered such which touches the issues of the form. The same rule is used to the requirements, which are pulled out to the internals which must have witnesses and which are needed for reality of testaments" [1]. So, it is conditionally possible to consider that the elements of the testament form, for example, can be age of the testator, which in many countries is below, by comparison to the legislation of Ukraine. In accordance from the Chapter 2229 Civil code of law of Germany the minor can accomplish the testament with achievement of sixteen years [3, c. 548], what is below from age of majority of person - eighteen years (Chapter 2 CC of Germany).If citizen of Ukraine, which attained of sixteen years age and has a permanent place of residence in Germany would accomplish the testament in accordance with requirements in relation to the form, which is set in Chapter 2229 - 2252 CC of Germany, such testament would have legal force in Ukraine, in accordance with Law of Ukraine "On tacking of Ukraine to Convention about the laws collisions, which touch the testaments form" from December, 17, 2009 [2].

The definition of important element of the testament form can be classified after certain grounds. The form of testament can be described on the criterion of participation of in it responsible public, official persons in procedure of action, certification and storage of testament. On this sign testaments are divided into private and public. Following of this feature the testaments can be private and public. As public, it is seems the testaments in procedure of action of which participate public, official persons of public authorities or public and official persons on which by the law laid functions of certification of testaments. Usually, public authenticity become by the notarial attestation of the will. So, acting CC of Ukraine foresees exceptionally the public testament in accordance with the requirements of the articles 1247-1252 CC. On the definition of testament as

the public legal transaction specified Chapter 2232 CC of Germany - "Public testament": "In a time of acting of the testament in form notarial record testator orally reveals to the notary the last will or passes to him text with the statement, that in text is contained his last will. The testator can pass text in an open or sealed up kind; text must not be handwritten by him " [3, c. 548]. The handwritten testament is examined as a separate type of writing form of this legal transaction.

The though indicated normative acts are use the term "certification of the testaments", the analysis of order of such certification allows to do the conclusion about "own notarial", but not so-called secret form of testament, as on the legislation of Ukraine so on the legislation of the indicated foreign countries. It should be noted that the use of term "notarial attestation of the will" can have general character, that understand the laying-on of functions of attestation of will also foreseen by the legislation on a court (CC of Hungary)[5, c.1098], public, official servants of organs of local self-government (article 1251 CC of Ukraine).

Equated as the notarial validifies testaments are also a public act, difference of which only in that attestation of will is carried out not by notary, but other public or official servant on which law is lay corresponding functions. Thus, public testaments are divided into notarial validified and equated with notarial validified.

A specially feature of the legislative technique in a field of adjusting of the inherited relations in the continental system of right is classification of testament forms directly in text of norms of civil codes. In the article 969 of the Civil code of France specified, that the testament can be handwritten, validified or secret [4, c. 346]. Chapter 2232 CC of Germany "Ordinary testaments" sets that: the "Ordinary testament can be written in the form: 1) notarial record; 2) statements, written by the testator in accordance from Chapter 2247 CC of Germany". Such statement, according, to the Chapter 2247 CC of Germany, is the handwritten testament which can be examined in a counterbalance public as a private [3, c. 548-549].

The testament in form public act, as an unilateral legal contract, have the sign of secrecy. In this connection, in relation to the special form of testament, which foresees notarial attestation of the will without an acquaintance with its maintenance (article 1249 CC of Ukraine, article 976 CC of France), is more expedient to use the term "secret testament" ,"closed testament", exactly in the value of secret testament is used the term "secret testament" in CC of Germany, CC of France. Participating of notary in the certification of secret testament testifies to his public character.

On the form of the will expression by the testator as the private testaments are divided into writing and verbal. Private writing testaments are characterized by expression of the testator will, which gets a simple writing form. Such testament can have the name of the handwritten testament (Chapter 2247 CC of Germany, article 969 CC of France) or holographic. According to the article 970 CC of France, with observance of this form is shut out writing of testament by the generally accepted hardwares - computer, printed typewriter, and others like that.

The handwritten testaments which have not the form of official document are foreseen also by the civil legislation of Italy, Hungary, Poland, Croatia, Czech Republic, Switzerland [5, c.1096-1147].In CC of Ukraine, unlike the legislations of many foreign countries, such writing form of testament as handwritten testament is not used, it can be applied only in accordance with the Law of Ukraine "On tacking of Ukraine to Convention about the laws collisions, which touch the testaments form" from December, 17, 2009, similarly as other, unconventional for our right forms of testaments.

As private can also be orally testament. Such form of testaments differs in a considerable specific in relation to the terms of their action. A "detail" does not characterize in their legal description: these testaments firstly are examined as such, that done in the conditions of extraordinary (exceptional) circumstances [5, c.1100, 1106].

It is needed to underline that the verbal form of testament is examined as an exception and always unites with the terms of exceptional (extraordinary) circumstances, in which such testament is accomplished. The verbal form of testaments, which acted in exceptional (exceptional) circumstances, is foreseen in the national civil legislations of Germany, Hungary, Switzerland. Orally testament must be settlement with the witnesses present, for example, in accordance to

Chapter 2250 CC of Germany person which have a mortal danger, when obviously, that to accomplish the testament in accordance to Chapter 2249 it is already impossible, can accomplish the testament in the verbal form in the presence of three witnesses. In accordance to indention 3 Chapter 2250 CC of Germany about action of the testament in such form it is required to lay down a record [3, c.550-551], what is not considered as the writing form of testament, because it can be written not personally by the testator, but by other persons (by witnesses), but it have matters proofs of settlement of the legal transaction and establishment of its maintenance.

Complicated requirements in relation to the testament form, which was made in exceptional circumstances foreseen in CC of France which shuts out the verbal form of testament even in the conditions of isolation or threat of life of testator. According with Division II of Chapter V of CC of France, which has the name "About the special form rules of some testaments", is set the certification of writing testament by certain public servants, except notaries, for example, part 1 article 985 CC of France is foreseen: "Testaments, made in locality with which any connection is stopped as a result of plague or other contagious disease, can be executed by the court member of small instance or by one of commune public servants in the presence of two witnesses" [4, c.350].

Thus, depending on the presence of exceptional (extraordinary) terms of action is possible to distinguish the special and ordinary function of the testaments. It is possible to set from positions of acts of civil legislation of foreign countries, that objective limitation of possibility to appeal after notarial attestation of will and (or) impossibility of transmission of the handwritten testament on the special official storage (Chapter 2247 CC of Germany) combines with exceptional (extraordinary) circumstances. The consequence of confession of presence of exceptional (extraordinary) circumstances the legislation is assumption of action of the testament in the spesial form, which can be simplified or complicated by comparison to an simple form.

Civil Code of Ukraine does not set the special form of the testaments depending on the circumstances of their action, which have exceptional (extraordinary) character. The testaments are equated as notarial validified (article 1252 CC of Ukraine), can not be described as a special form of testaments, exactly in connection with absence the norms of CC of Ukraine of such characterizing sign, as the presence of exceptional circumstances which can hinder to the action of testament in form of public legal transaction. As we have already marked, application of the special form of testament is possible only in the inherited legal relationships with the foreign element, in accordance to the Law of Ukraine "On tacking of Ukraine to Convention about the laws collisions, which touch the testaments form" from December, 17, 2009 [2].

Considerable originality in relation to the forms of testaments is differs the USA inherited right. There are two forms of testament - handwritten and the testament written in the simple form and signed by two or three witnesses. There is no other requirements in relation to the form of legal transaction of testament. [5, p.1121-1127]. Alike requirements are set by Law of testaments in 1837, which operates in Great Britain [5, c.1096-1097]. Such liberality in relation of formal requirements is explained in a work "Inherited right" by Antony Mellows, in England right for testaments and inheritance without the testament historically examined as part of objective right of ownership, and a right for distribution of inheritance - a hereditarily-judicial right, as a part of Justice right [6, c.68]. That means, that the testament, as the well agreement, seems as an ordinary prescriptive legal transaction in relation to the ownership right. That is why, characteristic for the European continental right perception of the inherited right as the special subsphere, accepted for forming of which as early qualified in the Roman law principle of division of right on that which touches relations between living, and rights “in case of death”, it is absented in the English-American right.

The inherited right for Ukraine, which belongs to the European continental legal system, owns certain features which underline its historical originality. In particular, absence in the inherited right for Ukraine of application of the mentioned reception of classification of the testament forms by the norms of CC can be explained by traditional perceptions of writing testament in exceptionally form of public act. This paradigm of legal thought, obviously, must gradually change to it passing an Act of Ukraine must promote "About tacking of Ukraine to Convention about the laws

collisions, which touch the testaments form " from December, 17, 2009, in accordance with maintenance of which it is possible to write by the citizen of Ukraine the testament in the oral form under exceptional (exceptional) circumstances [1].

Thus, development of the testaments right, in relation to the form of expression of the last will by the testator, takes place in two directions: providing of maximal authenticity and well-proven of the last will of person and providing of possibility to express this will in any terms, including in the conditions of isolation of residence of testator from the place of being of the authorized public, official servants and in terms which threaten to life of the testator. The first is incarnated by means of grant to the testaments form of public legal transaction, second - by assumption of existence of private testaments and testaments, which can be written in the conditions of exceptional (extraordinary) circumstances. The indicated directions of development of the legal adjusting of the testament forms are interdependent, that is attained by the mean of international standardization of norms of the inherited right.

References

1. Конвенція про колізії законів, які стосуються форми заповітів від 05.10.1961 р. / Електронний ресурс: Режим доступу: http://zakon.rada.gov.ua
2. Закон України „Про приєднання України до Конвенції про колізії законів, які стосуються форми заповітів" від 17 грудня 2009 року/ Електронний ресурс: Режим доступу: Hhttp://zakon1.rada.gov.ua
3. Гражданское уложение Германии = Deutsches Burgererliches Gesetzbuh mit Einfuhrungsgesetz: ввод. закон к Гражд. Уложению; пер. с нем. / [В. Бергман, введ.,сост.]; науч. редакторы – А.Л. Маковский [и др.]. – 2-е изд., доп – М.: Волтерс Клувер, 2006. – 816 с.
4. Гражданский кодекс Франции (Кодекс Наполеона) / Пер. с франц. В. Захватаев / Предисловие: А. Довгерт, В. Захватаев / Отв.ред. А. Довгерт. – К.: Истина, 2006. – 1008с.
5. Основные институты гражданского права зарубежных стран / отв. Ред. В.В. Залесский. – М.: Норма, 2009. – 1184 с.
6. *Паничкин В. Б, Боровик О. Ю.* Наследственное право США. – СПб.: Издательство Р. Асланова „Юридический центр Пресс", 2006. – 850 с.

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THE INSTITUTE OF LOBBY IN THE FIELD OF CIVIL AVIATION

The article is devoted to the lobby as a new arising institute of constitutional law of Ukraine. The peculiarities of lobbying of interests of aircraft enterprises in public authorities in Ukraine are analyzed.

The institute of lobby got the extension in the national systems of law of many foreign states at the end of XX century. The term «lobby» comes from Latin «lobia» (an opened portico that joins to building) and has a few definitions. Generalizing different interpretations, the concept «lobby» can be interpreted as a specific institute of the political system, essence of which is realization by certain social groups and public associations («pressure groups») of influence within the limits of law on the process of making some decision by state power bodies on the questions of domestic and external policy [1, 515]. Consequently, the purpose of lobby consists, at first, in balance of interests of different social groups and their providing by creation a possibility to lay information about the necessities of certain groups of society through the representative, and, secondly, in creation a transparent process of acceptance a state imperious decision (law, subordinate normative act), which anticipates coverage of information about the subject of legislative initiative, whose interests are represented by this bill and its financial substantiation.

Such a phenomenon as lobby has also negative features as: 1) lobby can act as a mean of non-legal influence on bodies of state power; 2) it can be the factor of development and defence of interests of separate groups in harm of public interests and to become the display of social injustice; 3) it can result in disbalance of interests; 4) it can block the indeed needed administrative decisions; 5) it can substitute the institute of democracy by the mechanism of influence of separate powerful groups etc. However it is more advantageous to understand the possible variants of its use and to legalize acceptable forms. For the society it is important the civilized lobby as comparison of group interests and consequences of different kind of actions, carried out within the framework of democratic procedure and shown in political rheniums, create the difficult system of checks and balances of economic subjects.

Institute of lobby, as a new institute of constitutional law, is a capacity of rules of law, which regulate activity of groups of citizens, associations of business, professional organizations in relation to advancement of the interests in public authorities. Lobby supplements the constitutional system of democratic representative office, allowing to take part in adoption and realization of political decisions those groups that don't have another such possibility. The basic elements of lobby are *an object of lobbying* (public authorities, which lobbying is directed on), *subjects of lobbying* (different organized agents that purposefully carry out pressure on body of state power), *article of lobbying* (spectrum of aims, which are put by lobbyists during realization of pressure on public authority), *methods of lobbying* (technologies, which are used for advancement of interests in public authorities). Among the basic types of lobbying it is possible to point out the branch lobbies, social and political lobbies, regional lobbies, foreign lobby, lobby of public authorities.

Most widespread in the Ukrainian policy there is a branch lobby. Subjects of this type of lobby are companies and organizations, integrated by a branch sign, financial and industrial groups, business unions and associations etc. Analyzing activity of subjects of branch lobby it is possible to affirm that an aviation lobby acts strong enough lately. Aircraft building is a priority sphere among different directions of national economy for any economic developed country. It can be explained by presence of large incomes both for aircraft enterprises and a state, and also proper image of the state that occupies leading position on a world airmarket. Each of the states aspires to development of airindustry, defense of domestic producer from negative influences of world economic crisis

using different means, and also lobbying of interests of airproducer both at the internal market, and outside.

The results of analytical researches, the subject-matter of which is a lobby in the Ukrainian bodies of power, indicate that the most lobbied objects are Cabinet of Ministers and Administration of the President. The confirmation of this is amount of the introduced and adopted legislative initiatives of the proper state bodies. Consequently, the appeal of domestic airproducers was directed exactly to the head of government – Timoshenko U., with the request to support civil aviation that is on verge of decline, and not only because of a world economic crisis.

The subject-matter of lobby of civil aviation representatives became the possibility to receive the budgetary means for development of this field of national economy and to get different financial preferences.

Using especially legal methods of influence on the government – systematic and purposeful meetings of airproducers with the Prime-Minister of Ukraine, coverage question in mass media at necessary aspect gave necessary results. Thus, the consequence of successful presentation of Ukraine as one of seven leading aviation states of the world that supplies the made technics to 50 countries of the world there became the determination by Prime Minister a primary task of the Government the carrying out of financial health improvement of state aircraft enterprises. At a council dedicated to the issues of support of domestic aircraft building, which took a place on March, 20, 2009, Prime Minister charged the profile ministries – Ministry of Industrial Policy, Ministry for Emergencies, Ministry of Economy and Finance, to develop the plan of top-priority measures for support of industry of aircraft building and take away it for consideration of Cabinet of Ministers of Ukraine.

Consequence of the Prime Minister meeting with the heads of two high-capacity Ukrainian aircraft plants was also the decision of government to appropriate approximately 380 million of hryvnias to Kharkov state aviation enterprise for completion of nine airplanes, the degree of readiness of which makes from 90 to 97 percents, and 200-250 million hryvnias to Kyiv aviation factory «Aviant» that already in 2008 got a system help from the Government in a sum 90 million hryvnias, and in 2009 30 million hryvnias, and also to carry out the restructuring of debts of these enterprises. Moreover, Prime Minister actively lobbies the adoption of Law «On support of aviation industry» by Verkhovna Rada that envisages the land tax remission of aircraft building enterprises and possibility of import of imported spare parts on favourable terms [2]. It is interesting circumstance that this bill was drafted by the people's deputy V'yacheslav Boguslayev, who is the chairman of board of Public Joint-Stock Company «Motor-Sich», and consequently comes forward either as object and subject of lobbying activity.

Unlike the Ukrainian airmen, Russian aviation enterprises initiated their appeal to the parliament, namely to Committee of State Duma on industry, building and scientific-capacious technologies, which chaired by Martin Shakkum on October, 14, 2004 on the meeting considered a question about state support of civil airbuilding due to means of federal budget in 2005 and during realization of the Federal specific program «Development of civil aerotechnics of Russia on 2002-2010 and on a period to 2015». In the federal budget statement on 2005 there was envisaged in support of civil airbuilding 6,0 milliards of roubles. These companies, using this resource of profile Committee, tried in such a way to influence on officials of the government, in a result of what the Committee recommended Government of RF to speed up reconciliation of order of grant of the indicated means [3, 111].

However lobby activity in Ukraine has on the whole more marginal character, than civilized as in other countries of the developed democracy. Thus, in the USA in 1946 the Law was adopted on adjusting of lobby activity, and in 1995 Congress of the USA adopted «Act on adjusting of lobbying», which set more strict terms of lobbying. In Lithuania there was also adopted the Law in 2000 that straight determines the terms and purpose of work of lobbyist – passing new laws or deprivation of force some current legal acts. In the most European countries the special law on the institute of lobby is absent, however the special organs are created in France, Austria and Holland, which function at parliament and have mostly the name of socio and economic council that has

definitive legal status and carries out the role of original «lobby parliament» (such a council is sometimes named the third chamber of parliament). In Germany the unions and groups of associations operate that facilitates development of social responsibility of organizations and civil society, however they don't have professional character unlike American ones [3, 64]. In Sweden the investigative committees that function by the governvent commit the drafted bills and other government decisions on conclusion of pressure groups, which present the interests of different social layers of society, and taking into account the received conclusion draw up legal text of bill for the governvent and in some cases with assistance of representetives of party factions of Riksdag [4, 153].

In Ukraine during the last years about six conceptions of the legislative embodiment and regulation of lobbying were drafted, but none of them didn't pass complete consideration and approval at Verkhovna Rada. The author sees the reason of delaying the adoption of the law in absence of the personal interest of representatives of higher echelons of legislative and executive power who have the parts in Ukrainian business that directly influences on a legislative process.

References

1. Juridical encyclopaedia: In 6 v. / Editorial board.: U70 U.S. Shemshuchenko (head of board) et al.. – K.: "Ukrainian encyclopaedia", 2003. – V. 3. – 790 p.

2. We will be reliably raise aviation in Ukraine // Uriadoviy kurier. – 2009. – № 47. – P. 1; Manufacturing growth – result of anti-crisis measures of government // Uriadoviy kurier. – 2009. – № 48. – P. 1-2; Aircraft building: from improving to development // Uriadoviy kurier. – 2009. – № 51. – P. 1-2.

3. *A. Mal'ko.* Lobby // Obschestvenye nauky i sovremennost'. – 1995. – № 4. – P. 58-65.

4. Government in foreign countries: Textbook / Edited by frofessors *A.N. Kozyrina, E.K. Glushko.* – M.: Os'-89, 2007. – P. 153.

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PROSECUTING AGENCY IN THE SYSTEM OF STATE AUTHORITIES

This article investigates the problem of reforming prosecuting agency and bringing it to conformity with norms and standards of Europe. Much attention is paid to the place and role of prosecuting agency in the system of state authorities. In the article prosecuting agency is examined as complex legal institution.

The Law of Ukraine "On Prosecuting agency" became a foundation for establishment of unified and centralized system of prosecutor's authorities in our state. It is important to mention that this law restricted the functions of prosecuting agency, especially while supervising law compliance by business entities, judicial bodies, public and social organizations. Later such legal collision was eliminated. According to the modifications to the current legislation, prosecuting agencies are obliged to supervise law compliance by local authorities and their executive committees, administration authorities, legal and natural persons, public organizations and officials. At the same time prosecuting agencies supervise law compliance by organs which carry out operational and detective activities, investigation and inquisition, law compliance in the places of detention and preliminary confinement, execution of sentences imposed by courts, law compliance by military organs, army units and institutions.

Problems and needs to reform prosecuting agency as a component of the state law-enforcement system are widely discussed in Ukraine by legal scholars and s and practitioners, especially after adoption of the Constitution. All this time different researches were carried out, certain steps of legislative and practical character were made to improve legal basis of the activities of prosecuting agency.

Policy of European integration which was officially proclaimed by the Ukrainian state provides for obligatory arrangement of conditions for our country in order to enter into the European Community. It is difficult and long process as all norms and standards of the home policy of the Ukrainian community should comply with norms and standards of Europe.

Reformation of law enforcement authorities, prosecuting agency and courts of Ukraine is the most important task of this process as they are key instruments of the state with the help of which such values of the nation as life and health of people, their rights and liberties can be protected.

It is a well-known fact system of check and balances in a democratic state provides for interaction and interconnection of different branches of power and does not allow any of them to abuse its authorities.

Functions and powers of prosecuting agency, aims, task and type of its activities depend on the place it has in the system of separation of powers.

Opinions of Ukrainian and foreign legal scholars and practitioners concerning the place of prosecuting agency in the system of separation of powers are quite different. Such legal scholars as O. Mykhailenko, V. Kovalsky, Y. Groshovy, V. Rokhlin, M. Shalunov, V. Besarabov, S. Lysenkov, I. Borshuliak, N. Kostenko, L. Grytsaenko.

The majority of them express an opinion that prosecuting agency is a public constitutional institution and this fact gives no reason to include it into any branch of power. Moreover, its activities are beyond the powers of any branch. This point of view is supported by Ukrainian investigators Y. Shemshutchenko, V. Tatsy, O. Mykhailenko.

Modern history of Ukraine shows that the prosecuting agency may cooperate efficiently with any branch of power in the interest of the law. And they (branches of the power) may use potential of prosecutor's supervision to solve tasks of development of democratic society, rights and liberties of citizens.

In mass media politicians, researchers, other specialists express different and even contrary opinions concerning the role of prosecuting agency in the society and prospects of its development in the future. Upholding their points of view debaters refer to the European democratic standards of prosecuting agency. However, Ukrainian prosecuting agency is quite different from world democratic standards.

Some of them consider that prosecuting agency is an institution of the Soviet totalitarian system which should be dissolved, it is a weapon in the hands of state authorities, organ of authoritarian government and "there is no place for it in the democratic constitutional state". The others support the idea that prosecuting agency should play a central role while controlling law compliance.

In the former USSR the main task of prosecuting agency, together with other law enforcement authorities and courts was to enforce law and order in the totalitarian state. Now Ukraine has chosen democratic way and the prosecuting agency should act in conformity with democratic standards.

There are various opinions concerning the place of prosecuting agency in the system of state authority in the Soviet and post-Soviet literature: 1) prosecuting agency has to be included into the judicial branch of the power and its main function has to be prosecution on behalf of the state; 2) prosecuting agency has to be included into neither executive nor judicial power, it has to be the organ of the Supreme Council to provide law observance; 3) taking into account the status of the President who is recognized as the guarantor of the basic law (the Constitution), rights and liberties of citizens the prosecuting agency should be a subdivision of presidential power which controls the observance of laws and decrees of the President of Ukraine; 4) activities of prosecuting agency are very special and independent and based on principles and powers inherent to this organ.

Today political situation in Ukraine is conflicting and unsteady. Not only legal scholars and practitioners are concerned with reformation of the prosecuting agency, but also ordinary citizens.

Experience of the Soviet and post-Soviet period of the history of Ukraine shows that numerous attempts to reform state structures were carried out by means of "trial and error". That is why before reformation of prosecutor's supervision system one should deeply analyze on the scientific basis whether such innovations are really able to improve protection of citizens' rights. Reformative changes may be justifiable when they are based on experience and expediency.

The main problem to be solved while carrying out constitutional reform is to determine the place of the prosecuting agency in the system of state authorities.

Nowadays the prosecuting agency is a complex legal institution with united centralized legal system carrying out a particular kind of state activity connected with the whole system of state mechanism and is not included to any branches of the power.

The prosecuting agency acts as a body of state and authoritative powers. The activity of the prosecuting agency of Ukraine is one of the important mechanisms of state authority which guarantees the supremacy of law, enforces law and order, protects the rights and liberties of a person and citizen.

Reformation of the prosecuting agency ought to be an integral part of judicial reform in Ukraine.

The prosecuting agency is a law enforcement body dealing with crime prevention, protection of public order and the highest social values. Law enforcement activities of the prosecuting agency are carried out in close connection with other public authorities, in particular with central executive bodies and local authorities.

Attention should be paid to legal status of prosecuting agencies in the state structure of other countries, i.e. foreign practices are worth taking into consideration. For example, according to the Constitution of Belarus the prosecuting agency is an independent state body. According to the

Constitution of the Russian Federation the prosecuting agency is a part of judicial branch, though de facto it is an independent body.

In the United States of America there are two officials with status similar to prosecutor's position. The first is the General Attorney appointed by the President of the USA and approved by the Senate. As the General Attorney is at the same time the Minister of Justice of the USA, he is a part of executive branch.

The other official is an "independent prosecutor". Unlike the General Attorney "the independent prosecutor" is a part of judicial branch.

Prosecuting agencies of most European countries belong to judicial branch.

In Estonia the Chancellor of Justice belongs to legislative branch.

According to the position of the prosecuting agency in the state bodies, the constitutional doctrine determines 4 groups of countries:

- countries where the prosecuting agency is a part of the Ministry of Justice (France, Japan, Poland and others);
- countries where the prosecuting agency is a part of judiciary (magistracy) (Italy, Spain and others);
- countries where the prosecuting agency is subordinate to the Parliament and (or) President (Democratic People's Republic of Korea, Slovakia and others);
- countries where the prosecuting agency is absent (Great Britain).

Inclusion of the prosecuting agency into executive or judicial branches of power has been a controversial question for many years among legal scholars. According to the Constitution judicial power exercises its authorities within effective legislation. The aim of justice is protection of constitutional regime, rights and freedoms of citizens, rights and interests of enterprises, institutions and organizations regardless of their ownership. The prosecuting agency is intended to enforce the supremacy of law, to prevent crime, to prosecute in the name of the state. In the opinion of V. Korge, the objective, functions and methods of prosecuting activity intended to protect rights and freedoms of citizens and state interests provide reasonable grounds to include the prosecuting agency into the judicial branch.

Taking into consideration European practices national historical experience of legal system of Ukraine should be taken into account.

In Ukraine the prosecuting agency ought to be an independent state authority of judicial power intended to protect legal rights of citizens and the interests of the state and society. According to the bill drafted by the General Prosecuting agency the prosecuting agency is a part of judicial branch. In particular, Article 121 states that the prosecuting agency in Ukraine is a united independent system of judicial power vested with the following authorities: criminal prosecution of pre-trial proceeding and public prosecution at the trial; protection of rights and freedoms of citizens, the interests of the state and society, and interest intermediation at the trial in cases specified by the law; supervision of law observance by investigation and search agencies. This bill draft was highly appreciated by the experts of the European Council as an important step towards democratic development of the prosecuting agency in Ukraine.

In the opinion of V. Korge, in order to include the prosecuting agency into the judicial branch of power a deep investigation concerning the place of the prosecuting agency among different branches of power should be carried out. Final decision may be made only on the basis of legal practice and conclusions of legal scholars.

The prosecuting agency being the governmental body should coordinate and balance activities of all branches to prevent them from abusing their authorities.

In the opinion of certain experts, the prosecuting agency should be a part of executive branch, subordinate to the Ministry of Justice. However, this contradicts the objectives of the prosecuting agency which controls executive authorities, including the Cabinet of Ministers, ministries, committees etc. Inclusion of the prosecuting agency into the Ministry of Justice or any other executive body would considerably change its supervision function resulting in destruction of traditional prosecutor's supervision

Inclusion of the prosecuting agency into the executive branch does not comply with democratic principles of the state governed by the rule of law and will result in destruction of "check and balances" system.

The prosecuting agency should act in the interests of all branches of power, interact with them, but should not be included into any of them.

Another point of view is to restrict the prosecuting agency' powers to criminal prosecution. However, without prosecutor's supervision it is impossible to enforce the supremacy of law and to protect the rights and freedoms of citizens. The prosecuting agency is the sole body able to curb lawlessness and provide law observance.

Some legal scholars do not share the opinion of the European Council as for reformation of the prosecuting agency in order to bring it in conformity with European standards. They are against propositions of the European Council to discharge the prosecuting agency from pre-trial inquiry and "general supervision". However, their opponents think that the prosecuting agency with function of general supervision is a vestige of the past totalitarian regime of the former USSR.

In our opinion, prosecutor's supervision may not be considered as an independent branch of state power. So, the prosecuting agency would be reasonable to act on behalf of the legislative branch, i.e. the Supreme Council of Ukraine and to enforce supremacy of law in all spheres of social life. If in the state that declared the principle of separation of powers the prosecuting agency is not independent, but at the same time is not included into executive or judicial branches, its activities may be closely related to the legislative power. The prosecuting agency in this way provides law observance by ministries, state committees, government departments, local Councils of people's deputies, public, cooperative and social organizations, institutions, enterprises and their associations, officials. Priority is given to protection of human rights.

References

1. Конституція України від 28.06.1996р. // Відомості Верховної Ради України. – 1996. – № 30. – С.141.
2. Закон України «Про прокуратуру» від 05.11.91,// Відомості Верховної Ради України. – 1991. – № 53. –С.794.
3. *Шумський П.В.* Історія прокуратури України. Київ Ген. Прокуратура – 2004. – 170с.
4. *Шумський П.В.* Прокуратура в правовій державі. Хмельницький ХІРУП. – 2000. – 120 с.
5. *Шумський П.В.* Прокуратура України: навчальний посібник для студентів юрид. вузів та факультетів. К.: Вентурі. – 1998. – 336с.
6. *Шумський П.В., Литвак О.М.* Функції прокуратури України. Хмельницький ХІРУП – 2002. – 390с.
7. *Шумський П.В.* Історичні аспекти становлення прокурорської системи. – ДЕРЖАВНА ПОЛІТИКА РОЗВИТКУ ЦИВІЛЬНОЇ АВІАЦІЇ ХХІ СТОЛІТТЯ: ЕКОНОМІЧНІ І СТРАТЕГІЧНІ МОЖЛИВОСТІ УКРАЇНИ: Матеріали науково-практичної конференції, Київ, 19-20 лютого 2009 р. – К.: Вид-во Європ. у-ту, 2009. - С. 173-177.

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FEATURES OF INTERNATIONAL AND NATIONAL AGREEMENT OF AIR TRANSPORTATION (COMPARATIVE DESCRIPTION)

In this article an author pays attention to the concept and features of national and international agreement of air transportation.

Entry. Civil aviation became an important mean of realization not only internal but also international air reports in our days. It plays an important role in the life of the world concord and the states.

Development of the transport activity in the modern states in a great deal certainly made by the strategy of their external economic connections becoming, which represent the general processes and changes in the system of international economic relations, managed by the norms of modern international law.

Legal positions which regulate the transport activity of the states are included in the system of international private law norms because they are intended for adjusting in this case of transport legal relationships, complicated by the foreign element.

Actuality of the article consists in the realization of the transport activity of the states, especially in the conditions of market relations forming, both in the national and in world economy, with the use of different forms and types of economic collaboration and partnerships, impossible without establishment of transport connections. So, in the time of air transportation, an important value is acquired by the choice of the necessary legal system.

For this reason the main **aim** of this scientific article is the lineation of the legal features of the agreement of national and international air transportation by the decision of such tasks:

to distinguish the basic scientific theories of understanding of national and international air transportation;

to give a definition of the concept "air transport agreement";

to distinguish the features of national and international transport air agreement;

to define their correlation with a foreign economic treaty.

Consideration of above-mentioned problems comes true by an author on the basis of analysis researches and scientific publications in this sphere of such specialists, as: Aliev E. A., Gureev S.A., Kopilov M.N., Dikovska I.A., Lukashuk I.I., Movchan A.P., Sadikov O.N., Chubarev V.L., Onishenko O.V., Shevchenko Y.M., Vitryanskiy V.V. and others.

Adjusting of the air transportation agreement according to the national legislation. In the Ukrainian (national) legislation founding for arising of direct obligation relations out of transportation is an agreement.

The civil code (in future CC) of Ukraine occupies a central place in adjusting of relations of transportation, that is why all norms which are contained in other legislative and normative acts, in particular, the norms of the Air code (in future AC) of Ukraine must answer to this Code, except for those cases, when CC of Ukraine there is another possibility of settlement of transportation relations [9, pp. 204].

In new CC of Ukraine the agreements of transportation are represented in a general view, where are given the substantial terms of this agreements, their definitions and classification [11, p. 161].

According to the article 60 the Air code of Ukraine, air transportations are executed on the basis of transportation agreement. At the same time, the Air code of Ukraine does not give the legislative definition of the air transport agreement.

Taking into account that an agreement of air transportation is a civil legal agreement, then the norms of the Civil code of Ukraine spread to him. According to the contractual obligations of this air transport agreement it belong to the group of agreements about services. What means that, to this agreement is possible apply the positions of Chapter 63 CC of Ukraine of "Service. General positions". According to the part 2 article 901 CC of Ukraine, position it heads can be used to all agreements about the grant of services, if it does not contradict to the obligations meaning. In addition, norms of Chapter 64 CC of Ukraine of "Transportation" is sanctified to the special regulation of services in transportation. [9, pp. 204].

So, the transportation agreements after objects are divided into such kinds as transportation agreements of load, luggage, passengers, and someone from the authors also distinguishes the transportation agreement of mail. Amount of transport organizations which come forward on the side of ferryman, an agreement can be: - transportation only by one type of transport which has the name of transportation in the local connection; - during transportation of load after one transport document by different transport organizations of one type of transport, then it is named transportation in direct connection [11, pp. 161 - 162]. Varieties of transportation agreement is an agreement of charter (chartering): by agreement of charter (chartering) one side is obligated to give to the second side for a pay all or a part of capacity in one or a few transport vehicles on one or a few trips for transportation of load, passengers, luggage, mail or with other aim, if it does not conflict with the law and other normatively-legal acts (p. 1 ar. 912 CC). The case definition also written in the article 61 AC of Ukraine: according to the charter agreement one side is able to give to another one for the pay one or some capacity of the aircraft for one or some flights of air transportation of the passengers baggage, luggage and mail or for another aim, if it is not conflict with the active Ukrainian legislation [9, pp. 204 - 205].

Analyzing the norms of the active legislation it is possible to do the conclusion that in Chapter 64 CC of Ukraine definition «transport agreement» can be understand through the row of agreements what is need to regulate different relations, which are related to transportation of loads, passengers and luggage. The noted agreements differ one from other by the different signs: by subject composition, by an object and others like that. That is why, in the modern terms to speech about only one agreement of transportation is not expediently. More precisely it seems to talk about the system of agreements, which division transportation of loads, passengers and luggage.

But, CC of Ukraine contains general rules, which do not represent the specific of carrying passengers, luggage, mail and load the different types of transport. More detailed regulation must be provided by the special normative acts in the field of air transportation basic from which is the Air Code of Ukraine. Accordingly, expedient would be to fasten in the AC of Ukraine the definition of both the air transport agreement its varieties [9, pp. 205].

Adjusting of the air transportation agreement according to the international law. Norms of international private law, which touch the transport activity of the states, are examined not only as part of the system of this field of law but also represent objective descriptions of transport relations managed by them, their general and specific properties and internals.

Before transportations between the states were regulated mainly by the norms of domestic (national) law. In the conditions of development and height of volume of carrying passengers and loads, especially in the connection of territory of a few countries, there were difficulties, related to substantial divergence of collision norms of the transport right of the corresponding states. Therefore with the aim of prevention of these difficulties the state began actively conclude international agreements, mainly as transport conventions [3, pp. 19].

In 1929 was accepted the Convention for standardization of some rules which related to international air transportation (Warsaw convention of 1929 year). This convention was created for the settlement of terms of international air transportation in relation to documents, which are used for these transportations, and responsibility of ferryman.

Warsaw convention of 1929 (with the further amendments of Hague protocol of 1955 year), Guadalajara convention of 1961 year, Montreal convention of 1999 year set the list and the forms of the same documents, which are used in international air transportations (passenger tickets,

baggage-checks and other), fastened type of rule of carrying passengers and loads on international lines, in detail settled the issues of responsibility of the ferryman before passengers and shippers, and also the responsibility of the fact ferryman (not by agreement) [8, pp.207].

About the role and the value of international agreements in the field of the transport activity of the modern states, the multilateral and two-sided agreements which regulate international transportations, is stay the most widespread form of fixing of all system between state legal relationships in the transport process [3, pp. 21]. This agreements determine the right on flights between the states-participants of this agreement, that means opening of the new international line between them, determine the concrete passing of this line, determine national airlines exploitation of this airline, and also contain position in relation to side documentation of air ships, certificates of members of crews, order of exploitation of line, including the issues of custom collections, property and equipments which is used for providing the flights.

It is considered that sign of national belonging of parties of agreement both for foreign economic treaties on the transport expedition and for agreements in relation to international transportation of passengers has no value. Decision in this situation is the fact of conclusion of the transport agreement, which foresees crossing of borders no less as two countries, and, in accordance with positions of which, the point of departure and point of setting are placed on territory of different countries or (but) the transit stopping is foreseen for territory of other country. Thus, only legal fact - the conclusion of treaty of corresponding maintenance in this case comes forward as a "foreign element" [8, pp. 208-209].

The structure of this agreement as in national so in an international law presents the single system of connecting norms. Therefore it must be examined as single unit in which all decisions are obligatory for parties. Usually the structure of agreement consists of three staples: preamble (entry) - specifies on reasons, aims and principles of conclusion of the treaty; central part contains decisions on a creature regulator relations; final part fixes the articles about the order of expression of consent of obligator of agreement, acquisition action and stopping of his action. An all greater value is acquired by fourth part, additional part - additions. Not all elements of structure are obligatory in every agreement, absence of those or other elements does not influence on his legal power.

Thus, on the basis of foregoing it is possible to do such conclusions:

- under the transportation agreement in the civil law means the agreement, after which one side (ferryman) assumes an obligation for the conditioned pay to carry out transferring of load, passenger or his luggage to the place marked in an agreement, understands in the civil law. Unlike this decision which is, correct from the point of view of any national legislation, from the point and view of international transportation means the transportation of load, passenger or its luggage, which comes true between two or more states on the terms, set celled between these states (whether after their participation) international agreement;
- as the civil aviation on this stage of its development inherent international character, then must exist and international documents which regulate aviation activity;
- distinguish a few types of national and international agreements in the field of civil aviation, which depend on different factors, for example, such as national belonging of parties of agreement, subject composition of agreement, type of transportation and other;
- in connection with development of civil aviation such sources of right as agreements acquire of all greater value, and especially international, that is why today the national legislation in the transport industry requires perfection. Consider a necessity more in detail to provide regulation in the field of air transportation special normative acts and adding to the Air Code of Ukraine, with the use of receptions of legal technicians.

References

1. Цивільний кодекс України. Прийнятий Верховною Радою України 16 січня 2003р. – К.: Ін Юре, 203.

2. Повітряний кодекс України: Офіційне видання. Міністерство юстиції України. – К.: Форум, 2006.

3. *Алиев Э.А.* Проблемы развития транспортной деятельности государств в доктрине международного частного права // Международное публичное и частное право. – 2006. – № 4 (31). – С. 18 – 22.

4. *Гуреев С.А., Копылов М.Н.* Международное транспортное право: Сб. междунар.-правовых актов. – М.: Изд-во Ун-та дружбн народов, 1987г.

5. *Діковська І.А.* Договір повітряного чартеру у міжнародному приватному праві: Автореф. Дис. – К.; 2002.

6. *Лукашук І.І.* Норми міжнародного права в міжнародній нормативній Системі., М., 1997р.

7. Международное воздушное право. Книга 2 / ответ. Ред. Доктор юридических наук *А.П. Мовчан*. – М.: «Наука», 1981г.

8. Міжнародне приватне право: Навч. посібник / За ред. *В.М. Гайворонського, В. П. Душмана* – К.: Юрнком Інтер, 2005. — 368 с.

9. *Оніщенко О.В.* Особливості цивільно-правового регулювання договору перевезення повітряним транспортом // Малий і середній бізнес (право, держава, економіка) тези науково-практичної конференції «Державна політика розвитку цивільної авіації XXI століття: економічний патріотизм та стратегічні можливості України». – 2008. - № 1-2. – С. 204 – 205.

10.*Садиков О.Н.* Правове регулювання международных перевозок. – М.: Юрид. Лит., 1981.

11.Цивільне право України: Академічний курс: Підруч.: У двох томах / За заг. ред. *Я. М. Шевченко*. — Т. 1. Загальна частина. — К.: Концерн «Видавничий Дім «Ін Юре», 2003. — 520 с.

12. *Чубарєв В.Л.* Міжнародне приватне право: Навчальний посібник. – К.: Атіка, 2006. – 608 с.

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THE LEGAL REGULATION OF THE WORLD SPACE MARKET AND NATIONAL SECURITY ISSUES OF UKRAINE

While analyzing the current situation of the legal regulation of the world space market, the author attempts to define the role to one of its key elements of the joint legal environment – space legislation in the process of national security system development

Introduction

One of the prominent features of our times is the internationalization and globalization embracing all spheres mankind activities and having crucial implications. **T**he immediate result of this overall process is the Global Civil Society formation materially based on the world market and unified international economic system. The World Market of Space Services and Technology (hereinafter referred to as the "**World Space Market**", or "**WSM**"), aiming to deliver the most important for the modern society - services and technology, appears to be an integral part of the world economic system.

The importance of this key element is steadily increasing while the world society takes into consideration the concept of the sustainable development.

The terms applicable to the phrase "World Space Market" are first mentioned in reporting materials to UNISPACE-III (1999) connected with reviewing the problems of legal regulation of commercial private element of the WSM. [1, P. 83-84, 86, 141-143].

However, the author provided a scientific definition of this notion later based on analysis of the noted documents pertaining to UNISPACE-III and other publications regarding WSM [2-6] and commercialization/privatization of the space activities [7-13].

From a legal standpoint, the World Space Market is a system of international legal relations attributable to space service sector, sale-purchase of space equipment and technology [14, P.16]**.**

The national security in the modern world is a specific and particular vector related with the identification, prevention and overcoming the destructive influence over the country's sustainable development, its citizens, and important social and state institutions. [15, P.3].

National security policy is effectuated to mitigate features worsening people's lives, destroying country's potential and development. Further, the national security policy mitigates any adverse implications pertaining to nation's real values (resources, cultural heritage, ecosystems etc.)

The domestic legislation defines national security as "safeguarding core interests of people and citizens, society and the state, which enables sustainable development of the society, timely identification, prevention and neutralization of actual and potential threats to national interests" [16, P.1]. Moreover, the following types of security are defined: political, economic, social, military, technological, ecological, informational and others, which are united into the common system of the national security.

The space and missile equipment and technology inevitably plays one of the prominent roles in development of the modern national security system. As noted in the Ukrainian National Space Program (2007-2011), "the space activities is to the largest extent influences the country's future, and therefore, defined as a priority, since it delivers sustainable development, maintains science and technology potential, preserves long-term targets of the state's national security and defense system" [17, P.2].

The features, providing state competitive advantages, their social and industrial mechanism perform an outstanding role under conditions of economic globalization and interdependence.

The states should engage the space means and information from the earth orbit on a wider basis to resolve security issues, environmental management, prevention from natural calamities and tecnotronic catastrophes. The states' existence in the modern world is dependent on use and exploitation of the space technology as a catalyst intensifying the internal sources for progress.

The space equipment and technology as a key feature of high-tech sector, is not only related with the above vectors [16] of the national security, but also the fact that some of them (e.g. military, scientific and informational etc.) are crucial as regards to adequately facing the challenges of the modern world.

The WSM Legal Mechanisms and National Security Issues

The space activities and its universal and global achievements have linked both internal and external political interests of the states starting from the first steps of human kind into the space:

- issues relating to the exploitation of expensive space equipment to resolve global problems of the mankind and domestic economic problems of separate countries;
- issues of international security (necessity to employ modern controls for disarmament etc) and demand to cut budget financing to further increase commercialization of space activities;
- curtailments on transfer of new technology (i.e. non-proliferation of missile technology) established by the space states and pessimistic scenarios to enhance social and economic development of the third world countries;
- establishment of the new information environment, a significant gap between different countries relative to their access to such environment (i.e. practical advantages while implementing information technology) and problems of the national security, including those of the information sovereignty of the states etc. [1, P. 33-88].

The commercialization of the space activities for the last 20-30 years has fostered the booming development of WSM involving private companies and non-state institutions to its transactions, which in its turn increased both the role of international economic law and stronger interference of the international private law into activities of the increased circle of participants at this market.

The subsequent development of the WSM, tightly linked with the exploitation of new space means and having its global impact, and also, deepening the role of transnational companies, banks and non-governmental institutions as proactive participants at this market, requires development of the dramatically new approaches towards the issues pertaining to control of the activities of these participants at the national and the global scale, their legal status, responsibility of the state for the space activities performed by its legal entities (and, recently, individuals: members of the International Space Station, space tourists etc.), preventing possible damages and reimbursement thereof.

One may conclude from the above that the legal mechanism regulating modern space activities rests within several dimensions: international space law (regulating relations of the states and intergovernmental organizations in the course of their space activities), international economic law (relations related with the international space equipment and technology trade), international private law (property and intellectual property relations encumbered with the foreign element), transnational trade law (relations involving transnational companies, banks, entrepreneurs and individuals in their foreign trade activities as well as states and intergovernmental as long as they are acting in the capacity of international traders) and national law (state regulation, licensing and export controls, mandatory insurance, patent law etc.) [18, P.26].

As a result of the WSM progressing, and involvement of more applied space activities in different countries resolving their up-to-date problems, these processes influence the scope and the featuring of the national legal systems to a greater extent. In its turn, the provisions of the national legislation based on UNISPACE-III recommendations, will have a greater impact on legal regulation of the modern space activities. [1, P. 81, 82].

Considering the specific features applicable to the space activities development at the modern stage and its regulation issues, the national legislation should have provisions governing commercial space exploration, including its complementary role as to the international law provisions in such areas as: state space activities governance, intellectual property rights, state support of space technology commercialization, control over missile technology non-proliferation, space debris mitigation etc.

It should be noted that the scientific papers have thoroughly covered both issues of WSM legal regulation and national security. However, the issues relating to legal regulation at the WSM as well as its influence on the national security system have not been properly addressed in the international legal system and modern doctrine. Certain author's publications may serve as an exemption from the rule [23-26].

Ways of Influence of the WSM Legal Mechanisms on National Security

The national security related to the WSM Legal Mechanisms has several ways, which include the following:

- observance of international obligations in the sphere of space activities (absolute responsibility of States for national space activities corresponding to the respective provisions of the Outer Space Treaty of 1967; observance of the Guidelines for the Missile Technology Control Regime (MTCR); monitoring of the national space activity entities compliance with the Direct TV Broadcasting, Earth Remote Sensing and Nuclear Power Sources Principles; national space activities practical application of the Space Debris Mitigation Guidelines provisions);
- State regulation of the space activities (implementation of the a) space activities licensing procedure, b) space technology certification system, b) export control system, etc. [20]);
- obligatory insurance of some space activities categories (originating from the Space Law fundamental principle on absolute material responsibility of States for national space activities results [14]);
- intellectual property protection created by the national space activity entities [11,12];
- principles of Space Debris Mitigation [23];
- property rights on space objects preservation.

From the author's point of view, having in mind the investment climate in the country and the economic security of the country, the most effective WSM Legal Mechanisms are those related to the property rights on space objects preservation.

Ownership Right in Space

Following the enlargement of the number of parties to space activity due to the involvement of the private entities and enterprises, and relations diversifying and developing world space market, the main issue related to the space exploration commercialization process is the ownership and other property rights. Such enlargement in its turn gives rise to necessity to develop the legal provisions intended to regulate the property relations of such parties. Abovementioned relations at first originated as relations between the states and international organizations in the process of practical outer space exploration, and at the current stage, they are transforming into property relations of certain state with foreign or international element. Whereas the first type of relations is regulated by the international Space Law, the second – is mostly regulated by the International Private Law. The mutual interpretation of the provisions of the Outer Space Treaty proclaimed in Article I (principle of freedom for exploration and use of outer space by all States) and Article II (principle of prohibition of national appropriation of outer space) in terms of modern International Space Law drives to the conclusion that outer space, including the Moon and other celestial bodies, is not subject to any exclusive rights, including but not limited to claiming the property rights pertaining to the states and cannot be the subjects of any commercial transactions.

On the other hand, when the matter involves the issues on: a) reservation of ownership rights on space objects in Space or return to Earth; b) creation of an ownership right on invention or engineering constituting the subject of the intellectual property, or during creation of new materials on board of space segments or during production of mineral recourses of the Moon or other celestial bodies.

Relating to the first group (i.e. reservation of right of ownership on space objects in Space or returned to Earth), it is worth noting that due to the commercialization and privatization of space activities the provisions of Article VIII of the Outer Space Treaty receive special emphasis. The principle enunciating that "ownership of objects launched into outer space, including objects landed

or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth" will co-operate to the settlement of conflict issues during the determination of such rights and their specific content under the "lex origins".

This conclusion is of special importance for the cases of international sale of an orbiting satellite when the points of contact - "lex loci contractus" and "seller's law" cannot be applied.

