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Dear readers,

Let me talk to you for the first time as a new chairman of the editorial board. I was appointed to this position in January 2013 after personnel changes had taken place in the Armed Forces Academy. I would like to thank the former chairman of the editorial board Prof. Dipl. Eng. Pavel Nečas, PhD. for his active and creative work he devoted to making the journal Science & Military.

Every editor naturally wants his or her journal to be one of the best, to be respected by other authors and to be registered periodically in international databases. Developing a new scientific journal, establishing its position at the national level and its acceptance at the international level is a long-standing process. We realize that it is not possible to make a quality scientific journal in a few days and that is why we try to improve our journal continually so that our readers can look forward to its next publication.

This year is not the exception. In 2013, the journal has undergone and it is still about to undergo several changes. We hope that these changes will be positive and that they will lead to improvement of our outcomes, but also the dynamics of the reviewing process.

In January 2013, the editorial board was complemented by other important members. At the same time, the editorial board was divided into two sections according to their specialization – the security, humanities and social sciences section and the engineering and computer science section.

The Science & Military Journal will be monothematic in the two fields of expertise, so I expect improvement of the output. The journal's main focus on application warfare will remain the same. The Science & Military Journal will be published biannually.

However, the main long-term goal of the editorial office is to include the journal in the ISI Current Contents databases. We realise that achieving the goal is only possible with joint effort because a good journal is neither the result of work of the editorial board, nor the editor. A good journal is represented by good articles that address the scientific community, but also the general public and provoke discussion.

Dear authors and readers, the quality and expertise of the journal Science & Military is in your hands. Your creative work and dedication can guarantee our journal a long perspective.

On behalf of the editorial board, I wish the journal Science & Military many good science articles, readers´ interest and a positive feedback from professionals.

Col. (Ret.) Assoc. Prof. Dipl. Eng.
Marcel HARAKAĽ, PhD.
Chairman of the editorial board

Col. (Ret.) Assoc. Prof. Dipl. Eng.
Marcel HARAKAĽ, PhD.

He received the MSc. degree in electrical engineering from the Faculty of Electrical Engineering, Slovak Technical University in Bratislava in 1983. In 1997 he successfully finished his PhD. studies in artificial intelligence. From 1983 to 1989 he worked as a research engineer at the Military Research Institute in Liptovský Mikuláš. In 1989 he joined the Armed Forces and since then he has worked in various teaching and managerial positions at the Department of Informatics. During his university career from 2004 to 2012 he led the Department of Informatics. Currently he is in the position of Vice Rector for Science of the Armed Forces Academy of General Milan Rastislav Štefánik, Liptovský Mikuláš, Slovakia.

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IMPACT OF PLASMA NITRIDING ON DEPTH OF DIFFUSION LAYER IN SELECTED STRUCTURAL STEELS

Martin KLATÝ, Jana MAJDOVÁ, Peter ČELKO

Abstract: Plasma-nitriding technology not only substantially increases surface hardness, fatigue strength but also corrosion resistance. This article presents a study of the effect of the process parameters on the depth of the diffusion layer in the selected plasma-nitrided structural steels based on the Vickers microhardness test.

Keywords: Plasma-nitriding, surface hardness, microhardness, steels.

1 INTRODUCTION

The technology of saturation of the steel surface with nitrogen resulting in extreme hardness of the surface layer of steel, improvement of its resistance to friction, improvement in fatigue properties and higher resistance to corrosion, is known as nitriding. One method of the thermochemical treatment of steels with a wide practical utilisation is plasma-nitriding. In comparison with other methods of nitriding, its major advantage is that the structure of the nitrided layer can be altered in order to achieve better properties which can be adjusted to resist the stress applied to the steel components. Plasma-nitriding is particularly efficient in improving the sliding characteristics and resistance to wear, especially as a result of significant enhancement of the surface hardness. To a lesser extent, it is used to increase the fatigue strength and resistance to corrosion. In general, it can be stated that any increase in resistance to corrosion depends on the compactness and depth of the "compound" or "white" layer on the surface most enriched with nitrogen. By contrast, the depth and hardness of the underlying diffusion layer are particularly important in increasing the fatigue strength. This article is aimed to examine the depth of the diffusion and the "compound" layers resulting from plasma-nitriding in various steel samples under various operating conditions.

2 EXPERIMENTAL

The samples used in the experiments aimed at the utilisation of plasma-nitriding were prepared from three steels: carbon steel C45E (STN 412050) denoted as 12 050, special steel 37MnSi5 (STN 413240) denoted as 13 240 and steel (STN 415230) denoted as 15 230 [1,2]. A total of fifteen samples were prepared, i.e. five samples of each steel grade.

Each individual sample was mint-marked with a unique identifier (Table 1) to distinguish the samples.

The chemical composition of the steel samples (mass % of the element) was verified using an optical emission spectrometer SPECTROLAB Jr^{CCD} [3] and compared with their concentrations as specified in the European standard [4, 5]. The results of the spectroscopic determinations and standard values are documented in Table 2.

Table 1 Samples used – specification of steels, identification of samples and equivalents of steel examined to EN 10027 standard

Material	Samples	Number of samples	Equivalent to steel by EN 10027-1 standard
12 050	A1 – 12 050	5	C45E
	B2 – 12 050		
	C3 – 12 050		
	D4 – 12 050		
	E5 – 12 050		
13 240	A1 – 13 240	5	37MnSi5
	B2 – 13 240		
	C3 – 13 240		
	D4 – 13 240		
	E5 – 13 240		
15 230	A1 – 15 230	5	-
	B2 – 15 230		
	C3 – 15 230		
	D4 – 15 230		
	E5 – 15 230		

Table 2 Chemical composition of steel samples

	Steel	12 050	13 240	15 230
Content of elements mass [%]	**C**	0.47	0.35	0.32
	Mn	0.75	1.18	0.53
	Si	0.29	1.51	0.29
	Cr	0.05	0.05	2.51
	Cu	-	-	0.04
	V	-	-	0.18
	Ni	0.02	-	0.04
	Al	0.03	0.05	0.02

The samples prepared and depicted in Fig. 1 were of cylindrical shape of a diameter of 35mm and length of 4mm. After the original material was sliced into smaller disks, the cut surfaces were subjected to light smoothing by polishing and the samples were treated thermally and chemically with plasma under the conditions specified in Table 3.