The use of satellites gives rise to numerous problems affecting the international obligations of States and universal international mechanisms of space activities regulation e.g. geostationary earth orbit satellite. The main part of the geostationary earth orbit (GEO) and radio-frequency spectrum necessary for their utilization are now allocated to States based on the principle of justice. Each State following the International Telecommunications Union (ITU) procedures can transfer its orbital slots and radio frequency in use to either legal entity. But if such legal entity intends to sell its GEO satellite located in such defined position and working on intended frequency to some foreign institution then apart from the very question of transfer of ownership right to this satellite, the other problem will arise on the necessity to either transfer this GEO satellite to the positions and frequencies allocated to State where such institution has its residence (Buyer's State) (which is from the technical point of view is not always practically possible) or assign the rights (at least for the temporary use) to such positions and frequencies from the Seller's State to the Buyer's State.

Among other problematic issues the most important relate to the passing of control on satellite and introducing changes to its registration which potentially may lead to the situation when the Seller's State will remain liable and bear the international responsibility including material under the Liability Convention (1972). Similar agreements with the possible option to resell the GEO satellite to third parties considering the lack of its international regulation may seriously damage the international legitimacy of the subject matter. The "place of ownership origination and other property rights law" may resolve this issue to the certain extent provided that the following principle prevails - "one may not assign more rights than it has".

The Convention on International Interests in Mobile Equipment (Cape Town Convention)

The first attempts to develop the new international regime regulating the fulfilling of the international obligations with respect to valuable equipment within the framework of UNIDROIT were made long before the signing of the Convention on International Financial Leasing of 1988. According to Article 7 of the abovementioned Convention there is a possibility to enforce the lessor's real rights in the equipment in relation to against the lessee's trustee in bankruptcy and unsecured creditors.

Such approach proved to be very successful and cause willingness of the UNIDROIT to apply this enforcement principle on the other special categories of the valuable equipment which is most likely to be transferred beyond the national borders of different States in the course of business activity and, moreover, it would be very difficult to apply the "*lex rei sitae"* principle, especially to the resolution of disputes on legal validity, possibility of enforcement and priority of satisfying such rights.

Besides, such judicial justification is backed by economic considerations. Due to the apparent problems faced by the mortgagors during the guarantee and collecting of the loans, asset based financing of the operations provided for such categories of equipment is still very limited.

A special advantage of asset based financing of the operations based on the high-cost capital equipment is to reduce costs arising from downgrading the risks applicable for financial specialists due to the possibility to use liquidity of the equipment, subject to the agreement, if the debtor defaults.

If to consider specific space assets, e.g. a loan backed by any space satellite, the private lender will definitely consider whether these assets are subject to any disputes by other lenders.

Currently, such potential lenders do not have the safe mechanisms mitigating any possible disputes in connection therewith. Moreover, if the centralized accounting system regarding

registration of ownership rights on space assets will not be implemented, the potential lenders are unlikely to have an access to such mechanisms.

Another practicality, which limited space asset based financing transactions up to this time point, was the practical issue of sequestrating the assets physically located on the Earth orbit, when the debtor fails to duly perform its obligations.

The Convention on International Interests in Mobile Equipment (Cape Town Convention) and Aircraft Protocol were adopted on the Diplomatic Conference in South Africa in 2001. The Protocol to the Cape Town Convention on Matters specific to Railway Rolling Stock was adopted in Luxemburg in 2007.

Meanwhile, the discussion process with respect to Preliminary draft Protocol to the Convention on International Interests in Mobile Equipment on Matters specific to Space Assets (Protocol on Space Assets) continues since 1997.

Protocol on Space Assets

Cape Town Convention comes into force for a definite State relating to the specific category of equipment only after accession of such a State to a Protocol regulating such equipment and only to the extent that the provisions of this Cape Town Convention will not be changed by the provisions of this Protocol on Space Assets. And the latter is aimed at regulation of the specific issues pertaining to the different categories of assets and requiring the appliance of the specific legal provisions.

A clear-cut distinction between the material spheres of appliance of the Cape Town Convention for each specific category of equipment is the main aim of each Protocol to the Cape Town Convention. This distinction is succeeded through definitions. For this reason, the Protocol on Space Assets provides for a general definition of space assets, allowing, on the one hand, to encompass both the material and immaterial property, and on the other hand – the property yet to be invented at the current stage of space technology, e.g. products manufactured in space.

The importance of appliance of the future regime not only to such material space assets as satellites and transponders was recognized due to the necessity for the financier to claim for the satellite repossession based on the access to different rights related to the satellite exploitation, i.e. a) rights arising from the State licenses and approvals and which cession is allowed by law; b) immaterial rights necessary for satellite supervision or exploitation or transfer of ownership or other rights thereupon; c) contractual rights related to satellite exploitation and acquisition of income thereof.

Such associated rights are inevitably related to satellite and constitute the integral part of its transaction value.

Other important aim of the abovementioned Protocol on Space Assets is to develop the identification mechanisms for the space assets, necessary and sufficient to be used as search criteria for such property together with the future international register.

The serial number coded by the manufacturer may be sufficient search criterion (determined as such in the Aircraft Protocol) for the aircraft equipment, while some items of the space assets may not have such numbers or their equivalents, which gives rise to the necessity to use several criteria for these purposes.

Difficulties related to the usage by the creditors of such judicial remedy provided for in the Cape Town Convention such as repossession of property or gaining control over such property lead to the necessity of implementing the special judicial remedy being seizin in law (e.g. exercising supervision over space assets from Earth through access and order codes).

The importance of this provision is stressed by the fact that such satellite can be an integral part of the communication or operation system, whereas the creditor cannot take possession or take control of such property in contradiction with the public order.

In order to promote the space asset based financing of the transactions, special insolvency optional regime provisions were included to the preliminary draft Protocol on Space Assets to strengthen the creditors position against trustee in bankruptcy in case of debtor's insolvency.

One of the most important spheres where the abovementioned Protocol on Space Assets will be applied to enforce the Cape Town Convention provisions is the definition of the main features and structure of the space assets' international registration system. The Cape Town Convention provides for the creation or appointment of the supervisory board, responsible before the contractual states, having international status with the corresponding privileges and immunities and responsible for the creation and maintenance of international register. Such supervisory board will be also responsible for the registrar appointment who will maintain the register on the day-to-day basis providing for its effective operation.

The expected implementation of the proposed UNIDROIT regime on enhancement of the financing opportunities for space related enterprises and the cost reduction of such financing may be a rather valuable tool for new clients of satellite services, including developing countries and countries with a transition economy which might have witnessed such financing issues up to this moment.

During discussions of the Cape Town Convention, the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space defined three spheres, which may cause difficulties to the States with regard to the provisions of the Protocol on Space Assets pertaining the standard judicial remedy provisions.

In those states, where the vast majority of space assets are state-owned, any attempt of the private party to take possession or to gain control over such property will provoke adverse reaction of the state authorities.

Likewise, in those States where there is an imperative provision prohibiting any technology transfer, particularly military technology, the State will oppose any attempts of such technology transfer to an unknown creditors.

Pursuant to third scenario, when the specific part of the space asset serves as a guarantee with respect to a state's service to some other state, specifically, for the security and navigation systems, such state would most likely oppose such gaining control over the space assets without properly guaranteeing such property exploitation under the same terms and conditions.

It has been assumed that these obstacles may be resolved by means of one of two solutions or a combination thereof. The first solution provides for the possibility for the states concerned to exclude some categories of space assets from the scope of this Protocol on Space Assets using reservation provision.The second solution provides for the compensation payment by the states to the creditor with respect to the damages incurred where the state's interests do not allow for the judicial remedies as prescribed by the Protocol on Space Assets, simultaneously balancing the interests of such states and creditors.

References:

1. Доклад Третьей конференции Организации Объединенных Наций по исследованию и использованию космического пространства в мирных целях. Док. ООН A/CONF.184/6. – Нью Йорк: Изд-во ООН, 1999. – С. 80-81.

2. Основи економічної теорії: Підручник / За ред. проф. Мочерного С.В.- Тернопіль: АТ «Тарнекс».- 1993.

3. *Г.Климко, В.Павлюк, В.Красильчук, М.Дідковський.* Проблеми інтеграції України в міжнародний поділ праці / Під ред. Г.Н.Климка.- К.: Книговид. центр «Посередник», 1994.

4. *В. Денисов.* Международное право как составная часть правовой системы Украины // Юридическая практика, 2000, №41.

5. *А.Мережко.* Lex mercatoria – теория и принципы транснационального торгового права.- К.: Таксон, 1999.

6. *В.М. Корецкий.* Избранные труды, Кн. 1.- К.: Наукова думка, 1989.

7. *E.Finch, A.Moore.* Astrobusiness.- N.Y.: Kluwer Law International.- 1984.

8. *О. Бєглий.* Закон України "Про космічну діяльність" і витоки національного космічного права // Космічна наука і технологія.- 1996.- Т.2: № 5-6.- С. 13-16.

9. *О. Бєглий, О. Кудрявченко, Р. Передерій.* Правові проблеми сприяння інвестиціям в космічній галузі України // Космічна наука і технологія.- 1997.- т.3, № 5-6.- С. 10-20.

10. *О. Бєглий.* Правові проблеми інтеграції України у світовий ринок космічних послуг і технологій // Держава і право. Щорічник наукових праць молодих вчених України. - Вип. 2.- К.: Юр. вид-во «Ін Юре», 1998 -1999.- С. 523-529.

11. *О. Бєглий.* Міжнародне право і проблеми захисту інтелектуальної власності у сфері космічної діяльності // Інтелектуальна власність.- 1999.- № 3-4.- С. 8-12.

12. *О. Бєглий.* Третя конференція ООН з космосу і проблеми розвитку права інтелектуальної власності // Інтелектуальна власність.- 2000.- № 4.- С. 3-9.

13. *О. Бєглий.* Правовий режим Контролю за нерозповсюдженням ракетних технологій // Правова держава: Щорічник наукових праць Інституту держави і права ім. В.М.Корецького НАН України. - Вип. 12.- К., 2001.- С. 463-475.

14. *О. Бєглий.* Правове регулювання світового ринку космічних послуг і технологій: Дис. канд. юр. наук: 27.09.02. - К.: ІДП ім. В.М.Корецького НАН України, 2002.

15. *В. Селіванов* Безпека України: нелегкий шлях становлення // Голос України. – 1997. – 6 квітня.

16. Закон України „Про основи національної безпеки України" // Відомості Верховної Ради (ВВР). – 2003, №39, ст. 351. – Ст. 1.

17. Розпорядження Кабінету Міністрів України „Про схвалення Концепції Загальнодержавної космічної програми на 2007- 2011 роки" від 31.05.06 р. № 306-р. – http://www.rada.gov.ua/cgi–bin/laws/main/cgi?nreg = 306-2006-р.

18. *Т. Кудлай, О. Бєглий.* Правове регулювання космічної діяльності в сучасних умовах // Юридичний вісник "Повітряне та космічне право". – 2006. – № 1. – С. 23-26.

19. *О. Бєглий.* Арешту українських ракет і супутників покликана перешкодити конвенція про міжнародні гарантії // «Дзеркало тижня».- 2004.- № 10 (485). - С. 9.

20. *О. Бєглий.* Державне регулювання космічної діяльності в світлі забезпечення національної безпеки України в умовах переходу до сталого розвитку // Юридичний вісник "Повітряне і космічне право". – 2006. – № 1. – С. 31-36.

21. *О. Бєглий.* Глобалізація і космічне право // Стратегія розвитку України (економіка, соціологія, право). – Вип. 5. Спецвип. / Гол. ред. О.П.Степанов. – Книжк. вид. НАУ, 2006. – С. 52-62.

22. *О. Бєглий.* Правове регулювання космічної діяльності та національна безпека України // Матеріали VIII Міжнародної науково-технічної конференції "Авіа-2007". – Т. 3 – К.: НАУ, 2007. – С.61.1-61.4.

23. *О. Бєглий, М. Дабіжа.* Організаційно-правові аспекти засмічення космічного простору // Юридичний вісник "Повітряне і космічне право". – 2009. – № 2. – С. 5-14.

24. Конвенция о международных гарантиях относительно подвижного оборудования. Док. DCME Doc. No. 74.- Кейптаун: Изд-во УНИДРУА/ИКАО, 2001.

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ON THE LEGAL STATUS OF A STATE CIVIL AVIATION AUTHORITY

The authors considers and analyses the legal acts of power, which concerns problems of an establishment the legal status for civil aviation administration body during years of independence in Ukraine and also reputes an establishment possibility for it by the legislation body.

To define a task complexity of administration and legal ensuring of civil aviation activities, in our point of view, is expedient to deliver different definitions given in following normative-law sources. For example, item 2 The Air Code of Ukraine adopted 04.05.93 №3167-XII [1] contains: "Aviation as a branch contains all kinds of the enterprises, organizations and institutions, and its activities directed on conditions creation for man's air space usage by aircrafts". On item 32 the Law of Ukraine "On transport" (10.11.94 № 232/94 – ВР) [2] such definition is foundlocated: "An air transport includes the enterprises of air transport, which realize carriage of the passengers and cargoes, aerial survey, agricultural works, and also airports, air stations, aero clubs, vehicles, control system of air movement, educational institutions, repair factories of civil aircraft and other enterprises, institutions and organization irrespective of patterns of ownership, which provide activity of an air transportation". For more package approach to consideration of aviation as the branch are necessary quoted one more concept, which is used in item 2 of the Decree of the Cabinet of Ministers of Ukraine "On the affirmation of the Provision usage of air space of Ukraine" (29.03.2002 № 401) [3]: "Aviation is the branch, which is the constituent part of transport system of the country, enterprises, institutions and organizations of which, irrespective of a pattern of ownership and subordination, own aircrafts and conduct activity connected with the usage of air space".

Thus there is obvious a presence of such different elements as airlines and airports, refuel complexes, system objects' of organization an air movement and diverse complexes maintenance service aviation products. And these different elements characterize not only these elements as such, but and levels, on which is realized administration of them by state bodies (for example, Ukrainian center scheduling usage air space of Ukraine and regulation of air movement (Ukraerocenter); the regional structural sub-sections of the center, into which composition are included the regional and auxiliary regional centers of service of air movement), pattern of ownership and subordination (for example, non government air carriers; the air carriers of department (відомчого) subordination: the Ministry of Defence, the Ministry for Internal Affairs, the Ministry of Industrial Policy; other enterprises, institutions and organization both state and private and ensure civil aviation activity).

The making and implementation significant of a legal material capacity, and its mastering by all participants of branch is a necessary condition for accomplishment of effective state civil aviation regulation.

Recognizing that the administration on the purpose constitutes is a "kind of state activity, within the framework of which the authority of the defined body, authorized to that" in our point of view wholly logically would be to consider administration (especially for civil aviation administration) "as such, that, among others, includes also historical moments" decision adopted by the President of Ukraine and executive power.

The legalize of formation the system of state bodies concerning economic complex administration in general, transport and civil aviation in particular began in Ukraine by such legal acts as:

- the law of the Ukrainian Soviet Socialist Republic "On the list of the ministries and other central bodies of public administration of Ukrainian SSR" from 13.05.91г. № 1030-XII, item 1 [4], among other Ministries Ukrainian SSR, is defined also the Ministry of Transport.
- the Decree of the Cabinet of Ministers of Ukraine "On creation of State administration of aviation transport of Ukraine" (25.03.92 № 146) [5] and "Issues State administration of aviation transport of Ukraine" (11.07.92. № 392) [6] with which with the purpose of ensuring efficient

administration of civil aviation... the creation of State administration of aviation transport of Ukraine (Ukraviaciya) was supposed and that Ukraviaciya is a state administration body (state executive power body), and realizes the administration of an air transportation and accomplish state policy in this branch. Ukraviaciya subordinated to the Cabinet of Ministers of Ukraine and also enters into system Ukraine's Ministry of Transport.

Gradually, on an extent over ten years the domestic legislation concerning regulation of aviation transport activity stays at a stage coming into being, accompanies by adoption of the novels and subordinate legislation and constant improvement "old".

First of all pays on attention process government decision search devoted to the legal status of civil aviation administration body. Failing to the complete list of the decisions of government concerning it, we believe to expedient this process stage by stage and to result some of the decisions, which are in our opinion most essential.

Thu, the assignee of State administration of aviation transport of Ukraine, according to the Decree of the President "On the Ministry of Transport of Ukraine" (26.11.92 № 581/92) [7] defined department of aviation transport, among others, is created in structure of the Ministry of Transport with transfer to it of functions of this administration body. And on executing of this Decree the Cabinet of Ministers of Ukraine is entrusted to result the Provision about the Ministry of transport of Ukraine and its structure in conformity with this Decree, as has found the display in the appropriate Decree of government (17.02.93 №106) [8]. To this Decree:

- the Provision on the Mintrans are affirmed and the State administration of aviation transport of Ukraine is liquidated.
- the Mintrans is the central state executive power body.
- the tasks, accordingly fixed to it, Mintrans realizes administration of usage of air space of Ukraine and service of air movement.
- as Mintrans's unit department of aviation transport was created.

The following step of power in directions of legal definition for the status civil aviation administration body became the Decree of the President "On the Provision about State department of aviation transport of Ukraine" (05.06.95г. № 425/95) [9], which the Provisions about this body are affirmed and that State department of aviation transport of Ukraine (Ukraviatrans) is the state central executive power body and subordinated to the Cabinet of Ministers of Ukraine.

Proceeding from definition Ukraviatrans as "the central body", analysis of the tasks, fixed to it, concerning realization of state policy in sphere of development of civil aviation, management of civil aviation and appoints the Chairman of this agency by the President of Ukraine, is possible to make conclusion, that its legal status has raised (increased) to a level of the ministry. In addition to that, according to the Decree, has changed not only legal status, and title: Ukraviaciya **to** Ukraviatrans**.**

During following of half-year by the Decrees of the President of Ukraine "On improvement of management of a transport complex of Ukraine" (11.09.95 № 826/95) [10] and "an issue of the Ministry of Transport of Ukraine" (27.12.95 №1186) [11], as is worded in the preamble first "with the purpose of ensuring efficient functioning of a transport complex of Ukraine", to system of the Ministry of Transport of Ukraine the State department of an air transportation of Ukraine has come also and it is defined as a body of the state executive authority. The Chief of this body is appointed by the President of Ukraine. Besides the Ministry of Transport of Ukraine (Mintrans) is the state central executive power body and it is subordinated to the Cabinet of Minister of Ukraine. Mintrans realizes state policy in the branch of transport and accomplish, including, management of an air transportation through State department of aviation transport of Ukraine; And the Provision on this organ affirms the Cabinet of Ministers of Ukraine. That is by these Decrees re-subordination state civil aviation administration body to Mintrans is putted in possession again.

Next. By the Decree of the President of Ukraine "Measures on reduction in order state regulation of civil aviation activity in Ukraine" (11.06.97 №531/97) [12] attention on ensuring of efficient functioning of civil aviation accented and improvement of system of state regulation in this branch. With this purpose in system of the Ministry of Transport of Ukraine the State air administration of Ukraine (Ukraviaciya) is formed on the basis of State department of aviation

transport of Ukraine and Committee on usage of air space of Ukraine, which will be liquidated. That is has changed as the title (Ukraviatrans to Ukraviaciya) and area of tasks, which became: Realization of state policy on development of civil aviation, accomplishment of the centralized state regulation in civil aviation branch of Ukraine, organization and ensuring of air transportation, works and services, effective usage air spacious, including in the military purposes, accomplishment certification of objects and subjects both of civil aviation and licensing of their activity, supervision of a safety in civil aviation branch. But about the legal status of a newly-created body in this Decree is not told. Obviously it has remained same - subordinated to Mintrans. Almost in one year, it is obvious in development of this Decree concerning legal succession of State air administration of Ukraine of the rights and duties of the liquidated state bodies, Decree of the Cabinet of Ministers of Ukraine (08.06.98 №815) [13] the Provisions about State air administration of Ukraine are affirmed, in which Ukraviaciya to something by a constant central body of the executive authority subordinated to Mintrans, which realizes state policy in sphere of civil aircraft (as well as in the mentioned Decree of the President "On the Provision about State department of air transportation of Ukraine" from 05.06.95г. № 425/95 [9], but central state executive power body is subordinated to Cabinet of Ministers of Ukraine).

The precondition concerning last legal definition for status civil aviation administration body became the Decrees of the President of Ukraine "On system of the central executive power bodies" (15.12.99. № 1572/99) [14] and "On changing in structure of the central executive power bodies" (15.12.99 № 1573/99) [15], according to it in conditions of conducting in Ukraine administrative reform, improvement structure of executive power bodies and the raise of efficiency of public administration were supposed:

- Possibility of formation by the Cabinet of Ministers of Ukraine governmental public administration bodies,
- Liquidation State air administration of Ukraine with charge of its functions on the Ministry of transport of Ukraine,

and this has found the display in the Decree of the Cabinet of Ministers of Ukraine "On establishment of State department of aviation transport" (29.03.2000 № 573) [16]. According to this Decree Department is public administration governmental body, acts in a structure of Mintrans and obeys to it. The consideration of this provision, Ukraviatrans's legal status (by the way has changed its title again) basic tasks and functions both, fixed to it gives the bases to assume, that on the defined term this department will not fall under "squall" liquidation and reorganization. To that on defined? Because the attempts of organization functioning and legal regulations of civil aviation activity were realized in directions conformity its to similar agencies (particularly last 4-5 years) functioning in development of foreign countries.

By the Decree of President (15.07.2004, № 803/2004) [17] Government service of Ukraine from a supervision after providing of safety of aviation (Derzhaviasluzhba) on the base of the State department of aviation transport of Ukraine is formed.

According to Decree Derzhaviasluzhba is a specially authorized central organ of executive power on questions a state supervision after providing of safety of aviation; activity of which is sent and co-coordinated by the Government, which provides realization of public policy in civil aviation and in the field of the use of air space of Ukraine and other activities.

For today legal status of civil aviation authority and position about it is defined by the Decision of Government „On formation of State aviation administration" (02.11.2006, №1526) [18] as a government body of public administration of Ministry of Transport and Communications of Ukraine. A Decision is fasten basic tasks and functions of this authority.

With given it is possible to conclude, that the legal acts, with civil aviation activity administration bodies in Ukraine were established pass complex (difficult) processes. On the basis of these acts there is whether creation, a reorganization or liquidation such state body in general. Changes, that were deposited to organization of civil aviation administration had a massing look, absence scientifically based directions for adoption of the appropriate decisions, from what administrative activity in this branch suffered; the competency of such bodies changed ("defined as

a capacity of state activity fixed to a concrete body, or some certain questions stipulated by the legislation, other legal acts, which it has the right to decide during practical activity" [19, p.59].

By the way organization and activity of executive power bodies concern the constitutional orders. That is such "organization and activity", according to item 12 article 92 the Constitution of Ukraine [20], can be adjusted "only by laws". And if Verhovna Rada of Ukraine will adopt the Law of Ukraine "On central executive power bodies" with definition of those branches, for state regulation creation central executive power bodies are needed (not necessarily ministries), taking into mind importance of such branch of regulation, wholly possible changing the legal status state civil aviation regulation body. And in addition for realization of aviation authority tasks and functions necessary constant interaction with the such ministries, as Ministry of Industrial Policy (certification production of aviation products released for aviation needs), Ministry of Defence (coordination scheduling and usage air spacious, service of air movement).

Consequently, historical-law research of becoming of legal status of civil aviation authority testifies (coming from an amount and legal force of acts which influenced and influence on forming it) to outstanding importance for the public activity of a civil aviation.

References

1. Повітряний кодекс України від 04.05.93р. №3167-XII.
2. Закон України “Про транспорт” від 10.11.94р. № 232/94-ВР.
3. Постанова Кабінету Міністрів України “Про затвердження Положення про використання повітряного простору України” від 29.03.2002р. № 401.
4. Закон Української Радянської Соціалістичної Республіки “Про перелік міністерств та інші центральні органи державного управління Української РСР” від 13.05.91р. № 1030-XII.
5. Постанова Кабінету Міністрів України “Про створення Державної адміністрації авіаційного транспорту України” від 25.03.92 р. № 146.
6. Постанова Кабінету Міністрів України “Питання Державної адміністрації авіаційного транспорту України” від 11.07.92р. № 392 .
7. Указ Президента “Про Міністерство транспєорту України” від 26.11.92р. № 581/92.
8. Постанова Кабінету Міністрів України “Питання Міністерства транспорту України” від 17.02.93р. №106.
9. Указ Президента “Про Положення про Державний департамент авіаційного транспорту України” від 05.06.95р. № 425/95.
10. Указ Президента України “Про вдосконалення управління транспортним комплексом України” від 11.09.95р. № 826/95.
11. Указ Президента України “Питання Міністерства транспорту України” від 27.12.95р. №1186.
12. Указ Президента України “Про заходи щодо впорядкування державного регулювання діяльності цивільної авіації в Україні” від 11.06.97р. № 531/97.
13. Постанова Кабінету Міністрів України “Питання Державної авіаційної адміністрації” від 08.06.98 р. №815.
14. Указ Президента України “Про систему центральних органів виконавчої влади” від 15.12.99р. № 1572/99.
15. Указ Президента України “Про зміни у структурі центральних органів виконавчої влади” від 15.12.99р. № 1573/99.
16. Постанова Кабінету Міністрів України “Про утворення Державного департаменту авіаційного транспорту” від 29.03.2000 р. № 573.
17. Указ Президента України “Про затвердження Положення про Державну службу України з нагляду за забезпеченням безпеки авіації” від 15.07.2004р. №803.
18. Постанова Кабінету Міністрів України “Про утворення Державної авіаційної адміністрації” 02.11.2006р. № 1526.
19. Адміністративне право України [Підручник для юрид. вузів і фак. / Ю.П.Битяк, В.В.Богуцький, В.М.Гаращук та ін.]; За ред. Ю.П.Битяка.-Харків: Право, 2001.-528с.
20. Конституція України від 28.06.21996р.

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LEGAL REGULATION OF CURRENCY RISKS ON AIRTRANSPORT AT THE INTERSTATE AND NATIONAL LEVELS

In the article the author considers and analyses the legal regulation of currency risks on air transport at the interstate and national level, the problems of interaction between the international and national legal regulation of currency risks on air transport raises a question of the necessity of the reviewing of some clauses of the international air conventions concerning currency instruments, which are applied at conducting of settlements.

Quickly ascending from the middle of XX century, the commercial relations between the states, their bodies, international organizations, legal entities and physical persons and using foreign currencies in banknote at conducting the settlements by participants in legal relations have raised the danger of approach of negative results of currency risks for all participants not only in the world, but national markets. In these conditions the theoretical and practical judgement of the legal nature of currency risks is needed and also formation of quite legal mechanism of their management.

The mentioned items can be disclosed in the example of air transport, which takes a special niche in the system of market relations. Meeting the needs of the clients for the international and domestic carriages, air transport contributes to the development of typical integration for the modern world economy processes. The second feature of legal relations in sphere of air transport activity is a wide use of foreign monetary units in settlements of the participants in contractual and non contractual legal relationships. In particular contractual legal relationships of the Ukrainian air enterprises can be formed in connection with the necessity of integration of civil aviation of Ukraine into the international system of civil aviation to involve additional volumes of international carriages and currency flow, reduction of expenses, approach to the international standards of flights safety, terms of carriages of the passengers and cargoes, creation of an effective leasing system of aircrafts and other engineering as the updating principles of park aircrafts, park of airlines, power and ecological indicators of air transport, and also in connection with the use of air space of Ukraine. According to the State complex program of the development of air transport of Ukraine for the period till 2010 approved with the Decree of the Cabinet of Ministers of Ukraine of July 27, 2001. № 919 for Ukraine, as for the state with the extremely large technical facilities for transit carriages the system of organization air traffic pushes into the foreground. The payments from servicing transit flights of foreign aircrafts in the top zone of air space of Ukraine come to more than 70 % of the revenue of the State enterprise of service of air traffic of Ukraine "Ukraeroruch" [1].

In all these cases the use of foreign currency in paper expression as the means of payment, which does not have its own real worth, results in approaching danger of currency risk owing to the fluctuation of exchange rates under the influence of subjective and objective factors.

Similar situation is typical for air transport activity practically for all countries of the world. Therefore the major trend in the formation of the legal mechanism of currency risks control is legal ensuring of the political decisions, accepted on this problem, at the interstate and national levels.

In this connection, it is necessary to note, that some articles of the multilateral agreements owing to the changes in financial and monetary situation in the world have become outdated. First of all, it concerns the article 22 of the Convention on the Unification of Some Rules, which concern the international airline traffic from October 12, 1929 (Warsaw Convention). In the article 22 of the Convention is limited to the responsibility of the carrier in relation to every passenger to 125 thousand Fr. But the passenger is given an opportunity to increase the level of a carrier's responsibility thanks to the special agreement with the carrier.

The carrier's responsibility is limited to the sum of 250 FR per kg while transporting the registered luggage and goods.

Concerning the passengers' personal things, the responsibility of the carrier is limited to 5 thousand Fr for a passenger.

The above mentioned sums expressed in French Franks, which come to 65,5 milligrams of the gold test 0.900. They can be expressed in any national currency with approximate figures [2].

From the mentioned provisions it is possible to see that in the Warsaw Convention, the countries, which signed it, tried to connect French Frank to the gold and thus to make an attempt to settle the matters of currency risk in the international legal act, as in the case with the devaluation of French Frank, and other national currencies as to Frank in which the compensation will be repaid. But in this article the mechanism of reconversion of Frank into the local currency is not well arranged, what causes certain difficulties at their recalculation. So, to simplify the procedure of the settlements the former Committee of Civil Aviation of the USA defined a limit of the responsibility to 20 thousand US dollars for 250 thousand Fr. [3]. Frequently the governments of certain states establish the sums of the responsibility in local currency with the help of legal acts, which in the conditions of fluctuations of exchange rates leads to currency risks, which both parties of the case bear. As the Convention provides for the claimant has the right to claim on his own choice in court of one of the countries - members, or in court in the location of the main office of the carrier or the carrier′s branch office , where the contract of carriage was drawn up, or in the court of the country of arrival and there is a possibility that in these countries the courts can convert Frank in local currency, having used the value of gold for this purpose .

The Hague protocol from September 28, 1955 makes alterations to the article 22 of the Warsaw convention. According to the Hague protocol the responsibility of the carrier related to every passenger is limited to the sum of 250 thousand Fr. But there is a possibility for the passenger thanks to the special agreement with the carrier to increase the level of the carrier′s responsibility.

The responsibility of the carrier is limited to 5 thousand Fr on the passenger as to the passengers' personal things.

In this article the sums defined in Frank, are considered to be a currency unit, which comes to 65,5 milligrams of gold of the test of 0.900. These sums can be recalculated in national currency in the approximate figures. Converting the sums in the national currency, which has no golden contents, in case of trials will be conducted according to the golden worth of these currencies for the date of ajudgement [4].

We see, that the enlarged limit of the responsibility of the carrier is twice longer 250 thousand Fr for each passenger. It increases both sums of disbursements, and sums of losses owing to the existence of currency risks. Besides due to international rule-making activity on currency regulation and currency risks regulation concerning the responsibility of the air carrier there is not only the concept of Frank, but a currency unit, which actually equals to the cost expression of Frank according to the Warsaw convention. Making an attempt to be protected from the influence of the fluctuation of exchange rate of the French Frank in the world currency market. But the introduction of a term " currency unit " has really changed a little, consequently it remains attached to the gold. Besides, demonetisations of gold, which were legally fixed owing to the Jamaican monetary reform (1976-1978 гг.), has led to the loss of monetary functions of the gold. Since 2001 in a world monetary-financial circulation all-European monetary unit – euro has been introduced. From this time French Frank, as well as almost all other national currencies of the countries - members of EU were withdrawn from a circulation. Taking into account the changes in the world and national monetary systems, the review of the appropriate articles of the Warsaw convention of 1929 and the Hague protocol of 1955 has become necessary.

It should be noted, that the countries - members have paid attention to the disadvantages of the Warsaw convention concerning legal regulation of currency risks, but again not in the complete volume. So, the question of conversion of the sums in the national currency which does not have the golden contents according to the golden worth of these currencies for date of ajudgement is regulated. Besides, the consideration of the cases in court can take considerable time and in the

period between air event and the adjudication the exchange rates can change unforeseeable, that due to action of currency risk will reduce as the sum of compensation, so otherwise seriously will strike on balance of air company. Thus, sore question concerning regulation of currency risk has remained again unsolved in the legal plan.

The adoption of the Convention on the Unification of Some Rules of international airline transportation from May 28, 1999 (Montreal Convention) have not changed the situation completely. In the article 21 of the Convention is limited to the responsibility of the carrier in relation to every passenger and the carrier can not exclude or restrict his responsibility if it is not more than 100 thousand SDR. In the article 23 given the order of the currency unit's conversion [5].

The problem of a possibility of the approach of currency risks in the air transport activity did not result in any alterations, which were made in the Montreal protocol of 1978 to the Roma convention on the damage caused by a foreign aircraft to the third persons on a surface. As a result of sharp fluctuations of the exchange rates in the world currency market in 70-80 years of the last century made it necessary to change originally acting units of settlements (in this case Fr) on conditional " currency units " or " the special drawing rights " (SDR). Taking into account it, and also new systems of the calculation of take-off weight Montreal protocol of 1978 establishes the responsibility in connection with the death or injury in 125 000 SDR (1 875 000 currency units) [3].

On the basis of the accepted decisions the limits of the responsibility were considerably raised. The sums specified in SDR, are considered as specified in the units, which are defined by the International Monetary Fund (further - IMF). The conversion of these sums into national currencies in case of trials is realized according to the value of national currencies in units of SDR for date of ajudgement. According to the practice the value of national currency of the country - member of IMF at transferring into units SDR is defined according to a method of definition of cost, which is applied by IMF to its own operations and settlements for the date of ajudgement. The value of national currency of the country, which is not the member of IMF, in the units of SDR, is defined on the method established by this country. The countries, which are not the members of IMF or which legislation forbids to apply SDR can calculate the limits of the responsibility proceeding from conditional currency units [3].

Having analysed the given facts it is possible to reach the conclusion, first, that there is a legal differentiation of the countries - members of IMF and countries, which are not the members of this organization at conversion of the sums in SDR into national currencies under condition of compensation of the damage, caused on foreign aircraft to the third persons. Secondly, it is possible to conduct a parallel with the Warsaw convention and Hague protocol with that difference, that in the Montreal protocol, with the purpose of the creation of legal base the prevention to currency risks, not the golden standard is used, but accepted international unit - SDR, which is an international currency unit as the records on the accounts. Thus again the problem of legal regulation of currency risks remain not settled. It is caused by a general legal situation, which has developed in world monetary system by then, namely the transition of the countries - members of IMF to the Jamaican monetary system, which is based on the international currency unit - SDR.

The importance of the solution of the question connected with legal regulation of currency risks is confirmed by that fact, that the claims, which are based on the provisions of the Roma convention (1972), can be acted only in courts of the country of a place of the cause of damage. But on mutual consent of the claimant and defendant the claims can be acted in court any country - member, if thus are not restrained the rights of persons, who committed the claims in the state, where the damage was caused. As beforehand unknown country, where the damage can be caused and there are no authentic information concerning what court of what country will entertain the claim and in what national currency the amount in controversy will be converted, it is impossible, to be protected from currency risk if there is no effective legal mechanism of currency risks regulation.

From the given provisions, and also taking into account that not unified in complete volume the questions of the responsibility arising at collision in the air of aircrafts, responsibility of bodies of air traffic management, liability for damage caused by noise or sound impact in the international air law, in the whole, the legal regulation of the compensation of damage caused by a foreign

aircraft to the third persons is realized basically according to the national law, which can have significant variances, in particular in the countries of the American legal system, which considerably raises the danger of increase of the sizes of the negative results of currency risks.

The leading air states try to unify the real laws, which regulate the international air activity. With this purpose the inter-governmental organizations in the sphere of civil aviation were created: the International Civil Aviation Organization (ICAO), the International Air Transport Association (IATA) and other.

The practical activity IATA is reduced to the regulation of commercial uses of the international airlines. Trying to reach unification of conditions of carriages on the international air transport, IATA adjusts and for all air companies - members establishes unified tariffs on carriages of the passengers, luggage and cargoes, affirms samples of the documents of carriage and etc. But legal mechanism of consecutive conducting in practice of activity of air transport of tariff policy IATA is not produced. It has resulted in that tariff, and the currency policy of the national air carriers actually has remained from the outside of legal influence of this greatest non-governmental organization.

The short analysis, conducted in the article, of a problem of interaction the interstate and national levels of legal regulation of currency risks on air transport makes the following conclusions:

- in conditions of growth of the danger of approach of negative results of currency risks for all participants in air transport legal relations the theoretical and practical judgement of the legal nature of currency risk is needed and also the formation of quite efficient legal mechanism of their management.
- one the trends of improvement of the risk – management mechanism is being reviewed by the world community and states of currency instruments, which are applied at settlements between the participants of air transport activity.
- the development of the system of currency risk insurance at the interstate and national levels.

References

1.Державна комплексна програма розвитку авіаційного транспорту України на період до 2010 року, схвалена Постановою Кабінету Міністрів України від 27 липня 2001 р. № 919 // http: zakon 1.rada.gov.ua.

2.Конвенція з уніфікації деяких правил, що стосуються міжнародних повітряних пебревезень від 12 жовтня 1929 р. // Internet. – http: www.rada.gov.ua.

3.Международное воздушное право: Книга 2. Под ред. А.П.Мовчана. - М.: “Наука”, 1980.

4.Протокол про зміни до Конвенції з уніфікації деяких правил, що стосуються міжнародних повітряних пебревезень, підписаної у Варшаві 12 жовтня 1929 р. // Internet. – http: www.rada.gov.ua.

5.Конвенція про уніфікацію деяких правил міжнародних повітряних перевезень від 28 травня 1999 р. // Відомості Верховної Ради України. – 2009. - № 15. – Ст. 201.

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NEW CHALLENGES OF NATIONAL SECURITY: JOINT NATIONAL TELECOMMUNICATION SYSTEM

This article focuses on the new challenges in information sphere for Ukrainian national security due to formation of the global telecommunication system and possible ways of responding through implementation of the Joint National Telecommunication System

According to the Concept of National Space Program on 2007-2011 [1], the development of the high space technologies as a mean for intensification of the sources of the internal progress is an existence condition for any sovereign state in the modern world. The space activity has a great impact on a state's future by promoting of the sustainable development, maintaining of the research and technology potential, meeting the long term state's objectives in security and defense spheres, environmental management, telecommunications and therefore is predetermined to be dealt with on a priority basis.

Promoting of such directions as earth remote sensing and navigation, commercial space communications, high-tech space projects and programs require up to date legal regulation of social relations emerging in different spheres of space activity. Unfortunately, most of the present international documents in this sphere fail to solve many practical issues of peaceful uses of outer space due to globalization and commercialization phenomena.

As stated in the National Scientific and Technical Task Space Program of Ukraine on 2008-2012 [2], the main purposes of modern space activity of states are the following: boosting economic and scientific and technical development, solving of the global problems of mankind, including by performing of space activity with a view on national security and defense and promoting of the sustainable development.

In pursuance of the abovementioned aims and in terms of national security of Ukraine in the international sphere, the government of Ukraine together with the National Space Agency of Ukraine developed the program providing for manufacturing and launching on an earth orbit of the first national communication satellite as one of the means guaranteeing security of the telecommunications network and information infrastructure of Ukraine. Such communication satellite will be transmitting the direct television broadcasting, providing access to information networks, using corporate and official earth-based satellite stations and operated both by the Ministry of Defense of Ukraine and by the National Bank of Ukraine. It is also planned that apart from Ukraine the capacity of this communication satellite can be used by Belorussia, Lithuania, Latvia, Estonia, Poland, Hungary, Check Republic, Romania and Moldova.

However, these plans mounted tensions with a number of European telecommunication companies as to orbit positions and radio frequencies assigned to Ukraine by the International Telecommunication Union (the "ITU"). One of the European satellite networks Eutelsat already turned to Ukraine stating that the proposed system will interfere with two systems already functioning on the earth orbit. According to international law all such issues should be solved prior to any launching with all of the parties concerned. At the same time, while negotiating such sensitive for the national security issues as information sphere, one should necessary have in mind all potential threats for the telecommunications network and information infrastructure of Ukraine and prevent creation of the "pressure-groups".

As it was emphasized at the World Summit on the Information Society [3], where mechanisms of information society regulation and its development strategies were largely discussed, the security enforcement includes: protecting of human rights and freedoms, guaranteeing data privacy, commercial abuse prevention, fighting against terrorism etc.

In this context it is worth mentioning that for the legal regulation of the Joint National Telecommunication System the governing principle of freedom of information is indissolubly related to the guaranteeing of national security and public order [4]. This concept was legally adopted in 1936 by the International Convention Concerning the Use of Broadcasting in the Course of Peace (the "Convention 1936"). This Convention 1936 also prohibited some of the illegal transfrontier transmittions. In 1950 the Draft Protocol to the Convention 1936 further provided that each of the contracting states shall refrain from radio broadcasts that would mean unfair attacks or slanders against other peoples anywhere and in so doing conform strictly to an ethical conduct in the interest of world peace by reporting facts truly and objectively, and to provide that each of the contracting states shall not interfere with the reception, within its territory, of foreign radio broadcasts [5].

In 1948 by adopting of the Universal Declaration of Human Rights [6] the principle of freedom of information was implemented containing the principle of freedom of broadcasting as its integral part: everyone has the right to freedom of opinion and expression; this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers.

According to Article 10 of the European Convention on Human Rights 1950 [7] the exercise of the principle of freedom of information may be subject to such formalities, conditions, restrictions or penalties as are prescribed by law and are necessary in a democratic society, in the interests of national security, territorial integrity or public safety, for the prevention of disorder or crime, for the protection of health or morals, for the protection of the reputation or the rights of others, for preventing the disclosure of information received in confidence, or for maintaining the authority and impartiality of the judiciary.

Furthermore, according to part 3 of Article 19 of the International Covenant on Civil and Political Rights 1966 [8] the certain restrictions of freedom of information provided by law may be imposed were necessary for protection of national security or of public order, or of public health or morals.

Following the general tendency, Article 3 of the Model law "On Transfrontier Satellite TV Broadcasting and International Satellite Information Exchange" [9] (the "Model law") prohibits creation of radio jamming or other technical, legal, organizational, financial and other obstacles for distribution of radio and television programs or telecommunication, except as directly provided by this Model law and in cases of direct threat to the national security.

Other Model Information Code 2008 for states members of the Commonwealth of Independent States (the "CIS") [10] (the "Model code") in its Articles 4 and 5 sets fundamental rights and freedoms in the information sphere and the restrictions thereof. Thus, the exercise of rights and freedoms in the information sphere may be restricted only by virtue of law in the interests for protection of constitutional order, national security, territorial integrity and public safety, for the prevention of disorder or crime for the protection of health or morals, for the protection of the reputation or the rights of others, for preventing the disclosure, use, destruction of the restricted data, or for maintaining the authority and impartiality of the judiciary.

Moreover, during performing of any activity on retrieval, obtaining and dissemination of information including in case of direct television broadcasting one should not only comply with the abovementioned principles, but with non-discrimination principle indissolubly related with the complex of international instruments for human rights protection in all spheres of human activity. This principle in general prohibits all ideas or theories of inferiority of minorities in political, cultural and economic spheres, sets some criteria and prohibits dissemination of such information. Thus, certain restrictions are imposed on the principle of freedom of information depending on its context.

According to Article 20 of the International Covenant on Civil and Political Rights 1966 [8], any propaganda for war and any advocacy of national, racial or religious hatred that constitutes incitement to discrimination, hostility or violence shall be prohibited by law. Furthermore, Article 4 of the International Convention on the Elimination of all Forms of Racial Discrimination 1965 [11]

condemns all propaganda and all organizations including in information sphere which are based on ideas or theories of superiority of one race or group of persons of one colour or ethnic origin, or which attempt to justify or promote racial hatred and discrimination in any form. Part b) of this Article also declares illegal and prohibits organizations, and also organized and all other propaganda activities, which promote and incite racial discrimination, and recognizes participation in such organizations or activities as an offence punishable by law.

Apart from this, the Model law [9] among other principles of transfrontier transmittions determines principles of preventing of tendentiousness, agitation and propaganda, contempt for events, occurrences and processes in independent states, and principle prohibiting transmission of programs containing comments and stories offensive for the sovereignty of any state, for national or confession feelings of one or other nations, or those contravening morals or legality. It is also prohibited to transmit programs focused on incitement of public to actions incompatible with internal legislation of states or endangering their security. Article 41 of the Model code also prohibits dissemination of information containing propagation of infringement of territorial integrity and sovereignty of state, propagation of war or of social, racial, national, religious, clan and class superiority, cruelty and violence, pornography etc.

Taking into account that in many cases the dissemination of information is treated as providing of services, e.g. direct television broadcasting, the General Agreement on Trade in Services (the "GATS") [12] in its Article XIV bis pays special attention to cases of prohibition of any requirements a) obliging members to furnish any information, the disclosure of which it considers contrary to its essential security interests; or b) to prevent any member from taking any action which it considers necessary for the protection of its essential security interests; or c) to prevent any member from taking any action in pursuance of its obligations under the United Nations Charter for the maintenance of international peace and security.

Another legal issue of the national security enforcement in the sphere of dissemination of information is protection of data privacy and confidentiality both on the state's scale and in connection with an average person. In accordance with the International Covenant on Civil and Political Rights 1966 [8], it is prohibited to disseminate the confidential information without consent of the definite person, and any use of such information for other purposes. The same provision was included in the Model Code specifically devoted to the cases of dissemination of information with limited access, including confidential and secret information. The legal regime for such information is to be prescribed by law. According to Chapter 3, the unauthorized dissemination and/or use of such information affects legal and natural persons, society and state. Furthermore, upon court's order such information can be disseminated and/or used without the owners consent if such information is of great importance to society and the society's right to receive it prevails over the owner's right to its protection [10].

Summary

Under current circumstances, in the rapidly changing world, the national security of states is challenged in many new ways inclusive of information security sphere. During formation of the global telecommunication system many of the practical issues of peaceful uses of outer space, e.g. commercial space communications, remain unsolved resulting in decreasing of the information security level of state and slowing the process of international coordination of such telecommunication systems under the ITU procedures. Furthermore, performing of any activity on retrieval, obtaining and dissemination of information, including while using communication satellites, should fully comply with the foregoing principles: freedom of information, non-discrimination and confidentiality principles (subject to restrictions and limitations set by the laws). Hence, the realization of program on manufacturing and launching on an earth orbit of the first national communication satellite, on the one hand, can foster international cooperation between states in its turn decreasing the threat to national security of Ukraine, and, on the other hand, can develop its information potential and authority at the international level.

References

1. Розпорядження Кабінету Міністрів України «Про схвалення концепції Загальнодержавної космічної програми України на 2007 – 2011 роки» // Офіційний вісник України. – 2006. – № 22. – С. 150, ст. 1659.

2. Закон України «Про затвердження Загальнодержавної цільової науково-технічної космічної програми України на 2008-2012 роки». – К.: ВВРУ, 2009. – № 12. – ст. 148.

3. Всемирная встреча на высшем уровне по вопросам информационного общества, Женева 2003 – Тунис 2005 [Электронный ресурс] // Официальный сайт Организации Объединённых Наций/ Конференции и мероприятия. – Режим доступа: http://www.un.org/russian/conferen/wsis/

4. *Волошко Ю.А.* Співвідношення принципів «свободи інформації» та «надання попередньої згоди» у сфері міжнародного безпосереднього телевізійного мовлення / Ю.А. Волошко // Актуальні проблеми міжнародних відносин: Збірник наукових праць (у двох частинах). – Випуск 69, Частина ІІ. – К.: Київський національний університет імені Тараса Шевченка, Інститут міжнародних відносин, 2007. – С. 61-63.

5. International Convention concerning the Use of Broadcasting in the Cause of Peace 1936 [Electronic resource] // Official site of the UN Refugee Agency / Refworld / A/RES/841. - Access Mode: http://www.unhcr.org/refworld/docid/3b00f0838.html

6. Загальна декларація прав людини // Международные документы по правам человека. – Харьков: РИФ «Арсис, ЛТД», 2000. – С.6-12.

7. Європейська конвенція з прав людини 1950 року // Международные документы по правам человека. – Харьков: РИФ «Арсис, ЛТД», 2000. – С.13-32.

8. Міжнародний пакт про громадянські та політичні права 1966 року // Международные документы по правам человека. – Харьков: РИФ «Арсис, ЛТД», 2000. – С.64-85.

9. Модельный закон «О трансграничном спутниковом телевизионном радиовещании и международном спутниковом информационном обмене» [Электронный ресурс] // Сайт Института проблем информационного права / Центр «Право и средства массовой информации» / Законодательство о СМИ стран СНГ и Прибалтики / Содружество Независимых Государств / Модельные законы и рекомендательные законодательные акты Содружества Независимых Государств. – Режим доступа: http://www.medialaw.ru/exussrlaw/l/sng/16.htm.

10. Модельный информационный кодекс для государств – участников СНГ 2008 года [Электронный ресурс] // Сайт Института проблем информационного права / Центр «Право и средства массовой информации» / Законодательство о СМИ стран СНГ и Прибалтики / Содружество Независимых Государств / Модельные законы и рекомендательные законодательные акты Содружества Независимых Государств. – Режим доступа: http://www.medialaw.ru/exussrlaw/l/sng/45.htm

11. Международная конвенция о ликвидации всех форм расовой дискриминации [Электронный ресурс] // Официальный сайт ООН / Документы / Декларации и конвенции / Декларации, конвенции и другие основополагающие документы, содержащиеся в резолюциях Генеральной Ассамблеи ООН / 1946-1969. – Режим доступа: http://www.un.org/russian/documen/convents/raceconv.htm

12. Генеральное соглашение по торговле услугами [Электронный ресурс] // Россия и Всемирная торговая организация/ Соглашения ВТО. – Режим доступа: http://www.wto.ru/ru/content/documents/docs/pril1B.doc

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THE FAIR AND RESPONSIBLE USE OF THE GEOSTATIONARY ORBIT: TOWARDS PUBLIC-PRIVATE PARTNERSHIP

Following the common tendency of space commercialization, activity in the area of the geostationary orbit (GSO) experiences significant changes which are related to growth of the interest to orbit/spectrum resources from both state power and private business. Objects of attention are exceptional value, unique physical nature and practical scarcity of this orbit.