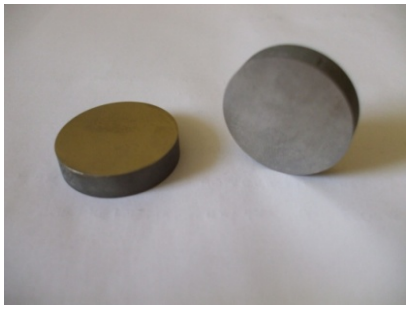


Fig. 1 Samples examined

3 PLASMA NITRIDING

Plasma-nitriding was conducted using RÜBIG 60/60 nitriding equipment (Fig. 2) with the N_2 : H_2 ratio of 3:1 and 1:3, respectively for 10h and 20h, respectively [6, 7].

Fig. 2 Rübig 60/60 equipment for plasma-nitriding

The samples were plasma-nitrided under the conditions specified in Table 3, at a temperature of 500°C, pressure of 280 Pa and voltage of 510 V. These parameters were maintained constant in the course of plasma treatment. The variables of plasma-nitriding were the nitriding time (parameter X) and the process gases composition, i.e. ratio of gases (parameter Y), as detailed in Tables 3 and 4.

Table 3 Parameters of plasma-nitriding

		Dusting	Nitriding
Input parameters	Temperature [°C]	480	500
	time [h]	0.5	X
	pressure [Pa]	80	280
	voltage [V]	800	510
	H_2:N_2 ratio [L/h]	2:20	Y

Table 4 Operating conditions in plasma-nitriding

Parameter		Plasma-nitrided steel samples		
X	Y			
time [h]	H_2:N_2 ratio [L/h]	12 050	13 240	15 230
10	8:24	B2 - 12 050	B2 - 13 240	B2 - 15 230
20	8:24	C3 - 12 050	C3 - 13 240	C3 - 15 230
10	24:8	D4 - 12 050	D4 - 13 240	D4 - 15 230
20	24:8	E5 - 12 050	E5 - 13 240	E5 - 15 230

Four of the five steel samples in each series, denoted as B2, C3, D4 and E5 (see Table 4), were plasma-nitrided. The samples denoted A1 in each series did not undergo the plasma-nitriding process and served as reference.

4 MEASUREMENT OF MICROHARDNESS

Microhardness was measured on the plasma-nitrided as well as un-nitrided samples by the method devised by Vickers (HV) [8, 9] using an AMH 43 software - controlled microhardness tester LECO LM 247 AT. A single indent (one vector) in a sample surface denoted as pattern 1 and in the core (jadro) were measured as illustrated in Fig. 3. A load of 0.05 kg (0.490 N) with a dwell time of 10 s was applied to the samples. For microhardness depth profiling, twenty-three indents were used in the direction from the surface towards the core, and three indents in the core of the steels under study.

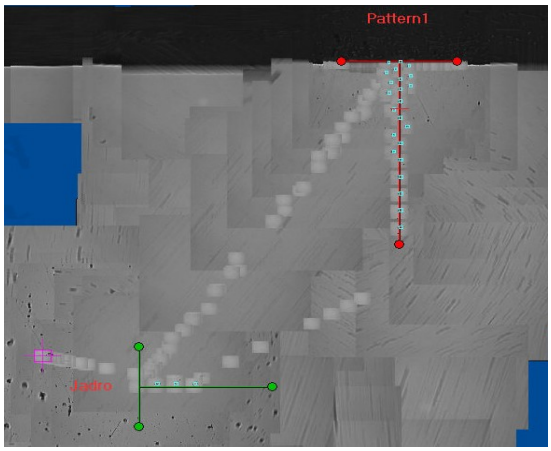
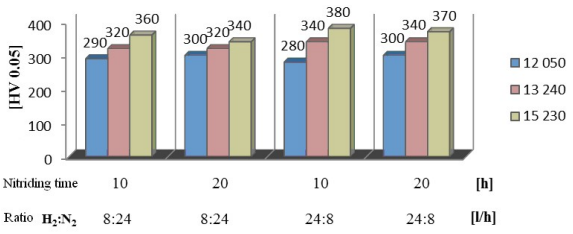


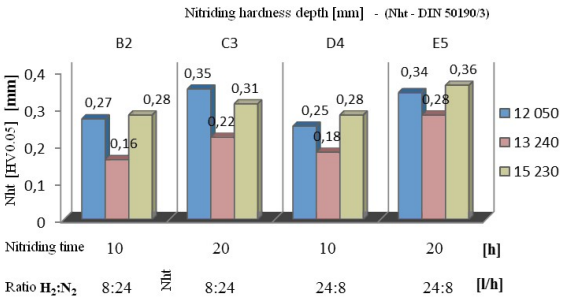
Fig. 3 Measurement method using AMH 43 software

Table 5 Results of measurements of microhardness, nitriding hardness depths (Nht - measured in accordance with DIN 50190/3), surface hardness and core hardness of steel samples