Principal multilateral space treaties and space-related documents of the International telecommunication union (ITU) has become the theoretical basis of research. The conceptual background of study of current issues of the GSO usage comprises the publications of specialists in international space law, in particular, Diederiks-Verschoor I., Hobe S., Kopal V., Lafferranderie G., Lyall F., Ospina S., Zhao Y. etc.

Long-term character and wide spectrum of existent legal problems in the area of the GSO confirms the necessity of development and specification of space law principles which are attached to commercial space activity. There is also a need to accomplish tasks which are not paid attention to by international space law until now.

These questions are of current interest for Ukraine which is on the stage of forming its own satellite network of communication and broadcasting on the basis of first geostationary communication satellite «Lybid-GSO».

The GSO is an universal naturally anthropogenic resource of space with defined spatial limits which is used for data acquisition and exchange by artificial earth satellites of various applications.

The orbit area has inseparable links to outer space as both are elements of unique natural complex and single normative system. Accordingly the GSO is the integral component of outer space, natural limits of this spatial duration conditioned by the physical specifics of certain type of satellites that utilized for space activities of mankind. Its legal status and regime are determined on the basis of international space law for taking into account legal rights and interests of all states.

Analyzing the characteristics of current usage of the GSO we can describe it as an aggregate of minefield of natural resources. In other words in each orbital slot it is possible to use only the certain amount of radio bands with the limited volume. It is non-renewable on the period of action of radiofrequency assignments of particular country and further usage by the operator of geostationary satellite network.

According to law it is not the orbit as the physical phenomenon which has the importance, but relations on questions of access, allocation, registration and usage of its resources for space services. The ITU is the exclusive organization which is legally authorized to allocate «…radio frequencies and any associated orbits, including the geostationary-satellite orbit…». The utilization of geostationary satellite is built on the basis of unified space-related rules and procedures which are compulsory for execution by all countries-participants of the Union.

Nowadays international space law remains legal fundamentals deviation from which is not allowed. The obligation of accordance of all activity in the GSO area with provisions and principles of international law which is established by article 3 of the Treaty on principles governing the activities of states in the exploration and use of outer space, including the Moon and other celestial bodies [9] and comes out of article 2 of the Charter of the United Nations, sets in which degree possible application of state jurisdiction and control in relation to international resources and territory is allowable.

The quantitative increase of private-legal agreements the subject of which is orbit/spectrum resources results to dominative interpretation of conception «the use of outer space» as its

commercial exploitation and appropriately needs introduction of binding legal mechanism for governing of economic relations in this area.

Degree of freedom of the GSO use and separation of this resource among common outer space is represented by the legal category of «limited natural resource» in application to the orbit. Understanding of space freedom in the area of the limited resource opens up through the concept of freedom of choice of orbit and allows to talk about existence of only the right on realization of certain types of space activity on the GSO in strict accordance with international space law. Concerning the GSO such concept is itemized in article 44 of the Constitution of the ITU that is purposes of activities on the orbit are providing of the rational, efficient and economical regime of the resources usage; establishing on a basis of equality access and irrespective of degree of economic or scientific capacities of countries; carrying out for the benefit and in the interests of all mankind; taking into account the special needs of the developing countries and the geographical situation of particular countries [3].

Actual users and factual owners of the geostationary satellite systems are business structures, including the specialized communication organizations and transnational corporations which today have direct relation to the use of the GSO resources. The distinctive feature of their participating in a world economy is an association of interests and capital only within the framework that is defined by desire of receiving the maximal profit. There are reasonable concerns that not only the states, but also possibly one or two private structures can claim to the global dominating in the market of space services and technologies.

As Ospina S. underlines in recent years the processes of space commercialization led to a situation, when a «national flag» is only private multi-national emblem [8, p. 258]. This thesis illustrates well the fact that the total market value for launch services over the period 1997 – 2006 decade was made at USD $ 33, 4 billion, of which USD $ 21 billion was used for launching geostationary satellites. Specialists forecast that in the future nearly 70 % of this market will be generated by commercial operators, the remainder coming from governmental agencies [4, p. 159]. In conformity with the Convention on registration of objects launched into outer space the UN Register of space objects nowadays furnished information about 861 operated satellite on the GSO [7]. Moreover, 1109 geostationary satellites networks are in coordination stage of the ITU and 1014 – in notification stage as of 31.12.2009 [1].

The most common cases of commercial agreements in the area of the GSO concern the rent of the radiofrequency satellites channels and orbital locations, cooperation of satellite operators relative to the use of geostationary slots, purchase/sale of spacecraft that placed on accurate position and working in certain radio frequency bands.

Such situations cause the main volume of practical problems which need the proper legal reflection. In particular, the change of owner of spacecraft is complicated by the obvious necessity of its moving as parts of contractual conditions in that part of the GSO which has been assigned to a country whose jurisdiction a buyer is under. At the same time there appears the question of withdrawal of the space vehicle from the national register of objects of space activities and bringing the proper changes in the analogical register of country-buyer and in the UN Register of space objects. Besides the problem of utilized the geostationary spacecraft as in the capacity of credit secure of certain space project sponsor is a growing concern: does such creditor have a right in the case of taking control of the space asset to use the orbit/spectrum resources which were allocated to the country of debtor?

In the resolution 59/115 of the General Assembly of the UN «Application of the concept of the «launching State» recommends that «States conducting space activities … consider enacting and implementing national laws authorizing and providing for continuing supervision of the activities in outer space of non-governmental entities under their jurisdiction» [2].

It is needed to mark that for today there are already a number of countries, which have national space legislation. Questions of state authorization, supervision, registration, liability, safety, transfer of ownership are regulated within the framework of space legislation of Ukraine. So in accordance with article 14 of the Law on Ukraine on space activity (1996) withdrawal of space

vehicles from the State register of objects of space activities of Ukraine by the National Space Agency of Ukraine is foreseen, in particular, in the case of its transfer to other state, international or foreign enterprise, establishment or organization [5, p. 36–43].

The last acts which were accepted at an international level have crucial role for commercial space activity. There is the Agreement on basic telecommunications (GATS/WTO, 1994), the Declaration on international cooperation in the exploration and use of outer space for the benefit and in the interest of all states, taking into particular account the needs of developing countries (UNCOPUOS, 1996), Some aspects concerning the use of the geostationary orbit: paper adopted by the Legal Subcommittee (UNCOPUOS, 2000), the Convention on international interests in mobile equipment (UNIDROIT, 2001).

Consequently the changes of space activity character lead to its complicated governing and continuing supervision by states due to activity of private companies. At the same time the use of such global resource as the GSO turns all participants of international community, at least as users of variable space services, into victims from the irrational, ineffective, uneconomical, inequality utilize and share of the orbit/spectrum resources.

Freedom of the GSO is actually limited because it is very difficult in practice to guarantee that all new comers will get orbital locations betimes. Professor Lyall F. marks that the present system in which in theory at least every state of any size has an equal rights to realization space activity is unrealistic [6, p.266].

It is clear that assignment of rights on the use of orbital slot and radio frequencies is one of a number of possibilities to create the new satellite system at the real congestion of the GSO. The mechanism of dynamic management promotes increasing of efficiency of the use of the GSO. Correspondingly second users be permitted alternative to utilize the GSO which occupies a primary user temporarily, while it is not being used. Thus in 2006 the first geostationary communication satellite of Kazakhstan «KAZSAT-1» was placed on Russian geostationary position for 15 years under Kazakh-Russian interstate agreement.

Taking it into account, freedom of the unforbidden economic activity is the component element of the space freedom, so there is the right of commercial activities in the GSO sphere without any restraints, if they are not enacted by international law.

International space law does not create (however and does not forbid) activity of commercial consortia and only obliges states to control activity of governmental agencies and non-governmental entities. It takes into account a substantial role of private sector in space activity and conforms exactly to fundamental principles of international space law namely of principle of the responsibility of the states for national activity in space which is carried out its natural or juridical persons.

The decision-making function of the ITU reflects the modern, competitive environment in which the private party plays the leading role while the regulatory authorities act as arbitrator of the wider public interest [10, p. 298].

As we can see from the abovementioned, the usage of the GSO hereinafter will be developed not in direction of complete internationalization of public space activity and absolutizing of role of international cooperation, but of the high use of private investments for development of the national and regional satellite systems.

The ITU remains the effective administrative model of governing of such activity, the flexible and adapted to current realities form of world coordination. International intergovernmental status of the organization only underlines the role of the state as central political unit which is considered to be the basic guarantor of adherence to purposes and principles of international space law. However there is not other alternative as use of private capital and accordingly satisfaction of business corporations interests also by realization of state support of space commercialization for providing of the global involvement spacefaring, newcomers and non-spacefaring states in the sphere of the GSO utilization today.

At national level the regulations of the GSO utilize must take place at the telecommunications sector which is managed by operators. Realization of the effective use of the GSO first of all

depends on the users of this space, their opened and mutual cooperation within the ITU framework as an international forum. The role of the state might be limited by questions of safety, competition, protection of consumers and national public interests.

Conclusions

The model of management of the geostationary resources within the international regulatory framework is the example of international-legal regime which encourages investments in the peaceful space exploration and use in the order of non-discrimination principle for interests of all countries.

Confirming the leading role of state administers it is believed that in the GSO sphere the legal regime might develop on a basis of public-private partnership which can be powerful source of fair access, reasonable use of the resources, conscientious trading of space and technologies, and forming single legal space.

References

1. Annual space report of ITU Radiocommunication Bureau 2009 on the use of the geostationary-satellite orbit and other orbits : Annex 4 // UN Doc. : A/AC.105/C.1/2010/CRP.9. – Vienna, 8-19 February 2010. – 89 p.

2. Application of the concept of the «launching State» // UN Doc.: A/RES/59/115. – 25 January 2005. – 2 p.

3. Constitution of the International Telecommunication Union : indicates a provision adopted by the Additional Plenipotentiary Conference (Geneva, 1992) and amended by both PP-94 and PP-98 // Basic Texts of ITU. – http://www.itu.int/net/about/basic-texts/index.aspx

4. *Goh G. M.* Dispute settlement in international space law – A multi-door courthouse for outer space. – The Netherlands : Martinus Nijhoff Publishers, 2007. – 495 p.

5. Law of Ukraine on space activities // National space legislation of the world . – Vol. 1. General issues. State regulation. – Editors in charge. Nataliya Malysheva, Yuryi Shemshuchenko. – Kyiv, 2001. – 446 p.

6. *Lyall F.* The role of the International telecommunication union // Outlook on space law over the next 30 years: Essays published for the 30th Anniversary of the Outer space treaty. – The Netherlands: Kluwer law international, 1997. – 253–267 p.

7. Online index of the object launched into outer space / United Nations Committee of peaceful use of outer space // Official website : www.oosa.unvienna.org/oosa/searc.do

8. *Ospina S.* Regulation of space resources // Essential air and space law. Space law: current problems and perspectives for future regulations. – New York : Eleven, 2005. – P. 255–272.

9. Treaty on principles governing the activities of states in the exploration and use of outer space, including the Moon and other celestial bodies : GA resolution 2222 (XXI), annex // United Nations treaties and principles on outer space. – UN Doc. : ST/SPACE/11. – Printed in Austria. – 56 p.

10. *Zhao Y.* The ITU and national regulatory authorities in the era of liberalization // Space policy. – № 18. – 2002. – P. 293–300.

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INFORMATION SECURITY AS PART OF CIVIL AVIATION SECURITY

In the article problems concerning understanding of the main point of information security of civil aviation field are investigated, and also suggestions for the field's law improvement are worked out.

Key words: *security, information security, civil aviation.*

Important feature of the present stage of economic and scientific and technical progress is swift development of information technologies, wide usage of the latter in all spheres of social life and in state government. Information and information technologies more and more determine technical and technological development of society and serve as new sources for national power growth and main potential of economy. In terms of establishment of information society all spheres of vital functions of mankind are changed radically. Besides, information society changes labour object, the base of which becomes information and knowledge. Meanwhile, the base of globalization becomes integration of different levels of information systems into one world information system, formation of one common information space, creation of global information telecommunication networks, intensive introduction of new information technologies into all fields of social life, including into civil aviation activity.

Modern air transport system is multifunctional and dictates rapid pace of technological and information processes. Information security in civil aviation field is an integral part of general security — either national, or regional, or contextual in separate economy fields. By such approach information security analyses supposes investigation of a set of the following objective factors: needs of citizens, society, state and world community; dependency of a person, society and state on information communication systems and digital technologies; presence of realized threats and dangers, which must be take into account by information security system etc.

Information security is a part of general problem of information support of civil aviation system functionality, which explains the actuality of the article topic.

The phenomenon of security, namely information, has been studied by many Ukrainian and foreign scientists, namely, O. Baranov, O. Bielov, K. Bielyakov, V. Bondarenko, V. Havlovsky, V. Holubiev, V. Horbatov, V. Hurkovsky, O. Dodonov, A. Zatvorny, R. Kaliuzhny, B. Kormych, H. Lazariev, V. Lipkan, O. Lytvynenko, V. Muntian, H. Pocheptsov, O. Sosnin, V. Tsymbaliuk, V. Shamray, M. Shvets, O. Shevchuk, V. Yarochkin and others.

In practical площині of social system existence security is not an abstract phenomenon, cut off from concrete life conditions. This phenomenon has, and shows in everything, its concrete sense depending on concrete circumstances and situation, social conditions. Security stays for need for human existence in general, only as need for existence of a person, nation, state particularly, because its functioning is connected with the satisfaction of the most important human and society need. Security is associated with life possibility, its preservation, is considered to be a value and main criterion of further development, connected with awareness of complex and system approach to the problems of subject being.

In modern science literature discussion takes place, which concerns the fact that formulation of security problem is caused by awareness of threats, that is security problem, secure existence of social system is connected to antipode – danger or threat. This is a direct dependency. From such point of view, a conclusion can be drawn: if danger is absent, there is no need in security, and consequently in creation and formation of protection system, defence, and opposition. If danger is present, such need occurs [1, p. 57]. This is one of the methodological approaches.

The main point of another approach states that security has to take place always, even if danger or threat, as danger implementation and its display forms, are absent. If you want peace – prepare for the war – a known saying, which demonstrates this approach to security understanding.

Investigation shows that existent methodological uncertainty about universal sense of security reflects in the definition of its certain displays, namely in information security sense.

There is a definition of information security as state, development tendency, society's living conditions, its structures, institutions and establishments, with the help of which qualitative functioning of information that is free and natural, and contains objectively reasoned innovations is preserved. A number of representatives of this approach consider information security to be danger absence, namely absence of influences and conditions that threaten directly to an individual, community, state from the information communication environment. Followers of such approach believe that information security is only a state or process of immunity of a person, society, state from real or potential threats [2].

Normative legal approach to the research of the sense of information security supposes that at the most general level information security can be seen as subject's ability to preserve his or her system forming features, main characteristics during pathological deorganizational, destructive influences on cyber space, information communication technologies. Representatives of this approach believe that information security is a kind of social legal relationship concerning creation, support, defence and protection of desirable for a person, society and state living conditions; social legal relationship connected with creation, spread, storage and usag eof information [3, p. 18].

It is worth mentioning the point of O. Lohinov, who states that the concept should not be limited to "state" only when category "information security" is defined, but he believes that it is a process. As a matter of fact, in his opinion information security must be seen through organical unity of features like state, property, and threat and danger control, which provides the selection of the optimal way of its liquidation and negative consequences influence minimization, particularly in the field of executive bodies' information activity.[4, p. 155].

Russian scientist, information law expert Bachylo I.L. focuses on the multidimensionalism of "information security" concept. She includes into investigation: open information protection, state secret protection, guaranteeing protection of limited access information, besides state secret, assurance information and information resources [5, p. 253].

By The Law of Ukraine «About the Basis of Ukrainian National Security» from 19 June 2003 № 964-IV, national security is defined as immunity of vitally important interest of a person and citizen, society and state, by which stable society development, timely detection, prevention and neutralization of real and potential threats to national interests are guaranteed [6]. By this law threats to national interest and national security of Ukraine in information field are defined: displays of freedom of speech and citizen access to information restriction; spread of violence, cruelty, and pornography by mass media; computer crime and terrorism; reveal of information that is defined by law as state secret, and any other confidential information owned by state or aimed at ensuring needs and national interests of society and state; attempts to manipulate by social consciousness, particularly by spread of unauthentic, incomplete or preconceived information.

Analyses of different approaches to the definition of concept „information security" gives a possibility to take notice of the necessity to study it in complex and system. The most common approach is integral, according to which information security is defined with the help of outlining its most important substantial features taking into account constant dynamics of information systems, including civil aviation as a social technical system.

In information field of aviation security interests are derivative from other social values protected by law. So, information security interests come of such values like human life and health, property, the security of air space functioning and usage, and security of transport system in general. Information security in civil aviation field acts as a feature of desirable social relationship in the field, which preserves essentially important features for existence under the influence of inner and outer threats.

Aviation field is one of the most expressive examples of existent and potential threats to human living, its sources and reasons (in most cases of complex sense). Aviation security is a complex property of aviation transport system, which means performing the functions with no damage (or minimal damage) to the system or population, for the interests of which it is developed [7, p. 17]. Its main components are flights security, aviation and ecological security. Namely to these components maximum attention is paid by national and international bodies and organizations that ensure civil aviation activity, particularly ICAO. However, lately national and global vulnerability to terrorism threats and any other kinds of unauthorized influence on aviation system has risen. Usage of global and

regional information networks in aviation transport system control actualizes the question of protection of information with the help of instrumental and software means, and increases the necessity of legal regulation of civil aviation information security.

In our opinion in aviation transport system information security is at the same level as flights and aviation security, so we suggest consolidating the statement concerning information security in civil aviation in the new version of Air code. Particularly, to define that civil aviation information security is an integral part of civil aviation security, including air and ecological security and flights security.

Information civil aviation problem is intensively studied by technical experts, but its understanding is limited to special means usage, methods and arrangements in order to prevent information loss [7, p. 17]. Such understanding reflects only one of many aspects of this sophisticated and complex.

In propositions to new version of the Air code of Ukraine Tsymbaliuk V.S. stresses on the necessity of implementation of statements in The Constitution of Ukraine, namely article 17, and defines that «support, defence and protection of aviation information security is one of the most important state functions, duty of everybody who is involved into aviation field activity». At the same time, he does not define information security of civil aviation, but suggests category «security of information system in aviation». It is proposed to include to the latter complex of social relationship concerning establishment and following the rules, conditions, determined by the legislation of Ukraine, in subordinate normative legal, normative technical and other acts, and also state technical standards that aim to proper support of functioning, defence and protection of information systems in aviation.[8, p. 8.]

In our opinion, at information security investigation it must taken into account that the main point is the inner sense of an object, which find its reflection in steady unity of all various and contradictory forms of being. Probability of higher risk of threat or danger implementation to civil activity in general and each of its structural elements must be considered as basic feature of information security. Main criterion of effective information security is its high level at minimum of correspondent cost (material, financial, moral, time etc).

Thus, civil aviation information security — is social relationship that determines the probability of steady and effective functioning of civil aviation for the purpose of support and implementation of interests of a person, society, state, and international community by timely detection, prevention and neutralization of real and potential threats to information relationship in civil aviation.

References:

1. Ліпкан В. Безпекознавство : навч. посіб. [для студ. вищ. навч. закл. зі спец. у галузі безпеки] / В. Ліпкан. — К., 2002. - с. 57.
2. Бєляков К. І. Інформація в праві: теорія і практика: монографія. / К. І. Бєляков. – Київ: КВІЦ, 2006. – 118 с.
3. Питання концепції реформування інформаційного законодавства України / Р. Калюжний, В. Гавловський, В. Цимбалюк, М. Гуцалюк // Збірник "Правове, нормативне та метрологічне забезпечення системи захисту інформації в Україні". — К., 2000. — С. 17—21.
4. Логінов О. В. Гносеологічний аспект управління інформаційною безпекою України / О. В. Логінов // Науковий вісник Юридичної академії МВС України. — 2004. — № 2. — С. 153—161.
5. Бачило И. Л. Информационное право : основы практической інформатики / И. Л. Бачило. — М. : [б. и.], 2001. — С. 253.
6. Про основи національної безпеки України : Закон України від 19 червня 2003 року № 964-IV // Відомості Верховної Ради України. — 2003. — № 39. — Ст. 351.
7. Безпека авіації / [В. П. Бабак, В. П. Харченко, В. О. Максимов та ін.] ; ред. В. П. Бабак. — К. : Техніка, 2004. — 584 с.
8. Цимбалюк В. С. Забезпечення безпеки інформаційних систем у цивільній авіації / В. С. Цимбалюк // Повітряне і космічне право : Юридичний вісник. Наукові праці Національного авіаційного університету. — 2008. — № 4(9). — С. 4—8.

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LEGAL PRINCIPLES OF DANGEROUS GOODS TRANSPORTATION BY AIR TRANSPORT

The article gives a general characteristic features of applicable legislation concerning the carriage of dangerous goods by air transport. The attention to consideration of this type aviation services as a kind of economic activity and concluded the complexity of its legal regulation.

The level of development of transport system of any state - one of the most important features of its technological progress and civilization.

The economic transformation taking place in Ukraine lately years, and necessity to have a highly developed transport system as the basis for efficient inclusion our country in the world community, of course, significantly affect to formation of transport infrastructure, including aviation.

Current native legislation provide that the aviation industry as a sector is a part of the transport system of our country, companies, institutions and organizations regardless of any ownership and subordination own aircraft and carry out activities associated with the use of air space [1], that is part of the air field, located over a land and water Ukraine's territory, including over its territorial waters (territorial sea) [2].

By Article 4 of the Air Code (AC) Ukraine disclose the contents of such activities, which is that in aviation any legal person or individual person (the operator) has the right to conduct business and business operation, maintenance, repair, production, development and other activities in the field of aeronautical engineering and received a license that permitted by law Ukraine.

Actually economic activity is the activity of economic entities in the sphere of social production, aimed at producing and selling the products, value works of service that have price certainty [3].

With regard to economic activities of transport enterprises, including aviation, its basis, as specified in Article 6 of the Law of Ukraine „About Transport", is a passenger carriage, baggage, mail and provide other transport services [4].

It should be noted that more than 10% of world cargo-turnover in our time – is air transportation. Although air cargo rates much higher than rates of railway or car, air transport is ideal in cases where the main value is speed and the necessity to reach distant markets [5, p.400].

In our country the market of cargo transportation by air transport for the last 10 years develop as ambiguous. Thus, according to State Statistics Committee of Ukraine, volumes of transportation cargo by air transport were described in 2000 – 19,5 thousand tons; 2001 – 26,9; 2002 – 90,3; 2003 – 148,4; 2004 - 101; 2005 – 123,6; 2006 – 98,9; 2007 – 104; 2008 – 102,1 tons.

Unfortunately, in 2009 for the aviation industry characterized by the continuation of negative trends by end of previous 2008 year, which were formed under the influence of the global economic crisis as a result, by official information of the State Aviation administration, the volume of cargo and mail decreased for 16,7% and amounted to 85,1 thousand tons.

According to Annex 18 to the Convention of International Civil Aviation, half of the goods that are transported by all modes of transport in the world belong to the category of dangerous goods - explosives, corrosive, flammable, toxic and even radioactive, essential for the global industrial, commercial, medical and research needs and processes. In view of advantages of aviation, most of these dangerous goods transported by aircraft.

Conducted our review of scientific literature shows that scientists researched the legal peculiarities of carriage of goods by rail, sea, inland waterway – by I.V. Bulgakova, O.V. Klepikova, G.V. Samoilenko, E.D. Streltsova, air charter contract in private international law – by I.A. Dikovska, contract cargo aircraft for civilian law of Ukraine – I.O. Bezlyudko.

Thus, the study of legal principles transport of dangerous goods by air transport as it appears on the current scientific and theoretical and practical points of view, because the functioning of air transport is a threat not only to transport operators, as well as life, health and property of people and environment.

In this regard, Article 63 AC Ukraine determines that the transportation of weapons, ammunition, explosives and poisonous substances, nuclear fuel, radioactive materials and other goods belonging to particular dangerous, undertaken with the permission of the competent authorities according to special rules that are established by government regulation of aviation of Ukraine.

Concerning the notion of dangerous goods, in general sense it should be understood under articles or substances that during air transport may endanger human health, safety of flight or property [6], but technically - substances, materials, products, waste production and other activities are due to inherent properties in the presence of certain biological factors may at the carriage cause explosions, fires, damage to hardware, devices, buildings and other facilities cause material damage and harm the environment and cause death, injury, poisoning people, animals, and that under international treaties ratified by the Verkhovna Rada of Ukraine, or the test results in due course depending on the degree their impact on the environment or the person assigned to one of the classes of dangerous substances, in other words explosives, gases, flammable liquids and solids, radioactive materials and others [7].

However, by Resolution of the Cabinet of Ministers of Ukraine – Government – „About approving the list of dangerous items and substances that are prohibited for carriage by air" dated 12.05.2007 № 723 held their separation of objects and substances are prohibited to transport passengers and crew of aircraft and civil aviation items and substances are prohibited to transport passengers and crew in the cabin, but are allowed in baggage.

According to Article 306 CC of Ukraine, the transportation of cargo, including dangerous, by air ways are economic activities associated with moving products industrial supplies and consumer products by air and freight transport on the basis of contract of carriage of cargo.

Furthermore, the relations connected with cargo transportation governed Chapter 64 of the Commercial Code of Ukraine and other regulatory legal acts.

In particular, AC Ukraine determines that an integral part of the business for all operators Civil Aviation regardless of ownership and departmental affiliation, are registered in Ukraine as a legal entity and carries out operation of civil aircraft is the procedure certification. It confirms the level of technical training required by the relevant person specified aviation regulations of Ukraine and the requirements of aviation security.

Carrying out certification and supervision of operators by the State Aviation Administration, according to which as of April 26, 2010 in our state are 74 airlines operating operator certificate - a legal document, issued in accordance with the Rules of certification of operators and shows that the operator complies with these AC Ukraine and Regulation and recommendations of the International Civil Aviation Organization. On this date in 23 the airline received certification for freight operators (indicated A2) and 16 - on transportation Dangerous Goods (indicated E11).

In order to accurately implement the operator certification requirements for carriage of dangerous goods, at the stage of preliminary evaluation of the application determines the State Aviation Administration: or operation of an aircraft is provided according to the loading of dangerous goods and control over the process, whether the selected type of cargo flights types of aircraft on which such flights will be carried out.

In step inspection certification test subject, including technology to a security baggage and cargo. Also operator must provide a daily airport or office-based information to the State Aviation Administration of fact over the past day flight plan and fly the next day and nature of the goods [8].

Furthermore, it is mandatory to obtain a certificate of airworthiness of civil aircraft are registered in the State Register of civil aircraft and fitness certificate on the noise level civil aircraft Ukraine.

Promoting the creation of institutional and legal framework to ensure aviation safety and effectiveness of civil aviation, current law imposes clear requirements: no ban air ship fly out in the absence of documents that give the right to conduct business and commercial activities in the field of civil aviation; mandatory controls on safety, equipment, hand luggage, baggage, cargo, courier and postage, onboard supplies, which are taken on board, the creation of each operator certificated service aviation security structure which may include security control unit, the unit (group) support passenger and cargo aircraft in controlled areas and other subjects.

In this regard, Article 16 of the Law of Ukraine „About Transport" provided that those enterprises, institutions and organizations that are senders or recipients of explosive, flammable, radioactive, toxic and other dangerous goods must ensure their safety and have transportation facilities and mobile units for emergency situations to prevent the transport of such goods or accident.

A staff of dangerous goods transportation entities involved in the classification, packaging, labeling or marking labels and placards on the package design transport documents, shipment, transportation or reception of dangerous goods, carrying cargo and other operations involving the transport of such goods shall pass special training to study the legal requirements and conditions of carriage of dangerous goods, which resulted in a corresponding certificate (certificate).

In our opinion, is reasonable and regulations regarding the obligation secured entities are providing services (such services performed for remuneration (commission) one person (Agency) on behalf of another person (airline or its General Agent) on sale of air transportation in Ukraine, whose content is that if enforcement agency activities related to dangerous goods, it should have in your state at least one specialist, who graduated from courses of the International Civil Aviation Organization (ICAO) or other certified courses on transport of dangerous goods by air [9].

In addition, under paragraph 31 of Article 9 of Law of Ukraine „About licensing of certain economic activities", provision of air cargo, including dangerous Cargo as one of their species, type of license a business [10].

According to the Rule „On approval of the licensing conditions of the business of providing services passenger and cargo air transport" dated 26.11.2001 № 139/821, license issued by the State Aviation Administration of economic entities that provide transportation services transportation by air, by regular and/or charter flights for 3 years, but mandatory in this subject up operator certificate, certified in due course [11].

This entity must comply with the Law of Ukraine on the transport of dangerous goods that define the organizational, legal, socio-economic bases of activity associated with dangerous goods by different modes of transport including air and have trained personnel for this activity.

Therefore, we examined the certification procedure and licensing of operators when they provide transportation of dangerous goods by air transport, of course, be considered as the main means of regulating the activities of state entities that corresponds norms 12 Commercial Code of Ukraine.

Detailed regulation of dangerous goods provided for in the "Regulations for the transport of cargo by air" dated 02.11.2005 № 822, particularly in matters of registration Declaration of the sender and trafficking of dangerous goods, transport of dangerous goods labeling, order placement and loading of dangerous cargo on the aircraft [12].

In addition, under the provisions of AC Ukraine and the Law of Ukraine „About insurance" to the types of compulsory insurance include liability of dangerous goods against negative consequences in the transport of dangerous goods, which is conducted to ensure the damage to life and health of individuals surrounding natural environment, property of individuals and entities in the transport of dangerous goods, including air transport [13].

Thus, transport of dangerous goods by air transport is a type of economic activity in the use of airspace and the legal basis of its proceedings are complex, which aims to ensure proper organization and safe air transport specified type of service.

References

1. *Resolution of Cabinet of Ministers of Ukraine „About approval of the airspace of Ukraine”* dated 29.03.2002, № 401 with changes // Official bulletin of Ukraine dated 19.04.2002 - 2002, № 14, pp. 85, article 727, act code 22030/2002

2. *Air Code of Ukraine* dated 04.05.1993 № 3167-XII with changes // Bulletin of the Verkhovna Rada of Ukraine from 22.06.1993 - 1993, № 25, article 274

3. *Commercial Code of Ukraine* dated 16.01.2003 № 436-IV with changes // Bulletin of the Verkhovna Rada of Ukraine from 02.05.2003 - 2003, № 18, article 144

4. *Law of Ukraine „About Transport”* dated 10.11.1994 232/94-VR with changes // Bulletin of the Verkhovna Rada of Ukraine from 20.12.1994 - 1994, № 51, article 446

5. *M.I. Didkivsky* International Activities: Manual - K.: Knowledge, 2006 .- 462 c.

6. *Law of Ukraine „About State Program of Civil Aviation Security Aviation*” dated 20.02.2003, № 545-IV // Voice of Ukraine dated 21.03.2003 - № 55

7. *Law of Ukraine “About the transportation of dangerous goods”* dated 06.04.2000 № 1644-III with changes // Voice of Ukraine from 13.05.2000

8. *Rule of the State Service for Supervision of Aviation Safety “About approval Rules of certification of air operators”* dated 20.09.2005 № 684 with changes // Official bulletin of Ukraine dated 11.01.2006 - 2005, № 52, pp. 575, Section 3375, act code 34811/2005

9. *Rule of the State Service for Supervision of maintenance Aviation Safety „About approval of certification entities that are providing services of sale of air transportation in the territory of Ukraine”* dated 30.12.2004 № 255 with changes // Official Bulletin of Ukraine from 28.01.2005 - 2005, № 2, pp. 438, Article 110, Code Act 31328/2005

10. Law of Ukraine „About licensing of certain economic activities” dated 16.01.2003 № 436-IV with changes // Bulletin of the Verkhovna Rada of Ukraine from 02.05.2003 - 2003 p., № 18, article 144

11. *Rule „On approval of the licensing conditions of the business of providing services passenger and cargo air transport”* dated 26.11.2001 № 139/821 // Official bulletin of Ukraine dated 21.12.2001 - 2001 p., № 49, pp. 226, article 2214, act code 20718/2001

12. *Rule of the State Service for Supervision of Aviation Safety* “Regulations for the transport of cargo by air” dated 02.11.2005 № 822 // Official bulletin of Ukraine dated 07.12.2005 - 2005 p., № 47, pp. 224, article 2976, act code 34405/2005

13. *Law of Ukraine „About insurance”* dated 07.03.1996 № 85/96- VR with changes // Bulletin of the Verkhovna Rada of Ukraine from 30.04.1996 - 1996 p., № 18, article 78

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DESCRIPTION OF THE BASIC CLASSIFICATION CRITERIA OF THE OFFENCES IN A SPHERE OF AIR TRANSTORT

Today in jurisprudence legal scientists made an attempt to give the scientific determination of the administrative misconduct concept. During long time by scientists were made a great work in a development of administrative and preparation of the theoretical base of the forming of the administrative responsibility and also were a project of Ukrainian Code of Administrative misconduct (next in the text – UCoAM). In modern legislation of administrative responsibility there is no norm of systematization in a one legislation act and such situation make competition of norms, disparity of the requirements which belongs to law norm and often this norms have some interpretation of the maintenance of the article disposition.

In an acting Ukrainian legislation of the responsibility which was made in a field of administrative offence given a definition that administrative misconduct is an illegal, guilty (willful or careless) action or inactivity which encroach to a property, rights and freedom of a citizens, state or public order in a set management order, in what, according to the law, the offender must bear an administrative responsibility for example, as administrative penalty. [1,12]. About this problem in the legal literature there are a lot of ideas, which were incarnate in a different projects of the administrative misconduct Code.

Another way of misconduct understanding was made by developers of Administrative delict Ukrainian Code. They offer such formulation: administrative misconduct is accomplished by a physical person unlawful, publicly harmful act (action or inactivity) for which in legislation foresees an administrative responsibility (ar.10 of the Code project). Farther in other articles of the same project they are determine the concept of the administrative offence, according of which administrative offence is made by an artificial person unlawful, publicly harmful act (action or inactivity) for which in legislation foresees an administrative responsibility (ar. 23 of the Code projects) [2,214-217].

The analysis of legislative concepts determination of administrative misconduct allows to select in-legal signs, what are incident to it. Description of the signs of administrative misconduct and its illustration will be carried out with the use of compositions of the administrative offences which are makes in the air transport sphere:

at first, it exceptionally act that means an action (for example, damage of the air field equipment, signs of the air fields, air ships and their equipment - it.. 3 ar. 111 Ukrainian Code of administrative Offenses (next in the text - UCoAO) or inactivity (non-fulfillment of rules about placing of nightly marking signs on the buildings – it. 2 ar.111 of UCoAO);

secondly, anti-social orientation of administrative misconduct, which is characterized by the public harmfulness.

thirdly, its unlawful belongs to the signs of administrative misconduct, also in the relation of the transport law in general, and legal orders which regulate the use air transport especially it is prohibition by the legal transport norm an act which harms or threatens a danger;

fourthly, the important sign of administrative misconduct is guiltiness, which is expressed in the display of the freedom and a person consciousness, his (her) psychical attitude to the proper act and to its consequences. An act can be made with the willful or from carelessness;

fifthly, the legal sign of administrative misconduct is an administrative punish ability, that means unlawful, guilty act would be acknowledged administrative offence (misconduct) only then, when for its accomplished provide an administrative responsibility application of which in the field of air transport activities have its own signs,

Next, that is need to notice, that the administrative offences (misconducts) in the field of air transport application have only its legal composition which set in the legislation and means aggregate of objective and subjective signs. A presence of these signs is necessarily, because act

without such signs is not an offence (misconduct). Point 1 ar. 247 UCoAO tells us, that the case realization about administrative offence can not be open, and opened case must be closed, when there are no action or administrative legal composition.

Exploring the concept of the object of administrative offence in the air transport purview, it should be noted that there are public relations which are well-regulated by the legal norms, guarded and protected by the legal administrative facilities. The signs of object in many cases straight register in the articles or their parts, which are foresee an administrative responsibility for the any other offences which can be accomplished in the field of air transport application, and which enable to classify the act of the subjects which accomplished this misconduct, depending on the type of the transport, or on maintenance public relations.

Classification of offences (misconducts) depending on the type of transport (motor, railway, marine, air, river transport and elektrotransport) allows more expressly to define their unlawfulness and belonging to one or other sphere of transport and choose the optimum measure of influence on the offender, taking into account the features of exploitation of one or other type of transport. And classification of misconducts on maintenance public relations helps to structure public relations, define their homogeneous groups, and select a family object.

For the transport sphere use the more complete classification of the transport misconducts objects allows to select specific objects, as a variety of family object, but with more general for the row of misconducts public relations. According from it all transport misconducts are possible to classify on the signs of the objects as: breaking of the rules in sphere of law protection and safety of motion enforcement on a railway, air, marine, river transport; breaking of motion safety rules and exploitation of vehicles by the transports drivers (on the motor transport); transports or ships management by persons which have no the authority on it management; management of transports or ships, and also admitting to management them persons which are in a intoxication; transports or ships management which are not registered in accordance with established procedure, with the counterfeit numbers of registrations and exploitation them with the destroying or counterfeit numbers of aggregates; issue on a line technically defective transports, and also issue in swimming of ships with disrepairs, which is forbidden with their exploitation; breaking rules of buildings maintenance for the stand of the ships, maintenance of the roads, norms and standards concerning with the safety of traveling motion, damage of main pipelines, roads, moves of railways and other buildings; breaking the rules by pedestrians and other participants of traveling motion; breaking rules of fire safety on the railway, marine, air and river transport; breaking rules of public peace and public safety in the transport; breaking rules, directed on providing of safety of loads and other property; violation of the ownership right.

Adjusting of protective and safety aspects in the sphere of use of the air transport are carried out by national civil and economic, administrative and criminal legislation, which taking into account implementation of the international legal documents in co-operating with other normatively legal orders creates the providing mechanism of observance of legal norms which regulate public relations in this sphere and protect them from the unlawful influencing.

The main legal basic of aviation tools function is the main law of the state – Constitution of Ukraine. Also the direct regulation of the aviation transport exploitation does such legal norms as Air Code of Ukraine, Ukrainian Law about Transport, about Cargo Transit, about Transport of Unsafe Cargo, about Function of the All Transport System of Ukraine in a s Special Period and others. There are also normative legal acts which were adopted by the Ukrainian Government, such as resolution of the Cabinet of Ministers of Ukraine about confirming of the regulation of the Ukrainian air use (29 of March 2002 year) and also such normative legal acts as regulation of the Ukrainian Ministry of Transport about Confirming Rules of the Cargo Air Transportation (14 of October 2003 year # 793) and others. This legal normative acts adopts according under the international legal documents in the sphere of the air transport which Ukraine connected to or ratified.

Analyzing the articles of the Ukrainian Code of the Administrative Offences, which realize safe and protect function of the norm activity of air transport, it is very important to notice that

construction of the administrative offence (misconduct) which have this norms are more then articles in this Code. From my point and view this is not enough. There are such articles of UCoAO as: 111 – breaking rules of flight safety, 112 – breaking rules of behavior in an airplane, 113 – breaking rules of fire safety in the railway, sea, river and air transport, 133 – breaking rule of transporting unsafe liquid and luggage, big size and heavy cargo on the transport, 137 – breaking rules which are devoted to protect cargo on the air transport. According to the analyze of the construction of this administrative offences, which can be done in the sphere of air transport use, this articles have a forming of reference disposition. UCoAO in its norms does not take into account rules, which describes the mechanism of the passenger safety, safety of their baggage, hand baggage and cargo, to adhere the rules which regulates normal use of the aviation techniques and equipment. This rule are written in the other normative legal acts and usage of this norms by the organs of administrative competence or an official man must take them into account for the right qualification of the done act.

The vital activity of the society and state doesn't stand in the one place, they are always in moving, they need to change. The regulation improvement in the sphere of social relations which connected with air transport use at all and a part of it which need to use protecting methods of legal administrative compulsion are in the moving too. So, taking into account this problem it is very important to say that the new norms of the UCoAM extending the social relations in the sphere of air transport use, which are need to protect. The developer of this project gives into account 23 or 25 articles, which are need to ratify for the future protection and safety of the social relation from the unlawful acting.

References

1. Кодекс України про адміністративні правопорушення / Упоряд. М.Хавронюк. К.; Атака,-2004.-240 с.

2. Проект Адміністративно деліктного кодексу України. / Д.М. Лук'янец Інститут адміністративної відповідальності; проблеми розвитку. Монографія. –К. Ін-т держави і права ім. В.М.Корецького НАН України, 2001. – 220с.

3. Адміністративне судочинство в Україні; Книга друга. Кодекс України про адміністративні проступки, (проект) (серія „Реформи судів України"). – Харків;Консул, 2003.-332 с.

4. Проект Кодексу України про адміністративні проступки. ВР Україні 2003 рік.- 268 с.

5. Науковий коментар Кримінального кодексу України / Проф.. Коржанский М.Й. – К.; Атака, Академія, Ельга-Н, 2001. – 656 с.

6. *Рабінович П.М.* Основи загальної теорії права та держави. Вид. 2-е зі змінами та доповненнями. – К., 1994. – 236с.

7. *Скакун О.Ф.* Теорія держави і права. Підручник. – Харків, Консум, 2001. – 656с.

8. *Колпаков В.К., Кузьменко О.В.* Адміністративне право України. Підручник. – К.: Юрінком Інтер, 2003. – 544с.

9. Транспортне право України. Навч. посібник / *Демський Е.Ф., Гижевський В.К., Демський С.Е., Мілашевич А.В.,* За заг. ред. *В.Г. Гижевського, Е.Ф. Демського* – К., Юрінком Інтер, 2002. – 416с.

10. Про транспорт. Закон України від 10 листопада1994 р. //Відомості Верховної Ради України. -1994.-№51.-Ст.446.

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PROBLEM OF LEGAL STATUS OF AIRPORT AS AIRLINE

This article investigates the legal nature and essence of the notion of airline from the positions of national legislation. The special attention is paid to illumination of the problem of the legal status of airport as a subject of ménage and disadvantages of transport legislation related to the definition of such status.

In connection with of Ukraine's transition to the market system of economy, changed in a root and the system of the legal adjusting of subjects of ménage, as at the planned system and state control almost on all levels of major industries of production there were not the special problems from a legal settlement in a that or other sphere. However, to date there are problems deterring of the legal status of certain subjects of ménage, which in turn cases difficulties in resolving of their relations.

In particular, this sphere is the aviation industry, because the legal status of airlines is not clearly prescribed in national legislation. But it had to be clearly specified in the Air Code of Ukraine, fundamental codified act, which regulates activity of the civil aviation. To problems of shortfalls in aviation dedicated many works of scholars such as Zhuk L.A., Klepikovoi O.V., Myronec O.M., Filippova A.V and others.

The purpose of this article is defined of the airport as an enterprise. Since the opinion of some scholars that is some technical appendix to airlines – is mistaken. Determination of the airport as independent enterprise, will establish it place in the system of management of air transport.

According to p.1 article 62 of the Economic Code of Ukraine an enterprise is an independent subject of ménage, created by the competent public authority or organ of local self-government, or other entities for satisfaction of social and personal needs through the systematic implementation of manufacturing, research, other economic activity in the manner required by this Code and other laws[1]. Civil Code of Ukraine, in turn, gives the notion of legal entity, namely the legal entity is an organization, established and registered in accordance with law [2].

Based on the above positions, paying attention to the notion of enterprises in the aviation sphere.

The airline – it either airline enterprise, which offers or operates air [3].

We consider that operation of air traffic is nothing more than something of the use of air transport aircraft, i.e. with its operation.

Article 59 of the Air Code indicates that an air carrier is recognised by any legal or physical person, who performs air travel operator, has the right of aircraft operator [4].

Thus we can conclude that airlines are the kind of enterprises, which provide certain services in an aviation sphere, and therefore is usually the legal entity.

Arguable, airlines are not only certain legal entities, and are integral part of all aviation. Thus, under article 32 of the Law of Ukraine "On Transport" to the aviation includes air transport, transporting passengers, cargo, baggage, mail, aerial photography, agricultural work, as well as airports, air fields, flying clubs, vehicles, air traffic control systems, educational institutes, civil aviation repair plants and other enterprises, institutions and organizations irrespective of ownership, providing air traffic operation [5].

Under paragraph 1.5 of the "Rules of operator permits departing from airports of Ukraine and arriving to airports of Ukraine" airport is an enterprise, that provides services in handling of passengers, cargo, baggage, mail, flights and provides aircraft maintenance and incorporates and uses Data needs for airfield, air terminal and other ground facilities, adequate equipment and traned personnel [6].

According to paragraph 1.6 of the Rules of Certification of Airports ratified by the Ministry of Transport of Ukraine on 05. 07. 2004 № 569 air-port – the enterprise, that receives and departure

of aircraft passengers, baggage, cargo and mail, aircraft maintenance and flights crews, which has for this airfield, air terminal and other ground facilities and necessary structure, equipment, aviation personnel and other workers[7].

Unfortunately the Air Code of Ukraine is does not define airport, but it would be appropriate, because it had to define the notion of airport, thereby determine its legal status. In the Air Code in article 42 fact that the airport has the status of enterprise legal person stated a little bit not directly, namely airport, including a joint venture with a foreign state enterprise, which owned by foreign investor, must be certificated and registered in accordance with existing rules of Ukraine [4].

Kozyreva V.P. considers that today for the majority of Ukrainian civil aviation entities characteristic is more or less the same range of problems, namely:

- changing economic environment in which they exist;
- loss of traditional markets in the sphere of air transportations and producing of own products;
- cessation of business, commercial relations with partners ;
- wear of aviation fleet and technical equipment of airports;
- changing of the planning system and, as a result a violation of rhythm of production activities;
- decline in economic activity in the use of airspace;
- instability of the legal field [8].

On the instability of the legal field, this problem is very acute today, as characterized by the absence of the appropriate legal documents to regulate economic activity of airports and fixing them to the status as subject of menage as legal entities.

The same opinion adheres and the president of the Association "Airports of Ukraine" who believes that an important issue that must be decided for airports is legislature. Today, airports need stable state support to improve the legal framework that defines the functions of airports and their relations with public authorities and organs of local self-government, airlines and other enterprises, including the Law of Ukraine «On Airport» [9].

Interesting is thought of Klepikovoi O.V. who thinks that Air Code of Ukraine adopted in 1993, and recently significant transformations took place to the system of national economy of Ukraine, formed the legal base of settlement of economic activity the issue of the need for amendments to this normative act [10].

Myronec O.M. notes that expedient and obligatory bringing of additions in the existing Air Code of Ukraine in sections "Air Transportation" and "Responsibility for violation of the legislation which regulates the use of Air Code of Ukraine". In the current Air Code a legislator did not pay sufficient attention to the construction and display of definitions [11].

Filippov A.V. indicates the on advantages of the draft of Air Code of Ukraine, which are:

Indentify a large number of terms used in Air Code of Ukraine;

detailed regulation of legal status, functions and powers of separate individual organs; definition of acts of illegal interference and their list [12].

We note that the draft of Law of Ukraine "On Airports" as opposed to the Air Code of Ukraine gives the concrete definition of the notion of airports and terms associated with them, namely in article 1 of this draft states, that the airport is a complex, that includes the air field, air terminal complex and other buildings and equipments, engineering's, technological, official and cultural and domestic buildings, objects of infrastructures, intended for acceptance and sending of aircrafts, surface maintenance of aircrafts, passengers, crews, baggage, mail, cargo, airport, air traffic service. Airport may include in its territory objects of the unified system of air traffic, meteorological support, heliports and heliports platforms, access roads to the diversion of stripes, objects of social sphere and other buildings and objects [13].

In the position of this bill, in article 2, stated the tasks of legislation, governing activity of airports are: definition of legal status and providing of the legal adjusting of airports functioning, satisfaction of needs of economy and citizens, in providing services, connected with providing transportation of passengers, baggage, cargo, providing of national security and safety of use of aviation transport is inherently contradictory because if the airport will be defined as a legal entity, which is about the legal status of the airport under the law we can speak.

Conclusions: Thus, even the draft of Law of Ukraine "On Airports" contains a number of shortcomings and that is why the problem of the legal status of airports is still unsolved. We therefore propose to bring changes to the Air Code of Ukraine on a priority basis because the definition of the legal status of airports in this codified act is required.

It must be clearly define what constitutes the airport as an object or subject of legal relations, i.e., make appropriate changes to the Law "On Airport". The airline is either airline enterprise, which offers or operates the air. From this it can be seen as an independent subject of menage that provides specific services in the aviation sphere. It is possible to assert that airlines are not only certain legal entities, and are part of the entire aviation sector. The notion airport is used in double meaning – as object and as subject of legal relations. In this is the problem of the legal status of airports because the double meaning of airport will cause the number of problems in dealing with certain issues not only organizational, but also highly practical value, for example in disputes of the compensation of persons damage and others.