Steel	Sample	Nitriding time [h]	H_2:N_2 ratio [L/h]	Nht (DIN 50190/3)		Core hardness [HV 0.05]	Surface hardness [HV 0.05]
				[HV 0.05]	[mm]		
12 050	B2	10	8:24	290	0.27	243	502
	C3	20	8:24	300	0.35	251	344
	D4	10	24:8	280	0.25	231	432
	E5	20	24:8	300	0.34	251	438
13 240	B2	10	8:24	320	0.16	270	649
	C3	20	8:24	320	0.22	274	716
	D4	10	24:8	340	0.18	294	534
	E5	20	24:8	340	0.28	287	622
15 230	B2	10	8:24	360	0.28	314	830
	C3	20	8:24	340	0.31	289	827
	D4	10	24:8	380	0.28	329	874
	E5	20	24:8	370	0.36	316	719



Graph 1a) Bar graph illustration of microhardness by Vickers at which nitriding hardness depth was determined



Graph 1b) Nitriding hardness depths of plasma-nitrided layers in steel samples (B2, C3, D4 and E5) prepared from various structural steels

4.1 Evaluation of measurements of microhardness

Previous research into plasma-nitriding [10] has noted that the content of silicon (Si) significantly affects the depth of the plasma-nitrided layer. This phenomenon is manifested in Graph 1b) in steel sample 13 240 which has a higher content of this element than the other steel samples under examination (Table 2). In steel sample 13 240 the greatest depth of the plasma- nitrided surface layer was 0.28mm achieved with the ratio of H_2:N_2 = 3:1 after 20h treatment.

The thickness of the nitrided layer [11] in steel 12 050, which was plasma-nitrided using the ratio of H_2:N_2 = 1:3 for ten hours, was 0.27mm; with the ratio of H_2:N_2 = 3:1 and the same period of plasma treatment, the plasma-nitrided layer achieved the thickness of 0.25mm. The greatest thickness of the nitrided layer of 0.35mm was obtained with the samples prepared from steel 12 050 with the ratio of process gases of H_2:N_2 = 1:3 following 20-hour plasma-nitriding treatment.

The samples prepared from steel 15 230 acquired the surface layer 0.36mm deep, which was affected by plasma-nitriding using a mixture of gases with the ratio of H_2:N_2 = 3:1 following 20h of plasma-nitriding treatment.

The greatest difference in depth of the layer resulting from plasma-nitriding was observed in steel 13 240; in these samples, the thickness of the layer following plasma-nitriding for 20 hours was comparable with the depth of the layer resulting from plasma-nitriding in the samples prepared from steel 12 050 and 15 230, respectively, which underwent plasma-nitriding for 10 hours. On the basis of the results thus obtained, it may be concluded that the depth of the layer as a result of plasma-nitriding is affected mostly by the time of nitriding, i.e. the deeper layers due to plasma-nitriding are observed after 20 hours of treatment in comparison with 10 hour of plasma treatment.

As far as the microhardness is concerned, the highest value was recorded with steel 15 230 (380 $HV_{0.05}$) with a ratio of H_2:N_2 = 3:1 after 10 hours of plasma-nitriding, as opposed to samples prepared from 12 050 steel (280 $HV_{0.05}$) which were plasma-nitrided with a mixture of gases H_2:N_2 = 3:1 following 10-hour plasma-nitriding in which the lowest values of microhardness were obtained. As can be observed in Graph 1a), the greatest effect on the microhardness of steel 12 050 resulted from plasma-nitriding conducted for 20 hours (300 $HV_{0.05}$) as compared with 10 hours of plasma-nitriding. On the other hand, in the samples prepared from steels 13 240 and 15 230, respectively, the major effect on the microhardness resulted from the gas mixture ratio of H_2:N_2 = 3:1 with higher values of microhardness than when this ratio was set at H_2:N_2 = 1:3. It may, therefore, be concluded that the composition of process gases, H_2:N_2 = 3:1, has a more beneficial effect on the microhardness in plasma-nitriding of the steel sample tested.

5 CONCLUSION

The experiments demonstrate (Table 5) that the microhardness of the steel samples studied increases as a result of plasma-nitriding. The

samples which underwent the plasma-nitriding treatment showed a higher microhardness than the steel samples which did not undergo the treatment. As can be observed in Graph 1a), the microhardness in the samples prepared from 12 050 steel was primarily affected by the duration of plasma-nitriding, reaching higher values after 20 hours (300 $HV_{0,05}$) as compared with 10 hours of plasma-nitriding processing. However, the major factor which affected the microhardness in the samples prepared from steels 13 240 and 15 230, respectively, was the composition of process gases of H_2:N_2 = 3:1 as compared with that of H_2:N_2 = 1:3. The results obtained suggest that the ratio of gases set at H_2:N_2 = 3:1 has a more beneficial effect on the microhardness in plasma-nitriding of steel.

Plasma-nitriding also has a substantial impact on the surface hardness of the steel samples. This property of steel increases with duration of plasma-nitriding but the composition of the process gas mixture used in plasma-nitriding also affects this parameter of steel.

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THE USE OF LINEAR PROGRAMMING METHODS TO OPTIMIZE TECHNOGENIC RISKS IN THERMAL POWER ENGINEERING

Inga URIADNIKOVA

Abstract: The paper shows that a complex technical system is described by nonlinear mathematical relationships that create significant challenges in optimizing its operation. Presented optimization of technological and environmental risks of complex systems in the presence of non-linear constraints. Some aspects of optimization of technological and environmental risks of complex systems using linear programming were discussed.

Keywords: Technological and environmental risks, linear programming, optimization.

Currently very relevant issues to optimize the management of complex systems in thermal power complex. That is how to optimize the technological and environmental risks arising from the operation of power.

The most common coolant in thermo-power equipment is water. Quality characteristics of the water have a large extent on the risk of malfunction of the equipment, it stops to repair before the end of the regulated period and the failure of the equipment. In this case, technological and environmental risks involved in the process of power lead to significant economic and environmental losses, the latter, in their turn-around, also mediated through the economy. Furthermore, it may be caused irrevocable ecological damage to flora, fauna and people.

The main indicator of the water used for process - rigidity G mg-ekv/kg. Moreover, the minimum stiffness minimizes risk. Consequently, for water treatment should be pursued to the minimum cost-effective values of stiffness.

One of the most advanced methods in water treatment, is a method of electrocoagulating cleaning, which is relatively easy to control the values of the stiffness by changing the process conditions [1]. Major modes affect performance water treatment systems is the current density q A/m^2, time of electric treatment of water in the machine- t min and the flow rate of water in electrocoagulators v [m / min]. It should be noted, the minimum hardness corresponds to the minimum the risk that the raw water is fed into the process or discharged into the environment. Thus, the function G to some extent influenced by the amount of risk.

In terms of the minimum hardness value the technological modes are easily identified. However, these same regimes affect economic indicators such as the consumption of metal electrodes F[mg / l], the specific energy consumption Q [g / l], hardness G[mg-ekv/kg] and the amount of risk R. Thus, if the risk is selected as an objective function, which must be minimized, then the values that will limit the range of modes in which you can have a minimum value of R will be G, F, Q. In order to examine this issue more, it was decided to conduct experimental simulation of the processes occurring in the lectrocoagulation unit. For this was made an experimental model of electrocoagulator [2] made of plexiglass at 1:50 scale. This model allows you to use all modes of water treatment, which occur in practice when using electrocoagulation unit. In addition, this design model is transparent, which makes it possible to observe all of the processes that occur inside the unit. Range processing modes used are the same that are commonly used in water treatment in electrocoagulator. For each mode was carried out the three measurements, and for the actual value of the mean value was taken, which is applied to the chart.

These relationships are as follows:

$$G = 10.48 \cdot G_н^{0,5} \cdot q^{-1,23} \cdot t^{-1,95} \cdot v^{-1,6} \quad (1)$$

$$F = 0,2 \cdot q^{0,85} \cdot t^{0,80} \cdot v^{-0,15} h^0 \quad (2)$$

$$Q = 1,53 \cdot 10^{-3} \cdot q^{0,84} \cdot t^{0,95} \cdot v^{-0,1} h^0 \quad (3)$$

$$R = 11,3 \cdot 10^{-3} \cdot q^{0,25} \cdot t^{0,13} \cdot v^{0,15} h^0 \quad (4)$$

where h is an auxiliary variable in degree zero; H_{in} - initial hardness of the water from the source to the unit inlet of electrocoagulator.

Thus, we need $R \rightarrow \min$ under conditions where $F \le L_2$, $Q \le L_3$ and $G \le L_1$, and L_1, L_2 and L_3 are selected based on economic considerations.

In other words, we need to minimize the objective function within the constraints of $G \le L2$, $Q \le L3$ and $G \le L1$.

To solve the problem in a general way, we introduce the values A= 10,48; B =0,2; D = 11,3$\cdot 10^{-3}$; C = 1,53 $\cdot 10^{-3}$; $x_1 = -1.23$; $x_2 = -1,95$; $x_3 = -1.6$; $x_4 = 0,5$; $y_1 = 0,85$; $y_2 = 0,80$; $y_3 = -0,15$; $y_4 = 0$; $z_1 = 0,84$; $z_2 = 0,95$; $z_3 = -0,1$; $z_4 = 0$; $k_1 = 0,25$; $k_2 = 0,13$; $k_3 = 0,15$; $k_4 = 0$;

In this case, we get:

$$R = D \cdot q^{k1} \cdot t^{k2} \cdot v^{k3} \cdot h^{k4} \rightarrow \min \quad (5)$$

$$G = A \cdot q^{x1} \cdot t^{x2} \cdot v^{x3} \cdot G_н^{x4} \le L_1 \quad (6)$$

$$F = B \cdot q^{y1} \cdot t^{y2} \cdot v^{y3} \cdot h^{y4} \le L_2 \quad (7)$$

$$Q = C \cdot q^{z1} \cdot t^{z2} \cdot v^{z3} \cdot h^{z4} \leq L_3 \quad (8)$$

In this case, equation (5) is nonlinear target function which is being minimized. And equations (6,7,8) are the constraints that limit the range of possible values of technological regimes.

The optimal value of q, v, and t are the values obtained from the joint solution of equations (6, 7, 8). These values, when substituted in equation (5) will give the minimum risk within existing constraints.

To solve the system of non-linear inequalities (6, 7, 8) we will hold their linearization and solve a logarithmic form, presenting them as strict equality.

Graphs of G, F, Q and R of v, q and t, the entire range of modes are as follows:

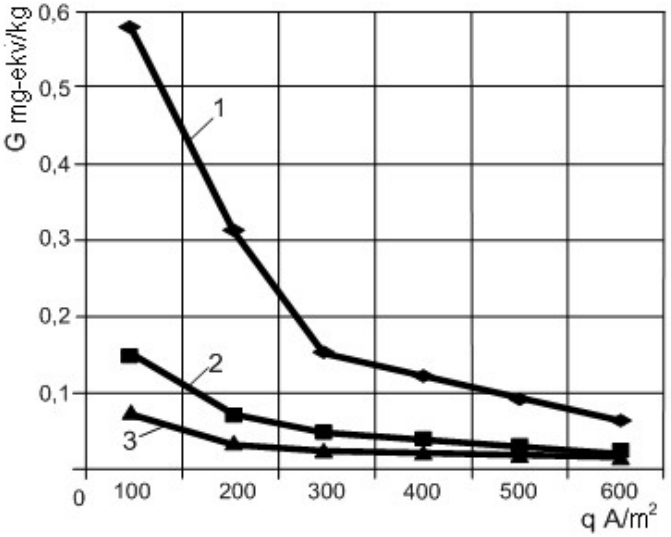

Fig.1 The dependence of the hardness of the water in the processing of it in electrocoagulator on the flow rate and the current density at different processing time. 1. - 3 min, 2. - 4 min, 3. - 6 min.