References

1. Economic Code of Ukraine (Information of Supreme Soviet of Ukraine (VVR), 2003, N 18, N 19-20, N 21-22, p.144.

2. Civil code of Ukraine (Information of Supreme Soviet of Ukraine (VVR), 2003,N40-44, p.1. article 80, p. 356.

3. A decision of the Cabinet of Ministers of Ukraine "On approval of the provisional rules of control to ensure the safety of civil aviation" on 2 Augusts, 1995 N 592 Kyiv.— http://www. verhovna rada. gov.uà

4. Air Code of Ukraine (Information of VVR), 1993, N 25, art.274, p. 42.

5. Law of Ukraine "On Transport" (Information (VVR), 1994, N 51, p.446

6. Rule grant of operator permits on departing from airports of Ukraine and arriving to airports of Ukraine .— http://www. verhovna rada.gov.ua

7. Rule Certifications of Airports ratified by order the of Ministry of Transport of Ukraine on 05. 07. 2004 № 569 http://www.ukraviatrans.gov.ua

8. *Kozyreva V.P.* Principles of the legal adjusting of insolvency and bankruptcy of air and space right : Legal announcer. Scientific labours of NAU.-Ê.: Publishing house of the National Aviation University. "NAU is a seal", 2008.- 78p., P. 34.

9. Appearance of the president of association "Airports of Ukraine" on a seminar "Air-ports 21–st century" from Octobers, 23, 2007. —http://www.ukraviatrans.gov.ua

10. *Klepikova O.V.* Ways of perfection of a transport legislation in the context of illumination of suggestions in relation to the necessity of making alteration and adding to Air Code of Ukraine. Legal announcer. Air and space right: scientific labours of NAU ¹1 (6).— K: A publishing house NAU "NAU is a seal", 2008.- 76 p.., P. 13.

11. *Mironec' O.M.* Expedience of bringing of adding to Air Code of Ukraine the Air and space right : Legal announcer. Scientific labours of NAU.-Ê.: Publishing house of the National Aviation University. "NAU is a seal", 2007.- 74p., P. 41.

12. *Filippov A.V.* Problem of safety of civil aviation: a comparative analysis of operating of Air Code of Ukraine and draft of Air Code of Ukraine is the Legal announcer. Air and space right: scientific labours of NAU ¹1 (6).—K: A publishing house NAU "NAU is a seal", 2008.-78 p., P.12.

13. Draft of Law of Ukraine "On Airports of Ukraine" .— http://www.ukraviatrans.gov.ua.

UDC 342

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INFORMATION SECURITY IN THE MODERN WORLD AS THE OBJECT LAW OBJECT OF PUBLIC ADMINISTRATION (METHODOLOGICAL ASPECT)

Abstract. In this publication are offered for consideration of issues and methodological aspects of information security in the modern world as an object as the object of law and public administration (for example the theory and practice in Ukraine).

Security rights, society, state, international community in cyberspace, is an important methodological category that ekstrapolyuyetsya of practice in science of public administration, law and others, in particular, as an object of public relations.

The concept of information security requires a unique definition as in the theory of international level and within each country and be enshrined in relevant international legal instruments and domestic legislation. Conducted using computer data-processing system of the Library databases and knowledge of State and Law "research showed that legal acts the Development of the definition of security goes to the health, capacity, properties, complex events, complex organizational and technical measures, working conditions, absence of unacceptable risk, the absence of any risk factors together, the state process, the aggregate valuation of properties, the complex characteristics of areas of life (human, society, state, international community) and so on. First of all invited to consider a few examples of wording key concept of "security" in legal acts:

- Security (Aviation Security) - a set of measures to protect civil aviation against acts of unlawful interference, and other unlawful acts, as well as human and material resources assigned to perform these activities. (Cabinet of Ministers of Ukraine "On approval of the provisional rules of control to ensure the safety of civil aviation (from 02.08.1995, number 592).

- Maritime - measures and human and material resources intended to protect civil aviation against acts of unlawful interference in its activities. (Ministry of Transport of Ukraine Order "On approval of guidelines for the formation rates of airport charges for maintenance of the aircraft and passengers at airports in Ukraine" (from 01.07.2003roku, № 472).

- Security - measures and human and material resources intended for protection against acts of unlawful interference and other unlawful acts against civil aviation. (Agreement between Ukraine and the Government of the Republic of Azerbaijan on cooperation in aviation security, signed by the Cabinet of Ministers of Ukraine of 22.12.1995).

- Security - measures and human and material resources intended to protect civil aviation against acts of unlawful interference and other unlawful acts. (Order Ukraviatrans, MIA of Ukraine "On approval of support in areas controlled airline passengers and material values" (from 11.06.1996roku, № 168/397. Joined: Ministry of Justice of Ukraine on 28.06.1996 № 334/1359).

- Safety (people, material objects, environment) - no unacceptable risk with the possibility of causing any harm, subject to security requirements. (Order of Ministry of Transport of Ukraine "On approval of the organization and implementation of demonstration flights" (the year of 08.04.2003, № 269. Joined: Ministry of Justice of Ukraine on 12.06.2003 № 479/7800).

- Flight safety - a comprehensive description of air transport and aerial work, which determines the ability to operate without threat to life and health. (Ministry of Transport of Ukraine Order "On approval of Instruction on the verification of financial and economic capabilities of the operator norms and rules on aviation safety" (from 08.02.1999 year, № 67. Joined: Ministry of Justice of Ukraine on 08.07.1999 № 448/3741 . expired).

- Security - no unacceptable risk tasks with the possibility of any damage to life, health and property of citizens, as well as for the environment. (Order Gosstroya Ukraine, Gosnadzorohrantruda "On measures to implement the Cabinet of Ministers of Ukraine

05.05.1797roku, N 409" On the reliability and safe operation of buildings, facilities and utilities "(from 27.11.1997roku, № 32/288. Joined: Ministry of Justice of Ukraine on 06.07.1998 № 423/2863).

- Safety - working conditions in which the possible effects on workers of dangerous and harmful production factors. (GOST 12.0.002-80). Guidelines for the certification of jobs for working conditions. Approved by the Ministry of Ukraine (from 01.09.1992roku, № 41);
- Security products - the absence of any risk to life, health, property, consumer and environmental conditions of normal use, storage, transportation, manufacturing and recycling products. (Law of Ukraine "On protection of consumers" (of 12.05.1991 № 1023-XII).

- Security services - complex properties of services (process) in which it influenced by internal and external hazardous (harmful) effect of factors makes the consumer, without compromising his life, health, property. (Rules for mandatory certification of food services. Approved Standard of Ukraine (from 27.01.1999roku, № 37. Registered: Justice of Ukraine, 15.04.1999r. Under № 235/3528).

- A safety of nuclear power plants (AU) - AU property under normal operation, violation of normal operation, emergencies and accidents to limit the radiation impact on personnel, population and environment set limits. Safety AS includes the notion of radiation and nuclear safety. (GA Nuclear Regulatory Order "approving terms of security of nuclear plants (from 09.12.1999roku, № 63. Joined: Justice of Ukraine, was on 06.03.2000 № 132/4353, expired).

- Security for Emergency Preparedness - state security people, objects environment from the dangers of emergency. (Gospvodhoza Order "On approval of a routine preventive maintenance reclamation systems and facilities (from the year 01.10.1999, № 151. Joined: Ministry of Justice of Ukraine on 12.04.2000 № 225/4446).

- A safety of trains - the complex organizational and technical measures for the safety work and ongoing maintenance in good repair rail facilities, roads, rolling stock, equipment, tools and devices. (Law of Ukraine "On Railway Transport" (from 04.07.1996, № 273/96-VR).

- Government or special security communication (communication system) state of communication (communication system), which provided for preventing possible leakage of information transferred in a system of communication (violation modes of communication). (Order Security Service of Ukraine "On approval Coll information that constitutes state secrets from 12.08.2005 № 440 Joined: Ministry of Justice of Ukraine on 17.08.2005 № 902/11182.

As a category of interest, information security securing the country found in Article 17 of the Constitution of Ukraine, where among other things stated in its most important asset of state functions, and cause all the Ukrainian people. Further constitutional provisions in the legislation of Ukraine formulation of information security is given as:

- State of information security environment of a society that provides its formation, the use and development in the interests of citizens, organizations, states (in the Agreement on free access and order an open exchange of scientific and technical information states - members of CIS, the year of 11/09/1998).

- An integral part of political, economic, defense and other components of national security, its objects are information resources, channels of information exchange and telecommunications, the mechanisms of operation of telecommunications systems and networks and other elements of information infrastructure (Concept of the National Informatization Program: Law Ukraine, from February 4, 1998, N 75/98-VR).

- The ability of telecommunication networks to provide protection from destruction, distortion, blocking information, its unauthorized diversion or violation of its established order routing (on Telecommunications: Law of Ukraine of 18.11.2003, № 1280-IV).

- State protection of vital interests of human society and the state in which damage is prevented by: incompleteness, nevchasnist nevirohidnist and information available, the negative information effect, the negative effects of information technology, unauthorized distribution, use and violations of integrity, confidentiality and availability information. (Basic Information Society Development in Ukraine 2007-2015: The Law of Ukraine of 09.01.2007, N 537-V. Section 13.

The Law of Ukraine "On the basis of national security of Ukraine" dated 19 June 2003, N 964-IV) formulation of information security as a component of national security is not, although it identified some important factors (in particular in Article 7, including threats to national interests and local security of Ukraine, the information field).

According to the Law of Ukraine defined national security case.

National security - protection of vital interests and rights of the citizen, society and state, which provided for the sustainable development of society, early detection, prevention and neutralization of real and potential threats to national interests.

According to the study mentioned formulation kalkuyetsya content not in other legal acts. And this is understandable, because it does not meet the needs of practice. First of all because a one-sided orientation - only security, thus remain outside the definition of other aspects of security: guaranteed, support, defense, security and so on.

As general conclusions are offered.

In theory of law and public administration theory is the doctrine that the objects of their social relations, not state, capacity, security, properties, factors, processes, signs and so on. Everything else can be the subject of legal or defining object.

At the methodological level, as universal, is proposed definition of information security, which also proposed the Law of Ukraine "On the Fundamentals of National Security of Ukraine" and according to his interpretation of the definition of information security in the future draft Code of Ukraine on information and determination of its legal varieties in international legal acts.

Information security - a public relations, defined conditions, capacity, properties, complex traits, organizational, technical and other methods, activities, facilities, absence of unacceptable risk, the set of factors, processes, valuation of properties in the information sphere of human life, society, state, international community.

Private review scientific aspects of information security software industry, making threats in cyberspace, disclosed in several publications, including those that are presented below in the references.

References

1. *Gurkovskyy V.I.* Information Security in Ukraine as part of national security / / Coll. Science. UADU Ave. - K.: Type of UADU. - 2002. - Vyp.2. - S. 9-18.

2. *Gurkovskyy V.I.* The role and place of the principles of international law in the sphere of information security / Bulletin UADU. - 2003. - № 1. - S. 496-501.

3. *Gurkovskyy V.I.* Implementation of an effective legal mechanism of interaction between state authorities as a basis for effective public management of national information security / NAPA Bulletin. - 2003. - № 3. - S. 87-93.

4. *Gurkovskyy V.I.* Safety as an object relations in public administration / / Features of the rule of law in terms of intensification of European integration processes: problems of theory and practice: Materials of All-Ukrainian scientific conference, Kyiv, NAU, February 18, 2010 - K.: University of Ukraine " , 2010. - S. 38.

4. *Tsymbalyuk V.S.* Defining information security as a component of aviation security (organizational and legal aspects) / / Features of the rule of law in terms of intensification of integration processes: problems of theory and practice: Materials of All-Ukrainian scientific conference, Kyiv, NAU, February 18, 2010 - K.: University of Ukraine, 2010. - P.101.

5. *Tsymbalyuk V.S.* Information Law: methodology theory and practice. - K.: "Education of Ukraine, 2010. - 388s.

6.Systema (Library) databases and knowledge of state and law [electronic resource on DVD] periodical. - K.: Research Center of Legal Information of the Academy of Sciences of Ukraine. 2010, January 12.

7. Інформаційна безпека: проблеми боротьби зі злочинами у сфері використання комп'ютерних технологій. Монографія */В.О.Голубєв, В.Д.Гавловський, В.С.Цимбалюк* За заг.ред.д.ю.н. Р.А.Калюжного. –Запоріжжя: "Просвіта". 2001. –252с.

8. Е-майбутнє та інформаційне право /*В.М.Брижко, В.С.Цимбалюк, М.Я.Швець, М.В.Коваль, Ю.В.Базанов* /За ред.. М.Швеця. – К.:НДЦПІ АПрН України. 2006. –234с.

9. Е-боротьба в інформаційних війнах та інформаційне право /*В.М.Брижко, М.Я.Швець В.С.Цимбалюк* /За ред.. М.Швеця. – К.:НДЦПІ АПрН України. 2007. –234с.

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OBJECT AND ARTICLE OF INFORMATION LAW: THE PROBLEMS OF DEFINITION AND SIGNIFICANCE OF THEM IN THE FIELD OF CIVIL AVIATION

In the article bring up problems of the methodological providing of information law and its significance in providing of safety of civil aviation.

Today is going on formation of information law, its dynamic development due to development of respective public relations which are subject the legal adjustment. Problems, related to forming of information law, cause the wide personal interest of scientists. In fact forming of public informative policy as leading factor of modernization processes of state administration, in particular in the field of civil aviation, requires the definition of methodological principles of scientific researches in the respective sphere.

The information law constituent is widely presented in the Constitution of Ukraine. This sphere is touching by the article 3, 10, 11, 15, 17 and much other. Accordingly there is a necessity in scientific researches on questions of information law which is important constituent in government regulation of public relations.

The principal law in the information field is the Law of Ukraine "On information" on 02.10.1992. Age of this law is already rather considerable in comparison with the rapid development of present-day information technologies, which encourages scientists to researches aimed at the codification of information legislation.

To determine features of information relations, need to answer the question, what is common for information law, and what combines public relations, regulated by the norms of this law into a single complex? Of course, information and information objects – compound objects, which shows specificity in the realization of rights, execution of duties and bearing liability arising from them in the information sphere. Uniformity and feature of information relations are determined by singularities and legal properties of these objects in connection with which information relations appears. These objects include information and information technology, means of communication and telecommunication.

In particular, importance should also address such issues as the place of information law in the system of the traditional branches of law. This problem can be solved with the definition of object and article of information law.

The goal — the problem of determining the object and article of information law, and the notion and species of information as an object of information law, and their reflection in the field of civil aviation security.

In preparing this work were used achievements of leading modern domestic theorists, namely: V.S. Tsymbalyuk, V.D. Havlovskiy, V.V. Gritsenko, G.V. Vinogradova and other articles on the Internet.

Based on theses of the traditional approach to the marking out certain branches of law, considered that the criterion of forming the branch of law is article and method of legal regulation. According to O.F. Skakun, “Division of the law to the branches is based on certain criteria. These criteria are article (a material criterion) and method (legal criterion) of law regulation”. “Branch of law is a relatively independent set of legal rules governing qualitatively homogeneous sphere (family) of public relations by specific method of law regulation”.

However, if the relations concerning information are an article of information law, then what is the information for it?

To resolve this and many other theoretical problems, some scientists suggest using the so-called system approach. In our opinion this approach can be used very successfully for resolving of

the problem of this research work. Proceeding from theses of system approach, it is proposed when considering branches of law use the following terminology, especially considering information law.

Object of legal regulation — separate sphere of public relations that have a common quality.

For example, the object of environmental law is separate group of public relations on rational use of natural resources and environmental protection; object of agricultural law consists of public relations for the organization and activities of farmers, land law — public relations for the rational use and protection of land; administrative law — administrative relations, labor law — labor relations and so on. Note that each branch of law has its own relatively separate sphere of regulation.

The article of legal regulation is activities, where certain branch of law provides legal regulation.

It should be noted that the existence of these approaches should be considered by all scholars in their writings, and in any scientific debate, oral or written, because violation of this requirements is a violation of one of the basic laws of formal logic — the law of identity. Based on these considerations, is considered appropriate to achieve unity among scientists, as a result of any debate should be achievement and understanding in order to make it possible to solve common and urgent problems jointly, otherwise debate turns into mindless chatter.

V.A. Kopylov distinguishes the following features of informational relations: arise, develop and terminate in connection with the information; define state policy regarding the observance and protection of human rights concerning information; reflect peculiarity of the using of public law and civil (private) law methods of legal regulation.

Circulation of the information in society provides grounds for the illation that a new type of social relationships appear — information relationships, which are subject of legal regulation. Accumulation same legislation in this area is the basis for decisions on the separation of the new branch of law.

The object of information law is public information relations — relations that arise in the manifestation of activities designed to meet the information needs of citizens, juridical persons and state.

The object of information law is social relations concerning information (data, knowledge, and signals), obtaining technology, distribution and storage in all areas of people vital activity, vital activity of their communities, society, state, international community.

The leading article of public information relations, is perspicuously information.

Direct articles are specific types and forms of information concerning specific information relations, information activities etc.

Information is documented or publicly announced data about events and phenomena that occur in society, country and environment.

Based on these considerations and traditional approach to the marking out certain branches of law, formulates the following definition of information law:

Information Law is a complex branch of law that regulates the social relations concerning information (data, knowledge, and signals), obtaining technology, distribution and storage in all areas of people vital activity, vital activity of their communities, society, state, international community.

Obviously, information relations in civil aviation sphere constitute significant component.

For example, an important role in ensuring the safety of civil aviation plays an exchange of information between the pilot and air traffic controllers, the use of advanced information technologies. Specifically, the Air Code of Ukraine included numerous articles related to information and its application in aviation, for example articles 7, 14, 55, 67, 71, 77, 82, and 99. Thus, Article 14 states that “aeronautical information for airspace of Ukraine is accessible to all users of the airspace of Ukraine”.

To ensure the implementation of this provision the Ministry of Transport of Ukraine has adopted rules of aeronautical information service approved by the Order № 564, 01.07.2004. Art. 55 Air Code establishes principles when performing radio operations. In pursuance of this article

also developed appropriate regulations under the law — Order of the Ministry of Transport of Ukraine "On approval of the aeronautical telecommunications in civil aviation of Ukraine from 23.09.2003 № 736.

In accordance with the Article 67 of the Air Code of Ukraine about the information and advertising providing of air shipments air carrier n the performance of regular transportations responsible to prove to the people (clients) by means of information and advertising routes and flight schedules of aircraft, passenger, freight and postal rates, and terms of service passengers and customers both on the ground before and after the flight and on board aircraft in flight.

Article 77 of the said Code about distress signal of aircraft and supply them to help provide say that for the early detection of aircraft that are affected or distressed and provide assistance to crews and passengers are set equal for all aircraft in Ukraine emergency distress signals and warning signals urgency and the danger.

The crew of an aircraft or experiencing distress should apply if possible appropriate distress signal via communication channels of the air traffic emergency frequency on established rules of radio.

While international flights signals are duplicated on the international distress frequency, selected to supply these signals.

There are many of such examples. They all demonstrate the unity of information rights and air rights, as standards of information law penetrate into air legislation. However, domestic scholars rightly suggest the need for a new Air Code, which would take into account changes in aviation that have occurred since the adoption of the current Code in connection with the development of technology and new international legislation for air transport sphere. In particular, develops information technology, and therefore complicated technical information relations in civil aviation. It requires attraction of sciences in the field of information law science to form and develop a new Air Code and further development of the information law science itself right now as an independent branch of law and direction of researches.

Development of information law science will lead the legal regulation of public relations concerning information which are now intensively developing in line with the times. But such development is impossible without development of consummate methodological basis of information law, which includes solving problems of its object and article of legal regulation of social relations.

According to O. Zolotar, "Private sector of the economy without introducing new information technologies is uncompetitive. So, especially in the field of civil aviation process of the informatization is much more intensive than in other spheres of social life. In this area of application of new technologies including information technology is objectively conditioned by necessity. Modern air transport system is multifunctional and dictates the pace of high technology and information processes. At the same time reliability and timeliness of information flows are an integral part of aviation security providing... ".

Based on the data sources examined, we see that researchers in the field of air law and information law reasonably suggest that scientific researches on the intersection of information law and air law are objectively determined by necessary, and solving of the theoretical problems of information law is necessary in addressing problems related to safety in civil aviation.

Conclusions

1. In scientific studies can be found different approaches to defining characteristics branch of information law as a compound complex branch of law, the issue of distinguishing between the object and article. Some of them based on the traditional conceptions about branch of law, some are innovatory. All of them certainly have a right to exist.

2. I consider it proper to comply with the view to which information law is a system that has its subject, object and article. It may allow providing further development of information legislation in line with the times. Such a view do not completely deprecate the classical approach to the selection of branches of law, but it improves when considering new information law as a complex area of law

3. It is worth mentioning that this problem still needs to be discussed in scientific circles as this direction of scientific research in the field of information law, as the branch of information law is very young, and yet little researched.

4. In any field of public relations there are essential component of information. And in the safety of civil aviation component of information law regulation, it plays a very major role. Therefore, as an important direction of research in the field of information law and improvement of legislation, has become a problem of legal regulation of information content of social relations in civil aviation.

5. Urgent need to accept the new Air Code and improve general aviation legislation requires engagement of scientists in the field of information law. Thus the emerging linkage areas of law, which in this case is very close.

References

1. Constitution of Ukraine: as amended by law number 2222-IV of 08.12.2004 — The Kyiv.: Veles, 2008. — 48 pp.

2. Law of Ukraine "On information" from 02.10.1992 № 2657-XII, as of 26.04.2010 p / Official Website of the Verkhovna Rada of Ukraine. — E-resource. — Mode of access: http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=2657-12.

3. Air Code of Ukraine. from 04.05.1993 № 3167-XII, as of 26.04.2010 p / Official Website of the Verkhovna Rada of Ukraine. — E-resource. — Mode of access: http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=3167-12.

4. Order of the Ministry of Transport of Ukraine "On approval of the aeronautical information service" from 01.07.2004 № 564 as of 26.04.2010 p /Official Website of the Verkhovna Rada of Ukraine. — E-resource. — Mode of access: http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=z0913-04.

5. Order of the Ministry of Transport of Ukraine "On approval of the aeronautical telecommunications in civil aviation of Ukraine" from 23.09.2003 № 736 / The Official Website of the Verkhovna Rada of Ukraine. — E-resource. — Mode of access: http://zakon.rada.gov.ua/cgi-bin/laws/main.cgi?nreg=z1001-03.

6. The problem of definition of object and subject of information law. E-resource. Official Website of the Ministry of Justice of Ukraine. — Mode of access: http://www.minjust.gov.ua/?do=dr&did = 7949 & sid = comments.

7. *Skakun O.* Theory of State and Law: Textbook. / Trans. from Rus. — Kharkov: Konsum, 2008. — 656pp.

8. *Tsymbalyuk V.S., Havlovskyy V.D., Gritsenko V.V.,* Principles of Information Law of Ukraine: Teach. posib. , Edited by. N. Y. Shvets, R. and P. Kalyuzhnyy Melnyk. — K.: Knowledge, 2004. — 274pp.

9. *Kopylov V.A.* newsletter right [text]: Tutorial / V.A. Kopylov. — Moscow: Yurist, 2002. — 512pp.

10. *Tsymbalyuk V.S.* Information Law: defining the nature and content of the complex field of law / legal science. — 2005. — № 2. — P. 5-14

11. *Vinogradov G.V.* Information Law of Ukraine: Teach. manual. — K.: AIDP, 2006. — 144 pp.

12. *Zolotar O.* Legal protection in civil aviation / Legal Informatics. — 2008. — № 2 (18) — P.42-51.

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ACTUAL PROBLEMS OF ADMINISTRATIVE-LEGAL REGULATION OF CORPORATIONS ACTIVITY IN UKRAINE

This article is devoted to individual problems of improving the administrative-legal regulation of corporations activity in Ukraine. Furthermore, the author tried to give a comparison of administrative-legal regulation of corporations in such foreign countries as: England, Japan and Germany.

Intensive development of market relations in the global economy in the mid-twentieth and early XXI centuries dramatically changed the nature of many large corporations around the world. Properties of corporate companies become more differentiated, in many of them large proportion of shareholders not exceed 10%. At this time practically formed class of professional managers and the shift to corporate management on a professional basis. Members of corporations competing with each other for the right to effectively manage corporations based on their experience, knowledge and abilities.

However, an at all positive trend it is still remains complicated and problematic issue of improvement of administrative-legal regulation of corporations activity in general. To further develop the corporate sector there is an urgent need for such regulation accent mainly on fundamentally new principles - purview, permissive, compared with commonly developed and established - imperative. This imperative purview and influence on corporate activities should be sufficient reasonably balanced. [1, p. 1919]

Existing domestic legislation that serves as the administrative-legal regulation of corporations activity, currently characterized by inconsistency, scattered and often to address only specific current problems. In addition to these problems on the efficiency of legal regulation of corporations activity affects another problem - the global economic crisis of the last time. The economic situation of many countries today can be compared to "big cleaning". It, like any state of purification, ultimately tends to accelerate the economic scale, particularly to natural selection in this sphere.

The world's airlines as a variety of corporate entities are an indicator of this kind of natural selection. Aviation industry, like all of today's economy remains in crisis, not like those who visited before. Before most air corporations a choice: - either adapt to new economic realities, or bunk. [2] Analysis of domestic airline market shows that the lion's share of air transport still accounted for the largest airlines of Ukraine, in particular: AC "Motor Sich", VOLARE Airlines, Lviv Airlines "," Nikolayev – AERO", AC "International Airlines Ukraine" "Aerosvit" Airlines and others.

Prospects for the development and strengthening of air transport market today, no doubt related to the consolidation of air corporations, their restructuring, alliances, enhancing their overall effectiveness and financial stability. In order to improve airport activity, enhance civilian traffic properties, creating proper conditions for building a national network of airport, core airports - hubs, with world practice of building air route networks ("star network"), should continue to manage the issue of optimal administrative-legal regulation of air transportation industry to create "rules of game" to ensure fair, formal and transparent conditions of access and work of air corporations in this market.

Today, work on creation of a new legal framework in air is four closely interrelated areas related to: licensing procedures for air transport, air transport market formation, allocation of slots at airports, to efficiently schedule of aircrafts. [3]

Urgent as at present is to introduce electronic settlements and electronic ticket processing. According to IATA resolution 722G, "electronic transportation documents - a way of documenting the sale and control of the passenger transportation (electronic ticket) and the related services

(documents) without processing of paper payment documents." The first electronic ticket concept design was developed for use on domestic flights in the U.S. in 1984 In 1990 airlines «United Airlines» make a first electronic ticket, and now it is over 90% of transportation carries only through electronic documents. Roughly the same percentage use this form to airlines «Delta», and «US Airways» sells 94% of traffic using the electronic form. [4]

Increasing role of the private sector, the world globalization and changing conditions of competition leads to the need for radical reform aviation industry, which is one of the pressing issues in today's business world. To do this, Ukraine will not need to invent a bicycle, and the experience of other countries to develop its own strategy targeting the domestic aviation industry in the fast track of development. This is part of world experience improvement model of administrative-legal regulation of this important sector. In particular, in international practice can be identified today three major models that characterize the specific administrative-legal regulation of corporations activity: Anglo-American, Japanese and German.

Summary Concerning the contents.

Anglo-American model is characterized by individual and institutional investors, neafiliyovanyh (i.e. those which are not connected) with the corporation (so-called external shareholders or outsiders), a well-developed legislation that defines the rights and duties of the three key stakeholders - managers, directors and shareholders and relatively simple mechanism of interaction between shareholders and between shareholders and the corporation as at the annual general meeting, and between them. [5, p. 670] In addition to managers, directors, shareholders, members of corporate relations of this model is also government agencies, stock exchanges, consulting firms that advise corporations and shareholders on governance and proxy voting. Anglo-American model allows the distribution of ownership and control over the activities of managers in corporations, as investors who invest their own money and now, are not legally liable for the actions of corporation. Council of directors in Anglo-American model is composed of insiders (people who work in community or closely associated with management company) and outsiders (individuals or institutions that are not directly related to the company and its management). [6, p. 174] Some positive and negative aspects of Anglo-American model of administrative-legal regulation of corporations activity is illustrated with the following table:

Table 1. **Anglo-American model**

Positive sides	Negative sides
1. Based on significant fragmentation of equity	1. Weak participation of banks in corporate relations
2. Relations between the shareholders and the corporation is well defined at the level of legislation	2. Conflicts of interests of individual investors seeking high profits
3. Developed a clear legal framework	3. Differences between different groups of investors, including state and foreign

The main signs of the **Japanese model** are uniting business from individual companies in the groups, which includes a high concentration of ownership in the hands of medium and large investors with their cross-ownership companies participating groups. The main source of financing groups has their own bank that concentrates in the savings deposit form and reduces the impact of the stock market. Management system aimed at social cohesion of all participants in corporate relations and is the principle of "equal terms". Illustrate the positive and negative aspects of Japanese models by following table:

Table 2. **Japanese model**

Positive sides	Negative sides
1. Banks are key stakeholders and develop strong relationships with corporations (in the Anglo-American model of such relationships are prohibited by antitrust legislation).	1. Support continuous business contacts important to members of "keyretsu" more than profit, and margin is less than the potential
2. Significant investment in human capital and technology	2. Lack of transparency about the activities of corporations
3. Key role in Japanese corporate governance model plays the government's economic policy, which is designed to help Japanese corporations and official and unofficial means government representation on the board of corporations.	3. Poor protection of minority shareholders and lack of attention to issues of corporate profits

German model differs significantly from the Anglo-American and Japanese, though seen some resemblance to the Japanese model. Banks are long-term shareholders of German corporations, and, like the Japanese model, bank representatives are elected to the Council of directors.

German model is characterized by the concentration of ownership in the hands of medium and large shareholders with considerable cross their possession. Enough big is the impact of banking groups. In particular the financing banking sector more than the stock market. At the same time the cost of raising capital is very low compared to the Anglo-American model. The system of governance is a two-tier, which includes distinguishing features of the supervisory board and management. Undoubtedly relations in corporations are more like partnerships and the interaction of a wide range of participants.

German model has two unique signs that distinguish it from other models:

1. Bicameral management which consisting of executive (corporate officials) and supervisory (workers, employees of the company and shareholders) councils;

2. Permissible restrictions on voting rights of shareholders - Charter of company limits the number of votes that a shareholder has in the assembly, which may not coincide with the number of shares he owns.

Most German corporations traditionally prefer a bank rather than equity financing because the stock market capitalization is small compared to the capacity of the German economy. The percentage of individual shareholders - low, reflecting the conservatism of investment policy. The structure of corporate governance focused on maintaining contact between the main corporate members - banks and corporations. Key members of the German model of corporate relations for banks and corporate shareholders. As the Japanese model, the bank is also a shareholder and creditor, issuer of securities and debt obligations and the depositary agent, which voted at the annual general meeting.

In our view, the main differences from the Japanese model of German and Anglo-American, are: a) the legal establishing of number of members of the supervisory board, which is permanent, b) mandatory membership in the supervisory board representatives of the employees c) to the supervisory Council insiders are not included, but this does not mean its stock is only outsiders. Illustrate the positive and negative sides of the German model by the following table:

Table 3. **German model**

Positive sides	Negative sides
1. Stimulation of small businesses	1. Despite the fact that at the legislative level, much attention is paid to minority shareholders, in fact the realization of their rights (especially voting rights and information) rather difficult.
2. Paying great attention to social orientation of the market	2. Despite the fact that most German shares issued to bearer, small shareholders prefer the intermediary services of banks during the vote, which creates additional grounds for conflict situations.
3. The existence of an extensive system of social benefits to participants of corporate relations	

Concluding the review of these basic models, it should be emphasized that none of them has a clear advantage - as each has its advantages and disadvantages. Therefore, when determining the priorities of national development model can hardly do without the sort of "mixing" of positive traits and characteristics of individual models.

Studies show that in Ukraine formed mixed with tangible signs outsider model of administrative-legal regulation of corporations activity, which today requires a corresponding analysis of diverse positive and negative sides.

Conclusions. Anglo-American, German and Japanese models of administrative-legal regulation of corporations activity are built differently, but each of them has proved its effectiveness. Modern trends of globalization formation economies impose new requirements to develop a model of administrative-legal regulation of economic processes of various subjects, including of corporations.

Important is the fact that Ukraine, which long had corporate governance, extremely important is to create the corporate model, which should not completely copy the model in other countries and take into account the positive aspects of their activities and reflect the socio-economic characteristics of our society. In our opinion, such system should be formed according to European traditions and reflect the positive experience gained by leading models of administrative-legal regulation of corporate activity.

References

1. *Ivashchenko O.M.* Administrative-legal regulation of corporate rights of the state: ABSTRACT. Thesis. for a science. degree candidate. Legal. Science: Spec. 12.00.07 "administrative right and procedure, financial right, information right" / O.M. Ivashchenko. - K., 2003. - 19 p.

2. Interview of Chairman of State Aviation Administration David A. [electronic resource] / access mode: http://www.wing.com.ua

3. On approval of the registration of civil aviation Ships in Ukraine: Order from 31.01.2006 № 67 / / State Service of Ukraine for Aviation Safety

4. The concept of a State program for airport development to 2020: Decree of the Cabinet of Ministers of Ukraine on March 5, 2008 № 506-p

5. Privatization, investment and stock market: Legal principles and practice / by common. edit. *S.O. Dovgogo* and *V.M. Lytvyn.* - V.1. - K.: Board, 2001. - 720 p.

6. *Vinogradsky M.D., Nashynets- Naumova A.Y.* Development of models of corporate governance / / Actual problems of economy. - 2006. - № 8 (62). - P. 172-177

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AN EVOLUTION OF THE LEGISLATIVE REGULATION OF SPHERE OF LEVY OF TAXES (OBLIGATORY PAYMENTS) IN UKRAINE

Assertion and providing human rights and freedoms the Ukrainian state proclaimed in 1996 as the main duty, fixing this position in the article 3 Constitutions of Ukraine. In accordance with the noted article human rights and freedoms and their guarantees are determined by maintenance and orientation activity of the state for which the last answers before a man.

In relation to a tax sphere, where the article of consideration from point of rights of personality it is been, foremost, as rights legal interests of taxpayer, in literature the mechanism of providing is formulated right legal interests of taxpayer. This mechanism is examined as a system of terms, facilities, methods and methods which provide realization of subjective possibilities of taxpayer in relation to application of protective, protective and restoration measures the organs of government tax service, by their public and official servants in relation to the broken rights and legal interests of taxpayer by application of financial and judicial norms.

Such mechanism contains: a) guarantees of realization of equitable rights and legal interests of taxpayers; b) system of organs of government tax service, their public and official servants; c) legal elements of mechanism of realization right legal interests of payers of tax; d) a process of practical embodiment of possibilities and necessities is in public relations, which arise up, develop and halted in the field of taxation; e) terms and factors which are instrumental in functioning of such process. Right basis of mechanism of providing and legal interests of taxpayers there are administratively-legal facilities among which one of leading places occupies proper normatively legal base. Whether legislative activity of the state in the field of collection of taxes answers to the proclaimed sending to providing of rights for personality in this sphere. Forming of legislative base in relation to the levy of taxes in Ukraine passed certain historical development.

One of the legislative steps in determination of organization and activity of public tax organs of Ukraine was become by passing an Act of Ukrainian SSR „About government tax service in Ukrainian SSR" from Decembers, 4 of 1990p., what brought in the row of innovations. At first, were borne change status of tax organs. In accordance with the article 1 under the name „Structure of government tax service it was set in Ukrainian SSR", that government tax service in Ukrainian SSR is created at Council of Ministers of Ukrainian SSR in composition the Main state tax inspection of Ukrainian SSR and state tax inspections on areas, districts, cities and districts, in cities. That, government tax service was shown out of the system of Ministry of finance of Ukraine. At the same time, as see, in a new law was stored and fastened structure of organs of government tax service from three levels, which can be de been sees designated as central, regional and local or base. The normative structure of determination of activity of tax organs tested changes, that, next to rights a task and functions of organs of government tax service was determined in a new law also. Yes, the normative structure of activity of organs of DPS purchased three-unit configuration: task – functions – rights. In accordance with the article of 2 Laws from Decembers, 4 in 1990 the main tasks of state tax inspections were determined as providing of inhibition of legislation about taxes, complete account of all of taxpayers and other obligatory payments in a budget, realization of control and providing of rightness of calculation and payment of these payments.

The system of normative functions of organs of DPS was differentiated in accordance with hierarchical structure of these organs. The article of a 8 Law laid the systems of organs of DPS on a central level, that on the Main state tax inspection of Ukrainian SSR functions essence of which in the generalized kind it is possible to expound as follows:

1) control after inhibition of tax legislation and after the order of carrying on individual labor activity;

2) perfection of tax legislation;

3) lawmaking is in relation to application of tax legislation;

4) development of forms of documents is in relation to a calculation and payment of taxes;

5) tax elucidations;

6) organization of work is in relation to the thriftless, inherited the state property and treasures confiscated; organization of control is in relation to a state duty and cash operations of executive committees of local Advices in relation to acceptance of tax payments;

7) control of work of state tax inspections of all of levels;

8) professional preparation and retraining of shots;

9) automation and computerization of state tax inspections.

In accordance with the article of a 9 Law from Decembers, 4 in 1990 in relation to state tax inspections on areas and cities it was set with a district division, that they carry out functions in relation to functions, foreseen in the article of a 8 Law. That, on the whole the functions of this level were certain as analogical the functions of central level. Marked thus, that in the cases when state tax inspections are indicated directly carry out control after the payers of taxes or other payments in a budget, they execute those functions in relation to these payers, that and state tax inspections on districts in cities and cities without a district division. In relation to a base level in accordance with the article of a 10 Law from Decembers, 4 of 1990. it was set that state tax inspections are on districts, districts in cities and cities without a district division execute functions essence of which in the generalized kind it is possible to expound thus: 1) control is after inhibition of tax legislation; 2) account of taxpayers and providing of rightness of calculation of payments; 3) control of timeliness of presentation and authenticity of documents is in relation to payment of taxes; 4) control of inhibition of legislation is about individual labor activity; 5) application of financial approvals and administrative fines; 6) passing to law enforcement authorities of materials is about the facts of criminal offences, presentation of lawsuits, about the penalty of facilities, got without the grounds set a law; 7) get documents about the sums of taxes which are subject payment and actually entered budget, included in the informative systems, related to the enterprise; 8) work is in relation to the thriftless, inherited the state property and treasures confiscated; 9) examine statements, suggestions and complaints.

Introduction of administratively-legal backer-ups rights for payers is related not only to the tax organs but also with the due settlement of procedures of levy of taxes. In this context one of the first documents was accepted on January, 21 in 1993 Decree of Cabinet Ukraine „About the penalty of the taxes and untaxed payments" to which were borne row of innovations in the tax legislation of Ukraine not borne in time, which touched the order of administration of obligatory payments directly. First the concept of organs of penalty was entered in tax legislation, their list and limits of jurisdiction are certain. A decree was inculcate the concept of arrears, as the unborn sum of the proper payments upon termination of the set terms of their payment, and extra charge of fine at the penalty of this arrears. Any terms of remoteness were abolished at the penalty of arrears after taxes, tax credit and other payments in a budget and off-budget funds. The organs of penalty were conferred the right indisputable penalty of arrears on the proper payments which was included in their jurisdiction.

The value of this Decree consists in that he, in spite of all of the imperfection from point of present, became the first document of level of law which pawned judicial bases of order of administration of tax debt normatively, and on the whole, bases of order of administration of taxes. On the whole it is possible to say that Decree was a prototype and put in the first approaching questions which in subsequent were developed Law of Ukraine „On the order of redemption of obligations of taxpayers before budgets and state having a special purpose funds", he lost an action with acceptance of the last Law actually and.

Considerable place in forming of the system of tax administration was taken the by Decree of President of Ukraine from March, 4 in 1998 № 167 „About measures on the increase of responsibility for calculations with budgets and state having a special purpose funds", which a concept and order of application of tax mortgage was first inculcated in accordance with. A decree, in particular, set that from the day of origin of tax debt all of property and property rights for a

taxpayer, and in relation to a physical person – subject of entrepreneurial activity – property and property rights which are utilized them for the course of business are in a tax mortgage, except for property and property rights, that in accordance with a law cannot be the article of mortgage, and capital assets of enterprise, acknowledged in the set order a public enterprise. A noticeable role in becoming of the system of administration of taxes was played also by Decree of President of Ukraine from July, 23 in 1998 № 817 „About some measures on deregulation of entrepreneurial activity". A decree was determine terms and order of realization of the planned and not provided for by the plan verifications of financially economic activity of subjects of entrepreneurial activity. The circle of organs of executive power was set, including the organs of government tax service, powerful, on behalf of the state to carry out such verifications and limits of their jurisdiction. Substantial influence on forming of the system of tax administration was rendered by Decree of President of Ukraine from June, 28 of 1999 № 754 „About the order of redemption of obligations of taxpayers before budgets and state having a special purpose funds" to which Statute was ratified about the order of redemption of obligations of taxpayers before budgets and state having a special purpose funds. And although Decree was actually declined Decision of Supreme Rady Ukraine from September, 16, 1999, however much he became the prototype of the of the same name law known under a number 2181 accepted soon in essence, which actually, and developed positions, stopped up afore-named Decree.

The system of administration of taxes tested substantial reformation in connection with taking Law of Ukraine over December, 21 in 2000 № 2181 „About the order of redemption of obligations of taxpayers before budgets and state having a special purpose funds". This document, in essence first, expressly outlined as such system, mechanism of administration of taxes in Ukraine. Without an overstatement, Law of Ukraine „On the order of redemption of obligations of taxpayers before budgets and state having a special purpose funds" is today basis of the system of tax administration in Ukraine. By a law from December, 21 in 2000 № 2181 were borne row of substantial changes and in Law of Ukraine „On government tax service in Ukraine", in particular, a right for the organs of DPS to stop the operations of taxpayers for accounts in establishments of banks, other financial-credit establishments is withdrawn, a right to apply financial approvals in the modified kind is carried in Law 2181, a right for the indisputable penalty of facilities is withdrawn, rights for a tax militia are specified.

On the certain stage the role of financial institutions was substantially enhance able in the process of administration of taxes. So by Law of Ukraine from June, 5 in 2003 were borne change in Law of Ukraine „About the system of taxation", in accordance with which financial institutions were obligated to open account the payers of taxes and collections (obligatory payments) only on condition of producing by them document which confirms taking them on an account in the organ of government tax service. Financial institutions were also obligated: to message about closing of account of payer of taxes and collections (obligatory payments) – legal entity or physical person – subject of entrepreneurial activity to the organ of government tax service, in which taxpayer is on an account; to begin expense operations on the account of taxpayer – subject of entrepreneurial activity (except for a bank) from the date of receipt financial institution of the documentarily confirmed report of organ of government tax service about registering of account in the organs of government tax service; to give the organs of government tax service upon their writing request of list about a presence and motion of facilities on current and holdings (deposit) accounts of taxpayers – clients of these establishments in an order, set a law.

Next stage of development of the legislative adjusting of process of administration of taxes, which is signified passing an Act of Ukraine from January, 12 in 2005 № 2322, it is possible to describe as strengthening of legal defense of citizens in the field of levy of taxes. Substantial rich in content and structural changes were born in rights for the organs of DPS, as a result the article 11 Law of Ukraine „On government tax service in Ukraine" was expounded in a new release. So, a right to inspect apartments which are utilized as a legal address of subjects of entrepreneurial activity was withdrawn, and also for the receipt of profits. From maintenance of the article 11 compositions of administrative offences were withdrawn. Actually speech went not about abolition

of administrative responsibility at violation of tax legislation as such, but about certain modification and transference of the legislative adjusting of this responsibility in the complement of Code of Ukraine about administrative offences. One of the most substantial additions, which was borne Law from January, 12 in 2005 № 2322 to Law of Ukraine „On government tax service" touched the order of lead through of tax verifications, in connection with what the last law was complemented such articles: article 11-1. Grounds and order of lead through of government tax service of the planned and not provided for by the plan departure verifications of timeliness, authenticity, plenitude of extra charge and payment of taxes and collections organs (obligatory payments); article 11-2. Terms of admittance of public servants of organs of government tax service are to the lead through of the planned and not provided for by the plan departure verifications.

Summarizing, maybe, that development of adjusting of sphere of levy of taxes in modern Ukraine from point of maintenance and character of administratively-legal facilities of influence on tax relations it is possible de been sees to divide into two stages. First from them, which engulfs a period to passing an Act № 2181 at the end of 2000 and marked the increase of the forced aspects of plenary powers of tax organs, it is possible to describe as an attempt of mainly direct power decision of problems of filling with of budget taxes. However much such approach, obviously, could not be effective, besides provoked social and political tension in society.

It is possible to consider acceptance of December, 21 beginning of period of liberalization of the administratively-legal mode of levy of taxes in 2000 to the law № 2181, which in particular, a right for the organs of DPS to stop the operations of taxpayers for accounts in establishments of banks, other financial-credit establishments, and also right for the indisputable penalty of facilities, was withdrawn, rights for a tax militia are specified and others like that. Liberal reforms in the direction of strengthening of legal defense of citizens in the field of levy of taxes were prolonged Law of Ukraine from January, 12 in 2005 № 2322, in accordance with which, in particular, a right for the organs of DPS to inspect apartments which are utilized as a legal address of subjects of entrepreneurial activity was withdrawn, and also for the receipt of profits, the legislative adjusting of administrative responsibility for violation of tax legislation was carried from Law „On government tax service in Ukraine" in the complement of Code of Ukraine about administrative offences. On the whole passing an Act of Ukraine „About the order of redemption of obligations of taxpayers before budgets and state having a special purpose funds", in our view, played a key role in administratively-legal adjusting of sphere of levy of taxes. This document, in essence first, outlined the mechanism of administration of taxes in Ukraine, system of organs of administration of taxes (supervisory organs) and for today is normatively judicial basis of the system of tax administration in Ukraine. It should be noted that considerable place in becoming of the system of the administratively-legal adjusting of sphere of levy of taxes in Ukraine played „lawmaking" of President of Ukraine, which in our view, was the substantial catalyst of development of the proper lawmaking processes and becoming of the today's system of the legislative adjusting of sphere of levy of taxes. On the whole, the evolution of administratively-legal facilities of sphere of levy of taxes goes in direction each time of the greater working out in detail of legislative orders, especially, in respect of order of redemption of tax obligations, plenary powers of organs of tax service. On the whole development of the administratively-legal adjusting of sphere of levy of taxes answers proclaimed Constitution of Ukraine to sending to assertion and providing of human rights.

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INTERNATIONAL ASPECT OF CRIMINAL LIABILITY FOR FRAUD.

The article deals with delimitation of criminal liability for fraud under the laws of Ukraine and Japan and Jordan.

In today's world there are many legal systems that regulate different criminal legal relations, legal systems also differ on certain characteristics that reflect their nature and factors affecting the components of the legal system. To determine the affiliation of a state to a legal system are not based on content of specific legal rules, and more steel (and more general) elements, which, considering the peculiarities of this state law can determine the characteristics inherent in its legal system, particularly criminal law. The aim of the study are: clarifying the differences and similarities in defining the crime of causing property damage by fraud and are offered as a result of implementation of the norms of criminal law in our legal system. For special research institute of the criminal law of foreign countries, be subject to analysis of crimes against property, such as fraud, for example, Far Eastern legal seminar "the (Japan), seven Muslim law" the (Jordan). The current Criminal Code was adopted by Japan in 1907 and called "Keyho. The special part called Keyho Kakuron - detailed provisions. As part of a special shuttle Japan formally crimes divided by the degree of severity. Unlike the Ukrainian Criminal Code, where crimes are grouped into generic objects, Criminal Code of Japan, instead of chapters, contains chapters that focus on one or more crimes, and in such detail, there are 40 chapters. Head of the Special Part of the Criminal Code of Japan have their names, but the articles have titles, although unofficial title of the article are given during their publication in the collections of laws, those names are contained in quotes, because they were not in the text of the law. Articles in the Criminal Code of Japan, often contain text? "(Tadasyhaky), beginning with" but "(Tadas). Chapter 37th regulates criminal liability for "fraud and extortion. In my opinion, the title of chapter, meets its content, that is, crimes that are placed in the head thing in common, namely: illegally acquired assets to meet their needs or the needs of others. This chapter contains a description of such crimes as: fraud, extortion, abuse of confidence, criminal acts equated to fraud.