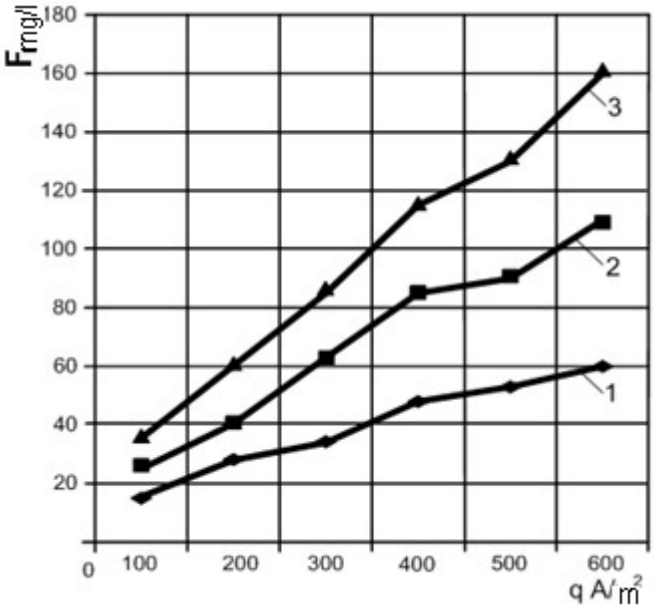

Fig. 2 The dependence of consumption of the metal electrodes in water treatment in electrocoagulator on the current density at different processing time. 1 - 2 min, 4.2 min, 6.3 min.

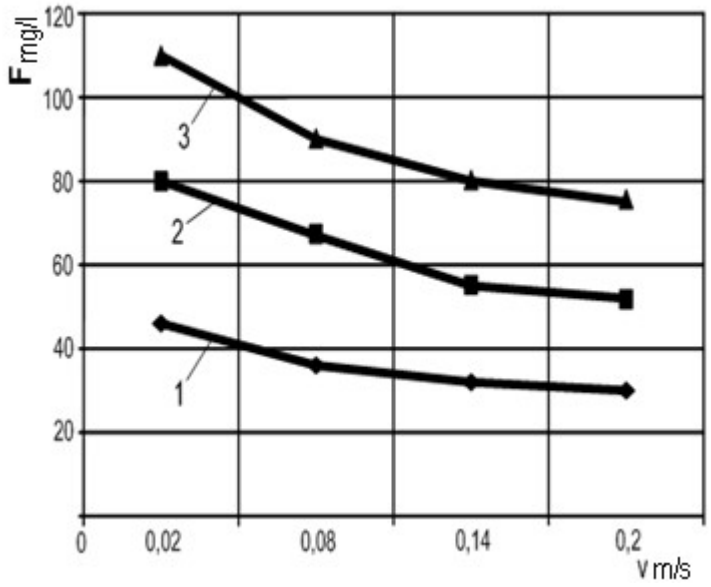

Fig. 3 Dependence of consumption of the metal electrodes in water treatment in electrocoagulator on the speed of the passage of water through the machine at different processing time.
1 - 2 min, 2 - 4 min, 3 - 6. min.

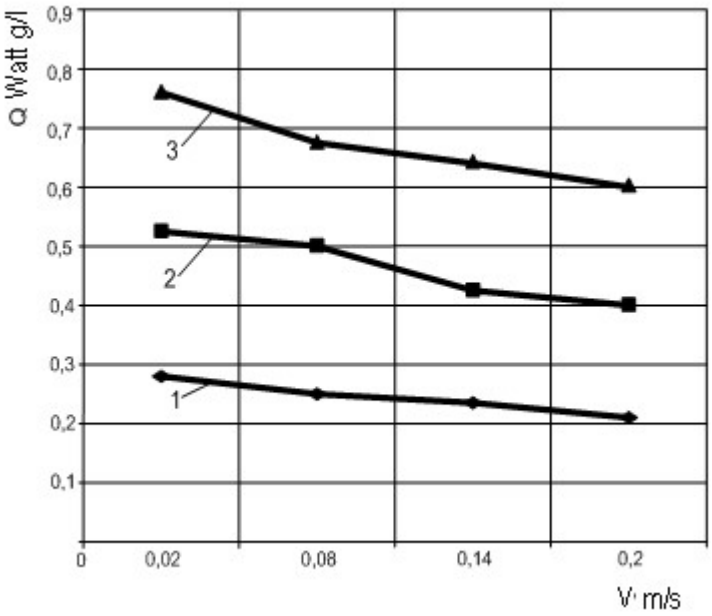

Fig. 4 The dependence of the specific energy consumption for water treatment in electrocoagulator on the speed the passage of water through the machine at different processing time.
1 - 2 min, 2 - 4. min, 3 - 6. min.