So, consider the crime of fraud. According to the Criminal Code of Japan, fraud is an act that is committed by deceit for seizure of any person. The doctrine says that a necessary condition for the formation of the fraud is the introduction of the injured party astray; criminal act can be both action and inaction, may be subject to encroachment and stiffness. So the subject of fraud may be movable and immovable property. Fraud and extortion "are different from theft and robbery, in which the extraction takes place against the will of the victim, so that the fraud and extortion victim, take action on its own - unconfirmed - of liberty." Criminal actions, which are equivalent to fraud include: the use of condemnation of the person or minor for possession of their property or obtain an illegal property benefit. As we see, Japanese lawmakers are trying to protect the rights of such citizens, moreover, these distinguished conduct in a separate article. In Sugiyama and Cottons comments indicate that the "use such means as deception, juvenile or condemnation regular staff person will create fraud. Obtaining property by deception is incapable of expression or the child of a person forming a heated warehouse theft. However, interpretation of the Criminal Code, do not remove this article and it is by no means disappeared and are not equivalent to fraud or theft. In Japanese legal literature great emphasis on this type of fraud as kisser dzesyam: tickets only race nearest to the departure and arrival stations, and transportation medium race "hare." Commentators note that there are two versions of defining moment of fraud - when passing control and deception controller (turnstile) at the station of departure or arrival station. Special attention should be paid to the abuse of trust. During this crime falling, act attorney, if with intent to obtain for himself or another person's property acts against the will benefit the principal, fundamental breach of their

duties, and as a result, causing property damage principal. Under this Article within a principal-agent relationship, moreover, this article provides alternative actions for attorney namely: violation of fundamental duties and act for their own benefit or the benefit of others. The article makes mandatory certain ways of committing the crime that makes the crime more open to his commission. With regard to Muslim law is an autonomous branch of science. It is only one side of religion Islam. This is religion has, first, theology, establishing dogmas and specify in which a Muslim must believe, and secondly, the Shariat, which tells the faithful that they should do and what should not. Shariat means in translation "route" and is what is called Islamic law. It is a set of norms or rules learned from divine revelation, which must keep believing Muslim, if he wants to properly carry out its religious obligation. The mouth of all clearly shows the profound difference between Islamic and Western law. Jordan's Penal Code was adopted in 1961, it significantly limits the notion of some property crimes, including fraud. Property crimes legislation in Jordan are divided into three groups - crimes, misdemeanors, violations. Property crimes legislation in Arab countries are divided into three categories - crime, guilt and violations, mainly depending on the punishment prescribed for them. However, legal description (section) of these acts in Jordan spacecraft can vary depending on their implementation under certain aggravating circumstances, which characterizes the object, subject, place, time, method of implementation, and sometimes afterwards. Part of the responsibility for property crimes in the criminal law of Jordan begins with a definition of theft, which is traditionally considered the most dangerous crime against property. Common the standards for spacecraft Arab the responsibility for property crimes is that they do not include these motifs acts as a necessary sign of their moral element. CC NDRY too limiting notions of certain property crimes (fraud, breach of trust, issuing a check unsecured) which covered the law strictly some cases their implementation. According to CC Jordan, fraud is recognized acquisition of property by using a false deceptive means to enter the victim's confusion, in which he will give his wine estate. Questions of the deception is very controversial in the criminal law of Jordan. For example, is any deception, under the influence of which the victim handed over his property and his right to another person, and forming a criminal fraud, because in terms of legislation, doctrine and case law, criminal fraud must meet certain requirements: - rogue uses false name or title - it create a situation that is necessary for fraud, is not a prerequisite: the use of assistance from other persons As a result, many cheaters, but they are mainly representatives of their own structures, to avoid liability due to the fact that the manner of deception to which they tell lies to take over other people's property, not the laws. Or for example, breach of trust occurs only when the guilty awarded, ordered or wasted assets that were already in it legally - in effect a contract of trust. Many Arab scholars, particularly Ifreyh Nasser Yousef, proposes to expand the notion of other property offenses, particularly fraud, which would include all cases of possession of alien property by any kind of fraud. Since fraud is a crime subject, it is interesting to install the signs of fraud that is the subject of individual property. According to Jordanian civil law, the property has the following characteristics: a) determining the value, b) a movable or immovable, c) is false. However, physical removal or transfer of property (as is the case in the definition of fraud) may be made on personal property because real estate can not be removed physically transferred to another location, but it can wrap its unlawfully or any other person (other people) favor. Aggravating circumstance for fraud are: implementation under the pretext of work or positions in public administration by claiming to the public in connection with the issuance of shares, bonds or any documents of any company or project of a trustee, guardian of the victim or the person responsible for his interests in law, court decision or special agreement. Criminal legislation Jordan has determined that fraud is a physical entity compos mentis person 16 years old and a legal entity. Special subject of official acts. In particular are the subject of interdependence and subjective side. To determine intent in criminal law of Arab countries used the term "malice", which means crime guilty conscience of their actions or criminal consequences of their foresight and willingness to occurrence of such effects. Criminal intent for criminal liability for acts or other property is ambiguous. For example, to attract people to take responsibility for theft, extortion, fraud, breach of trust and destruction or damage to property through any means other than burning and explosion, requires not only intellectual element

(common intention), resulting in awareness and anticipation guilty of crime and the consequences of their actions, but volitional element (special intent) which is understood as a desire to condemn their actions harm others. Lack of volitional element in the implementation of these actions can serve as a pretext for excluding criminal responsibility. However, specific force or dangerous nature of certain acts (check unsecured issuance, destruction or damage to property by arson or explosion) criminal responsibility comes even in the absence of volitional element. Another crime against property commit only on private property is a breach of trust. During course malpractice wrongful use of a person convicted of trust that have developed between her and the victim is necessary for the latter causing material damage (including failure of any promises or agreements, misuse of rights (enjoyment), which delegated the owner, or other (others), competence). Relationships of trust have not only on the basis of family ties, but since there are sufficient grounds to trust the person, such as: relationships that have developed on the basis of civil and commercial contracts, management relations, etc.. The subject of this offense is only movable property. If fraud was acceptable subject, in the form of movable or immovable property, then the breach of trust not. Feature of criminal intent is that unlike fraud, it occurs after a property which is then returned to its rightful owner. Criminal liability for breach of trust, it may be burdened, depending on the implementation of this particular category of person - adult or guardian incapacitated person, lawyer, notary, executor of will or marriage contract, which manages charitable organization. Summarizing the analysis of the legal systems of the world concerning the crime of causing property damage fraud can be identified by the presence of similar and distinctive features of the Ukrainian criminal law. Start a comparative analysis of similarities, they are: 1) these states, whether that is the dominant source of law, precedent, religion, criminal codes are written. 2) written penal codes dissociate oneself fraud and causing property damage. However, the penal code found another name for crime, such as breach of trust. 3) Code of Japan special circumstances include exemption from criminal liability, prescribed in the articles are of particular parts. Summarizing what we can be surprised that the Criminal Code of Ukraine contains so few similarities with the prosecution of foreign countries. This is because the Ukrainian lawmakers paid little attention to the positive heritage of foreign countries and almost made the process of harmonization of Ukrainian legislation to European standards. Obviously, the lion's share of the comparison are features that can later serve as the foundation for implementation required standards of criminal law. Among the distinctive features distinguish: 1) Criminal Code of Japan, in determining the composition fraud use only way it occurs, namely "through deception." Generally, construction articles are wrong, arguing this thesis can bring these conclusions: the lack of articles in qualifying and especially qualifying signs. This is because there is no need to prescribe the common truth that contained a total of spacecraft Japan. With this statement of Japanese scholars disagree, as is the principle person can put the blame in many circumstances and I think this approach is humane and such, which corresponds to the level of democracy in Japan. Crime of fraud under the Criminal Code of Ukraine provides that two ways of committing, including: fraud and breach of trust; detail prescribed qualifying and qualifying particular circumstances, including repetition, committed group of people, causing varying degrees of property damage. For spacecraft Japan a great emphasis on mental and volitional qualities of the victim. The use of such means as deception in relation to persons with reduced mobility forms of fraud staff. Obtaining property by deception from the incapacitated person or minor forms of staff theft. Ukrainian legislation are two possible ways to address this situation. Firstly, the conclusion of any agreement on civilian incapacitated person is invalid. Therefore, the property returns guardian. Responsibility for prosecution for fraud is not following. Pretty hard in Japan to treat unpaid fare. Unpaid passage falls under signs of crime. In Ukraine outstanding travel in check case, refers to administrative offenses and provides for fines.

Breach of trust is similar to causing property damage ... (st.192 KK Ukraine), but present many differences. First, the subject of crime is just believe, that is followed by a condition for signing a crime by the civil legislation of Japan, the treaty commission. Victim recognized principal. In our criminal law, we are not limited only to the principal attorney and, yes, there are

certain peculiarities about the subject, but I believe that Ukrainian lawmakers did right, legally, leaving a large space for the victim and the subject. Criminal Code of Japan, said no way to commit this crime. If the fraud, commission of lawmakers predicted way, then for breach of trust, ways not foreseen. Way of committing fraud and causing property damage ... (st.192 KK Ukraine) for criminal law of Ukraine, is fraud or breach of trust. Question ways of committing these crimes are quite controversial in legal science, as a number of proposals for further separation of these ways, but the availability of scientific debate, does not deprive the legal effect of these two methods. 2) appropriation act to the crime, according to CC Jordan, must have aggravated, that aggravating circumstances are different from ours. Note that the spacecraft Jordan, unlike art. 190 Criminal Code of Ukraine, the only way fraud is recognized fraud, which should be defined as the deliberate introduction of a victim of their deceptive acts or mistakes of it to obtain illegal profits of property and / or causing damage to property (such as ignoring the past or future circumstances of time can affect the behavior of the victim). Fraud, abuse of trust, issuing a check unsecured committed only intentionally. General rules for Arab countries is the lack of binding motive of the crime.

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CONTEMPORARY PROBLEMS OF COMBATING TERRORISM

At the beginning of the third millennium, mankind is experiencing one of the most complex, controversial and painful stages of political development, associated with a significant increase of threats of terrorism, which became one of the active methods of fighting of the political actors for power and influence. Modern political terrorism as a dominant factor appears to destabilize the political situation in several countries and regions. It differs greatly from terrorism earlier periods of history on the degree of mass casualties, destructive impact on society. The real was the danger of catastrophic consequences as a result of the possibility of terrorists obtaining weapons of mass destruction and their use of other technological achievements of civilization.

Conflict potential terrorism in particular has grown from 60 years of the twentieth century, when entire regions of the world were covered areas and fires on its various activities targeting terrorist organizations and groups. In the world today there are about 500 illegal terrorist organizations. From 1968 to 1980 they made about 6700 terrorist attacks in 3668 killing 7474 people and wounded. According to some research of the scientists and the facts of the foreign research centers, the total budget in terror is from 5 to 20 billion $ annually.

Given the urgency of spreading terrorism, many experts pay much attention to research this phenomenon.

Describing modern terrorism with the need we conclude that it has acquired an international, global. Globalization and the increasingly broad internationalization of terrorism is an undeniable fact, to which humanity found itself today. This phenomenon is caused by expansion and globalization of international relations and cooperation in different regions. International character of human life, new communications and information, new types of weapons drastically reduce the significance of national borders and other means of protection against terrorism. [1]

According to Professor Adrian Helke of the Center for Research in ethnic conflicts in Belfast, the U.S. administration makes a mistake, considering September 11 "turning" for modern history. The way of the international terrorism - this new form of resistance to U.S. hegemony almighty - opened the collapse of the Soviet Union. In the eyes of Washington any movements are already terrorist that are resisted American hegemony, they are not only those which adopt it. State Terrorism is tolerated or encouraged if it is in U.S. interests. In multipolar world terror remains the only weapon with which the weak can threaten the strong peace in this asymmetric conflict [2]

Terrorist activities in modern conditions are characterized by wide scale, the absence of express state borders, the presence of communication and interaction with international terrorist organizations and centers, solid organizational structure that consists of managerial and operational level, intelligence and counterintelligence units, logistics, battle groups and cover; rigid secrecy and careful selection of personnel, availability of law enforcement agents and public bodies; good technical equipment, competing, and even equipment of the prevailing government forces, availability of an extensive network of secret shelters, training bases and ranges.

Contemporary terrorism is a powerful structure with their respective scale equipment. Terrorism has become a very profitable business on a global scale developed "labor market" (mercenaries and others) and additional capital (supply of weapons, drug trafficking, etc.)..

Distinctive feature of modern terrorism is the creation of international and regional governing bodies to solve the tasks.

In recent years a close connection with terrorist groups whish organized criminal groups and communities whose interests they often represent are seen.

Terrorism is one of transnational crimes that requires the same approach to its interpretation and, more importantly, to development of the common international legal concepts to implement the agreed assessments and actions to combat it.

Terrorism as a kind of international crime has the most contradictory opinions. It became political or was considered as an ordinary criminal offense. Today more substantive understanding of the problem became between lawyers of the world. In many issues of terrorism and as a phenomenon and as an international crime a certain unity is achieved, that is important because of the danger that terrorism poses to mankind.

NN Reshetnikov considers cause of terrorism in its present form impossible for some countries to conduct military operations in traditional way (especially from neighboring countries and world leaders - the reasons are obvious enough and do not require special justification).

Most Arab countries do not have adequate military organization and no modern army can resist the Western powers. But some Arab countries already have significant economic potential. But still: there are available funds, but no possibilities. For war - no, but for intimidation shares -yes. [3]

Modern researches of terrorism allow highlighting many of the existing problems, among which we dwell on those that are recognized by almost all researchers.

First, all the experts agree that terrorism in modern terms becomes an International acquire.

Globalization of international terrorism is accompanied by acquisition of a number of other features. Equally important among them are substantial changes in the ideological orientation of political terrorism. In a disruption of contradictions between two confronnfnional world social systems dramatically the prevalence of nationalist (mainly separatist) and religious, mainly - Islamic terrorism has risen.

Second, available to date views on international terrorism there is a number not matching approaches to the concept of this type of terrorism, the definition of its subjects, defining its basic forms, etc. Known as the point of view of the impossibility of making the international community recognized definition of international terrorism, and not to such a general concept of validity in more urgent identification of the specific manifestations of this kind of terrorism. [4]

Among the controversial and not clearly resolved by international law issues that relate to the definition of international terrorism, the question on the subjects of this phenomenon is also featured. The main issue of disagreement about the subjects of international terrorism lies in determining the state in international terrorism. [4]

League of Nations before World War II sought to develop an agreement to prevent and suppress terrorism, but has not achieved success due to lack of consensus among member countries on its definition. For the same reason, despite the debate that lasted 60 years, the UN also failed to define terrorism. In effect this International Criminal Court, established in 1998, had to delete from its practice the international terrorism.

Hereupon, there is the original interpretation of interest I.M. Ilyinskiy the complex phenomenon of modernity, which is international terrorism. In his view, terror is a privilege of power (force), the minority over the majority, it is "top down". "International terrorism"is a response of "weak" on international terror of "strong". [5]

In terms of individual researchers, problems that require further scientific development are: social basis of modern terrorism ,causes and driving forces of terrorism, problems of international terrorism organization, relationship of terrorism and organized crime, combating terrorism, technological threats, ideological concepts of modern terrorism and combating their spread; funding of terrorism and fight with them, the nature and content of anti-terrorist state; direction and forms of international cooperation in countering terrorist threats, national, regional and international anti-structure, direction and form of their interaction, the role and place of the armed forces in combat terrorism, the use of civil society in combating terrorism, religious terrorism and the organization againstit and others. [6]

According to A.I. Gusher, this time existing arrangements against terrorism in most countries of the world are inadequate to modern threats of terrorism.

Current magnitude and nature of the terrorist danger make unacceptable position to achieve positive results in combating terrorism bid to use some intelligence and law enforcement entities as counter to this threat.

One of the problem situations is separation terrorism from the liberation of the national liberation struggle. [7]

In terms of M.M. Reshetnikova main problem of combating terrorism is that it is still, as such, strictly speaking, practically was not treated. [3]

Political situation in Europe is threatening complication of terrorism, extremism and separatism. A wide range of measures to combat terrorism stiffness is set in Britain. In the final stage of project development is an anti-terrorism law that provides for renewal of delay suspected of involvement in terrorism without bringing formal charges from 28 to 56 days and other measures. Security budget is increased from 2.5 to 3.5 billion pounds.

A political crisis in Belgium was provoked with a confrontation between the Flemish and Babylonia parties.

Scotland continues to demonstrate the desire to be separated from the United Kingdom.

According to the Finnish newspaper Karyalla "38% of Finns (2005 - 36%) believe that the Russian Federation has to allow Finland to resume sovereignty over Karelia.

President of Moldova V. Voronin accused Romania in "permanent aggression" against his country at a press conference in Brussels.

The most difficult is to find mutually acceptable solutions to the issue of speed off measures aimed at reflection of certain terrorist acts. [8]

Separately, I would say about the problem of double standards in combating terrorism. Policy of double standards in combating terrorism is a statement of the leaders of some countries, government officials, politicians, civil society, are manifested in an attempt to divide terrorists into "bad" and "good" (particularly the last often include so-called freedom fighters) in flirting with fanatics, extremists and terrorists in trying to "appeasement"; manifestation of humanity to the terrorists in attempts to understand and justify their heinous actions, in persecutions around the world of al-Kaidy and simultaneous indulgence representatives of Chechen "branch"; in quest to weaken anti-terrorist coalition forces when the world community efforts are directed solely at fighting the effects of terrorism, forgetting about the causes of this phenomenon.

Without going into detailed analysis of the current situation in Ukraine, V. Krutov evaluates which gave head Antiterrorist Center of the Security Service of Ukraine: "... available in the state a fertile ground for extremists of their criminal intentions, and under certain conditions possible activation terrorism in Ukraine. So for our country it is important to identify ways of countering modern terrorism. [9]

Summarizing the diversity of methods and international action against terrorism one can define, in our opinion, those which are recognized by most researchers.

- The develop of a sort of code of conduct of States in combating international terrorism, building principles and basic rules of mutual assistance in specific situations. Joint development of crisis response mechanisms to large-scale manifestations of international terrorism;
- Further improvement of mechanisms for identifying and establishing firm control of the international community over the international terrorist networks, their centers and headquarters, training bases and other terrorist organizations. Toward this end, the UN is expedient to create a unified international anti-terrorism center, which will produce a strategy to fight terrorism;
- The world community against the ideology of terrorism;
- Organization of internationally coordinated research and creative work on a common concept of terrorism, or at least its basic features;
- Development of international framework of international anti-terrorist operations assigned binding UN Security Council sanctions for their implementation and control over their course;
- Exchange information on methods and tactics of terrorists, information regarding businesses and individuals suspected of financing terrorist and extremist organizations;
- Denial of asylum to terrorists, which they use to restore their strength and hiding from

responsibility for the crime, [6]

- Unification of national legislations in the field of combating international terrorism and related criminal offense;
- Activation into practice existing agreements on combating terrorism [8]
- Importance in counter-terrorism system would use information resources targeted to discredit in the eyes of the public ideology of terror and violence, the formation of disadvantageous for the subjects of terrorist activity information;
- To study the whole range of issues of terrorism and extremism, suggest counter measures to concentrate the intellectual potential of Ukraine and other countries.

References

1. *Korolev A.A.* International terrorism in the modern phase of UDC 94 // Electronic Journal "Knowledge. Understand. Ability." - 2008. - № 6 - http://www.zpu-journal.ru/e-zpu/2008/6/Korolev_terrorism/

2. See.: Eric Rulo. Good, evil and «terrorism» // La Monde diplomatigue. 2007. May. S.19.

3. *Reshetnikov M.M.* Islamic confrontation and the problem of terrorism // http://anthropologia.spbu.ru/

4. World Anticriminal and Antiterrorist Forum. Features of modern terrorism and some law problems of combating // http://www.waaf.ru/index_ru.php

5. See: *I.M. Ilyinskyy* Terror and terrorism/Between future and past .M, 2006. S. 239, 242.

6. *Zhuravel V.P.* About important in combating terrorism ideology // Journal of Law and safety ", 2008. - 2 (27)

7. *Gusher A.I.* The problem of terrorism on the eve of the third millennium in a new area of mankind // Eurasian Journal. - 2000. - N 3.

8. *White. E.V.* A fight against terrorism as a world problem . // Lomonosov's readings

http://lib.socio.msu.ru/l/library?e=d-000-00---0lomon--00-0-0-0prompt-10- - 4 ------ 0-0l - 1-ru-50 --- 20-about --- 00031-001-1-0windowsZz-1251-00 & cl = CL1 & d = HASH936463c7ece8e05186d09a.1.2 & x = 1

9. *Krutov V.V.* Mars' birds / Considerations on the image of modern terrorism and opposition to it // Mirror of week № 21 (801) 5 - June 11, 2010

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THE AUTHOR ANALYZED THE FEATURES OF COMPETENCES OF PROFESSIONAL QUALIFICATIONS FOR FUTURE AVIATION PROFESSIONALS

Competence based approach of professional qualifications

Ukraine – is one of the few world powers that has full range of aviation activities - from designing aircraft, aircraft engines to their operation, maintenance and repair. In the aviation industry is also an important educational and research activities, because they provide training, efficiency and safety of air transportation. Education provides for a young man's ability to find and acquire such socio-economic, status, socio-psychological amount of knowledge that would allow to demonstrate innovation in relation to society. Traditional organization of general education are more consistent with the existing problem of reproduction of social relations, social settings. In modern conditions, when a new system of values, new moral standards, and dynamics of social change makes weather what values and standards of conduct can provide adequate social behavior in the future, gets a special role sociocultural identity and support the formation of social competence of the individual. Focusing on the modern labor market, education refers to the priorities of today's ability to operate such skills and knowledge that meet the needs of modern society, young people prepare for new roles in this society. That's why it's important now is not only the ability to operate their own knowledge, but be prepared to change and adaptaion to new labor market requirements, operate and manage the information to act quickly to make decisions for lifelong learning. Simultaneously analyzing the experience of the educational systems of many countries and research scientists [1, 2, 3, 4], one way to update content of education and educational technology, coherence with modern needs, integration into European and world educational space is competency approach and develop effective mechanisms for its implementation.

Background migration to new criteria for assessing the quality of training - that the university partners (employers) now require not only highly specialized workers who possess certain personal qualities and impressive exhibit behavior problems in the profession, but should include knowledge and performance of a person who studied for a particular educational program. Higher education institutions should improve internal training processes. Thus, one major challenge is to move from the ongoing training of the institution (internal verification of declarative knowledge) to qualifications based on competence, that is, mechanisms that are based on an assessment of the participation of social partners, the willingness of graduates to perform specific tasks of professional activities and identify specific behaviors. Implementation of competencies in educational content and implementation of measurement system for monitoring the quality of education is gradually accompanied by extensive discussions and thorough scientific and methodological tools. Since the notion of competence, key competencies are quite diversified, its definition and interpretation is always subject to scientific debate.

The International Committee of the Council of Europe in its documents as regards the notion of general competence, or key, skills, basic skills, key skills, abilities or skills krosnavchalni, key ideas, basic knowledge. Experts believe the Council of Europe expertise includes: ability and personality to take responsibility for individual and social needs; set of attitudes, values, knowledge and skills. European Union experts define the term competency as the ability to apply knowledge and skills that provides active use of educational achievements in new situations. The recent publication of UNESCO competence concept is treated as a combination of knowledge, skills, values and attitudes that are used daily and considered as a person: the ability to apply knowledge and skills effectively and creatively in interpersonal relationships - situations that involve interaction between people in a social context as well as in professional situations. A, respectively - are considered as the notion of competence, which logically stem from attitudes to the values and

skills to knowledge of According to the definition of the International Department of the notion of standards of competence is defined as the ability to perform skilled activities, perform a task or job.

This notion of competence is a collection of knowledge, skills and attitudes that enable a person to operate effectively, certain functions to achieve certain standards in a particular industry or professional field. Since 80 years, the Organization for Economic Cooperation and Development (OECD) began their research in this direction. Experts of this organization for several years collecting and analyzing data on education in different countries from the perspective of effectiveness and efficiency, which helped define the system of educational indicators. OECD concluded that no sufficient research in theoretical and conceptual framework of competences. Organisation for Economic Cooperation and Development is now considering in detail and seeks to resolve problems of implementation competencies in educational content. OECD Working hours [3] based on the provisions that now are basic to most relevant research organizations and professionals working in this direction.

The main provisions are as follows: a competence is a result of interaction of many different factors; modern life requires both a specific set of rights acquisition, complex skills called key; selection of the most important general skills called key should be carried at a fundamental level, given the current ideological ideas on society and individuals and their interactions; must be taken into account the impact of the cultural society of the country; the selection and identification of key competencies affect subjective factors related to the same person: age, sex, social status; identifying and selecting key competencies requires extensive study among different specialists and representatives of various social spheres. Only under these conditions can make the selection, identification and ensure further development of key competencies population and relevant factors of their development. In this case it is a formal mechanism, and just recognition, ie recognition that a student who was trained on a specific curriculum, knows, understands and can do. Scientific narobky proposed recently to enhance understanding of competence as an integrated indicator, but not considered as criteria for assessing the quality of training. In our opinion, the basic idea of modernization of higher education nowadays is to develop such criteria as that would bring in the highest degree of training to employers' expectations, for them to regular assessment procedures and staff development organizations, and professionals - a chance to get a job. In this regard, the main tasks of scientific - methodical materials in the system of quality education are the following: - Quality criteria need to adapt training to the needs of education social partners; - Use in higher education mechanisms of selection, evaluation, training and staff development are tested in practice human resources management; - Graduates - future employees of various organizations. The purpose of educational programs - provide not only knowledge threshold within the profession, but also a powerful behavior.

Have define main approaches to the definition of competence, highlight their main feature: the competence should be favorable for all members of society, that is relevant to all regardless of status, race, culture, marital status and language. In addition, competencies must be consistent not only with ethnic, economic and cultural characteristics and the relevant conventions of society, but also match the priorities and objectives of the community and be personally oriented nature. The orientation of educational system in the assimilation of knowledge, which was traditional and justified a few decades ago no longer meets the modern social order, requires self-education, initiative and responsible members of society, able to interact effectively in the implementation of social, industrial and economic problems. Implementation of these tasks requires substantial strengthening of independent productive activity of students, develop their personality and creativity, skills independently acquire new knowledge and solve social and professional issues in the target society. Presenting the various approaches to the definition of key competencies being established through the efforts of international educational institutions [3], it should be noted that debate, which lasts over the past 10 years has enabled many countries to make their own synthesis and determination, but the main role in the development of key issues competencies belonging to international organizations.

They tried to summarize the achievements of teachers from around the world. The main impetus for efforts in competences are the requirements of business and entrepreneurship. Modern employers do not have any claims to the level of technical knowledge graduates, but they often celebrated as a lack of modern education - graduates of uncertainty, lack of experience in integration and application of knowledge in decision making. Note that according to statistics most people take the day making about 1000, most of them unimportant, but some-are becoming critical. Help students learn, to find the right solutions in specific situations, teaching, life, then - professional - one of the goals of education. Individual activities, including acquisition of any knowledge, skills and behavior of concrete actions, operations. In carrying out these actions, reflecting on their performance, realizing the need for them and evaluating their importance to themselves or to society, a person thus develops expertise in a particular area of life. If life, in which a person feels able to function effectively (ie competent) is quite broad, it's a so-called key competencies or life. If competence extends to narrower scope, for example, within a scientific discipline, we can talk about subject or sectoral expertise. Thus, under the authority of future specialist understands: properly structured (organized) sets of knowledge, abilities, skills and attitudes, which are possessed in the learning process. They allow him to determine that is to identify and resolve irrespective of context (situation), problems that are specific to certain areas.

References

1. *Shust N.* Ukrainian higher education on the way to global Partnerships / / World Congress-Developing global partnerships, New-York city, February 18-20, 2008, page 65-66.

2. Компетентностный подход к проектированию государственных образовательных стандартов высшего профессионального образования (методологические и методические вопросы): методическое пособие: Изд. 2-е./ *В.И. Байденко.* – М., 2006.

3. Ключевые компетентности как результативно-целевая основа компетентносного подхода в образовании / *Зимняя И.А.* – М., 2004.

4. Использование зарубежного опыта при разработке государственных образовательных стандартов высшего профессионального образования РФ нового поколения (на примере США, ФРГ, Великобритании): Информационно-методическое пособие для разработчиков ГОС ВПО / *К.Н. Цейкович, О.Л., Ворожейкина, Л.Н. Тарасюк.* – М.; 2006.

5. Функционально-сетевые модели компетентносного подхода для описания интеграции образования, науки, производства / *Ищенко В.В., Сазанова З.С.* – М., 2007.

6. О возможности построения единого макета образовательного стандарта стран СНГ как динамичной модели нормы качества высшего образования / *В.И. Байденко, В.Ф. Пугач, Н.М. Розина, Н.А. Селезнева, В.Т. Федин.* – М., 2006.

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DEFENCE OF PROOFS IS IN CRIMINAL BUSINESS ON LEGISLATION OF UKRAINE

Annotation: in theses problems of access restriction is examined to evidential information, electing of measure of suppression as detaining in custody and providing of safety of physical persons which are the carriers of evidential data as varieties of defence of proofs.

One of directions of defence of evidential information there is an access restriction to it. Item 121 KPK of Ukraine provides for, that information of pre-trial investigation can be declared only with permission an investigator or public prosecutor and in that volume in which they acknowledge possible.

Thus, from a law swims out, that any participant of criminal procedure activity is under an obligation not to divulge information which make the secret of pre-trial investigation without permission of the persons adopted higher. Then is there a question – who does determine what information makes the secret of investigation, and which – no?

Part 2 st. 121 KPK of Ukraine specifies only, that in necessary cases an investigator warns persons which are present during the leadthrough of consequence actions, about a duty not to divulge information of pre-trial investigation without his permission.

In this case presumably it follows to consent from A.E.Maslov, which divides information which makes an investigation secret into two kinds:

1). Information which make the secret of pre-trial investigation at realization of every criminal case, regardless of type of crime. Here it follows to take information about consequence versions, tactic of leadthrough of consequence actions, safety measures which are used in the relation of subjects of criminal procedure activity and others like that.

2). Information, attributing of which to the secret of pre-trial investigation depends on an investigator, investigator and public prosecutor. Yes, taking into account the circumstances of investigation an investigator and public prosecutor can attribute to the investigation secret information about the results of separate consequence actions, about personality suspected and defendant in the commission of crime [4, s. 81].

A disclosure of information of secret of pre-trial investigation can be intentional and unintentional. A person who carries out investigation owns the most volume of evidential and other confidential information in criminal business. Here take information about planning and direction of investigation, information, which are got in the process of leadthrough of consequence actions, investigate measures, about tactic of leadthrough of separate judicial actions, information about witnesses or other participants of process, about safety measures in relation to the subjects of criminal procedure activity et al.

A most danger for investigation is a threat of source of informative information from the side of workers of law enforcement authorities. Presence of informant in the organs of investigation in particular, whether in law enforcement authorities in general enables them more actively and skilled to counteract establishment of truth, and sometimes and to reduce to the zero effort of workers of organs of investigation in relation to finding out of circumstances of feasance publicly dangerous act. Therefore workers of organs of investigation must be careful in socializing with colleagues on work, especially when the surplus personal interest of those or other employees is felt to information which is not included in a circle them official plenary powers.

It should be noted that quite often the disclosure of evidential information is begun with the review of place of event, and at that by leading composition of law enforcement authorities. Often it touches grave and especially heavy crimes.

Through mass medias persons which did publicly dangerous act can obtain information about present in consequences proofs. And thus take measures on elimination of other tracks of crime, neutralization of present proofs.

In spite of recommendations of research workers, giving of facts, about ignoring of requirements practical workers in relation to the nondisclosure of information which make an investigation secret and their consequences, the separate workers of law enforcement authorities of investigation continue to ignore these requirements. Thus they divulge such information the colleagues, including former, to the acquaintances and friends. Certainly, these actions of workers of law enforcement authorities directly are not directed on the concealment of criminal activity, neutralization of evidential base, in criminal business. However to a great extent facilitate such concealment the interested persons.

Preparatorily organizationally an action in relation to the leadthrough of judicial measure is carried out as follows: after the receipt of information about the possible location of objects which matter for business decision about a search or coulisse accepted in law enforcement authority. There about it the certain group of workers the actions of which judicially conform to the public prosecutor and court is reported. At the same time, it is not always possible to talk about effectiveness of the planned consequence actions, especially it touches criminal cases about grave crimes, crimes in the field of economics, bank activity and others like that. And that is why, on what stage the divulged information was about the leadthrough of the transferred judicial actions to find out, as a rule, it is not succeeded.

It follows also to remember, that consequence workers, public prosecutors and judges, are exchanged present information or get new traditionally through a state public-call network. For today it is the most widespread and accessible mean of receipt and information transfer, which actually is least protected from illegal encroachment. It is not reliable also and mobile communication means, computer technique, through which also a disclosure of evidential information is possible. Suitable is position of V.S.Kuz'michev, which considers that expansion of limits of publicity during realization of investigation activity is one of new and actual directions of democratization and humanizing of this activity [3, s. 11]. At the same time it follows to underline that not all information, which is contained in materials of criminal case behaves to evidential or is such which makes an investigation secret. Generally known that admission of methods of conduct of investigation is limited the scopes of KPK of Ukraine, which is the opened legislative act and investigator, however right a judicial figure at investigation in criminal business is not to violate the orders of criminal procedure law. In fact public interests require that information which contains information about acceptance of separate judicial decisions was accessible for the members of society. Such decisions can be decisions about laying an action, accusation to the concrete persons or electing in relation to them of measure of suppression, closing the case, and others like that. However much not all scientists and researchers adhere to such position. The separate consider that all information in criminal business must be closed and accessible the only authorized law subjects which carry out investigation of this criminal case.

A no less important place is taken in this question electing of measure of suppression a person which is suspected or laid to the commission of crime. In particular, that touches the measure of suppression as detaining in custody as a variety of defence of proofs, especially in questions publicly dangerous acts, perfect group persons. By legal foundation of electing of measure of suppression is detaining in custody – is, concordantly ch.1 st.155 of KPK of Ukraine, commission of crime for which punishment is statutory as imprisonment on a term over 3 years a person. In exceptional cases this measure of suppression it can be applied in businesses about crimes, for which punishment is statutory as imprisonment and on a term not more than three years. Actual grounds is a presence of sufficient evidences to consider that suspected, defendant, defendant, condemned will try to avoid investigation and court, or from implementation of judicial decisions, to hinder establishment of truth in business or to continue criminal activity (ch. 2 st. 148 KPK of Ukraine). On occasion, with the purpose of diminishing of possibility of intercourse of prisoners with companions in a crime, which are at liberty, and with other persons – suspected or defendants

are placed in remand of other areas or remand of Security Service of Ukraine. Such measures are used more frequent all, when arrested are members of the organized criminal groupments which accomplished the row of grave and especially heavy crimes.

The use of scientific and technical facilities comes forward other no less important question in the process of collection and proper providing of proofs in business. Problem aspects in this question are introduction of facilities of technical defence of the adopted establishments, their perfection, in obedience to the requirements of current legislation. One of factors of failure to observe of these requirements there is an unfavorable economic situation in the state. At the same time to the state track more self-weighted to go near problems which exist in law-enforcement activity, as open urgent questions of investigation affect effectiveness of work of law enforcement authorities of Ukraine. And that is why an important moment is introduction of obligatory review of all without exception persons which pass to remand, regardless of their judicial status. A review must include and passing through technical control with the purpose of exception of possibility of carrying of unsolved objects, including communication means. On this occasion to Law of Ukraine „On a pre-trial conclusion" it follows to bring in the proper changes.

In the process of providing of proofs the scientific and technical providing comes forward other important question without the use of which it is impossible to talk about a comprehensiveness, objectivity and plenitude of leadthrough of judicial measures. They complement a protocolary record and evidently represent motion and results of that or other investigation action. To such hardwares fixing sound belong and videotape recording, photography. Their application plays a positive role, as maximal plenitude of information is here provided. Besides, the audio recording allows saving the emotional colouring of language of participants of investigation action, and the videotape recording – the visible displays of their conduct yet and: mimicry, gesticulation. And it is an important enough moment for the leadthrough of psychological examination of conduct of person, fixed the videotape recording, for finding out of question about sincerity of testimonies, whether disguise of veritable intentions and others like that. On a present tense most widespread is videography, which is used for the leadthrough of review of place of event, search, coulisse, recreation of situation and circumstances of event and other consequence actions. Discrediting the value of the videotape recording defendants and their defenders sometimes specify on his editing. However refuted all of it is the leadthrough of fono-videoscopes examination which videotape is probed in the process of. The videotape recording has a conclusion about absence of changes, and also fixing of date and time of leadthrough of investigation action on tape, confirm its authenticity and allow using in the process of finishing telling [6].

At the use of the videotape recording during investigation of organs of inquest and pre-trial investigation workers the most typical errors which facilitate the attempts of subjects of concealment of criminal activity to discredit maintenance of the formed proofs are assumed. In particular:

- the videotape recording of all investigation not action, but his separate fragments is carried out, for example, at a search searching actions are not fixed;
- at video shooting of detention the process of exception for the detained person of objects or documents which matter for business is not fixed;
- the actions of investigators and operative workers „fall" out at the survey of recreation of situation and circumstances of event, as a result of what it is impossible to check or they do not „lead" by a conduct suspected or defendant;
- during the leadthrough of consequence actions „off" screen there are concepts: not evidently, whether there are in a they position to confirm motion, results and fixing of this investigation action [5, s. 159].

Appears, that the removal of these errors only will be instrumental in reliability of collected in matters of proofs.

Lately on the pages of legal editions a question is discussed about validity of grant a defendant on completion of investigation of copy of accusatory conclusion, proofs which disrobe a person in the commission of crime are in detail analysed in which. Separate research workers consider that

investigation thus gives out a defendant and his defender strategy and tactic of prosecution on the judicial trial of criminal case. They suggest to hand a defendant only copy of the resolution part of accusatory conclusion, without the analysis of proofs, as it does not violate his right of defence. In fact during an acquaintance with materials of business a defendant directly can perceive and estimate an amount and quality of evidential base of prosecution [5, s. 183].

Consider that such position scarcely is acceptable. Materials of criminal case contain the considerably anymore volume of information on the evidential base of prosecution, than accusatory conclusion. And exactly there defender with a defendant search possible miscalculations and errors of investigator, which can be used during the judicial trial of business with the purpose of discredit of his actions and meeting the charge. In what cases possible free access of suspected or defendants to the carriers of evidential data? Most widespread are two such the cases. Above all things, it takes place then, when an investigator during the leadthrough of interrogation or other investigation action produces certain documents with the purpose of refutation of untruthful testimonies of person, whether motive to gift of testimonies. It is et al – traditional, when an investigator executes the requirements of st.218 of KPK of Ukraine that on completion of pre-trial investigation produces a defendant all materials of criminal case for an acquaintance. Is there what exit from this situation? At such situations an investigator is not sure in a conduct suspected or defendant, he must produce for an acquaintance the copy of such documents or other financial carriers of evidential data. About it in criminal business the explained decision darts out with pointing of grounds of such replacement of original on a copy.

At the same time it should be remembered that can be lost or destroyed criminal case on the whole. Then there is a row of problems, related to its renewal. Experimental investigators, investigating heavy and especially grave crimes or crimes are perfect the organized criminal groups always conduct it control-observant realization. To this control-observant realization they place the copies of basic judicial documents about motion of criminal case (a decision is about raising action, decision, about the leadthrough of search, coulisse, protocols of leadthrough of these actions, decision, about electing of measure of suppression, decision about attracting of person as a defendant and others like that). Such observant realization is kept to acceptance of court decision in criminal business. In the case of loss of criminal case or its elimination an investigator is able quickly to pick up thread a criminal case.

In defence of proofs a substantial role is played by a certifying function which in a criminal process will be realized by concepts. For today part of research workers and practical workers suggest in general to liquidate the institute of concepts in the criminal legal proceeding, or substantially to narrow the list of consequence actions which they must be present at. For example, in opinion of R.S.Belkin, concepts must take part only during the leadthrough of search. And, not in an order to protect a law from an investigator, but, to protect an investigator from slander, that he knocked up something in the place of search and then „found" out it, whether he took away something from the place of search and did not note about withdrawn in protocol [1, s. 211].

Other research workers consider the maintainance of institute of concepts archaism which is not instrumental in an operationability and clearness of consequence actions, and only testifies to the mistrust of judicial law an investigator [5, s. 163].

It is scarcely possible to accede to such going near this judicial institute. Concordantly st.127 of KPK of Ukraine concepts, present at realization of consequence actions, certify the signature accordance of records in protocol the executed actions. It means that their presence is directed on providing of guarantee in relation to the possible checking of motion and results of consequence actions for their accordance of law. Especially it touches those consequence actions during which the subjects of criminal process are perceive the considerable volume of evidential information directly, thus from different sources, and this information is easily added curvature, falsification.

As justly mark M.Vander and V.Isaenko, an investigator is above all things interested in the presence of concepts, as they provide the maintainance of valuable proofs, help to refute assertions which do not answer reality, create terms for the effective directorate of public prosecutions. In a judicial right for the entire developed countries the known participants are with functions,

analogical the certifying actions of witnesses. For example, in France are witnesses, in the USA are disinterested persons which deserve not inferior polices trust, in Great Britain are witnesses which are present on call of the searched person [2, s. 4].

Analysing international experience and domestic investigation practice it is needed to underline that the institute of witnesses has a right on existence and it follows to save him. However much it costs to change going near his use. Thus there is not a necessity expressly to determine the list of those consequence actions during the leadthrough of which there is an obligatory presence of witnesses on the modern stage. Their use must depend on will of investigator, as it is today certain a legislator in relation to such investigation action as examination.

Summarizing contained, it should be noted that the process of providing proofs in criminal business in accordance with the current legislation of Ukraine contains the difficult associate in theory is grounded and the concerted character is practically organized. Effectiveness of the proper providing proofs in criminal business is formed from important constituents which are expressly certain in a criminal procedure legislation and a failure to observe or violation of them in end-point will affect quality of the investigated business.

References

1. *Белкин Р.С.* Криминалистика: проблемы сегодняшнего дня. – М., – 2001. – 264 с.

2. *Вандер М., Исаенко В.* Объективизация доказательств по уголовным делам. //Законность. – 1996. – № 10. – С. 2-5.

3. *Кузьмичов В.С.* Слідча діяльність: сутність, принципи, криміналістичні прийоми та засоби здійснення: Автореф. дис. д-ра юрид. наук. – К., 1996. – 36 с.

4. *Маслов А.Е.* Характеристика сведений, составляющих тайну предварительного расследования //Воронежские криминалистические чтения. – Вып. 2 – Воронеж, 2001. – С. 80-86.

5. *Трухачев В.В.* Преступное воздействие на доказательственную информацию. – Воронеж, 2000. – 223 с.

6. *Грошевой Ю.М., Стахівський С.М.* Докази і доказування у кримінальному процесі. Науково-практичний посібник. – К.: КНТ, Видавець Фурса С.Я., 2006. – 272 с.

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IMPACT OF THE ADMINISTRATIVE LAW ENFORCEMENT ON THE STATE OF PERSONAL SAFETY

While considering the problem of personal safety, special attention should be paid to legal mechanism efficiency that ensures this safety. Theoretical division of the legal mechanism into units helps identify the efficiency of its work. Firsly, work of the mechanism should be evaluated in full, as a whole phenomenon; secondly, it's determined by the function quality of its individual blocks, parts and components.

The problem of legal mechanism efficiency to ensure personal security is versatile. It affects different aspects: physical, procedural, international norms and principles, as well as regulations, international agreements and treaties; activities of various social institutions of civil society, including the state and its institutions; international governmental and non-governmental and intra-governmental human rights organizations; procedural political and legal mechanisms of human and citizen rights protection, international and internal control mechanisms (governmental and nongovernmental) to secure human rights.

To determine the efficiency of legal mechanism means to enrich its academic characteristics; create preconditions for practical approach to improving protection measures and protection of human and citizen rights; determine value priorities of individual's interests in various spheres - economic, political, cultural; determine readiness of citizens to defend their rights and freedoms, and individuals' relation to the proclaimed by Constitution of Ukraine rights and freedoms, develop the system of justice effectiveness, activity of law enforcing bodies, other state and international community human rights institutions.

The problem of legal mechanism efficiency foresees consideration of indicators and performance criteria, basing on both broad and narrow interpretation of this phenomenon. However, the efficiency criteria of human rights differs from the efficiency criteria of citizen rights, as the source and scope of human and citizen rights do not coincide, i.e. studying the mechanism of individuals' rights protection, one should take into account the characteristics and nature of interconnection of natural and positive law's norms and principles, it does not mean, though, the primacy of natural law over the whole system of positive law, and can be considered from this perspective: notion "system is the source, content and implementation of the guarantee". The value of this approach is in its possibility of a fresh look at the criteria and guarantees of human and citizen rights, as well as possibility to conduct the scientific audit.

The fact of legislative establishment and strengthening the legal guarantees system is not indicative of the quality of human rights. The law stipulates in its rules only the static beginnings of mechanism of citizen rights protection together with the guarantees system. The dynamics of this mechanism in real life is associated with the organizational work of the governmental bodies and the population activity, and is inalienable of the officials' legal consciousness and culture. Regulatory, institutional, procedural and organizational elements of the legal guarantees system will function effectively, provided the system is based and operate on the principle of "guarantee to guarantees".

Notion of efficiency in general and efficiency of legal mechanism to ensure personal safety, in particular, provides an element of comparison. It's always important to know which methods, means, conditions, and factors bring the expected results, and which ones operate with less efficiency.

Thus, the level of legal status of criminal process participants and the victim allows us to judge about the overall protection of citizen rights and freedoms. At authoritarian methods of government the following happens: "permission of Publicity in the state is a dictate of moderate language and awareness, Freedom is a dictate of conscience, Democracy is a dictate of freedom, but weak standards, which include people interests, is demagoguery of power, embodied in law".

The efficiency can be judged by the nature of economic, political, moral, legal conditions, first, the economic potential, that can fully satisfy the needs of the country and population, as well as social justice: second, the system of general and special guarantees of human and citizen rights and their responsibility before the law, third, publicity of public opinion in a democratic society; fourth, system of internal political and economic stability, property protection, public and personal security of individuals.

The efficiency of legal mechanism to ensure personal safety is measured by formula: “goal - means – result”, which is attractive, but dangerous, as various life collisions can establish whether democratic or antidemocratic regimes.

It’s difficult to study the efficiency, excluding the goal and the results. Even the opponents of “actual result and goal ratio” concept acknowledged it. L.L. Popov, criticizing the views of M.D. Shargorodskyy on the subject, gives a general definition of efficiency through the "dimension", the research degree of any purpose (task).

Arguments of the ratio concept opponent are convincing. But the formula of efficiency, especially in the field of human rights, should be used in relation to the terms "reasonableness", "legality", "optimality", i.e. that "reasonable goal - legal means - better results”.

Reasonable goal is a harmony of human interests, and the regulatory strengthening of obligations of a legal, social state is to serve the interests of people and society; legal means are antipodes of confusion, irresponsibility, moral disbeliefs; best results are the consequence of "reasonable goals" and "legitimate interests”.

Formula "reasonable goal - legal means - the best results" is attractive, but it is of ideal character.

The study of the efficiency of rights and freedoms is devoted much attention in the scientific literature. This notion, first of all, depends on the subject and object of research.

The efficiency of the studying phenomena is topical and problematic in the field of human rights. It concentrates on all rights and freedoms of individuals, proves the need and efficiency of legal institutions, as well as various intra-governmental and international human rights organizations.

Of course, legal mechanism efficiency to ensure personal safety is a model, structure, consideration of factors of legal regulation expediency in social relations and consciousness, legal culture of citizens and officials, law-making and enforcement.

The core efficiency of the studying mechanism is moral, political, and legal consciousness of individuals, the typical measure of quality determination of all its structural elements. Law awareness acts as a generalized indicator of the efficiency of social and legal mechanism to ensure human rights.

The efficiency of legal mechanism to ensure personal safety is multifaceted. One of the facets is a comparative evaluation of individual elements efficiency, such as publicity and public opinion.

Comparative evaluation of publicity and public opinion is based on the analysis of their qualitative characteristics.

Publicity is an indicator of society openness, an important evaluation criterion of spiritual freedom. Public opinion can be both a publicity index and its driving force. Correspondingly, public opinion and evaluation criteria, despite their identities, do not coincide in content. Of course, the generalized indices of publicity and public opinion are not excluded, when the state assumes the "concern" of their supervision. It concerns incentives and restrictions in the system of publicity and public opinion. According to A.V. Malko neat expression, the legal incentives and restrictions are peculiar generalized means of efficiency, operating at both normative and individual regulation. A.V. Malko examines the concept of efficiency in correlation with social values, defines it as the degree of implementation, achievement of appropriate values. He believes that the efficiency itself acts as an accomplished goal-value, effective value or valuable result, the quality of the implemented value (utility). This is exemplified by publicity and public opinion.

Publicity and public opinion are important democratic values. They help to meet various needs of society and personality -: spiritual, spiritual and practical, expanding and practical. Information acts

as a form of meeting these needs and, simultaneously, a typical efficiency measure of publicity and public opinion. In its turn, the information efficiency depends on the objectivity, efficiency, content accessibility, volume of broadcast time or print space.

The efficiency of such social value, as a mechanism of human rights performance, requires in relation to itself the awareness of certain conditions, specifically, awareness of the fact, that the main efficiency conditions refer to investigated social value, and the latter, having been implemented circumstances, creates its efficiency. In the legal literature scientific disputes related to circumstance problems, factors and efficiency conditions arose many times. Scientists made unsuccessful attempts to categorize and systematize the efficiency conditions, to delimit efficiency conditions and factors, to develop common and private methods of studying conditions and efficiency. With the whole complexity of scientific grounds the main idea always remained the same: the social value is one of the mandatory conditions (preconditions) of its efficiency. V.M. Fatkullin wrote: "Effective are those processes that contribute to the natural social development. If the social value is imaginary, objectively it has no efficiency.".