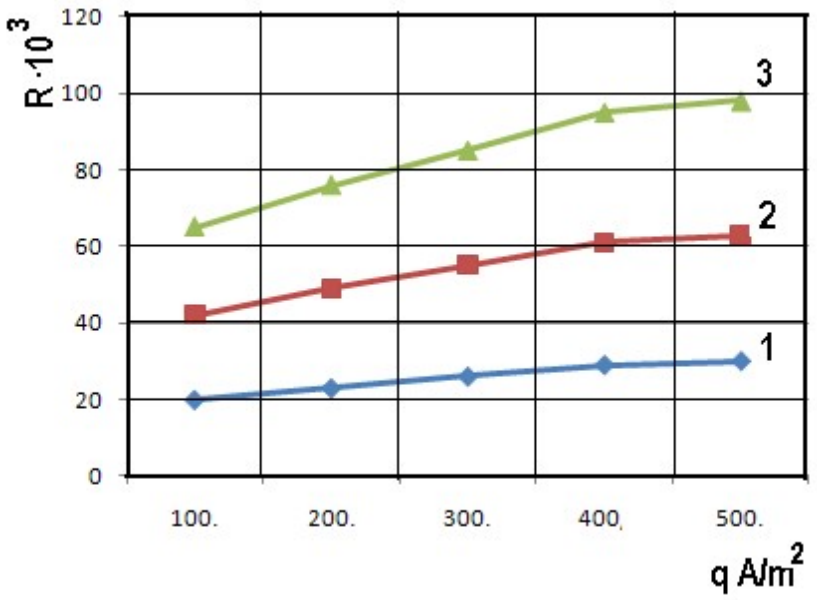

Fig. 5 The dependence of the risk in water treatment in electrocoagulator on current density at different processing time. 1 - 2 min, 2 - 4. min, 3 - 6. min.

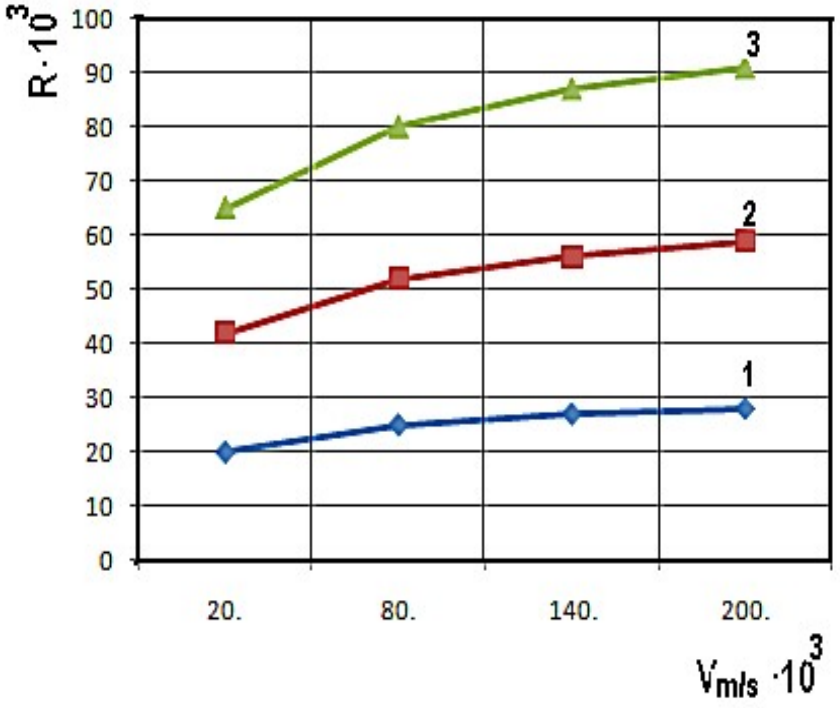

Fig. 6 The dependence of the risk in water treatment in electrocoagulator on the speed of passage of water through the unit at different times of treatment 1 2 min 2.4 min 3.6 min.

Then we have:

$$\ln R = \ln D + k_1 \ln q + k_2 \ln t + k_3 \ln v + k_4 \ln h \rightarrow \min \quad (9)$$

$$\ln G = \ln A + x_1 \ln q + x_2 \ln t + x_3 \ln v + x_4 \ln G_н = \ln L_1 \quad (10)$$

$$\ln F = \ln B + y_1 \ln q + y_2 \ln t + y_3 \ln v + y_4 \ln h = \ln L_2 \quad (11)$$

$$\ln Q = \ln C + z_1 \ln q + z_2 \ln t + z_3 \ln v + z_4 \ln h = \ln L_3 \quad (12)$$

Transform equation (10), (11) i (12) as follows:

$$x_1 \ln q + x_2 \ln t + x_3 \ln v + x_4 \ln G_н = \ln L_1 - \ln A = M_1 \quad (13)$$

$$y_1 \ln q + y_2 \ln t + y_3 \ln v + y_4 \ln h = \ln L_2 - \ln B = M \quad (14)$$

$$z_1 \ln q + z_2 \ln t + z_3 \ln v + z_4 \ln h = \ln L_3 - \ln C = M_3 \quad (15)$$

Enter the new values: q * = ln q; t * = ln t; v * = ln v; h * = ln h; lnGn = G * and then the system of equations (13) - (15) can be rewritten as:

$$x_1 q^* + x_2 t^* + x_3 v^* + x_4 G^* = M_1 \quad (16)$$

$$y_1 q^* + y_2 t^* + y_3 v^* + y_4 h^* = M_2 \quad (17)$$

$$z_1 q^* + z_2 t^* + z_3 v^* + z_4 h^* = M_3 \quad (18)$$

The objective function is:

$$R^* = D^* + k1\, q^* + k2\, t^* + k3\, v^* + k4 h^* \quad (19)$$

Optimal values of q *, t * v * will be solutions that satisfy (16), (17) and (18)

$$q^{**} = \frac{\begin{vmatrix} M_1 & x_2 & x_3 & x_4 \\ M_2 & y_2 & y_3 & y_4 \\ M_3 & z_2 & z_3 & z_4 \end{vmatrix}}{\begin{vmatrix} x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \\ z_1 & z_2 & z_3 & z_4 \end{vmatrix}} \quad (20)$$

$$t^{**} = \frac{\begin{vmatrix} x_1 & M_1 & x_3 & x_4 \\ y_1 & M_2 & y_3 & y_4 \\ z_1 & M_3 & z_3 & z_4 \end{vmatrix}}{\begin{vmatrix} x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \\ z_1 & z_2 & z_3 & z_4 \end{vmatrix}} \quad (21)$$

$$v^{**} = \frac{\begin{vmatrix} x_1 & x_2 & M_1 & x_4 \\ y_1 & y_2 & M_2 & y_4 \\ z_1 & z_2 & M_3 & z_4 \end{vmatrix}}{\begin{vmatrix} x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \\ z_1 & z_2 & z_3 & z_4 \end{vmatrix}} \quad (22)$$

Substituting q **, t **, v ** in (20 - 22), by the values of potentiating we obtain values of q, t and v, which will be the optimal value for the minimum risk R within the selected limits L_1, L_2, L_3.