Recognition of the highest value of human rights and freedoms serves as a barrier for a state, its authorities and officials, and prevents the absorption of society by the state, as it happens at totalitarian regimes. The state must not only recognize, but strictly observe and protect the rights and freedoms, while citizens can not only take certain affirmative action, but also use material and spiritual benefits, meet their diverse interests and needs. The legal conditions, which contribute to the quality of law enforcement in the field of human rights, are a perfect law, legal procedures, established by regulation, legal status of executive authorities and expanding the scope of their power, constitutional control.

Central place among the mentioned conditions is given to constitutional norms. Effectiveness of these norms in the field of human rights B.S. Ebzeyev identifies through the legality of citizens' constitutional rights and freedoms; conscientious execution of constitutional responsibilities by the citizens, creation of tangible and intangible benefits, that are transmitted in individual use with the help of subjective rights, and their protection; fair distribution of the accumulated social benefits between the society members, creation of necessary conditions for unimpeded use of these social benefit.

Unfortunately, citizens do not always pay attention only to reasonableness and optimality, but also to every day social value of constitutional requisites. Although these requisites reflect the objective life needs, people interests are the legal basis for their achievement. Transferring the needs and orientation in the plane of subjective rights and interests, protected by Basic Law, constitutional rules provide reliable guarantees and ensure their implementation. Thus, the notion of legal mechanism efficiency to ensure personal safety, on the one hand, should be understood as a set of circumstances, that consider a man as the highest value, on the other - factors, which availability or changes affect the level, methods and action techniques of an individual, as well as social institutions to implement this higher value. Thus, increasing of legal mechanism efficiency to ensure personal safety is favored by the economic, political and ideological factors. Economic factors are the actual equality of all property forms, which is an important condition for improving the individual's business activity. Political factors are further democratization of social life, development of civil society. Ideological factors - aimed, systematic propaganda of ideas about the priority of human rights. These factors determine ways of improving the legal mechanism to ensure personal safety at the international and national levels: development of international partnership in the humanitarian sphere, creation and revitalization of existing governmental and nongovernmental organizations, that specialize in human rights implementation; definition of inter-regional and regional policy in terms of forming the common minimum standards to ensure citizen rights, etc.

The analysis of legal mechanism efficiency to ensure personal safety should be based on the principal of methodological assumption, and the presence of subordinate relationship in it. They should be considered when assessing the efficiency of social norms and institutions, general and special guarantees, monitoring, oversight, publicity and public opinion. The important result of this analysis will obviously be rational theoretical and practical suggestions that will contribute to enhancing the social and legal protection of individuals.

SYMPOSIUM 9

CONTINUOUS EDUCATION. UPGRADING AND RECURRENT TRAINING

UDC 005.8:005.94 (045)

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THE INTEGRAL METHOD OF ESTIMATING KNOWLEDGE IN THE PROCESS OF AVIATION SPECIALISTS TRAINING

Integral method of estimating the level of aviation specialists training at in-plant training in the system of additional vocational training is considered here. Learning objectives in this system are formed and modern approaches to estimating the education quality are described in the article.

A modern concept of the social development is based on the necessity of continuous development of technologies and an increase of scientific potential of every enterprise. Another goal lies in an increase of professional knowledge of every member of the society. Its intellectual component is a most important strategic resource of innovative potential of the society. Thus in the work [1] modern society is considered as a well-organized and manageable system in which the main priorities are: provision of a wide range of services to the population, carrying out fundamental and applied scientific research within the frames of state and private programs, educational system development. The main group of professionals which provides functioning of this system is the group of technical specialists. Economic results of their work mainly depend on the level of their theoretical knowledge. So, the primary role in creating new intellectual technology is played by a class of information carriers, who accumulate and use theoretic knowledge. The information assimilated by the carrier in the training process becomes his subjective, personal knowledge which is inseparable from the personality of the carrier and can develop only together with the subject.

In this context qualitative changes in technologies and technical equipment in many ways define economic development of the country as a whole. Positive dynamics of the development becomes possible with applying the appropriate level of intellectual resources that are directly related to the quality of higher and additional vocational education.

The marked characteristics are gaining a greater importance and every employee in aviation sphere should correspond to them. All mentioned above imposes certain requirements on the process of forming important professional qualities of future specialists while influencing the architecture of educational process.

Competence of a modern specialist is considered one of the most-to-date characteristics. The presence of necessary knowledge in particular sphere is now becoming only one prerequisite of getting a job and does not guarantee a successful professional career. For example, in [2], the author points out that such specialist qualities as ability to navigate in a large flow of information acquired by practical skills, quick adaptation to external changes and the ability to self-development are increasingly importance in today.

Thus, we are observing a global shift in economic paradigm which influences an evolution of qualitative characteristics of educational services, forming qualification requirements to personnel and putting new educational goals. In this context, a professional training level of specialists in the in-plant system of additional vocational education acquires a qualitatively different level of importance.

Specialist training within the system of additional vocational training differs from learning within a traditional higher education system. The differences involve the need for specific knowledge and skills, as well as deepening and getting new knowledge in a professional sphere, which is reflected in the formation of educational objectives in the system of additional vocational training.

Formation of educational objectives includes such components as:

- Cognitive ones, which include knowledge(concepts, notions, rules, modes of action) and skills (clarification, application, analysis, evaluation and solution of a problem);
- Affective ones, which are based on subjective attitude (reaction to the situation taking into account the system of values);

- Psychomotoric built on behavioral aspects (execution of manufacturing operations, building a line of conduct depending on the circumstances).

The mentioned above components directly influence the formation of approaches to evaluating the quality of education. The major types of approaches to evaluating the quality of education are the following:

1. An approach to the perception that takes into account a subjective assessment based on emotional perception of the quality of educational services by a man.
2. An approach focused on the qualitative characteristics that are the corner-stone of the development of educational programs on the basis of measuring characteristics of training levels.
3. A production approach based on observance of standards and regulatory documents in order to achieve the required quality of education.
4. An approach from the consumer point of view where the major criterion is the degree of meeting the consumer's needs.
5. An approach based on value characteristics of education quality for meeting the consumer's needs with assessment of the funds spent and the maximum effect from their use.
6. A qualifying approach from the standpoint of the student's future professional activity which takes into account the person's ability for self-organization in the working place.

Analyzing the existing types of approaches to assessing the quality of education, we can conclude that the main criteria affecting the quality of training are:

- Policy and strategy of development as well as mission and target set by the educational institution;
- Procedure of students' recruitment;
- Nature and content of training programs;
- Teaching methods and links of the programs with practice;
- Resource and information provision of the training process;
- The qualification of the teaching stuff and its participation in the scientific research activities;
- Confirmation of the status of programs implemented at the primary accreditation by public authorities;
- Independence of the influence of the educational institution on the content of the programs and the procedure of their implementation.

One of the main indicators of the quality of the educational process is the level of competence of the future specialist, determined by different methods of control. In this case, at evaluating the level of students' mastering educational materials such factors are taken into account: an ability to reproduce the main elements of the knowledge bulk and their application for solving typical tasks of the students' specialization; using the knowledge bulk to meet new challenges while acquiring new knowledge.

We should state that it is rather difficult to objectively assess the quantitative indicators of the level of students' knowledge if we use only current indicators of their progress. That's why the problem of objective assessment draws the attention of many scientists and teachers of higher educational establishments. For example, in the work [3] methods of quantitative evaluation of students' knowledge are presented. According to it, the basic assessment of every student's knowledge level is calculated, then a system of additional scores (premium) begins to work. These additional scores are presented in the form of weight coefficients. Such accumulative method lets to make a quantitative assessment of the knowledge level as a system of summarizing the premium scores is on. As the authors say, it leads to stimulating students' independent work and a rise of their personal activity. This method of evaluation is based on the Bologna principles [4], where this accumulative system is an indicator of the level of students' learning the material and, at the same time, it stimulates personal activity of a student.

But, taking into account the specificity of specialist training at in-plant training in the system of additional vocational training together with the priority of needs of the customer and practical application of the received knowledge, the model described in the work [] pays attention to and es-

timates only one component and does not give a possibility to estimate the diversity of aspects in specialists' training.

There are many methods which are used for assessing qualitative indicators of the students' knowledge level. They are:

- Methods of peer review,
- Methods of assessing the quality of student's training,
- Testing,
- Module and rating systems of evaluating the quality of students' knowledge,
- Quality monitoring,
- Diagnosis of students,
- Portfolio method, which contains individual educational achievements, assessment of competency level and student's educational rating.

Carrying out a qualitative assessment of knowledge we can get quantitative meaning of every parameter which is being estimated. In our opinion, such parameters are:

- A level of studying the training material by the specialist;
- An ability to apply the received knowledge in practice;
- Acquired skills;
- An ability for creative and scientific approach in solving manufacturing tasks;
- Creativity and ability for concentration;
- A positive psychological attitude to professional duties.

We believe that all the indicators mentioned above should be considered as an integral unity. These criteria of estimating combined into an integral system give an opportunity to assess a synergetic effect and they also let us give comprehensive characteristics of a specialist's training and his potential as a professional.

We propose to visualize the received results using a reflection in a polygon. The data are depicted in a diagram built in polar coordinates in the form of a hexagon. The same approach is used in different spheres of studies for visualization and comparison the received data [5, 6]. The quantity of facets depends on the quantity of parameters compared. We compare 6 parameters of assessing the quality of a specialist training, so we shall use a hexagon for visualization. The meanings of the criteria are plotted in the axis of the hexagon, going from the center along the radius. 2 meanings of each parameter are plotted on the same axis of the diagram: the necessary level of knowledge (customer's requirements) and the current meaning of the level of knowledge according this criterion. In figure 1 one can see the example which illustrates this method.

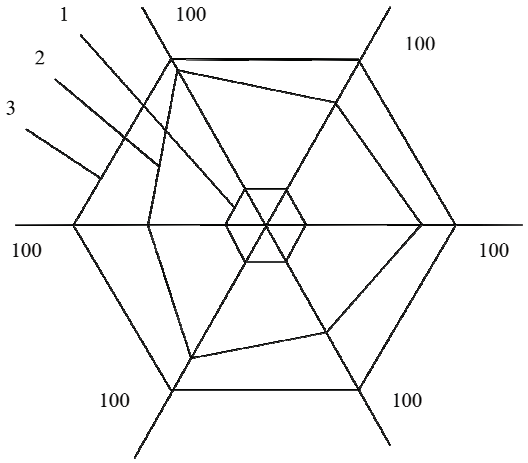

Fig.1. Graphic illustration of the method

All the current marks of the students are plotted in the diagram according to a 100- score scale (curve 3). Curve 1 corresponds to minimum criteria of estimation of students' progress. A figure is built, which illustrates quantitative estimation of the student's progress.

The restrictions and assumptions used:

1. The parameters under control should have a quantitative expression and a 100-score scale of evaluation should exist foe each of them;
2. The parameter is plotted on the axis according to this 100-score scale.

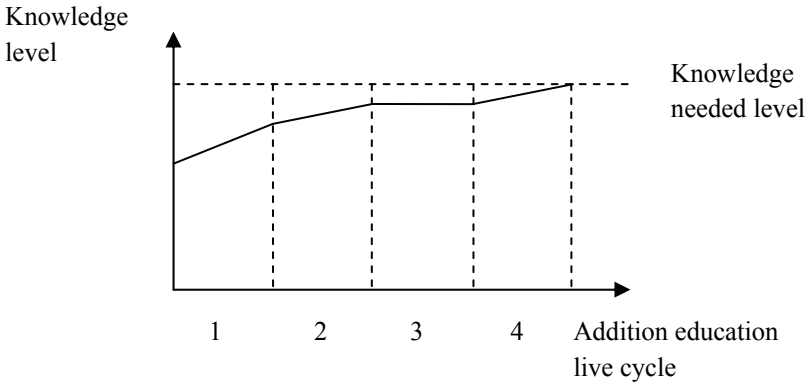

Fig.2 Stages of additional education cycles

An integral estimation of the level of student's training is made in several stages during the whole cycle of training. This cycle can be presented as a live cycle of a specialist training project. The stages of the live cycle are:

- Initial, during which the main terms and concepts come into use.
- Reproductive. During this stage students use the received knowledge with the aim to reproduce the main elements of the knowledge. Seminars, conferences and individual work are the tools used at this stage.
- Simulative – professional. The knowledge is used for solving practical tasks. Practical works, laboratory tasks, individual tasks are the tools at this stage.
- Creative (professional). At this stage the student masters his skills and creative ability using such forms of studies as discussions, conferences, management games, project making and conducting research according to the chosen theme of his diploma.

References

1. *Inozemtsev V.L.* Modern post-industrial society: nature, contradiction-being, the prospect: Training manual for high schools. / V.L. Inozemtsev. - M.: Logos, 2000. – 304p.

2. *Ignatiev E.Y.* Knowledge Management in the management of quality of educational process in the higher education: monograph / E.Y. Ignatiev: Novgorod State University of Yaroslav the Wise. - Velikiy Novgorod, 2008. – 280p.

3. *Glaser P. G.* Methods of quantitative assessment of student knowledge / - M.: Journal "Herald of the Finance Academy" 3 / 2009, p. 40-45.

4. The Bologna Process: Bregensky stage / under the scientific editorship of V. Baydenko. - M.: ITSPKPS, Russian New University, 205. 174p.

5. *Tkachenko, V.V., Velikanova L.O.* Models and methods for improving the management of grain production in the northern zone of the Krasnodar Territory. Krasnodar: scientific journal of the Kuban State Agrarian University, № 37 (3), 2008. 21p.

6. *Polkovnikov A.V., Dubovik M.F.* The introduction in a corporate system of project management: risks, success factors, choice of strategy. - M.: Journal of Project and Program Management, 01 (05), 2006. p.42-49.

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THE MODEL OF PILOT SKILLS TRAINING

The model of pilot skills is observed using compatible flight and simulator training. The moments of time of switching between kinds of training which are optimal of minimal values and minimal time training criteria are found. Also the regularity of optimal decisions using variation of relative value of flight training and asked level of knowledge is determined.

Task of level increasing of professional preparation of specialists in aviation considered in many publications [1-4]. It is stipulated by the new going near providing of safety of flights, by the making progress deficit of flying shots and considerable resource charges in the process of their preparation. Meaningfulness of the transferred factors grows in the conditions of economic crisis, especially for the states which build the system of the professional training of flying personnels.

Important direction of pilots skills training is optimization of time distribution between flying and trainer preparation [3]. Further realization of theoretical results of optimization in practice is possible on condition of exposure of conformities to law of optimal decisions depending on the changes of parameters of studies. These conformities to law must become basis of administrative decisions at electing of strategies of studies.

Requirements to time of flying and trainer preparation are contained in international and national standards from preparation and certification of flying composition. Traditionally the level of pilot qualification and permission on the management of airplane a corresponding type are determined by hard requirements to the amount of time in flying practice. By the example of the modern going near methodology of pilots training, which is characterized by the considerable increase of time of trainer preparation and reduction of general time there is the program of preparation of pilots of polynomial crew - Multi - Crew Pilot License (MPL). For realization of competent approach at program of MPL development international organization of ICAO recommended to use methodology of development of courses of ISD (Instruction Systems Design), which allows to set intercommunication between skills and abilities for the some job processing and corresponding program of professional preparation.

But in the considered approaches absent ground of requirements to distribution of flying and trainer preparation, that does not allow to accept reasonable optimal decisions in relation to strategy of studies of pilots both at the use traditional and competent approaches.

Will define conformities to law of optimal decisions on the criteria of a minimum of cost and a minimum of time of studies of pilot at the change of parameters of processes of studies at the compatible use of flying and trainer preparation.

As base dependence of model of pilot skills at the compatible use of flight and simulator preparation logistic dependence [is select 1, 2] as ordinary differential equalization which shows the dynamics of increase of pilot skills as a result of flight

$$\frac{dx_L}{dt} = k_L x_L (a_L - x_L), \tag{1}$$

where x_L is a level of pilot skills, k_L, a_L are coefficients, t is time. Training is described by equalization:

$$\frac{dx_T}{dt} = k_T x_T (a_T - x_T), \tag{2}$$

where x_T is a level of pilot skills, which is attained as a result of training, k_T, a_T are coefficients, a_L and a_T show the maximally possible level of pilot skills which can be attained by some training

level. By experts data, these values are a_L = 0,85 – 1,15; a_T = 0,35 – 0,65. In our the investigation a_L = 1; a_T = 0,45. As $a_T < a_L$, the pilot skills training can be used in this case $x_L < a_T$.

Different levels of pilot skills x_L (that must be attained to the end of the training) are equal to the different terms of further admitting to the flight:

x_{L_level} = 0,3 is simulator training with an instructor;

x_{L_level} = 0,5 are independent flights on the simplest program;

x_{L_level} = 0,7 are independent flights on the program of middle complication;

x_{L_level} = 0,9 are independent flights on the pilot level.

It is possible to introduce other levels of preparation, training of crew commanders, as an example. A correct choice of preparation necessary levels is important for the different models of both flight and simulator training. For example, simulator training begins with a zero level for tasks of initial pilots training, the imitation of nonpermanent situations on simulator is not so important as for the increasing of pilot level. For the tasks of increasing pilot level, adaptation at the work condition change (approbation of the route, establishment of new equipment).

Simulator training can have negative consequences. It is of the people which studies in conditions of absence of the real influence of external factors, feeling, surplus self-confidence, groundless risk of behavior. It is necessary to add to the previous equalizations:

$$\frac{dx_{Tm}}{dt} = k_{Tm} x_{Tm} (a_{Tm} - x_{Tm}), \tag{3}$$

where x_{Tm} is a level of negative influence of simulator training on pilot skills, k_{Tm}, a_{Tm} are coefficients. In usage of simulator training this constituent reduces the general level training x_L, but with the beginning of flight training realization its action goes down. Here is the complete model of flight and simulator training:

$$\begin{aligned} \frac{dx_L}{dt} &= k_L x_L (a_L - x_L); \\ \frac{dx_T}{dt} &= k_T x_T (a_T - x_T); \\ \frac{dx_{Tm}}{dt} &= k_{Tm} x_{Tm} (a_{Tm} - x_{Tm}). \end{aligned} \tag{4}$$

By means of the simplified model (4) there was the executed design of initial preparation of pilot at one switching from trainer on the flying stage studies (fig. 1) [3]. Resulting dependence consists of simulator x_T and flight training x_L; dependence x_{Tm} characterizes negative influence of simulator training; c is charges on training.

The choice of correlation of time of flight and simulator preparation for optimization of expense of resources behaves to the tasks with a few objective functions, which can be contradictory and arrive at a maximum in the different points of great number of alternatives (multicriterion tasks). The decision of such tasks is not possible without the synthesis of effective and suitable for practical application multidimensional model which characterizes dependence of quality of studies on the spent resources.

For being of optimal moment of switching time t_2 from a trainer on flying preparation there was a model dynamics of studies for all possible sizes t_2 (with a certain step) within the limits of region of acceptability. Both for dependence of cost of preparation $C(t_2)$ and for dependence of time of preparation $T(t_2)$ optimal (minimum) values (fig. 2) are found [4].

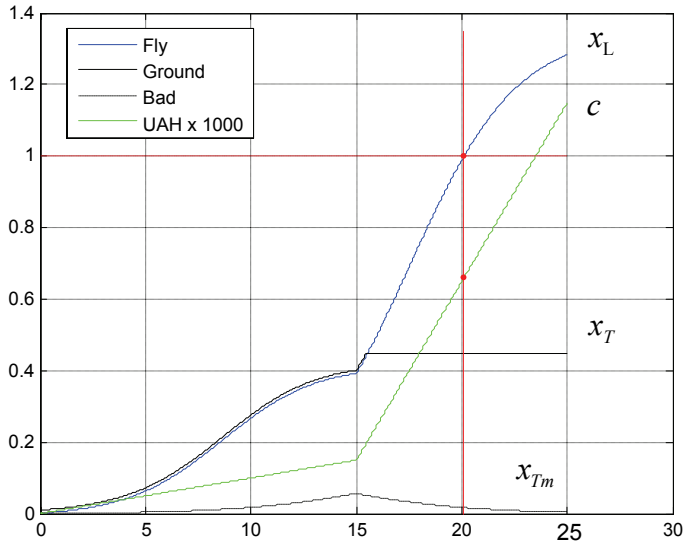

Fig. 1. Results of modeling of compatible flight and simulator training of pilot

The found decisions are optimal on contradictory criteria. In first case it minimum costs $I_C = \min_{t_2}(C(t_2))$, in the second case is minimum to time of preparation $I_T = \min_{t_2}(T(t_2))$. The first criterion it is expedient to use for primary to preparation of pilots which do not have a practical experience or at the selection of candidates for further studies. The second criterion is at retraining of operating pilots on other type of airplane, at mastering of new equipment or at preparation of soldiery pilots in military time.

At investigational problems most interest presents opening of nature of optimal decisions depending on the change of physical terms of process which is optimized. In our case by the most influential factors the possible level of preparation x_{L_level} (what we can vary from 0.5 to 1, x_{L_level} = {0.5, 0.75, 1.0}) and size of cost of types of preparation is inflicted minimum. Additional researches showed that optimal size of time point t_1 from one on other type of preparation practically does not depend on the absolute values of cost of types of preparation (here and farther there is a cost of time of preparation unit), but depends on correlation of their costs. As trainer preparation cheaper, then her cost will take for unit (dCT=1), and the relative value of flying preparation will vary in a range from 2 to 160 with a step 5 (dCL=2:5:160 in notation of Matlab), that embraces practically all range her possible values. The results of optimization design are brought around to fig. 2.

Here presented sizes of optimal time t_1 of switching from one on other type of preparation for optimization on the criterion of a time minimum preparation $T1_T$ and criterion of a cost minimum preparation $T1_C$. We have graphics that depends of optimal to time of yTT and costs of yCC. All graphic are depends on the relative value of flying preparation (dCL=2:5:160).

All four types over of charts are brought as families of dependences for the different sizes of the inflicted level of preparation x_{L_level} = {0.5, 0.75, 1.0}. In all families of optimal sizes of yTT(dCL) and yCC(dCL) dependence for x_{L_level} =0.5 is from below, and dependence for x_{L_level}=1.0 is from above. During optimization on the criterion of a minimum of time of preparation, all three graphic arts for optimal time of switching (dCL) coincided (id est during optimization on this criterion an optimal decision is invariant to the size of the inflicted level of preparation) fully. It follows notices, that during optimization on this criterion and optimal time of switching and optimal size of time of preparation do not depend (invariant) on a relative value flying preparation.

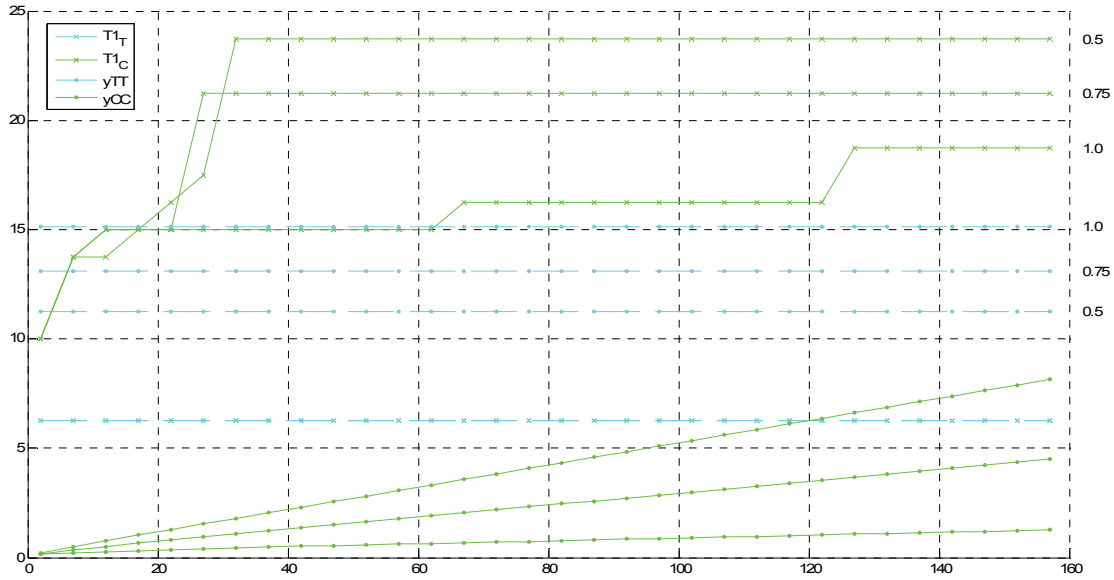

Fig. 2. Dependence of optimal decisions parameters of the inflicted levels of training x_{L_level}={0.5, 0.75, 1.0} and a costs of simulator (dCT=1) and flight (dCL=2:5:160) training

We have the other situation during the optimization on the criterion of a minimum cost preparation. Optimal size of a preparation cost practically straight proportional relative value of flight training. But the optimal time size between the types of training $T1_C$ (dCL) has difficult character and consists of area increasing next to the increasing of flight training dCL and stabilizing area where $T1_C$ =const. Depends on x_{L_level}={0.5, 0.75, 1.0} the order of graphics is reverse. Thus, dependence $T1_C$ (dCL) for a case x_{L_level}=1.0 is down, and dependence for x_{L_level}=0.5 is up.

The found decisions expose conformities to law useful to determination of optimal strategies of educational process control. Decisions testify that optimal dependences are not obvious and in every case require the careful construction of model and implementation of corresponding process of optimization. On preliminary estimates optimal decisions for the accepted raising of task provide studies cost effectiveness from 4 до17%.

Thus, the model of pilot skills is observed using compatible flight and simulator training. The moments of time of switching between kinds of training which are optimal of minimal values and minimal time training criteria are found. Also the regularity of optimal decisions using variation of relative value of flight training and asked level of knowledge is determined.

References

1. *Савінов О.М.,* Бобрович Моделі оперативного прогнозування якості навчання фахівців технічного профілю // Зб.наук.праць ЦВСД НУОУ. – вип.1(39). – К.:НУОУ. – 2009. – с. 75-79.

2. *Савінов О.М., Поривай О.В.* Багатовимірні моделі прогнозування якості навчання // Зб.наук.праць ЦВСД НУОУ. – вип.2 (40). – К.:НУОУ. – 2009. – с. 100-106.

3. *Савінов О.М.* Модель навченості льотчика при сумісному використанні льотної та тренажерної підготовки // Проблеми інформатизації та управління. Зб.наук.праць інституту комп'ютерних технологій НАУ. – вип. 1 (29). – К.: НАУ. – 2010. – с.145-149.

4. Руководство по управлению безопасностью полетов (РУБП). Doc 9859. Издание второе. Международная организация гражданской авиации. 2009.

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FACTORS INFLUENCING PROCESS OF INTEGRATION OF ADDITIONAL PROFESSIONAL EDUCATIONAL SYSTEM

At the present stage of development of economy and society the top question is the integration of additional professional education, state government, business and influence of the process to the labour market. Necessity to update education, vocational training arises each time when the person faces the new phenomena in professional and private life.

"I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me." Sir Isaac Newton.

For today, the main feature of changes in society is the process of globalization of economics due to appearing multinationals corporations and financial structures. However, the quantity of small and middle enterprises is quickly increasing. Our civil aviation has been rapidly gaining altitude since year 2000 but now it is running the risk of loosing the positions it has already achieved. Some airlines that used to qualify for leadership recently are bankrupt today. Some outsiders leave, others have to sell the companies to stronger and more successful airlines. Delocalization of the enterprises leads to cardinal changes of migrations in the labor market. Above mentioned processes occur within the demographic crises; what make a big problem for the state, economics, labor market and educational system. But, may be, the most difficult problem is internalization of the culture, social mind, education and those' processes which are closely connected to financial and economic activity. From the one side there is a need of internalization of the education, for example, the Bologna Process, from another side we need to keep the best national traditions.

In this content the very important thing is cooperation and integration of the main forces of the society and the higher education system. That means the good cooperation between state government, parliament, business, labor market and mass media.

The world is running and changing, the content and face of the higher education and additional professional education are also modifying. The main difference of the additional professional education lays in uniting of scientifically-informational and educational functions which is the most similar to people' and business' needs. Modern labor market is globally changing. There is a distribution and redistribution of experts and specialists, including experts of aviation branch in common and experts of flights' safety in particular, to other spheres of a national economy and on the contrary. That is why the system of the additional professional education took an honor place in society.

Manufacture of the information and new knowledge carry out science and education. But in itself, without cooperation of labor market, business and education is not derivative factors of development of economy. A science which makes new knowledge, and education which prepares the qualified specialists for a national economy first of all create necessary conditions for economy development, but realization of these conditions is carried out only in the course of manufacture and business, thanks to the human factor. Today the person acts as a principal cause of self-development and self-education of society and its professional and business structures. The people factor is the central feature in rapid modernization of any business, and of social level of any industrial branch. The main goal of the additional education system is collaboration of the processes of professional socialization of the person, and rapid adaptation of the person to the professionally productive system of the society. The main task of the additional education system can be considered as the education of professionally socialized person. To reach this goal we need to coordinate the efforts of all related centers, and first of all, the bases of such coordination should lay down in the standards and

programs of additional education system, what should be supported by state government and business structures accordingly.

So we can say that additional professional education is system making component of scientifically-educational-social-professional infrastructure, what is forming round itself the especial innovative, informative and communicative sphere. The integration of the additional professional education system into existing social-economical sphere and modern model of the labor market we can consider as the main precondition and the important way of its maintenance, of its effective functioning according to national interests of the country and interests of different spheres of the population.

The question of cooperation and integration of education, of additional professional education are researches of domestic and foreign scientists. For example, O.Golichenko [1] considers a question of integration from a position of adjustment of effective systems of cooperation and specialisation between participants of this process, O.Amosha, A.Zemljankin, G, Moiseev suggest to improve interrelation of a science, education and industrial production by creation of scientifically-educational or educationally-scientific complexes with attraction of the business. Remote education has arisen in 1840 - Isaak Pitman has offered students training through a mail service. It should be noted, that the questions of principles of additional professional system integration are discussed and found its improves on the international level, for example, international recommendations for professional education,1962: 'the state organizations and different public or private organizations who are involving in educational process in every country, should be free to have initiatives and should support adaptation to the needs of different economic branches, administrative districts and lands, should cooperate for the development of totally coordinated terms and conditions of education' [2], the Bologna Process. The analysis of existing researches and publications shows that the question of modernization and adaptation of the additional professional education system remains not enough worked out, and also, that in modern conditions the Ukrainian legislation in sphere of integration of system of additional vocational training stays at a formation stage.

From the point of view of a substantiation of logic of research, communication between processes of public transformations, on the one hand, and transformations to an additional professional education systems, - on the other hand, allow to define the following methodological scheme of the complex analysis:

- the analysis of the current social-economic sphere and the main directions of structures' modifications;
- the formation of demands to integration of additional professional education system, that should be oriented to VIP components: state, business and people interests;
- the examination of existing additional professional education system, labour market;
- the definition and a substantiation of stages of modifications' shifts in an education system with an estimation of their influence on a labour market;
- the consolidation of the practical methods of reforms in the additional professional education system, which will be absolutely correct in accordance with social-economic-labour market situation on the every stage;
- definition of the legal status of integration structures, the mechanism and an order of their creation and functioning;
- creation of methods of the state supports of process of integration.

Thus, an education system, for example, from the point of view of equation of a supply and demand on a labour market and qualities of the characteristic of a labour in the conditions of transition to innovative model of developments have, out of doubt, paramount value for economy and for business and direct increase of a standard of life of the population.

The analysis of the present situation in the additional professional education system gives us the possibility to make conclusion that its standards, programmes and methods should include innovative, multilinked and differentiated subsystems according to force of their influence. Construction of the good strategy and tactic of additional professional education system demands the complex view on decision of economic, social and demographic problems, which have direct influence and appoint its situation.

We think, one of the main task of additional professional education system, which will give an opportunity at the present situation to prepare the specialists of the highest level of qualification, who can easily be adopted to labour market, to be mobile, to be ready to self-realization on today's reality is coordination of work plans and programmes and avoiding of self repeating in curriculum.

The National programme 'Education Ukraine XXI century' had been planning to supply all necessary for development of education on the basis of new progressive concepts, involving to educational process innovative pedagogical technologies and scientifically-methodological researches, creating new information system of education, to provide entrance of Ukraine to intercontinental computer's informative system. In the same time, we strongly believe that, methodologically important principal of additional professional education system should be based on the self- and distance education. The correct usage of its will lead us to:

- appearing of new opportunities to renew a content of education and curriculum methods and absorption and presentation of knowledge;
- widening of exit excess to all educational levels, realization of possibility to graduate for many people, including those who can not learn in traditional higher educational institutes due to lack of money, or health problem, engaged in full-time job, fare from big cities and prestige institutes and so on;
- realization of the system of non-stop or life-long education, including secondary, higher and post-graduated education;
- individualisation of education within the total education;
- engaging of the foreign progressive experience and innovations.

Safety and security must remain of paramount importance in the operation and development of international air transport and States must accept their primary responsibility for ensuring of safety and security, irrespective of any change in economic regulatory arrangements. Safety and security measures should be implemented in a cost-effective way in order to avoid imposing an undue burden on civil aviation.

At our point of view the consolidation and mix of 'APPLE' corporation's principals and ideas of innovation distance education in connection with experience and information data base of such organization as ICAO, IATA, EUROCONTROL, ASECNA, JEPPESSEN, STOCKHOLM RADIO should be principally new element in the additional professional education system in the aviation branch and especially for air safety system. It should be open system of training which provides active dialogue between the teacher and the student by means of modern technologies and multimedia. Such mode of study gives a freedom in choosing of a place, time and rate of training. And also consultation possibility in the diversified situations and circumstances, on the earth and in air that is especially important for safety of flights. If knowledge has received concrete communication with actions, it is necessary constantly "to train itself", filling up, improvement the knowledge and skills. This purpose we put before itself in the future project.

The resolving of above mentioned problems is depend on providing of innovation development of the state economic, integration of additional professional education system, state government and business on principals of social partnership.

Summary. In conclusions we should mark, that together we should be worked our and approve on the state level the conceptual steps of integration of additional professional education system, state government and business, that will be directed to satisfy current and future tasks during education of international higher level specialists, operative and flexible reaction to changes in the condition of economical reforms. To fix the rights of participants of process of integration concerning creation of integration structures, and also get the state support and stimulation. Definition of the mechanism of attraction of the industry and business to interaction with spheres of a science and system of additional professional education. In the course of working out with official documents it is necessary to consider the previous practice of creation integration units. For this purpose it is necessary to involve all interested parties which in practice will use these documents in to the process of discussion of projects of official documents.

So, working out with methods of integration we should note that the discovery transformative modifications in society and labour market, that should perform innovation model of the additional professional education system, which will be totally answer for modern social and economical development of the state and will be able to give the strong impulse to the economical increase - can be only the peoples' factor.

References

1. *Golichenko O.G.* The higher education and science: integration or partnership?/ O.G. Golinichenko // Economics and mathematics methods. - 2005. - T. 41. - №1. – P. 119-127.

2. The international legislation on a labour safety: conventions and recommendations MOP : B 3 t. — K. : Bases, 1997. — T. 2. — 427 p.

3. *Savushkin N.N.* International model of different level of professional education // Professional education. : B 3 t. — K. : Bases, 1997. — T. 2. — 427 p.

4. The Bologna Process: Bregensky stage / under the scientific editorship of *V. Baydenko*. - M.: ITSPKPS, Russian New University, 205. 174p.

5. *Salimov R.M.,* The terminology coordination in branch последипломного formations, as a necessary stage of integration to the European education system [the Electronic resource] / R. M. Salimov, O. M. Savinov // Official site of Addition education Institute, National aviation university. — Access mode: http://ipn.nau.edu.ua/content/ view/199/94/lang,ua/

UDC 504.62.2:338.246.027

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CONTINUOUS EDUCATION IN AIR TRANSPORT SAFETY

The article shows the necessity of creating special programmes and techniques for upgrading specialists in aviation safety. The author names and describes components of the post-graduate education system in the field of aviation safety and introduced in the study process by Ukrainian experts.

Upgrading specialists has always been important for safety of the transport branch. The aviation, where the human factor is of special importance, has state systems of retraining, upgrading and certificating specialists.

This system survived in none of the Independent States with air traffic. It increased the aviation safety in these countries first of all on account of the human factor. For example, in Ukraine 95 % of the air accidents involve the human factor, with 60-70 % in more developed countries.

It is necessary to create a system of post-graduate education in aviation safety. This system should use the experience and requirements of the international organisations for aviation safety, take into account interests of national companies at the air traffic market, and conform the price and the quality of the training.

To elaborate on the system of the post-graduate education in the field of aviation safety and the principles of its functioning we shall consider the notion of aviation safety using the approaches adopted in civil aviation today. The safety of aviation is a complex feature of air traffic system which functions without causing damage (or causing minimum damage) to the system itself and the population. The system's main components are flight safety, aviation and ecological safety. The aviation safety also includes economic safety of the aviation plants, which is a topical problem for airline companies of developing countries facing tough competition from the world leading air traffic actors.

Aviation is the most innovative among not only transport branches. Every years sees increase in requirements to reliability of equipment, aviation systems and units, introduction of modern materials and technology, improvement in communication techniques. But there is no decrease in aviation accidents, the faults of the human factor as the reason rising (by 10 % in last 10 years according to ICAO). That is why the aviation traffic activity pays more and more attention to the human factor, under which they mean the integral feature of a specialist's personal qualities dealing with his affecting sociatechnical system. The human factor comprises 4 main components: organisational, technical and technological, professional and ethical.

We shall elaborate on the technical and technological and professional components of the human factor as they are directly connected with the post-graduate education of aviation specialists. The technical and technological component is the maximum account of specialists' capability in designing the aviation equipment, units and devices, developing techniques for maintenance of the aviation equipment. As early as at the first stage of designing a new sort of equipment it is necessary to find the best solutions with respect to the human factor, which reduces the time of designing and the prime cost of developments that are becoming science capacious and demand pretty investments.

The professional component includes aspects of a specialist's professionalism as to air traffic. At present, the post-Soviet countries have many virtually uncontrolled small ventures, which make it a pressing problem to upgrade aviation specialists. To achieve this purpose it is necessary to control the quality of training, introduce promising communication, computer and psychophysiology technologies while selecting, training and upgrading aviation specialists.

Thus, the system of the post-graduate education in the field of aviation safety has two principal components: technical and technological and professional.

The technical and technological component includes the following principal components:

- innovative management in economic activity;
- innovations in flight control;
- innovations in flight safety;
- innovations in ecological safety.

Introduction of modern technology has a positive effect on all the aspects of aviation safety in question. Scientific and technical innovations are important for economic survival and growth of transport companies; they have to be properly planned and controlled. In spite of economic problems, some aviation innovations succeed. The post-graduate education is to compose training programmes to teach the modern technologies using the latest methods.

As an example of training aviation specialists in innovations we can cite programme of teaching in the An-148 avionics developed by a team of 200 Ukrainian, Russian and other companies. The Antonov Academy acted as a system integrator of the on-board equipment, the flight and technical performance systems and units developed by the Russians and the Ukrainians.

The method complex designed to study the on-board equipment comprises programmes on:

1) the computer system of aircraft piloting VSS-100 controlling horizontal and vertical navigation, optimising flight data, and expanding the use of navigation bases internationally;
2) the four channel electrical and distant control system of improved reliability providing safe control of air traffic operational bodies;
3) the system of computer aided control SAU-148 allowing landings in the II and III ICAO categories. The equipment to be studied meets all the latest world technical and safety standards.

The professional component is the most extensive and composed of refresher courses in maintenance of aviation systems and flight facilities. The courses are chosen according to the qualification and post of the personnel. The managing personnel are offered short-term amd long-term courses (over 72 hours) in personnel management techniques, conflictology, management psychology. The professional component of training specialists in flight safety (without respect to specialisation) includes the following sections:

- upgrading of aircraft maintenance specialists,
  upgrading of managers,
- upgrading of flight control (flight control system),
- upgrading of airport personnel.

The third component includes special training of aviation specialists in safety, i.e. studying normative documents, foreign organisations activity regulating safety. Training must be given to as more personnel as possible, be regular and periodic (once a year) and carried out by aviation experts in aviation organisations. Another form of special training is training provided to safety consultants using definite programmes, e.g. training safety inspectors according to the "Investigation of accidents and preventive measures", registration personnel according to the "Deciphering and analysis of flight data". Consultants should be trained in educational institution equipped with laboratories. After attestation graduates are qualified and certificated.

Principle 1 is continuity. Training in safety is carried out during all the period of professional activity in cycles, programmes and techniques improving with every new cycle. Principle 2 is obligatory. The state bodies of safety regulation establishing periods and duration of training. Principle 3 is in-control of knowledge. Before training, students undergo individual control of their knowledge and get a corrected programme. Principle 4 is to follow the certification procedure. Aviation personnel is allowed to perform their duties only if they have a Certificate issued by authorised bodies. Principle 5 is a usage of innovative training techniques (active training methods, communication techniques).

SYMPOSIUM 10

AVIATION CONGRESS SCHOOL OF YOUNG SCIENTISTS IN PROBLEMS OF ENVIRONMENT PROTECTION FROM CIVIL AVIATION IMPACT

UDC 656.7.08:65.011.3:656.71 (043.2)

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METHOD TO ASSESS THIRD PARTY RISK AROUND AIRPORTS

This paper presents an approach of assessing Third Party Risk around airports by means of three models: the crash frequency model, the crash location model and the crash consequence model. Calculated individual risk contours are demonstrated as an example at the vicinity International airport "Kyiv" (Zhulyany).

In the context of planning approval procedures at many major European airports, safety relevant issues today gain increasing importance over e.g. noise or environmental issues. When analyzing the safety in air traffic, one essential method for airport related safety studies is the determination of Third Party Risk that is the risk of death due to an aircraft accident for people who do not participate in the air transport system, generally people living or working in the vicinity of an airport.

Despite the lack of regulations relating to Third Party Risk in most European countries (with the exception of The Netherlands and Great Britain), determining Third Party Risk becomes a central instrument for evaluating risks due to aircraft accidents for people living around airports.

The Third Party Risk expresses the statistical potential of a human being receiving fatal injuries as the result of a severe aircraft accident or its potential consequences in form of secondary effects on the ground (damages to an industrial plant, for example). This potential is important around airports, because the operational accident risk for aircraft is highest during takeoff and landing and so Third Party Risk calculations generally refer to an airport. The Third Party Risk refers to the fact that the risk is calculated for those people who are not formally participating in the air transport system during a given time period. Typically, this is the population residing in the area around that airport, or people who work there (employees). More precisely, these are people located at least temporarily within a selected investigation area around the airport.

The method to assess Third Party Risk around Airports consists of three models: the crash frequency model, the crash location model and lastly the crash consequence model.

In order to investigate Third Party Risk around airports, objective measures of risk are required. Risk is defined as a combination of the probability of an event and the severity of that event. For Third Party Risk analysis two dedicated measures of risk are often used: individual risk and societal risk.

Individual risk is defined as the risk of death per year to a representative or specified individual as the result of the realisation of specific hazards. For airport Third Party Risk modelling purposes, the individual concerned is assumed to reside at a particular location for 24 hours a day, every day of the year. The risk relates to death as a direct result of an aircraft crash.

Societal risk is defined as the probability (per year) that more than N people are killed as a direct consequence of a single aircraft accident.

While individual risk is location specific, it is present regardless of whether or not someone is actually residing at that location; societal risk applies to the entire area around the airport and hence is not location specific within that area. Societal risk only exists when people are actually present in the area around the airport. In an unpopulated area, individual risk levels may vary from location to location, but societal third party risk is zero by definition.

The calculation of individual risk for different locations around an airport allows a risk contour map to be built up. The contours join points which are subject to the same individual risk. The regions most at risk from crashes can then be readily identified. This is of particular use for determining the most appropriate areas for PSZs.

The calculation of individual risk contours requires three basic quantities:

1) the annual probability of a crash occurring near a given airport (crash frequency model);

2) the distribution of such crashes with respect to location (crash location model); and

3) the size of the crash area and the proportion of people likely to be killed within this area (crash consequence model).

The crash area is represented by a square, the length of whose sides are *'a'*. If a crash occurs centred at any point within the shaded square area, the point indicated in Figure 1, would be impacted.

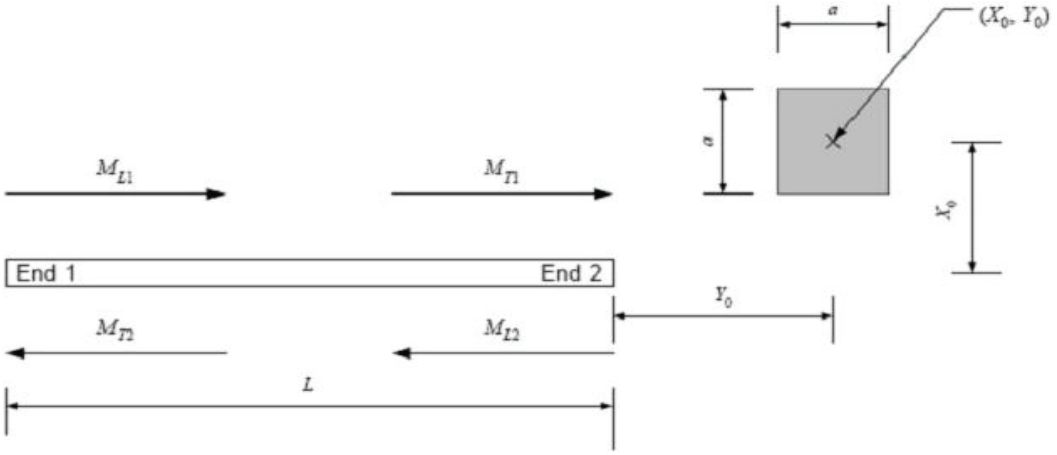

Figure 1 Individual Risk Calculation Schematic

Therefore, the individual risk at the point indicated in Figure 1 is the frequency with which a crash would occur within the shaded square. This is evaluated by the following integral, over two dimensions as shown in Equation 1:

$$IR_{Large} = \int_{X_0-\frac{\alpha}{2}}^{X_0+\frac{\alpha}{2}} \int_{Y_0-\frac{\alpha}{2}}^{Y_0+\frac{\alpha}{2}} \begin{bmatrix} 2R_{TO}M_{T1}f^{TO}(x,y) + 2R_{LO}M_{L1}f^{LO}(x,y+L) + \\ 2R_{TC}M_{T1}f^{TC}(x,y) + 2R_{TC}M_{T2}f^{TC}(x,-y-L) + \\ 2R_{LC}M_{L1}f^{LC}(x,y+L) + 2R_{LC}M_{L2}f^{LC}(x,-y) \end{bmatrix} dx.dy \qquad (1)$$

which can be expanded to Equation 2:

$$\begin{aligned} IR_{Large} = {} & 2R_{TO}M_{T1}\int_{X_0-\frac{\alpha}{2}}^{X_0+\frac{\alpha}{2}}\int_{Y_0-\frac{\alpha}{2}}^{Y_0+\frac{\alpha}{2}} f^{TO}(x,y)dx.dy + 2R_{LO}M_{L1}\int_{X_0-\frac{\alpha}{2}}^{X_0+\frac{\alpha}{2}}\int_{Y_0-\frac{\alpha}{2}}^{Y_0+\frac{\alpha}{2}} f^{LO}(x,y+L)dx.dy + \\ & 2R_{TC}M_{T1}\int_{X_0-\frac{\alpha}{2}}^{X_0+\frac{\alpha}{2}}\int_{Y_0-\frac{\alpha}{2}}^{Y_0+\frac{\alpha}{2}} f^{TC}(x,y)dx.dy + 2R_{TC}M_{T2}\int_{X_0-\frac{\alpha}{2}}^{X_0+\frac{\alpha}{2}}\int_{Y_0-\frac{\alpha}{2}}^{Y_0+\frac{\alpha}{2}} f^{LO}(x,-y-L)dx.dy + \\ & 2R_{LC}M_{L1}\int_{X_0-\frac{\alpha}{2}}^{X_0+\frac{\alpha}{2}}\int_{Y_0-\frac{\alpha}{2}}^{Y_0+\frac{\alpha}{2}} f^{LC}(x,y+L)dx.dy + 2R_{LC}M_{L2}\int_{X_0-\frac{\alpha}{2}}^{X_0+\frac{\alpha}{2}}\int_{Y_0-\frac{\alpha}{2}}^{Y_0+\frac{\alpha}{2}} f^{LC}(x,-y)dx.dy \end{aligned} \qquad (2)$$

where M_{T1} is number of take-offs per year in Direction 1; M_{T2} - number of take-offs per year in Direction 2; M_{L1} - number of landings per year in Direction 1; M_{L2} is number of landings per year in Direction 2; R_{TO} is take-off overrun frequency per movement; R_{LO} is landing overrun frequency per movement; R_{TC} is take-off crash (non overrun) frequency per movement; R_{LC} is landing crash (non overrun) frequency per movement; $f_{TO}(x, y)$ is probability density function for take-off overruns; $f_{LO}(x, y)$ is probability density function for landing overruns; $f_{TC}(x, y)$ is probability density function for take-off crashes (non overruns); $f_{LC}(x, y)$ is probability density function for landing crashes (non overruns); a is length of side for square crash area; x is distance perpendicular to the extended runway centreline; y is distance along the extended runway centerline.

The maximum extent of the contour occurs on the extended runway centreline (i.e. $x = 0$). Therefore, to calculate the maximum extent of the individual risk contours it is important to calculate the individual risk at $x = 0$. However, the probability density functions (PDFs) exhibit singularities (i.e. are undefined or infinite) for $x = 0$.

These singularities can be eliminated by mathematically transforming the PDFs. All the PDFs can be constructed from the following base functions as shown in Equation 3 and Equation 4:

$$Gamma\,(y,\alpha,\beta) = \frac{1}{\beta^{\alpha}\Gamma(\alpha)} y^{\alpha-1} \exp\left[-\frac{y}{\beta}\right] \qquad (3)$$

$$Weibull\,(y,\alpha,\beta) = \frac{\alpha}{\beta^{\alpha}} y^{\alpha-1} \exp\left[-\left(\frac{y}{\beta}\right)^{\alpha}\right] \qquad (4)$$

There is main Equation for Third Party Risk assessment. The Equation 5 includes three main components of the calculation model:

$$R = \Sigma\,(Ni \times Pi \times fi(x,y)) \times Aeff \qquad (5)$$

where R is aircraft crash Third Party Risk; N is number of relevant flight operations (operations/year) for i category of the aircraft; P is aircraft crash rate (takeoff, landing); $f(x,y)$ is aircraft crash location conditional probability (1/km^2); $Aeff$ is effective area of the possible target on the ground (km^2).

The coefficients probabilities were performed for types of aircraft crash: take-off crashes from flight, take-off overruns, landing crashes from flight, landing overruns. Today in this model such approach is used as synthesis results taking in Nederland and Great Britain. At the present time the coefficients probabilities is used only for transport aviation that defined by the Gamma and Weibull distributions. But the coefficients probabilities for the general aviation it is necessary to define using Gamma and Weibull distributions.

With these three models and all required airport related parameters Individual Risk will be calculated and shown in individual risk contours around the airport area. Following Figures demonstrate such individual risk contours as an example at the vicinity International airport “Kyiv” (Zhulyany). These Third Party Risk contours are based on present air traffics in 2007, forecasts air traffics in 2017, maximum capacity in 2017 of International airport “Kyiv” (Zhulyany) indicated in Figure 2 to Figure 4.

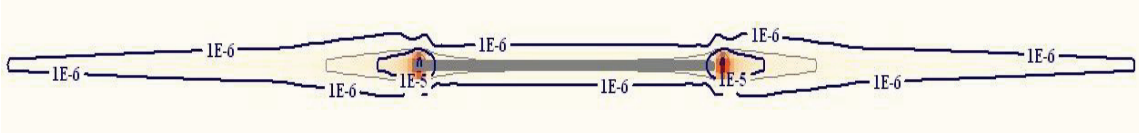

Figure 2 - Third Party Risk contours of 2007 at International airport “Kyiv” (Zhulyany)

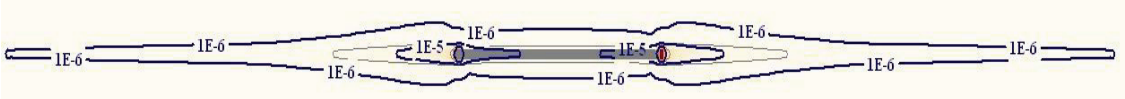

Figure 3 - Forecasting of Third Party Risk contours of 2017 at International airport “Kyiv” (Zhulyany)

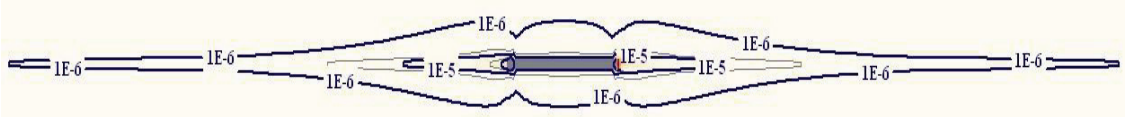

Figure 4 - Third Party Risk contours of maximum capacity of International airport “Kyiv” (Zhulyany) in 2017

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SHORT-TERM FORECASTING OF NOISE ABATEMENT PROCEDURES IMPLEMENTATION

An approach for maximizing airport noise capacity, based on entropy method with the use of analytical models, was proposed. The entropy noise model also includes possibility of implementation of noise abatement procedures for increasing noise capacity. The method, algorithm and application software were obtained for operative management, short and long-term forecasting of aircraft noise for aircraft fleet and were verified on the base of operational data of the international airport.

Among environmental concerns, excessive aircraft noise and its control has become a major objective of airport authorities. The capacity of airports, particularly in Europe, is eliminated by noise impact, and it can be increased only with the implementation of effective transport management system, which reduces this impact on local community [1].

Decisions have been made to enable the choice of possible solutions of aircraft noise control around airports. For the control of aircraft noise impact around an airport, it is necessary to implement all of the possible measures including low-noise flight procedures, sound insulation of buildings, sound screening, etc [2].

Low-noise flight procedures include: route optimisation in the airport vicinity; low-noise take-off and approach flight procedures; optimal distribution of the aircraft among the routes, etc.

Procedures from these categories could have very different efficiency for different aircraft type and operational conditions. And at the stage of aircraft movement planning and environmental impact forecasting it can be difficult to choose the most effectual noise abatement procedures for desired conditions [3,4].

The approach is based on entropy method with the use of analytical models.

The airport is considered as the complex system that exists and develops taking into account row of constrains, including operational and noise ones. In the most generalized form sets of the system state depend on the number of aircraft types *i*, number of paths *j*, possible operational methods of noise reduction *k*, time period under review *m* - month (or year *r*) and the aircraft quantity T_{ij}^{km}. Constraints of the operational capacity lie in given number of aircrafts of each type Q_i, that operated in the airport:

$$\sum_{j,k,m} T_{ij}^{km} = Q_i \,. \tag{1}$$

Noise constrains take into account prescribed levels in critical areas.

$$\sum_{i,j,k,m} T_{ij}^{km} \cdot P_{ij}^{km}(l) = 1 \,, \tag{2}$$

$$P_{ij}^{km}(l) = f(T_0, La_{ijkm}(l), L_{aeq}(l)) \text{ or } P_{ij}^{kr}(l) = f(T_0, NEF_{ijkr}(l), NEF_0(l)) \,,$$

where $P_{ij}^{km}(l)$ and $P_{ij}^{kr}(l)$ depend on the criteria for noise assessment.

Criteria definition depends on the necessary forecasting type (Table 1). It is efficient to use such criteria as Maximum noise level, Equivalent noise level, Sound exposure level (SEL) etc for operative management (for a day) and short-term forecasting (from month to year)). Noise exposure forecast (NEF) can be used during long-term forecasting – for period from few years up to few decades.

The system is determined by any quantity of distribution T_{ij}^{k} and the number of possible states of the system with distribution T_{ij}^{k} is equal to $W(T_{ij}^{k})$ [5]:

$$W(T_{ij}^{km}) = \frac{T!}{\prod_{i,j,k,m} T_{ij}^{km}!} \,,\; T = \sum_{i,j,k,m} T_{ij}^{km} \,.$$

Table 1

Criteria definition

Type of the fore-casting	Operative Management	Short-term	Long-term
Period	Day	Month - Year	Few Years - Decade of years
Criteria	*LAmax, LAeqD, LAeqN, SEL, ...*	*LAmax, LAeqD, LAeqN, SEL, ...*	*NEF, EPNL*
v	$v_{ij}^{k} = C \cdot A_{V\,ij} \cdot B_V{}^{k}$ $\sum_{i,j,k} v_{ij}^{k} = 1$	$v_{im} = ca_{im} b_m D_m S_m$ $\sum_{i,m} v_{im} = 1$	$v_{ijr} = V_{Vi} \cdot V_{ijr}$ $\sum_{i,j,r} v_{ijr} = 1$
T	$T_{ij}^{km} = \frac{v_{ij}^{m} \cdot Q_i \cdot \exp\left(-\sum_l \beta_l \cdot P_{ij}^{km}(l)\right)}{\sum_i v_{ij}^{m} \cdot \exp\left(-\sum_l \beta_l \cdot P_{ij}^{km}(l)\right)}$	$T_{ijm} = \frac{v_{im} Q_i \exp\left[-\sum_l \beta_l P_{ijm}(l)\right]}{\sum_{j,m} v_{im} \exp\left[-\sum_l \beta_l P_{ijm}(l)\right]}$	$T_{ir} = \frac{T_r v_{ir} \exp(-\beta_r P_i)}{\sum_i v_{ir} \exp(-\beta_r P_i)}$

The probable implementation of operational methods and distribution of aircraft on routs are defined by the relative extremum of the system entropy [6]:

$$S = \ln T! + \sum_{i,j,k,m} T_{ij}^{km} (\ln \frac{v_{ij}}{T_{ij}^{km}} + 1), \tag{3}$$

where v_{ij} - normalized frequency the of the usage of aircraft *i* on *j-th* route with noise implementation NAP *k*. The probable distribution of aircraft T_{ij}^{km} is defined by the relative extreme of entropy (3) with additional constraints (1-2):

$$T_{ij}^{km} = v_{ij}^{m} \cdot Q_i \cdot \exp\left(-\sum_l \beta_l \cdot P_{ij}^{km}(l)\right) \cdot \left(\sum_i v_{ij}^{m} \cdot \exp\left(-\sum_l \beta_l \cdot P_{ij}^{km}(l)\right)\right)^{-1} \tag{4}$$

The formulas are used in iteration procedures till the value *T* is found and criterion of noise and air quality control are fulfilled. Algorithm of the considered method consists of the next basic stages: model formation for optimization; definition of the criteria form; data preparation; preliminary estimation; entropy optimization and resulting control. The algorithms and application programs designed using an informational data for local circumstances.

The aim of the operative management is control of the noise level correspondence with the normative constraints during time period up to 24 hours. Noise constraints are written in the following form:

$$\sum_{i,j,k} T_{ij}^{k} \cdot P_{ij}^{k}(l) = 1, \; P_{ij}^{kl} = \frac{1}{T_0} \cdot 10^{0,1 \cdot L_{A\,ij}^{kl} - 0,1 \cdot L_{Aeq}^{l}},$$

were T_0 - observation period; L_{Aij}^{kl} - noise equivalent levels, that each aircraft of type *i* creates during flying on track *j* taking into account possibility of NAP implementation in the critical zone *l* and normative noise equivalent levels; L_{Aeq}^{l} - normative noise equivalent levels in zone *l*.

Parameter v_{ij}^{k} in case of operative forecasting (Table 1) depends on A_{Vij} - priori estimate of the usage of aircraft *i* on *j*-th route and $B_V{}^{k}$ - using possibility of the NAPs taking into account meteorological or others conditions (can be equal '0' or '1').

Consider for example typical operation situation in the international aviation airport 'Borispil'. Initial data are presented in Table 2. Total amount of aircraft is 400, which are distributed equally on routs (by 10 aircraft). As you can see, three critical zones with noise levels

upper than 55 dBA were determined during aircraft approach. And as NAOPs it was proposed implementation either optimal route distribution, either noise abatement approach procedures.

It was possible to use 1 standard approach procedure and 4 noise abatement approach procedures in the airport vicinity. Altitude approach procedure profiles are presented on the Fig. 1: Standard ($k=1$), CDA (Continuous Descent Approach) 1 ($k=2$), CDA 2 ($k=3$), CDA 3 ($k=4$), CDA 4 ($k=5$).

Optimal aircraft distribution was received on 743 iteration and for following Lagrangian coefficients: $\beta_1=15$, $\beta_2=56$, and $\beta_3=69$. Relative error of calculations didn't exceed 0.001.

Results of the operational management modelling are shown for each aircraft type on the Fig. 2. Diagrams show that even distribution was determined as the optimal one for aircraft type B 737 800, B 777 800 and A 320 (except using of standard departure profiles ($k=1$) for track $j=6$. For aircraft type A 330 and A 340: the busiest track is j=5 and the most efficient NAP is CDA 4 for special conditions.

So, the implementation of the listed routs and NAPs in the ration defined by entropy optimizing allows to decrease noise impact in critical zones to normative levels (Fig. 3, green curve). The area of the environmental protection zones decreases on 9 %, and noise levels in the control zones 1, 2 and 3 are reduced on 6.0, 5.6 and 4.5 dBA correspondingly.

Concluding remarks

The optimal entropy noise modelling in the airport vicinity allows to estimate the airport capacity, taking into account noise requirements; minimize noise impact on the airport vicinity; forecast daily and monthly flights schedule; and make long-term forecasting prediction.

All of the algorithms of the proposed methods have been realised in computer programs

Table 2

Initial data

Parameter	Aircraft type	Route	Noise abatement procedures	Critical area	Time period	Normative level	Operational procedure
Designation	i	j	k	l	t	L_{Aeq}	
Operative forecasting	$i=1$, B 737 800 $i=2$, B 777 300 $i=3$, A 320 $i=4$, A 330 $i=5$, A 340	$j=1$, 18LA21 $j=2$, 18LA22 $j=3$, 18LA23 $j=4$, 18LA24 $j=5$, 18RA21 $j=6$, 18RA22 $j=7$, 18RA23 $j=8$, 18RA24	$k=1$, Standard $k=2$, CDA 1 $k=3$, CDA 2 $k=4$, CDA 3 $k=5$, CDA 4	$1...3$	7.00 – 23.00	55 dBA	approach

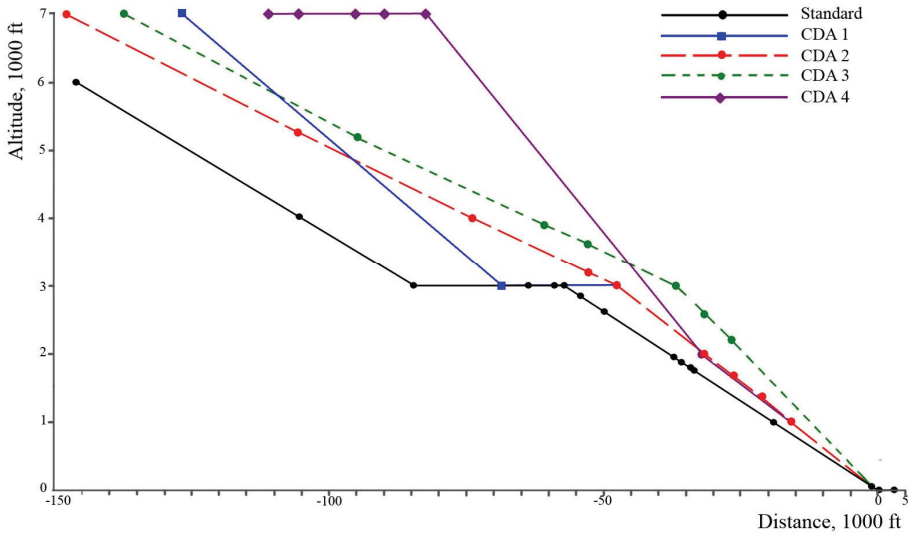
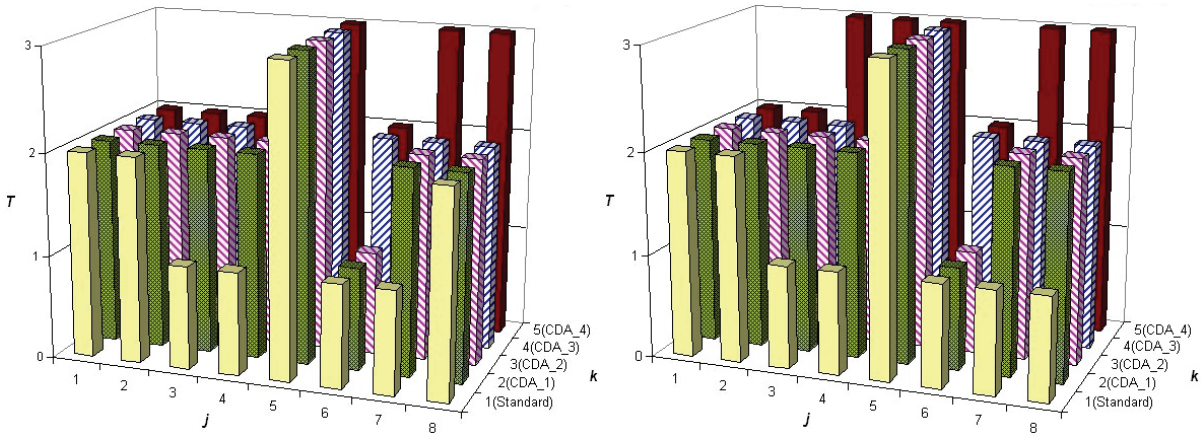


Fig. 1. Altitude approach profiles



a *b*

Fig. 2. Results of the operational management modeling: *a* – A 330 (*i*=4), *b*– A 340 (*i*=5)

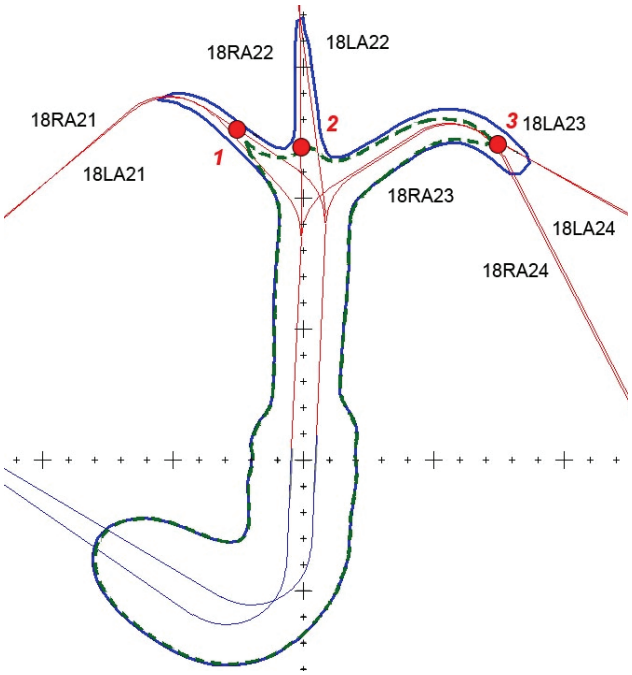


Fig. 3. Noise equivalent levels 55 dBA before (full curve) and after (broken curve) optimized aircraft distribution; *1…3* – critical areas.

References

1. *Konovalova O.* Optimization strategies to reduce aircraft noise. Proceedings of the 3rd world congress "Aviation in XXI century". Safety in aviation and space technology. Sept. 22 – 24, 2008, Kyiv, Ukraine, Vol. 2, pp. 4.18-4.21, 2008

2. *Hepting M.* European Toolset for Environmental Aviation Modelling. A Project Proposal in the 7th Framework Programme. Proceedings of the 3rd world congress "Aviation in XXI century". Safety in aviation and space technology. Sept. 22 – 24, 4 p., 2008.

3. ICAO Balanced Approach to Noise Management around Airports. – 3 p. Available on *http://www.iata.org/NR/rdonlyres/5176A849-8FD6-4844-AB79-110F7D7789D2/0/-BalancedApproachtonoisemanagementaroundairports.pdf*

4. *Review* of noise abatement procedure research & development and implementation results discussion of survey results. International Civil Aviation Organization. Preliminary Edition – 2007. – 29 p. Available on www.icao.int/env/reviewnadrd.pdf

5. *Zaporozhets, O.I. & Tokarev, V.I.* Aircraft noise modelling for environmental assessment around airports. // Applied Acoustics, vol. 55, No 2, p. 99-127, 1998

6. *Wilson A. G.* Entropy in urban and regional modelling. – Pion Limited, London, 186 p., 1970.

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PASSIVE VIBROACOUSTIC CONTROL BY ATTACHED CONCENTRATED MASSES

The linear dynamic behavior of the beams carrying concentrated masses and subjected to a harmonic exciting force at an arbitrary point is analyzed. An application of a genetic algorithm for determining the optimum parameters of concentrated masses for minimum of vibration response and sound radiation of cantilever and simply supported beams is described. The beam optimization problem is formulated as a constrained task with different objective functions.

In order to control the response of the beam to exciting forces it is necessary to find optimal parameters of the concentrated masses. Let us consider transverse motion of the beam of finite length L with concentrated masses m_m attached at the points x_m (Fig. 1). External force $F_F(t)$ is located in the point x_F.

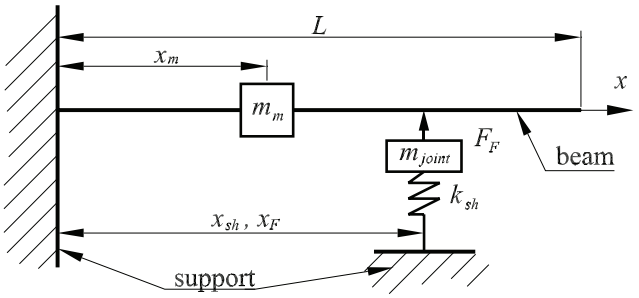

Fig. 1. General scheme of the modeled object

The equation of beam transverse motion with attached concentrated masses is obtained from principle of virtual work [1]:

$$\sum_{F=1}^{K} F_F(t)\delta\vec{w}(x_F,t)\vec{n}\exp(i\varphi_F) = \\ = \sum_{F=1}^{K} k_{shF}\left[\vec{w}(x_{shF},t)\vec{n}\,\delta w(x_{shF},t)\vec{n}\right] + \sum_{m=1}^{M} m_m \frac{\partial^2\vec{w}(x_m,t)}{\partial t^2}\vec{n}\,\delta\vec{w}(x_m,t)\vec{n} + \\ + \rho S\int_0^L \frac{\partial^2\vec{w}(x,t)\vec{n}}{\partial t^2}\delta\vec{w}(x,t)\vec{n}\,dx + EI\int_0^L \frac{\partial^2\vec{w}(x,t)}{\partial x^2}\vec{n}\,\delta\left(\frac{\partial^2\vec{w}(x,t)}{\partial x^2}\vec{n}\right)dx, \tag{1}$$

where $\vec{w}(x,t)$ is vector of a beam displacement, $\vec{n}$ is normal to beam, $E = E'(1+i\eta)$, η is damping loss factor, I is the beam moment inertia, S is the beam cross section, E' is the Young's modulus, ρ is the beam density. The beam is loaded by harmonic forces $F_F(t) = F_F\exp(-i\omega t)$ with phase φ_F and ω is angular frequency, M and K are respectively the number of masses and forces. For homogeneous materials we suppose that E' is constant but damping loss factor is function of frequency. For the harmonic oscillations equation Eq. (1) can be rewritten as

$$\delta\Phi = \sum_{n=1}^{\infty}\frac{\partial\Phi}{\partial A_n}\delta A_n = 0,$$

$$\Phi = \sum_{F=1}^{K} F_F\vec{w}(x_F)\vec{n}\exp(i\varphi_F) + \frac{\rho S\omega^2}{2}\int_0^L\left(\vec{w}(x)\vec{n}\vec{w}(x)\vec{n}\right)dx - \frac{EI}{2}\int_0^L\left(\frac{d^2\vec{w}(x)}{dx^2}\vec{n}\frac{d^2\vec{w}(x)}{dx^2}\vec{n}\right)dx + \\ + \frac{\omega^2}{2}\sum_{m=1}^{M} m_m[\vec{w}(x_m)\vec{n}\vec{w}(x_m)\vec{n}] - \frac{1}{2}\sum_{F=1}^{K} k_{shF}\left[\vec{w}(x_{shF})\vec{n}\vec{w}(x_{shF})\vec{n}\right]. \tag{2}$$

The general solution for the beam is approximated using a series of trial functions:

$$w(x) = \sum_{n=1}^{\infty} A_n \psi_n(x). \tag{3}$$

Computations can be done for any geometric boundary conditions. In this case function $\psi_n(x)$ has to satisfy them. Application of orthogonal function $\psi_n(x)$ leads to more simplified solutions. The boundary conditions, corresponding to cantilever beam, can be defined in the following form:

$$w(0) = \frac{dw(0)}{dx} = 0, \qquad \frac{d^2 w(L)}{dx^2} = \frac{d^3 w(L)}{dx^3} = 0, \tag{4}$$

and shape of oscillations satisfying them can be written as

$$\psi_n(x) = \left(\cos k_{bn} \frac{x}{L} - k_{bn} \frac{x}{L} \right) + \frac{\sin k_{bn} - k_{bn}}{\cos k_{bn} + k_{bn}} \left(\sin k_{bn} \frac{x}{L} - k_{bn} \frac{x}{L} \right), \tag{5}$$

where k_{bn} is determined from characteristic equation

$$\cos k_{bn} k_{bn} = -1$$

The boundary conditions and function $\psi_n(x)$ for SS beam are:

$$u(0) = \frac{d^2 u(0)}{dx^2} = 0; \qquad u(L) = \frac{d^2 u(L)}{dx^2} = 0; \tag{6}$$

$$\psi_n(x) = \sin\left(\frac{n\pi x}{L} \right). \tag{7}$$

The function (3) allows to apply Ritz method. Substituting the assumed solution (5) or (7) into eq. (2) allows to define unknown Ritz coefficients A_n from the following expression:

$$\frac{\partial \Phi}{\partial A_n} = 0.$$

The opertion leads to the system of *N* equations. Where N is the number of modes, which are taken into account:

$$\begin{bmatrix} B_{11} & \cdots & B_{1N} \\ \vdots & \ddots & \vdots \\ B_{N1} & \cdots & B_{NN} \end{bmatrix} \begin{bmatrix} A_1 \\ \vdots \\ A_N \end{bmatrix} = \begin{bmatrix} C_1 \\ \vdots \\ C_N \end{bmatrix},$$

Eigenfrequencies can be found as the roots of the following polynomial:

$$\det[\mathbf{B}(\omega_n)] = 0$$

Sound power level evaluation. The governing equations of this problem are the Helmholtz equation and the equation of the transverse motion of the beam (1). The Helmholtz equation and its boundary condition describe the sound propagation above the baffle

$$\Delta p + k^2 p = 0. \tag{8}$$

For solving the Helmholtz equation and for the calculation of the acoustic field around the beam a model of plane piston, which is set in an infinite rigid baffle, may be proposed. For the vibrating plane piston following conditions must be fulfilled on the beam $\frac{\partial p}{\partial z} = \rho \omega^2 w(x)$ and on the baffle (for $z = 0$) $\delta p / \delta z = 0$. Substituting the solution of eq. (11) into expression for acoustic power one can receive:

$$W = -\frac{\rho \omega^3}{4\pi} \int_0^L \int_0^b \int_0^L \int_0^b \mathrm{Re}\left[i \cdot u^*(x,y) \frac{\exp(ik \cdot r(x_0, y_0, x, y))}{r(x_0, y_0, x, y)} \cdot u(x_0, y_0) \right] \cdot dy_0 dx_0 dy dx$$

where $r = \sqrt{(x - x_0)^2 + (y - y_0)^2}$. r is the distance between elementary source and receiver of acoustic radiation.

Vibroacoustic optimization. The optimization of point mass parameters is aimed on reduction of sound radiation and vibration response of the beam subject to external excitation. The following objective functions are used for this purpose:

$$L_A = 10\lg\left\{-\frac{\rho}{4\pi\cdot 10^{-12}}\int_{\omega_{\min}}^{\omega_{\max}}\omega^3\int_0^L\int_0^b\int_0^L\int_0^b Re\left[i\cdot w^*(x)w(x_0)\frac{\exp(ikr)}{r}\right]dy_0dx_0dydxd\omega\right\},$$

$$L_V = 10\lg\left\{\frac{\rho cb}{\omega_{max}-\omega_{min}}\int_{\omega_{min}}^{\omega_{max}}\omega^2\int_0^L w(x)w^*(x)dxd\omega\right\},$$

where in the above formula the $(^*)$ asterisk represents complex conjugate value of the transverse motion w, c is the sound speed. L_A is related to acoustic radiation and L_V is related to the beam vibration.

The next objective is defined as: what are the optimal values of the concentrated mass parameters, that provides the minimal transverse motion at a single point of the beam $(x = x_0)$ in the range of frequencies from $\omega_{\min}$ to $\omega_{\max}$.

$$\min \quad L_{VP} = 10\lg\left\{\frac{1}{\omega_{\max}-\omega_{\min}}\int_{\omega_{\min}}^{\omega_{\max}} w(x_0)w^*(x_0)d\omega\right\},$$

The displacement $w(x)$ in all of these objective functions should satisfy to Eq. (1) and boundary conditions (5) or (8). Additional constraints are imposed on parameters:

$$E, I, \rho, S, F_F, \text{ are held constant,}$$

$$\sum_{m=1}^{M} m_m \le M_0, \quad g_1 < x_m < L - g_2$$

where M_0 is restriction on carrying mounted concentrated masses, and g_1, g_2 are the gaps near the beam supports related to physical limitations. These gaps are usually more than the half of mass dimension in x-axis direction.

Application of genetic algorithm for the solution of optimization problem. The mathematical feature of a researched problems considered by the example of a beam with concentrated masses. The objective function L_{VP} in point $x_0 = 0.9925L$ ($g_2 = 0.0075L$) for 5 modes of aluminium alloy cantilever beam vibration is presented on Fig. (2). Objective function dependence on relative coordinate $x_R = x_m/L$ and relative mass weight $m_R = m/m_B$ (where m_B is beam mass) shows several local minima for single mass. The problem becomes more complicated, when few masses are mounted on the beam. Therefore, the optimization algorithm has to be able to make a choice between these local minima. Genetic Algorithm (GA) was chosen for this purpose.

The chromosome coding of the individual is presented with vector of mass weights and their locations. Thus each chromosome has a total length of $2M$ genes. As the population type the double precision vector is used. Meaning, that individual's genes can accept any values within the above mentioned constraints. Each set of point mass weights and their locations represent the point in a search space for GA. This point also can be treated as one of the structural configurations of beam carrying concentrated masses.

During the evolution all individuals are checked up for their consistency with overlap conditions. Because these constraints are discrete, the GA cannot take it into account. Such conditions were programmed inside of the fitness function. The high values of the fitness function were set to the individuals, which corresponds to the beam configuration with 2 or more overlapping objects (masses, force joints). This prevents their selection as the parents. Stochastic uniform function was chosen for selection of parents according to their rank in the raw scores list.

Usually 10% of the population size was set as the elite individuals. For the optimization of parameters for 2 additional masses 100 individuals appears to be enough to guarantee that the resulting optimum is global. This means that during the first generation, the optimizer generates 100 random new configurations. The creation of other generations is governed by the natural selection algorithm. After selection of the parents the generation is created by processing of the parents by mutation and crossover procedures. Also the best individuals, named elite, are passed to the next generation without any changes in order to preserve the gene pool.

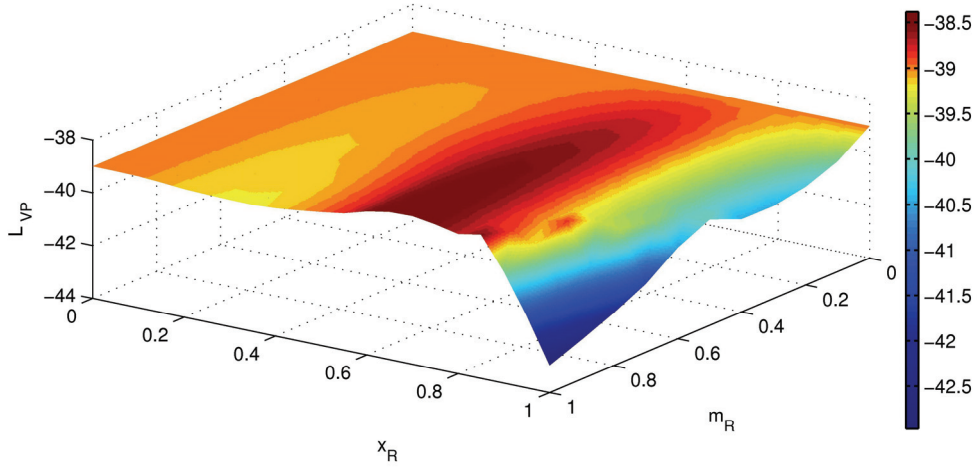

Fig. 2. Proposed objective function dependence on the parameters of the single point mass

The uniform mutation function and scattered crossover are the good choice for this problem type. In addition to GA optimization, the MATLAB hybrid functions 'patternsearch' and 'fmincon', which employs sequential quadratic programming, are used in order to get deeper into the found optimum. The hybrid functions accepts the best individual from the last generation of GA as their starting point. The implementation of the numerical genetic algorithm was carried out by using the computer program MATLAB and authors - written programs for evaluation of fitness function. Also separate routines were programmed for adaptive assessment of acceleration level.

Conclusions

The agreement between the predicted and experimental data indicate satisfactory adequacy of results. The problem of choosing the optimal location concentrated masses on the beam is formulated as the optimization task with use of a principle of virtual work and Ritz method. Researches have shown, that the solutions of the given class of optimization tasks have some local minima. Therefore, in this case genetic algorithm have advantages over other numerical methods.

The numerical and experimental results have shown the effect of decreasing of the acceleration level for optimum distribution of concentrated masses. The difference of the mode shapes, eigenfrequencies, mode node location for the beam with mass and without it has been demonstrated. No change in eigenfrequency, mode shapes takes place when mass is located at the mode node, compared to the case of cantilever beam vibration without mass.

The vibration parameters reduction is achieved due to two effects. The first refers to the excitation influence decrease due to the nodal line shift in the position of exciting force. The second relates to the change of amplitude and dimension of the wave part, in which the point of researchers' interest is located. Generally, both of these effects are caused by the mode shape changes.

References

[1] *G.H. Koopmann, J.B. Fahnline,* Designing Quiet Structures. A Sound Power Minimization Approach, Academic Press Inc., San Diego, London, Boston, 1997.

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DESIGNING AN LIFE CYCLE ASSESSMENT (LCA) PROJECT

Life cycle assessment of production in the control system of the environment. The control system of the environment analysis on the basis of Standard ISO of the series 14040 are considered. Series ISO-14040 sets itself as an object is to establish ecological standards for products and services at the interethnic level, first of all, for those that are used in international trade.

In ISO 14040 LCA is defined as the "compilation and evaluation of the inputs, outputs and potential environmental impacts of a product system throughout its life cycle". Thus, LCA is a tool for the analysis of the environmental burden of products at all stages in their life cycle - from the extraction of resources, through the production of materials, product parts and the product itself, and the use of the product to the management after it is discarded, either by reuse, recycling or final disposal (in effect therefore, 'from the cradle to the grave'). The total system of unit processes involved in the life cycle of a product is called the "product system".

The environmental burden covers all types of impacts upon the environment, including extraction of different types of resources, emission of hazardous substances and different types of land use. The term 'product' is taken in its broadest sense - including physical goods as well as services; it includes goods and services at both operational and strategic levels. It is important to note that in comparative LCA studies, it is not the products themselves that form the basis for the comparison, but the function provided by these products.

LCA is, as far as possible, quantitative in character; where this is not possible, qualitative aspects can - and should - be taken into account, so that as complete a picture as possible is given of the environmental impacts involved.

Most important, a cradle-to-grave analysis involves a 'holistic' approach, bringing the environmental impacts into one consistent framework, wherever and whenever these impacts have occurred, or will occur. One fundamental reason for choosing such an approach is related to the fact that the final consumption of products happens to be the driving force of the economy. Therefore, this final consumption offers core opportunities for indirect environmental management along the whole chain or network of unit processes related to a product.

Another fundamental reason is that a cradle-to-grave approach avoids 'problem shifting'. It is important in eco-design not to solve one environmental problem merely by shifting it to another stage in the product's life cycle. For instance, making a car out of aluminium instead of steel means that its gasoline consumption is reduced, but the production of aluminium requires more energy than that of steel. Only when all these facts are taken into account can it be judged whether a car made of aluminium is truly more environmentally friendly than one made of steel.

The main applications of LCA are in:

- analysing the origins of problems related to a particular product:
- comparing improvement variants of a given product;
- designing new products;
- choosing between a number of comparable products.

Similar applications can be distinguished at a strategic level, dealing with government policies and business strategies. The way an LCA project is implemented depends on the intended use of the LCA results.

LCA can play a useful role in public and private environmental management in relation to products. This may involve both an environmental comparison between existing products and the development of new products, which also includes comparisons with prototypes.

An LCA project is more than just a study. The results of the project could be used in decision-making by industry government and non-governmental organisations. They could guide decisions on investment, policy issues or strategy determination. So it is best to consider an LCA project as an organisational process which can be carried out in several ways.

This process approach is based on the idea that the results of an LCA will only be considered authoritative if the most important stakeholders have been involved in the analysis. This has to be done in a proper and correct way, necessitating a process design which should define:

- the parties and the individuals who will be involved in the LCA project,
- the tasks and responsibilities of parties/individuals involved,
- the actual planning and management of the process

The execution of an LCA and the accompanying process should be carefully attuned to its ultimate goal. This requires that both the LCA client and other possible stakeholders reflect upon this goal. Meanwhile the LCA researchers themselves should also keep the goal firmly in mind conceding how this could affect the conditions and constraints of the project itself The LCA client also needs to consider the design, the organisational set-up and the management of the accompanying process

A suitable process design can be defined as a set of rules agreed on by the parties involved, these cover who is involved and also when and how the process is to be earned out A proper and transparent process can only be realised by a design that miximises all potential advantages, whilst keeping the risks of the process approach to a minimum.

The advantages of the process approach are that a qualitatively better LCA is realised, and that broader support for the results from the parties involved is more likely to be achieved After all the stakeholders are far more likely to support the results of an LCA project]f they themselves have been actively involved in the execution of the analysis

Further advantages of the process approach include:

- the opportunity to educate stakeholders and shape their views;
- better quality of the data and other information used in the LCA;
- improved transparency of the LCA report,
- better quality of execution of the LCA.

However, the process approach does carry some risks - mainly of improper manipulation by stakeholders or researchers of the study itself, the results of the analysis or the decision-making process.

The process design must be clear in its objectives, which means that a distinct starting point and a distinct endpoint of the process must be defined An optimised interaction between the execution of the LCA as such and the practical use of the LCA's results should be arranged

In general, four steps can be distinguished in LCA-based decision-making processes:

- assignment of the research;
- execution of the LCA
- presentation of the LCA's results with conclusions;
- implementation based on the LCA's results.

All parties involved can influence the procedure and choices in these four steps. A process design should indicate who can make decisions, when they should be made, and what can be decided in each step.

This section contains a description of commonly used production processes, associated raw materials, by-products produced or released, and materials either recycled or transferred off-site. This section also describes the potential fate via air of these waste products. Figure 1 shows a general aerospace manufacturing process. (1)

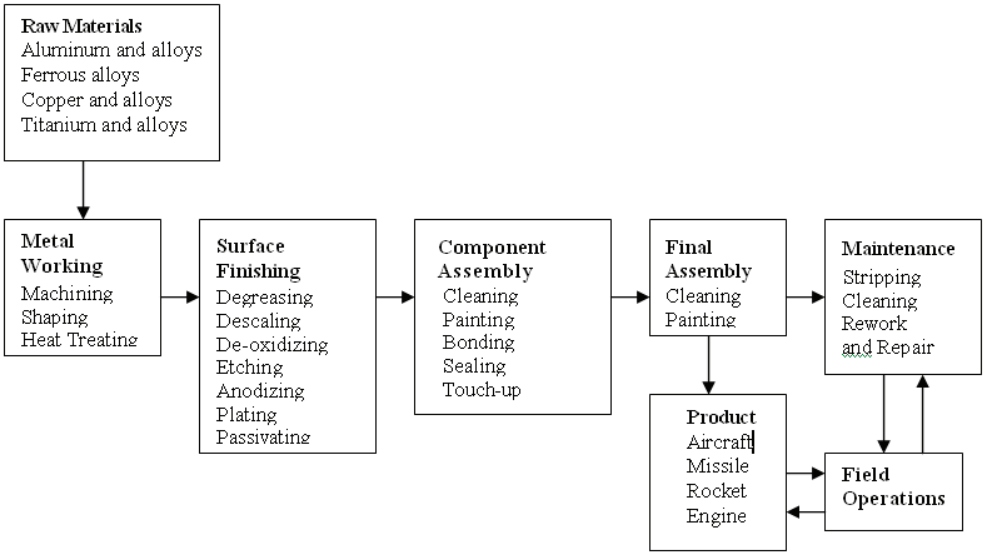

Figure 1: The Aerospace Manufacturing Process

In the table 1 are resulted Air Pollutant Releases by Industry Sector (tons/year)

Table 1

Industry Sector	Carbon Monoxide CO	Nitrogen Dioxide NO_2	Sulfur dioxide SO_2	Volatile Organic Compounds
Aerospace	**4,261**	**5,705**	**3,705**	**10,804**
Oil and Gas Extraction	132,747	389,686	238,872	114,601
Non-Fuel, Non-Metal Mining	31,008	21,660	9,183	138,684
Textiles	8,164	33,053	26,326	7,113
Lumber and Wood Products	139,175	45,533	95,228	74,028
Pulp and Paper	584,817	365,901	177,937	107,676
Inorganic Chemicals	242,834	93,763	52,973	34,885
Pharmaceuticals	6,389	17,091	31,645	4,733
Organic Chemicals	112,999	177,094	162,488	17,765
Agricultural Chemicals	12,906	38,102	62,848	8,312
Petroleum Refining	299,546	334,795	292,167	36,421
Rubber and Plastic	2,463	10,977	110,739	6,302
Stone, Clay, Glass and Concrete	92,463	335,290	21,092	198,404
Iron and Steel	982,410	158,020	67,682	85,608
Metal Castings	115,269	10,435	17,301	21,554
Nonferrous Metals	311,733	31,121	7,882	23,811
Fabricated Metal Products	7,135	11,729	108,228	5,043
Electronics and Computers	27,702	7,223	46,444	3,464
Shipbuilding and Repair	109	866	4,345	707
Ground Transportation	153,631	594,672	101,775	5,542
Water Transportation	179	476	3,514	3,775
Air Transportation	1,244	960	1,815	144
Fossil Fuel Electric Power	399,585	5,661,468	42,726	719,644
Dry Cleaning	145	781	7,920	40

Repair/Rework Operations

Repair operations generally include all conversions, overhauls, maintenance programs, major damage repairs, and minor equipment repairs. Although specific repair methods vary from job to job,

many of the operations are identical to new construction operations. Repair operations, however, are typically on a smaller scale and are performed at a faster pace. Jobs can last anywhere from one day to over a year. Repair jobs often have severe time constraints requiring work to be completed as quickly as possible in order to get the aircraft, missile, or space vehicle back in service. In many cases, piping, ventilation, electrical, and other machinery are prefabricated prior to the major product's arrival. Typical maintenance and repair operations include:

1. Cleaning and repainting the aircraft's surfaces, superstructure, and interior areas;
2. Major rebuilding and installation of equipment such as turbines, generators, etc;
3. Systems overhauls, maintenance, and installation;
4. System replacement and new installation of systems such as navigational systems, combat systems, communication systems, etc;
5. Propeller and rudder repairs, modification, and alignment. (2)

Data in the table 2 are below resulted about Air Pollutant Releases by Rework Operations at the 410 Plant of civil aviation, (tons/year).

Table 2

№	Air Pollutant	Class of danger	MPC mg/m^3	Year		
				1997	2001	2006
1	Cadmium	1	0,003	0,0004	0,0004	0,0004
2	Chromium Compounds	1	0,002	0,009	0,004	0,004
3	Nickel	1	0,002	0,000008	0,000008	0,000008
4	Ozone	1	0,2	0,000008	0,00001	0,00001
5	Lead and Compounds	1	0,001	0,00003	0,000006	0,000006
6	Copper	2	0,003	0,001	0,001	0,001
7	Sodium the hydroxide	2	0,01	0,2	0,1	0,1
8	Acid nitric	2	0,4	0,014	0,008	0,008
10	Acid sulphuric	2	0,3	0,027	0,009	0,009
11	Aluminium oxide	2	0,1	0,009	0,006	0,0008
12	Phenol	2	0,01	0,0006	0,0004	0,0002
13	Formaldehyde	2	0,04	0,00095	0,0006	0,0004
14	Dihloretan	2	3,0	0,01	0,01	0,005
15	Csilol	3	0,2	22,9	17,5	6,99
16	Toluene	3	0,6	13,6	10,2	7,44
17	Ouayt-spirit	4	1,0	1,8	0,29	0,14
	Sum after 17 Pollutant	-	-	**38.57**		
	Sum after all (near 60) contaminating matters	-	-	**228,07**	**112,07**	**91,73**

The requirements of standards of quality of natural environment impose restraint on the output of matters, contaminating territory, air and water, especially having a 1 class of danger. An ecological policy foresees aimed on the permanent improvement of ecological indexes, warning of contaminations, observance of ecological laws and norms.

References

1. *Part 2a Guide.* May 2001. – 101 p.
2. *EPA/310-R-98-001.* EPA Office of Compliance Sector Notebook/ Project Profile of the Aerospace Industry, November 1998. – 132 p.

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MODELING OF SOUND FIELDS IN THE SHADOW ZONE BETWEEN NOISE BARRIERS AND BUILDING FACADES

A ray model was developed for studying the barrier efficiency near the building façade. The model was used for calculation of barrier efficiency for upright standing and inclined barriers in front of building. It was determined the relative impact of façade presence on barrier performance.

Exploitation of noise barriers to shield transport noise from traffic, railways and aviation has been implemented extensively in many countries of the world since the late 1960s. Various theoretical studies, scaled-model experiments, and full-scale field experiments were conducted for prediction of noise barriers performance in various situations and for various conditions.

Usually, implementation of noise barriers is considered for shielding from noise in low-rise residential areas or on the territory of airports with large distances separating noise source and receiver. For Ukraine this problem is even more complicated, as nowadays noise barriers are practically absent. Existing ones are used for shielding from railway transport or in private sector.

It was used a model, proposed by K. M. Li and Siu Hong Tang [2], in which a noise barrier of height H is aligned parallel to a row of tall buildings. The barrier is designed to shield residents in the buildings from noise sources that are located on the opposite side of the barrier. To model the problem, it was assumed that the tall buildings are replaced by a plane facade where the barrier is built at a distance L in front of it, above an absorbing ground. Figure 1 shows a schematic diagram of the specified problem. The facade is situated along the *y* axis at the *x*=0 plane. Furthermore, the facade is assumed to be much higher than the barrier and receiver so that diffraction of sound at the top of the facade can be ignored. The interest was in considering a three-dimensional problem where the barrier and building facade are placed on the ground surface at the plane of *z*=0. They are extended to infinity in both directions along the *y* axis, i.e., $-\infty<y<+\infty$, so that sound diffracted at their side edges is omitted. To simplify the problem, let the source and receiver be located at the same vertical plane at *y*=0. A time-dependent factor $e^{i\omega t}$ is understood [2].

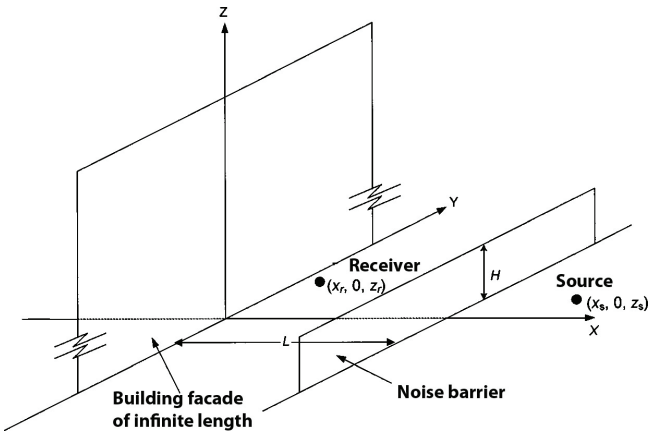


Fig.1. Schematic diagram of the source/receiver configuration in a facade–barrier system

A rectangular coordinate system is used where the receiver is positioned at *R(xr,0,zr)* between the barrier and facade. A noise source is placed on the opposite side of the barrier at *S(xs,0,zs)*, where *xs>L* and *zs, zr>0*. In the present study, we wish to investigate the case where the receivers are located in front of the facade but are separated from the source by the barrier, i.e., *L>xr>0*. Let us consider a more general situation where the ground surfaces have the specific normalized admittance of β_1 at the receiver side and β_2 at the source side. Since acoustically hard materials are commonly used for the facade and barrier surfaces in most residential areas, the flow resistivity of

the facade and ground surfaces are assumed to be 20 000 kN·s·m^{-4} for characterization of perfectly hard surfaces [2].

In this article it is considered the situation when the barrier blocks the direct line-of-sight contact between the receiver and noise source, the receiver itself is located in the shadow zone. In this case, the diffraction of sound at the top edge of the barrier is the only transmission path for the propagation of noise toward the receiver, as the transmission of sound through the barrier is ignored. On reaching the top edge of the barrier, part of the diffracted waves propagate toward the receiver directly. Other parts of the diffracted waves are reflected at the ground and facade surfaces before they reach the receiver. The point of diffraction at the barrier edge, which is located at H above the ground surface, may be treated as a secondary noise source. Since this secondary noise source is located at the top edge of the barrier's surface, multiple reflections take place between the facade and barrier before the diffracted waves arrive at the reception point. Images of the primary source are formed in the half space $z<0$. Images of secondary sources are formed in the half space $z<0$ and as a mirror reflection from building façade.