This is the rigidity R is minimal and cost-effective for these specific conditions and determines the minimum risk of heat-generating plants.

Continuously monitoring the value of G, it is possible, in case of change of stiffness, change the values of L_1, L_2, L_3 upwards and get the lowest possible value of the stiffness at higher economic costs will be justified if the input electrocoagulator comes highly contaminated water.

The above solutions of equations can be implemented on a PC and presents 3D graphics which shows how the risk based on changes in the value restriction.

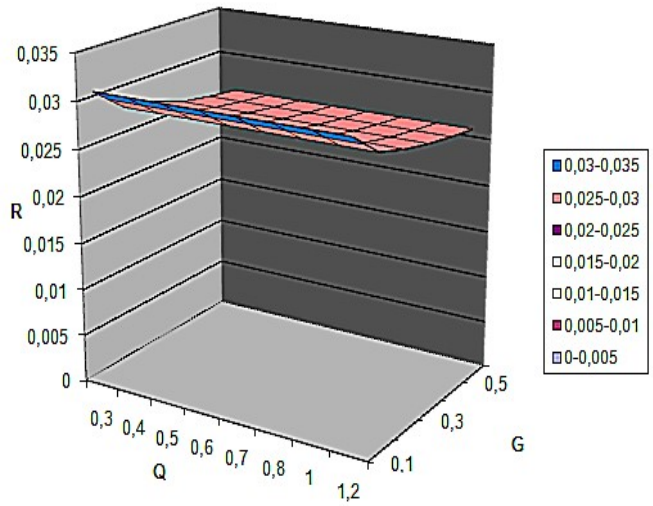

Fig. 7 The dependence of the risk on changes in value of constraints Q (axis X) and G (axis Y). F = 40

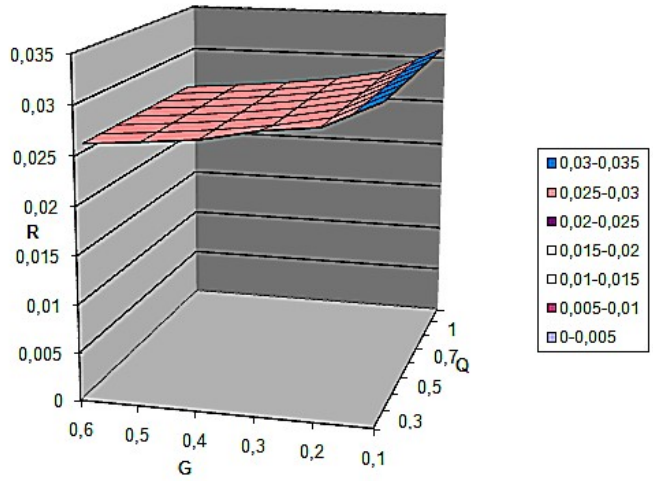

Fig. 8 The dependence of the risk on changes in value constraints Q (axis Y) and G (axis X). F = 40

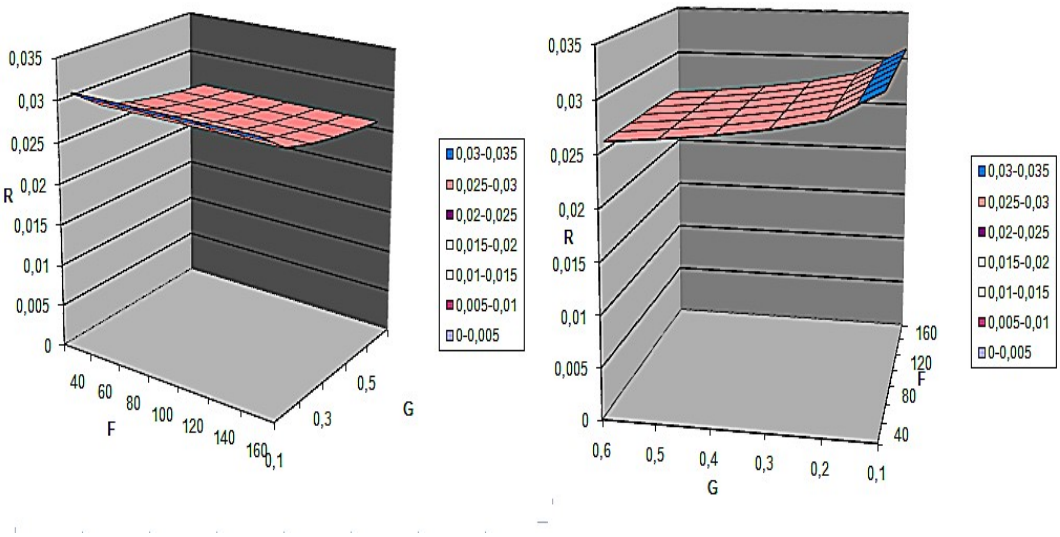

Fig. 9 The dependence of the risk on changes in the magnitude of restrictions F i G; Q = 0.6