For a point source located at Ψ_0 *(xs,0,zs)*, receiver at *R(xr,0,zr)*, and the point of diffraction at *D(xd,0,zd)*, Pierce's formulation may be used to compute the diffracted sound field by using the following formula:

$$P(S,R,D)=\left(\frac{e^{i\pi/4}}{\sqrt{2}}\right)\left[\frac{e^{ik(d_S+d_R)}}{4\pi(d_S+d_R)}\right]\left[A_D(X_+)+A_D(X_-)\right], \qquad (1)$$

where d_S and d_R are the respective distances from the source and receiver to the diffraction point as shown in fig. 2. The function, $A_D(X)$, is the diffraction integral given by:

$$A_D(X_\pm)=\mathrm{sgn}(X)\left[f(|X|)-ig(|X|)\right], \qquad (2)$$

where sgn(X) is the sign function, and $f(X)$ and $g(X)$ are the auxiliary Fresnel functions of real argument X. The arguments of the diffraction integral, X_+ and X_-, are determined by:

$$X_\pm = X(\phi_R \pm \phi_S), \qquad (3)$$

where

$$X(\Phi)=\left[-2\cos\left(\frac{\Phi}{2}\right)\right]\sqrt{\frac{2\cdot d_S\cdot d_R}{\lambda(d_S+d_R)}}, \qquad (4)$$

where λ is the wavelength of the diffracted sound, and the angles φ_R and φ_S are defined in the surface of the screen, as shown in fig. 2. The argument Φ in (4) is either ($\varphi_R+\varphi_S$) or ($\varphi_R-\varphi_S$) for X_+ and X_-, respectively.

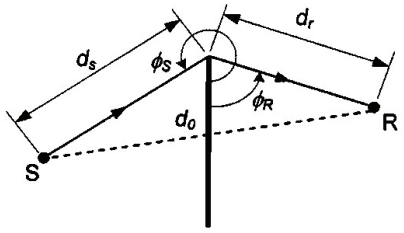
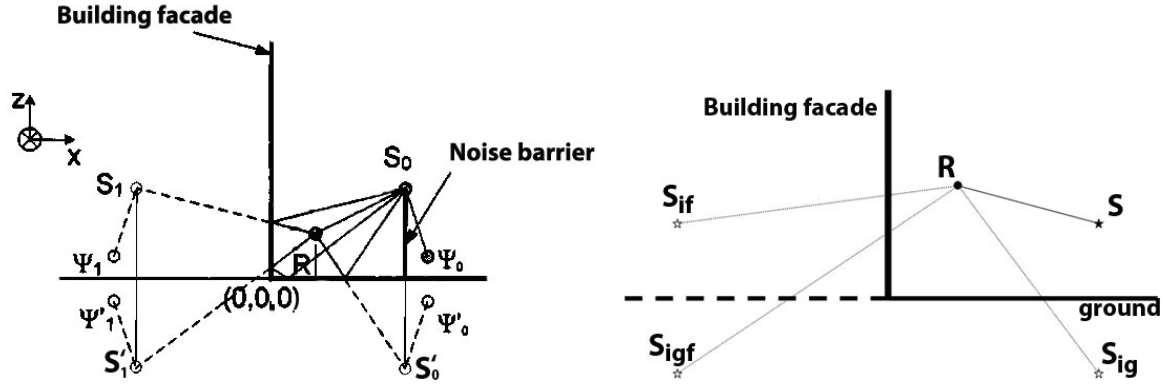


Fig. 2. The geometrical configuration for the diffraction of sound by a thin barrier

For modeling barrier efficiency in the shadow zone the model was simplified to consideration of eight principal rays as depicted in fig. 3(a). Eight considered rays are: first – direct ray from source Ψ_0 to receiver R through diffraction point S_0; second - from source Ψ_0 to R through diffraction point S_0 with single reflection from ground surface on the side of receiver (represented on the scheme by ray path $\Psi_0'S_0'R$); third - from source Ψ_0 to R through diffraction point S_0 with single reflection from facade surface (represented on the scheme by ray path Ψ_1S_1R); fourth - from source Ψ_0 to R through diffraction point S_0 with double reflection from ground surface on the side of receiver and facade surface (represented on the scheme by ray path $\Psi_1'S_1'R$); fifth - from image source Ψ_0' with reflection form ground surface on the side of the source to R through diffraction point S_0; sixth - from image source Ψ_0' with reflection form ground surface on the side of the source to R through diffraction point S_0 with single reflection from ground surface on the side of receiver;

seventh - from image source Ψ_0' with reflection form ground surface on the side of the source to R through diffraction point S_0 with single reflection from facade surface; eighth - from image source Ψ_0' with reflection form ground surface on the side of the source to R through diffraction point S_0 with double reflection from ground surface on the side of receiver and from façade surface. Rays fifth, six, seventh and eighth are not presented on the scheme by lines, but can be shown by connecting instead of real source Ψ_0 with image source Ψ_0' like for first four rays.



(a) (b)

Fig. 3. (a) Schematic diagram showing multiple reflections between the façade and barrier surfaces for the receiver height is less than that of the barrier; (b) schematic diagram showing reflections from the façade in the absence of noise barrier

For studying inference effects of sound propagation spherical reflection coefficient was introduced and calculated according to methodology, described in [3]. Barrier efficiency was determined relatively to the field near the façade in the absence of barrier by following formula:

$$\Delta L_{barrier} = 20\log\left(\left|\frac{P_{total}}{P_{w/b}}\right|\right), \qquad (5)$$

where

$$P_{total} = P_1 + Q_{gr}P_2 + Q_f P_3 + Q_{gr}Q_f P_4 + Q_{gs}(P_5 + Q_{gr}P_6 + Q_f P_7 + Q_{gr}Q_f P_8), \qquad (6)$$

where P_1-P_8 are eight described rays, Q_{gs}, Q_{gr}, Q_f are spherical reflection coefficient near sources side, spherical reflection coefficient near receiver side and façade spherical reflection coefficient,

$$P_{w/b} = \frac{\exp(i\cdot k\cdot SR)}{4\cdot\pi\cdot SR} + Q_g\frac{\exp(i\cdot k\cdot S_{ig}R)}{4\cdot\pi\cdot S_{ig}R} + Q_f\frac{\exp(i\cdot k\cdot S_{if}R)}{4\cdot\pi\cdot S_{if}R} + Q_gQ_f\frac{\exp(i\cdot k\cdot S_{igf}R)}{4\cdot\pi\cdot S_{igf}R}, \qquad (7)$$

where SR, $S_{ig}R$, $S_{if}R$, $S_{igf}R$ are rays propagating without barrier presence as shown in fig.3(b).

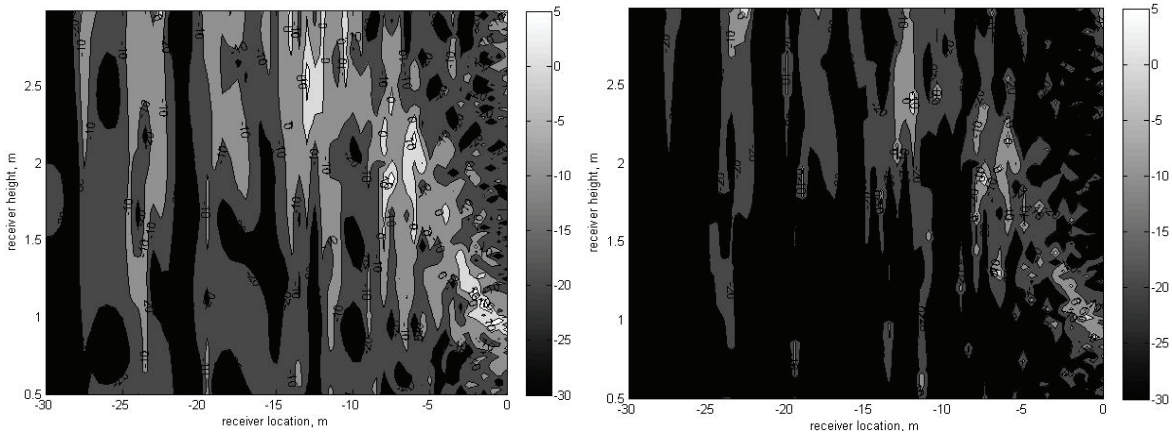
Building façade impact on screen performance was calculated relatively to sound pressure level with barrier, but without façade by the following formula:

$$\Delta L_{facade} = 20\log\left(\left|\frac{P_{total}}{P_{w/f}}\right|\right), \qquad (8)$$

where

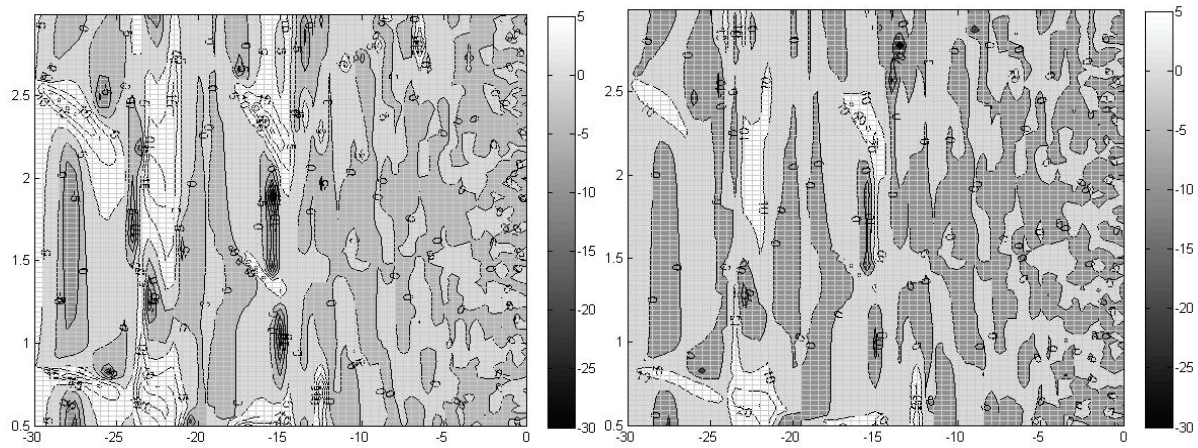
$$P_{w/f} = P_1 + Q_{gr}P_2 + Q_{gs}(P_5 + Q_{gr}P_6). \qquad (9)$$

For realization of proposed model MatLab application programs was used. Results of simulation of barrier efficiency at presence of façade and façade influence on the efficiency of barrier are given on fig. 4-5. Calculations were done for up-right standing barrier and barrier inclined on 10 degrees form the normal to the ground surface. It can be seen that for inclined noise barrier in fig. 4 the efficiency is increased and in fig. 5 it can be observed the decrease of barrier performance degradation due to façade presence at inclined barrier condition. The fluctuations in efficiency levels are explained by interference effects taking place due to various path length of propagating rays.



(a) (b)

Fig. 4. Efficiency of noise barrier at presence of façade (plane y=0) for frequency 1000 Hz: (a) for barrier inclination 0 degree; (b) for barrier inclination 10 degree



(a) (b)

Fig. 5. Façade influence on the efficiency of noise barrier (plane y=0) for frequency 1000 Hz: (a) for barrier inclination 0 degree; (b) for barrier inclination 10 degree

Conclusions

The aim of the given work was to study the influence on the building façade on the performance of noise barrier as a typical urban scenario. It was shown that due to additional multiple reflections from façade surface the presence of façade decreases barriers performance. That's why the calculations for inclined barrier were done. This proved that locating the barrier angled relatively to its uprigh position can decrease the façade degradation impact and improve barrier performance. The further study will be devoted to widening the model for counting more reflections. It is also useful to study the influence of various impedance surfaces, covering facade and barrier, on barrier performance.

Taking into account the peculiarities of Ukrainian cities, it is reasonable to study the problem of installation of noise barriers in the vicinity of tall buildings. That's why the next step will be devoted to extending the model for barrier efficiency model above shadow zone.

References

1. *K.M. Li, H.Y. Wong*. A review of commonly used analytical and empirical formulae for predictingsound diffracted by a thin screen // Applied Acoustics.- 66.- 2005.- p. 45–76.

2. *K. M. Li and Siu Hong Tang*. The predicted barrier effects in the proximity of tall buildings // J. Acoust. Soc. Am.- 114 (2).- 2003.- p. 822-832.

3. *K. Attenborough*. Review of ground effects on outdoor sound propagation from continuous broadband sources // Applied Acoustics.- 24.- 1988.- p. 289–319.

UDC 504.055(043.2)

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GIS APPLICATION FOR CALCULATION PREDICTION OF ELECTROMAGNETIC SITUATION OF RADIOLOCATION STATIONS

It was considered GIS application for solution of personnel electromagnetic safety on airport objects of civil aviation.

Radar stations of civil aviation (RS CA) work in the ultra-high (UHF) and super high (SHF) frequency ranges. Electromagnetic radiation (EMR) of given frequency ranges is an ecological factor, the influence rate of which on population quickly increases with increase of the amount of radio-technical airport infrastructure objects.

With the aim of human protection from EMR impact, created by RS CA, it is carried out both previous sanitary control at design and building stages and current control during RS exploitation. Measurements of electromagnetic field (EMF) levels are specific and their results are often connected with significant errors that depend on used measurement equipment and on measurement methodology [1].

Among methodological problems of objective evaluation of electromagnetic safety the fact that on practice the procedure of ecological monitoring of EMF in most cases does not take into account the peculiarities of electromagnetic pollution: equipment that is used for measurements has rather high lower detection threshold that does not allow obtaining continuous (in spatial relation) description of pollution structure. That's why it is impossible correct evaluation of real radiation intensity [2].

During measuring of EMF on the territory it is possible to take into account only certain near-ground sites of the territory. One more existing problem is data actualization and updating – the greater the controlled territory is the lower data updating efficiency will be. The alternative of direct measurements in situ could be calculative prognosis of electromagnetic situation.

Energy flow density (EFD) of EMF is determined with the help of the method of calculation of density flow of electromagnetic energy (EME) in UHF and SHF ranges. Calculation of EMF EFD, created by single frequency of RS is carried out by the following formula [3]:

$$D\left[\mu W / cm^2\right] = \frac{8 P_{av} g_m \Phi_g F^2(\theta)}{r^2}, \qquad (1)$$

where P_{av} - transmitted power (W),

g_m - gain of radar transmit antenna,

Φ_g - gain of ground effect,

θ - angle in vertical plane between direction of maximum antenna radiation of and direction to the target point, deg,

$F^2(\theta)$ - gain of directivity pattern in the direction t the target point,

r - distance from radar to target point, (m).

For multi-frequency RS and double-frequency RS that form two directivity patterns in the vertical plane the calculation of EFD is carried out by the formula [3]:

$$D\left[\mu W / cm^2\right] = \frac{8 P_{av} g_m \Phi_g}{r^2}\left[F^2(\theta) + F^2(\theta + \delta)\right], \qquad (2)$$

where δ - theta displacement for maximum radiation of first and second frequency channels, deg.

With the help of formulas (1) and (2) it can be determined EFD of RS radiation on various distances for different differences between heights of location of antenna radiation electrical center and irradiation point. On the base of these calculations the directivity patterns are built and further applied for prognosis and determination of existing electromagnetic situation in the region of RS location.

For realization of this task geographic information systems (GIS) can be applied. GIS is object oriented data base, where information about any space object consists of two interconnected parts: positional data (or object metrics) and non-positional data (semantics (attributes) of the object) [4].

GIS can be both an instrument of electromagnetic pollution monitoring and prediction system of ecological situation quality change relatively to electromagnetic factor.

GIS can be used as a mean of solution of the following tasks:

- inventory of radiating technical airport facilities;
- mapping of radiation systems;
- assessment of electromagnetic situation relatively to electromagnetic factor;
- modeling of electromagnetic situation on radio technical object;
- impact minimization of EMR of production, parasitic and non-production origin on the personnel of RS;
- optimization of active airport equipment location.

The initial information for GIS is the results of measurements and calculations of EMF intensity in various points of airport and nearby territories.

It is required to create a system, which would allow complementing and editing measurements base. On the base of point measurements data it is possible to do interpolation of EMF intensity. Thus, electromagnetic situation on the territory of airport can be represented on the map in the form of isolines or color grading.

For information processing in the zones of EMR performance, created by RS, it is necessary to develop electronic territory map that would include necessary topical layers: sources of electromagnetic energy radiation; residential and industrial build-up; territory relief; vegetation cover; coordinate grid. After measurements of EMF intensity levels in the determined points results are added to data base that saves the measurements results and allows obtaining necessary information on their base. Creation of electromagnetic situation map is carried out by interpolation of given point measurements. Such system will allow representing real electromagnetic situation on the airport territory and can be applied for ecological situation analysis.

Conclusions

GIS application is reasonable way of electromagnetic safety tasks solution of CA RS personnel. Integration of data about electromagnetic fields with locality geographic coordinates allows creating maps of environment electromagnetic pollution. Simultaneous use of high accuracy radiophysical methods for prediction of electromagnetic situation with purpose-designed GIS will allow elevating on qualitatively new level of objective realization of nearby territories ecological assessment. Such new level will provide the possibility of electromagnetic situation prediction and detection of particular reasons of eco-pathogenic zones emergence. This will allow making motivated decisions, directed on optimization of ecological situation.

References

1. *В.О. Нічога, П.Б. Дуб, Е.М. Грудзінський, Л.І. Сопільник, С.В. Каракай.* Вимірювальні прилади і системи для моніторингу електромагнітного техногенного забруднення навколишнього середовища // Системы контроля окружающей среды. – Севастополь, 2004. – С. 15 – 24.
2. *А.П. Сухоруков и др.* Возможности систем геопространственного моделирования в задачах прогнозирования распространения радиоволн и электромагнитной экологии. – Материалы III Всероссийской конф. «Радиолокация и радиосвязь» - ИРЭ РАН, 26–30 октября 2009 г. – С. 630 – 639.
3. Методические указания по определению уровней электромагнитного поля средств управления воздушным движением гражданской авиации ВЧ-, ОВЧ-, УВЧ- и СВЧ- диапазонов / Сост. М.Г. Шандала, Ю.Д. Думанский, Л.С. Иванов и др. – М., 1988. – 44с.
4. *ДеМерс, Майкл Н.* Географические информационные системы. Основы.: Перевод с англ. – М.: Дата +, 1999.

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ELECTROMAGNETIC RADIATION INSIDE THE OFFICE BUILDINGS OF AIRPORTS

To ensure the electromagnetic safety offered some general recommendations regarding placement and maintenance of electrical wiring and electrical appliances which is used inside the office buildings of airports.

Ukraine has own standards on electromagnetic safety, which differ from international ones [1]. These issues are governed by regulatory documents [2, 3, 4] and others. In accordance with recommended, before the commissioning of electrical equipment, as well as at regular intervals, workplaces must be certified. Study of regulatory documents in the Ukraine show the absence of scientific and systematic approach to improve the electromagnetic safety in the office buildings [5].

A magnetic field is produced whenever an electric current flows. The larger the current, the higher the magnetic field produced. A mains powered electrical circuit effectively starts and ends at the local electricity substation transformer. The supply from the substation feeds the building's electricity meter, main switch, consumer unit ("fuse box") and final circuits. The outward and return currents in the phase and neutral conductors should be equal. As long as this is true and the two currents are close to each other, the magnetic fields produced are small. Significant magnetic fields arise either when the two currents are not equal – there is a "net current" – or when they are separated [6, 7].

There are two primary sources of electromagnetic field (EMF) pollution in the office buildings of airports: electrical wiring and electrical appliances. When considering the EMF of electrical appliances can distinguish the following three groups: life-support and life-safety systems, major electrical appliances for the office work and additional auxiliary electrical appliances.

Life-support and life-safety systems

Large air conditioning units are likely to be externally mounted, with pumps and motors giving off high levels of magnetic fields. They should be 1.5 meters from anything important.

Convector heaters, Infrared heaters, Radiant 'bar' heaters and Oil filled radiators all give off magnetic fields close by. Be careful of chair and bed positions - half a metre away is usually adequate.

Storage heaters give off up to 0.3μT at 1 meter when charging up and should always be at least 1 meter away from people. This especially applies to landings where fields can extend through walls.

Fan heaters have electric motors and heating elements with magnetic fields of about 0.22μT at 50 cm., and they should be kept at least 1.2 metres away from chairs.

There are many types of fire alarm. The most common type are powered by a 9 volt battery and do not give off any EMFs, however they do use a very low level radioactive source and should only be installed on ceilings and disposed of carefully if you renew them. Central fire alarm systems often have both temperature detectors and infra-red detectors built in. These are quite safe and do not give off EMFs.

Humidifier / de-humidifiers work like a 'back-to-front' refrigerator. They cool the air from the room, forcing the water vapour in the air to condense out on the cooling coils and collect in a water container placed underneath. They have electric motors, with a magnetic field of 0.3μT at 50 cm. Chairs should be at least 1.2 meters away.

Motors of extractor fan generate high EMFs, up to 0.5μT at 50 cm. If it is at head-height, reduce time spent nearer than one meter when it is on.

Desk fans contain an electric motor which gives off quite high magnetic fields. Some only have a two-wire lead and are not 'earthed,' so they also give off high electric fields. Ceiling fans contain an electric motor which will give off quite high magnetic fields resulting in a magnetic

'hotspot', extending outwards and upwards (depending on the strength of the motor) into the room above.

Electrical power sockets always give off electric fields. "Leakage" and / or residual damp in walls can lead to high electric field levels all over walls.

Transformers are used whenever the mains electricity has to be stepped down to operate a piece of equipment. They are used for battery chargers, etc. They can give off very high levels of magnetic fields. The highest magnetic field levels of from such transformers of appliances can exceed 1 microtesla [12].

Ordinary incandescent light bulbs don't cause much of an EMF problem. They use relatively small currents and the relatively low mains frequency (50 Hz) magnetic fields that are created fall off rapidly from the bulb. Much higher magnetic fields can be caused by undetected faults in the lighting wiring, especially due to the fact that two-way (i.e. two switch) lighting circuits are sometimes incorrectly wired.

Energysaving light bulbs give off more electromagnetic radiation than incandescent bulbs, and also emit radiofrequency radiation. A Centre de Recherche et d'Information Independantes sur les Rayonnements ElectroMagnetiques (Criirem) document shows that energy-saving lamps, up to 1 meter, generate very strong electromagnetic fields, varying between 2 and 180 volts per meter. According to SCENHIR, this should not be a problem, as the measured values are far below ICNIRP [6]. Criirem says there ought to be a warning not to use energy saving lamps at too close a distance, for example, as desk lamps.

Ordinary fluorescent lights give off high levels of magnetic fields up to half a metre from their ballast coils – these fields will go through the ceiling to any room above. Some of the modern high-frequency ones give off high levels of Very Low Frequency (VLF) fields (2 kHz - 200 kHz, usually 32 kHz with some harmonics at 64 and 96 kHz). Ordinary ones produce high magnetic fields from their ballast coils. Rooms with low ceilings and fluorescent lights may have readings above 0.2 microtesla at head height. In multi-storey buildings with fluorescent lights, although personal may be far enough away from the ceiling fixtures, on upper floors they may still be exposed to EMFs from the lights on the floor below [10].

Major electrical appliances for the office work

Laptops with LCD or TFT screens give off very low EMFs. They do not need the strong low frequency magnetic fields of a traditional CRT monitor, however they use high-frequency fields for driving the back-illumination and also can emit significant levels of radio-frequency electric fields (30 kHz to 300 kHz) from the back illumination and scanning processes.

However when they are run from the mains adapters they can give off VERY high electric fields next to the keyboard and display. This is because they usually come with two-wire mains leads or adapters and are often described as being double-insulated. This is done for a variety of reasons, including protecting against electric shock. It is cheaper to cover metal objects in plastic than it is to ensure good electrical earthing of exposed metal parts. Also, if you are holding a plastic object it doesn't provide an electrical return path to earth in the most unlikely event of your also happening to touch a 240v live electrical conductor, so you will not get a severe electrical shock.

The downside is that they tend to 'float' to half the electrical supply voltage (i.e. to about 120 volts a.c.) and this causes them to radiate very high electric fields (often several hundreds of volts per metre nearby). Most of these can be cured of giving off high electric fields by taking an 'earthing' wire from their mains plug to an exposed screw or piece of metal on the laptop. Any metal connector shell on the back of the computer will do. It is often convenient to use a 'crocodile' clip on the earth lead so that it is easy to attach and detach when you need to move it. It is also possible for a qualified electronics engineer to modify the mains charger unit so that it has a three-wire mains lead and the internal 'zero volt' power supply line is connected to the electrical mains safety earth. Or charge the laptop away from where you sit, and then run it off its internal re-charged batteries [11].

Photocopiers can give off very high magnetic fields close to the motors. Stand back at least 50 cm. Photocopiers emit ozone, which is affected by the surrounding electric fields. Ensure good ventilation. Toner powder is toxic when inhaled and is attracted to static electricity.

Laser printers give off ozone, which is affected by the surrounding electric fields. Ensure good ventilation. Toner powder is toxic when inhaled and is attracted to static electricity.

Film and slide projectors have motors which give off magnetic fields which fall away within half a meter. It is unlikely to be a problem, but keep your distance to avoid cumulative exposure.

Most of the scanners give off negligible fields, although some have separate mains transformers, which give off high magnetic fields.

Fax machines give off high magnetic fields from internal transformers. If they have only two-wire mains leads, they can give off high electric fields at the keyboard.

Satellite dishes and receivers can give off high electric fields if the TV system or satellite decoder is not 'earthed' to the mains electricity safety earth. Most TVs, DVD recorders and satellite systems are not earthed when you buy them, as they only have two-wire mains leads. Walls will give some protection from the electric fields; windows are less effective at screening them. It is important that these systems are earthed.

Additional auxiliary electrical appliances

The amplifiers contain a transformer which gives off low levels of EMFs. Take care in its placement if used in the home.

The heater of coffee maker will give off high EMFs which drop away quite rapidly. Short periods of use should be no problem.

The motor of coffee grinder will give off high EMFs of up to 0.3μT at half a meter, which drop away quite rapidly. Short periods of use should be no problem

Headphones attached by a lead to the musical equipment are fine as long as the equipment itself is earthed. If it is unearthed the headphones will give off high electric fields.

Remote cordless headphone systems have a microwave transmitter attached to the base unit. The receiver is in the headset worn by the person listening. Headsets are safe, but the transmitter gives off high fields. Sit a reasonable distance away from the transmitting unit.

The heater of immersion heater and its associated wiring will give off high magnetic fields. The pumps give off high fields close by - over 20 microtesla - which typically fall to around 0.5 microtesla at 50 cm. We recommend that chairs are located at least 1.2 meters away.

Lift motors give off high fields. If you have a lift in one-storeyed building, the motor will be in a separate housing at the bottom of the liftwell, at the top, underneath an integral chair, or underneath the lift floor if the lift is used specifically for wheelchairs. The closer the motor is to your body the higher the fields you will experience.

Stairlifts have motors mounted on the actual chair, so you are exposed to high magnetic fields when using it. This probably is not a problem as long as you only use it relatively few times each day.

In a multi-storey complex, the lift motors are much larger and if you work in the top apartment then it is wise to find out where the motors are, and either keep at least 3 meters away, or measure the fields to see how far they extend.

Electric pencil sharpeners have motors giving off high EMFs. They are not usually a hazard being used occasionally for short periods.

Smoke detector are many types of these. The most common type are powered by a 9 volt battery and do not give off any EMFs, however they do use a very low level radioactive source and should only be installed on ceilings and disposed of carefully if you renew them. Smoke detectors feeding a central fire alarm system often have both temperature detectors and infra-red detectors built in. These are quite safe and do not give off EMFs.

Electric typewriters give off high magnetic fields (due to cheap transformers), and, if unearthed, the keyboards can give off high electric fields. Switch it off at the socket when it is not being used.

Cheap dimmer switches and wiring give off radio-frequency noise, raising the overall levels of electromagnetic pollution. Most give off quite high electromagnetic fields up to a few inches from the light switch and wires [9].

Conclusions

Electrical wiring and many electrical appliances inside the office buildings of airports at different frequencies radiate different levels of EMF. It is important to provide staff information on possible influences of electromagnetic fields from electrical, the recommendations for their deployment, operation, and their electromagnetic compatibility. It is urgently for solution of these issues to develop scientific and systematic approach with express methods for the rapid study of the traditional and new electrical.

References

1. *Глива В.А., Лук'янчиков А.В., Левченко Л.О.* Нормативна база України з електромагнітної безпеки та шляхи її вдосконалення // Матеріали VIII Міжнародної науково-технічної конференції "Авіа-2009". – К.:НАУ, 2009, т. 3.

2. ДСНіП 239-96 (ДНАОП 0.03-3.30-96) Державні санітарні норми і правила захисту населення від впливу електромагнітних випромінювань / Наказ МОЗ України від 01.08.96 № 239, зі змінами від 10.12.2007 № 804.

3. НПАОП 0.00-1.31-99 (ДНАОП 0.00-1.31-99) Правила охорони праці під час експлуатації електронно-обчислювальних машин / Наказ Держнаглядохоронпраці України від 10.02.1999 № 21.

4. ДСанПіН 3.3.6.096-2002. Державні санітарні норми і правила при роботі з джерелами електромагнітних полів. / Наказ МОЗ України від 18.12.2002 № 476.

5. *Барабаш О.В., Глива В.А., Лук'янчиков А.В.* Питання узгодженості нормативної бази електромагнітної сумісності та електромагнітної безпеки засобів обчислювальної техніки // Прикладная радиоэлектроника. Состояние и перспективы развития: 3-ий Международный радиоэлектронный форум (21—24 октября 2008): Сб. науч. тр. — Х.: АНПРЭ, ХНУРЭ, 2008. — 6 том. — С. 159 – 162.

6. International Commission on Non-Ionization Radiation Protection. Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz) Health Physics, vol. 74 – 1998 – p. 414-522.

7. *Глива В.А.* Методи забезпечення електромагнітної безпеки користувачів персональних комп'ютерів: Дис. канд.техн. наук. 05.26.01. - К.: 2006- 156 с.

8. Stakeholder Advisory Group on ELF EMFs (SAGE). Precautionary approaches to ELF EMFs. Supporting Papers to the First Interim Assessment: Power Lines & Property, Wiring in Homes and Electrical Equipment in Homes. — Ellsdone: R K Partnership Ltd, 2007. — 103 p. // http://dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_074228.pdf

9. *Alasdair and Jean Philips.* Electrical Appliances. // http://www.powerwatch.org.uk/library/downloads/appliances_1_intro_a_c-20100429.pdf, http://www.powerwatch.org.uk/library/downloads/appliances_2_d_h-20091005.pdf, http://www.powerwatch.org.uk/library/downloads/appliances_3_i_r-20091005.pdf, http://www.powerwatch.org.uk/library/downloads/appliances_4_s_z_earth-20100429.pdf

10. *Alasdair and Jean Philips.* Lighting and EMFs. // http://www.powerwatch.org.uk/library/downloads/lighting_emfs-20100520.pdf

11. *Alasdair and Jean Philips.* Computing Overview. // http://www.powerwatch.org.uk/library/downloads/computing_overview-20090521.pdf

12. *Tomitsch J, Dechant E, Frank W.* Survey of electromagnetic field exposure in bedrooms of residences in lower Austria. // Bioelectromagnetics. — Bethesda, USA: National Center for Biotechnology Information, U.S. National Library of Medicine. — 2010. — Apr; 31(3):2008 // http://www.ncbi.nlm.nih.gov/pubmed/19780092

UDC504.054 (45)

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CFD SIMULATIONS OF AIRCRAFT ENGINE JETS AS A MONITORING TOOL FOR LOCAL AIR QUALITY CONTROL

The monitoring of air pollution, produced by aircraft engine emission, is an actual task, providing evidence on the actual pollution situation, validation the model and useful initial data for improving air quality simulation systems, thus aiding an increased understanding and control of airport-related air pollution. CFD simulations of aircraft engine jet dynamics to improve local air quality modeling and assessment of aircraft emission contribution in airport sanitary-hygienic zoning

Background

Air pollution resulting from airport emissions is a growing concern because of the expansion of air traffic over the years. Future air traffic movements are forecast to grow at a mean annual rate of 5 to 7 percent.

Even though most engines have become more fuel efficient and less pollutant, the expansion of air traffic more than compensate for this reduction, maintaining the high levels of emissions locally and globally.

Aircraft exhaust emission is dominant source of air pollution at airport, as in lower atmosphere (local, regional pollution) during LTO cycle inside the airport area, so in upper troposphere and lower stratosphere during cruise mode (global air pollution).

During last decade a lot of studies are also focusing on the aircraft emissions impact on local and regional air quality in the vicinity of airport.

Aircraft emissions impact on local and regional air quality in the vicinity of airport is actual problem, specially for city airports, which are quite closely located to habitation areas, so ground operation contribution to local air quality.

Air quality deterioration in the airport area adversely affects the health of staff, passengers and residents of surrounding areas. Compliance the emission characteristics of air pollution sources with developed quality standards is providing by air safety system. Upholding of air quality established standards within and around the airport is defined adequacy and objectivity of data about air pollution level and the corresponding causes of its changes. Such information is provided by the instrumental and information monitoring system. Solving the considered problems has highlighted the importance of monitoring system organization within and around the airport.

The use of combined approach for aircraft activities impact evaluation by measurement campaign and modelling techniques should provide a more accurate representation of the contribution to total air pollution from airport area.

Reliable and timely obtaining information based on monitoring system determines the quality of decisions and recommendations for reducing air contamination, as well as bring information to the relevant authorities and the general public.

Instrumental monitoring of air pollution in the vicinity of airport

The organization of instrumental monitoring with aim to assess local air pollution from aircraft should consider the influence on measured concentration value of the other emissions sources inside the airport and surrounding areas. According to described combining pollutions sufficiently high levels of air pollution can be generated, significantly greater than under the influence of separate aircraft emissions impact.

The location of monitoring stations should be chosen such way that the results of measured concentrations most objectively correspond to the impact of aircraft engine emissions at this mode of operation and in view of the prevailing wind direction in the area of the airport.

The scientific objectives for instrumental monitoring of air pollution produced by aircraft engine emissions in the vicinity of airport:

- Measurement of priority contaminants concentrations during aircrafts operation in the vicinity of the airport;
- Determination of the aircraft emission indices for actual operation conditions and more precise calculation of the aircraft emission inventory;
- Determination of the representativeness of airport air quality monitoring sites for the characterisation of airport air quality;
- Providing useful initial data for improving air quality simulation systems;
- Verification of modelling tools by measurement campaign for different operation conditions in airport.
- Determination influence of airport emissions upon air quality in the surroundings as well as validation of local- and mesoscale numerical simulations.

So, presented scientific tasks of instrumental monitoring are aimed to accurate assessment of aircraft emissions impact on air quality within and around the airport, and also to validation and control of sanitary-hygienic zone of airport

Zurich Airport has monitored the local air quality in the vicinity of the airport for many years. The monitoring sites have been selected following a monitoring concept that has been developed with the local authorities and last updated in 2005 [1].

The locations of monitoring stations are grouped according to their potential main contributor specified in the airport's ambient air quality monitoring concept (May 2001):

- monitoring stations most likely to be dominated by road traffic;
- monitoring stations most likely to be dominated by airport activities;
- monitoring stations most likely to dominated by other sources;
- background monitoring stations.

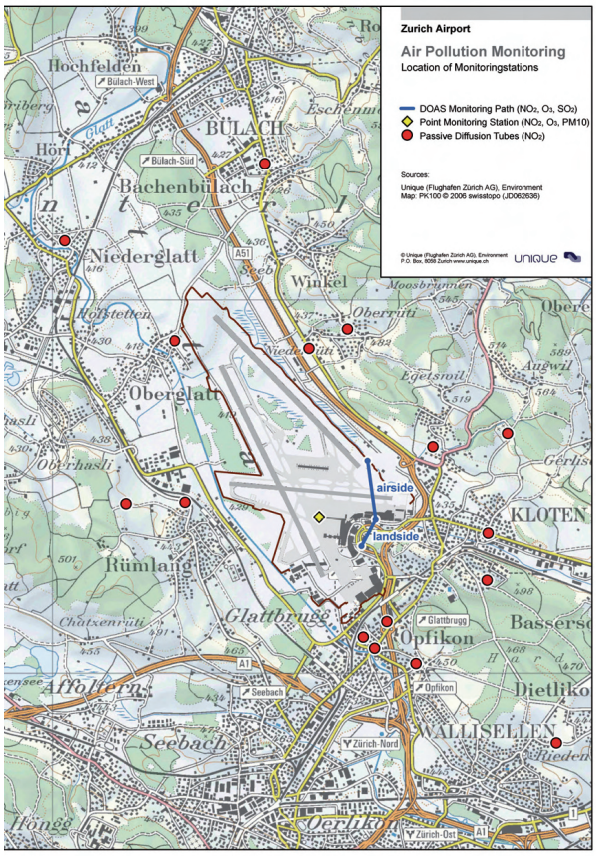

Fig.1 – Instrumental monitoring of air pollution within and around Zurich airport

With aim to receive full, objective and reliable information, instrumental and informational monitoring systems should complement each other.

In some cases, technical activities of instrumental monitoring do not allow identify and assess the contribution of individual emission sources to total AA pollution within the airport. Considered problem is solved by modelling of air contamination from different emission sources, that is a task of information monitoring.

Today the instrumental monitoring of local and regional air pollution producing by air-transport systems, in particular aircraft emissions, is absent in Ukraine. Insufficient material and technical base do not allow develop a general information system of observations for monitoring purposes. The scientific and technical basis for monitoring organization is also absent, particularly concerning formation of the database and the system of analysis and air quality predicting. Lack of objective and correct information does not allow to define adequately the air state, and naturally the priorities in making decisions concerning the air protection, particularly in the field of the air transport.

Information monitoring of air pollution within and around the airport

The aim of information monitoring of AA pollution during aircrafts operation inside the airport is prediction and prevention of dangerous concentrations of contaminants in AA within and around the airport.

Tasks of information monitoring aircraft emissions within airport:

1. calculation of mass contaminant emissions in surface layer of the atmosphere (up to 900 m) from a single aircraft and their actuality for defined time interval for various operational and meteorological conditions;
2. calculation of instantaneous concentrations field of contaminants in AA from aircraft engine exhausts during standard or real LTO-cycle in vicinity of airport;
3. calculation of averaged (maximum short-time or 24 hours) concentrations field of contaminants in AA in the vicinity of airport for air traffic scenario.

Based on the estimated information on aircraft and other sources of contaminants emissions, sanitary-hygienic assessment of the AA is implemented, size of sanitary-hygienic zone and limitations of habitation areas around the airport are examined.

Therefore, for determining sanitary-hygienic zone around the airport and development of nature-conservative measures correct, reliable and validated method plays dominant role for calculating contaminant concentrations in AA from aircraft engine emissions (task of information monitoring).

Size of sanitary-hygienic zone of enterprise should be verified by AA pollution calculations according to normative methodology OND-86 [48].The basis of this method is calculation model of contaminants concentration in accordance with solution of semi-empirical equation of turbulent diffusion.

According to international practice 3 well-known tools for accurate assessment of local air quality inside the airport were developed:

- LASPORT Emission Calculation and Dispersion Model System – assessment of air pollution levels from all emissions sources inside and around the airport. This program system is based on Langragian dispersion model LASAT [2];
- EDMS Emission and Dispersion Model System. This modelling system is based on Gaussian dispersion model AERMOD [3];
- ALAQS-AV, Emissions Inventory was developed by EUROCONTROL Experimental Centre (EEC) [4]. Model LASAT and model AERMOD is used for assessment of contaminant dispersion in AA.

It should be emphasized that an important feature of a researched source of emission is the presence of jet of the fulfilled gases, which can transport contaminant on rather large distances. The extent of jet can change within the distances of 20…1000 m and sometimes even more.

Aircraft is special source of air pollution due to following features:

- Moving source, result in velocity, direction and acceleration of aircraft movement has been changed in within the wide limits;

- Excess of the jet fulfilled gases temperature over the air atmosphere temperature;
- Sufficiently high velocity of fulfilled gases jet at engine nozzle section;
- According to aircraft movement conditions in the vicinity of the airport, engine operation modes have been changed from idle to maximum operation mode – correspondingly temperature, velocity of fulfilled gases jet and emission characteristics of aircraft engine has been also changed within the wide limits.

At present the development of computer technology allow to solve quite complex equations and problems (numerical methods of computation). State-of-the-art Computational Fluid Dynamics (CFD) software packages represent the most advanced mathematics that can be applied to the simulation of aircraft-engine jet.

Numerical simulations of fulfilled gases jet from aircraft engine close to the ground in the airport area by CFD codes (Fluent 6.3, Ansys) provides a more realistic configuration of aircraft engine, the most appropriate technique to characterize aircraft plume dynamic and transportation of air contamination during different stages of the take-off and landing phases.

Such modeling tools obtain accurate contribution of aircraft engine emission impact on airport air quality for different operation conditions and should be use for improving of air quality.

Conclusions

CFD simulations of aircraft engine jet dynamics to improve local air quality modeling and assessment of aircraft emission contribution in airport sanitary-hygienic zoning

Therefore, the development of calculation models and methods of air contaminants concentrations during the aircraft operation inside the airport, including three-dimensional problem solving of contaminants transport and dispersion by jet of fulfilled gases from aircraft engine, is an actual research.

Numerical investigation of properties and structure of aircraft engine jets with CFD codes will give a realistic checked material, on the base of which a necessary scientific reasoning of transportation of the contaminants by engine jets should be used with the biggest commercial, ecological and social effectiveness.

References

1. Airport Local Air Quality Studies Emission Inventory for Zurich Airport with different methodologies EEC/SEE, 2004
2. Janicke Consulting, LASPORT version 1.3 Reference Book. – November 2005. – 93 p.24,4
3. Emissions and Dispersion Modelling System (EDMS) Reference Manual. FAA-AEE-01-01. U.S. Department of Transportation Federal Aviation Administration, Washington, D.C. CSSI, Inc., Washington, D.C. – September 2002.
4. *Peeters S.* ALAQS-AV Application Reference Manual. – Eurocontrol Experimental Centre, 2003 26,4

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CALCULATION OF POLLUTANTS CONCENTRATION IN THE AIRPORT AREA WITH PEGAS LAQ TOOL AND COMPARATIVE ANALYSIS OF MEASUREMENT AND COMPUTATIONAL RESULTS

The aircraft pollution impact on the environment in the vicinity of the airports is one of the modern environmental problems, being investigated by many different methods including concentration measurements and numerical modeling. As the part of the standardized parameters of the sanitary-hygienic airport zone the air pollution has to be calculated and predicted within the appropriate accuracy. Proper and consistent modeling of the aircraft-emitted pollutant dispersion allows estimating the environmental situation and the corresponding aircraft impact.

In this paper the procedure of calculation the pollutants concentration from the aircraft engine emissions in the airport area (PEGAS LAQ software tool) is considered and applied to predict the pollutant concentration in the areas of several airports. The atmospheric dispersion is described by the statistical Gaussian dispersion model based on the Euler approach. The turbulent diffusion being the complex and complicated physical problem is solved by means of several methods for obtaining precise and reliable result. A number of ICAO recommendations were taken into account and implemented.

The proposed pollutant concentration calculation is based on the following input data: atmospheric and meteorological parameters; aircraft modes and data; airport and tracks geometry and additional options. Since the human health and the environment are affected by a number of air pollutants from aviation-related activities, the following main pollutants are considered: CO, NOx (NO and NO2), SOx, C, HC. These pollutants are standardized in the Russian Federation.

In order to precisely predict the pollutant distribution the analysis of the calculated pollutant concentration fields is conducted. The comparison of the measured and the calculated concentrations in a group of probe points is made to achieve a greater correlation between the computational methods and the actual environmental state. The minor deviations occurred are expected as a result of the complexity of the atmospheric processes and the uniqueness of the each airport area.

Although the problem of the atmospheric dispersion and the environmental safety is only in the process of investigation and has several approaches to solutions, the results achieved are appropriate for sanitary-zones construction and the planning of the airport modernization.

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APPLICATION DATA ON METEOROLOGICAL CONDITIONS IN THE TERMINAL AREA IN PURPOSE TO PREDICT THE EFFECTIVENESS OF THE USE OF AIRCRAFT'S TAKEOFF / LANDING DIRECTIONS

This work is devoted to exploring the possibility of using data on meteorological conditions in the terminal area in purpose to predict the distribution of aircraft's takeoff\landing directions.

In this work will be shown a list of meteorological parameters, which can form the basis for the prediction distribution ratio of aircraft's takeoff\landing directions, including characteristics depending on the airfield's lighting equipment. Will be described the requirements for meteorological equipment installed at the airfield, and to a system for collecting and storing data on meteorological conditions.

On example of the actual work, carried out by the State research institute of civil aviation at the airport Perm will be demonstrated the possibility of using meteorological data to predict the distribution ratio of takeoff\landing directions at different operating conditions of the airfield (including the case of commissioning of a new runway) with further use of compiled forecast for the calculation of future emission of pollutants and noise exposure on the territory adjacent to the airfield during aircrafts' explotation.

Based on the analysis of meteorological information and data on the actually used takeoff\landing directions will be shown the possibility of evaluating the effectiveness of current distribution ratio of the airfield's magnetic courses and the perspectives of theirs change in order to reduce negative impacts on the territory which are sensitive to such impacts.

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COMPUTERIZED APPROACH TO THE QUESTION OF SANITARY-HYGIENIC ZONES DEVELOPMENT OF COMMERCIAL AVIATION AIRPORTS

The report of «Computerized approach to the question of sanitary-hygienic zones development of commercial aviation airports» is touched the following questions drafting of sanitary protection zones Airports Civil Aviation:

Description of the current need of a lot of projects of SPZ GA airports on the territory of Russia;

Main challenges were enumerated, which were faced by engineers while designing projects of SPZ GA airports at present;

The need for automated complex of the development of the SPZ was identified, as single program calculation SPZ for all existing and planned airports GA;

Examples of domestic and international experience in automation were given: the existing software systems, which are used by engineers in designing projects of SPZ airports;

Requirements for the structure and contents of possible automated program to develop SPZ GA airports were set out;

Positive results of creating such automated complex of the development of SPZ GA airports were presented;

The definitive conclusions and the prognostication of the transition in the future to a new level of organization of the project development process of SPZ GA airports were made.

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COMPLEX APPROACH TO CLIMATE GAS EMISSION CONTROL IN CIVIL AVIATION

During discussions on assessment of ICAO environmental goals, air traffic operational goals, and aircraft and engine technology goals, the question of metrics has been extensively debated by CAEP. For application to the CAEP/8 trends assessment a metric named the Commercial Air System Fuel Efficiency (CASFE) metric was developed. The CASFE metric takes the familiar form of fuel consumed divided by sum of (payload x distance).

For the air traffic operational goal input to CAEP/8, application of the CASFE metric was offered as an interim measure with the same caveats and issues apply as for the application of CASFE to the ICAO Environmental Goals trends assessment. Beyond CAEP/8, it was recommended that given the complex relationship between fuel efficiency and operational efficiency, consideration of a fuel efficiency metric applicable to future Operational Goals is not regarded as a separate task but is undertaken as part of the Goals process itself.

While the CASFE metric is considered suitable for application to the Environmental Goals trends analysis, further work on improvement of payload data and on further validation of the CASFE metric against actual airline data was still suggested. It was also stated this metric is suitable for kerosene-like fuels only keeping in mind that this does not take into account life-cycle CO2 costs of any potential alternative fuels.

A potential Aircraft greenhouse emissions standard be referred as a “CO2 standard” based on “fuel efficiency” concepts within the certification requirement metric. In addition, the the following definitions were proposed by CAEP too:

- Parameter – a measured or calculated quantity that describes a characteristic of an aircraft (e.g. Foo, MTOW, Optimum Cruise Speed)
- Metric – a certification unit consisting of one or more parameters (e.g. Dp/Foo)
- Procedures – specific certification procedures, including applicability requirements (e.g. Annex 16 Volume II, Chapter 2)
- Instrumentation and measurement methodology – technical measurement procedures (e.g. Annex 16 Volume II, Appendix 3)
- Certified level – approved for a specific product by a certification authority to demonstrate compliance with a regulatory level, as determined by the certification requirement
- Regulatory level – a limit which a certified level must meet (e.g. CAEP/6 NOx)
- Certification requirement – the combination of metric, procedures, instrumentation and measurement methodology, and compliance requirements
- Standard – combination of a certification requirement and a regulatory level

It was agreed that the deliverable to CAEP/8 would be a report on agreed voluntary measures between Government and Industry to limit or reduce international aviation emissions. Voluntary agreements are often considered as market-based measures as they are regarded as an alternative to regulation.

3 initiatives undertaken were under a formal voluntary agreement between Government and 3 initiatives undertaken were under a formal voluntary agreement between Government and Industry as follows:

- Industry as follows: Asia and Pacific Initiative to Reduce Emissions (ASPIRE), which involves airlines, air traffic control, airport authorities and governments in a voluntary agreed measure to work together to reduce aircraft fuel burn and CO2 emissions through efficiency improvements on key Asia and Pacific routes.
- Memorandum of Understanding between Transport Canada and the Air Transport Association of Canada to limit or reduce emissions of greenhouse gas (GHG) from aviation in Canada. The Agreement sets out a GHG emissions reduction goal for members of the Air Transport Association of Canada and covers both domestic and international air transport; and
- A negotiated agreement in Romania involving airlines, air traffic control, government and manufacturers, which involves: Direct routes; Continuous Descent Approach at Henri Coanda International Airport, and Non-standard arrival trajectories (direct arrivals) at airports which provide approach services.

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