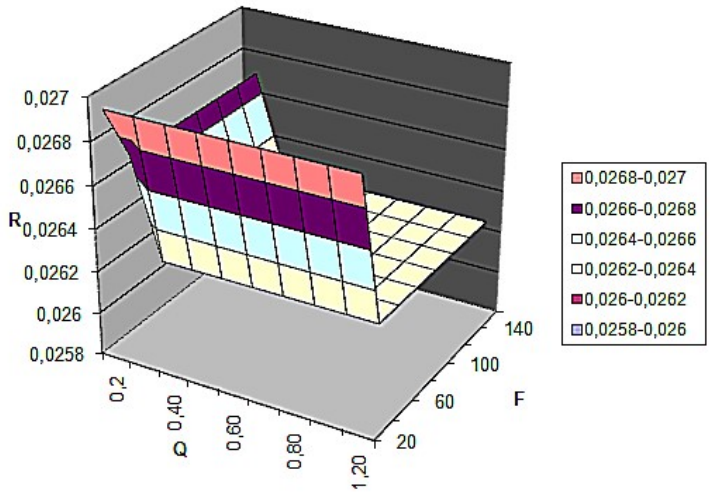

Fig. 10 The dependence of the risk of changes in value constraints Q (axis X) and F (axis Y). G = 0.5

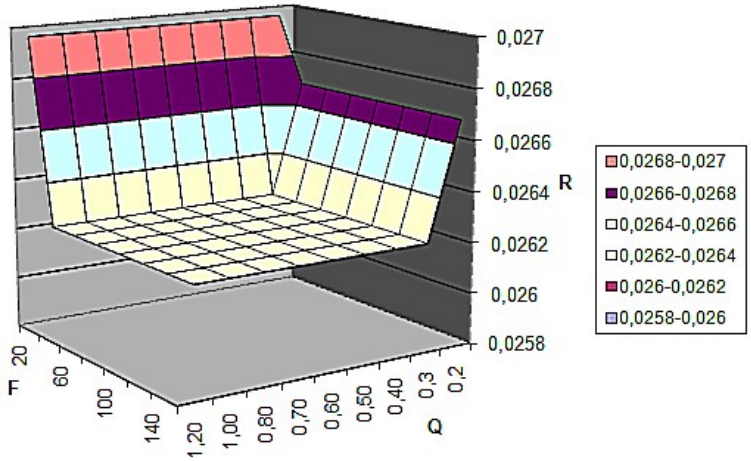

Fig. 11 The dependence of the risk on changes in value constraints Q (axis Y) and F (axis X). G = 0.5

For the convenience of optimizing technological and environmental risks of complex systems using linear programming software designed to calculate the risk in complex systems.

Seen from the figures that the range G_{in} (in this case the initial value of the rigidity of the treated water) can be entered in advance and when you click "quick calculation" window appears with the schedule.

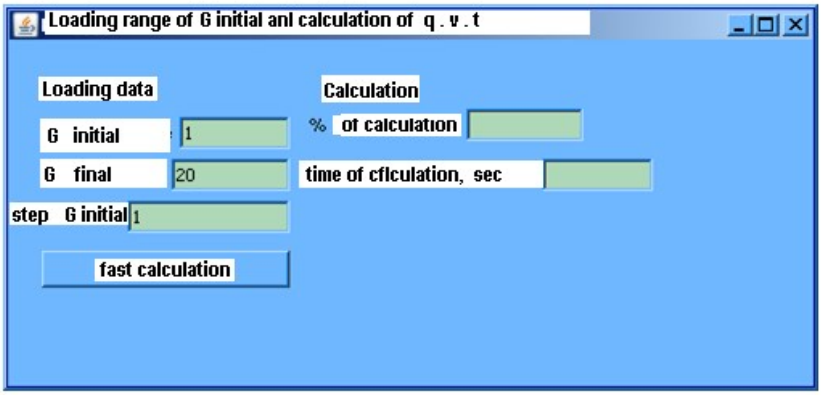

Fig. 12 In this window, you can set some values in the range G_{in} and view the corresponding value of R_{min}:

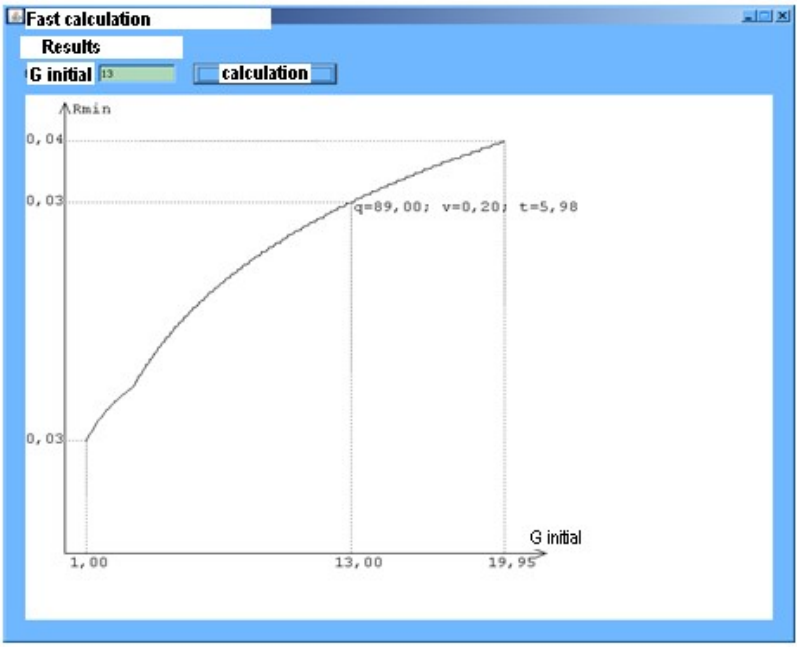

Fig. 13 View the results of the calculations

Thus, the optimization of technological and environmental risks of complex systems in the presence of nonlinear constraints can be quickly calculated for any complex system, using this program.

CONCLUSIONS

1. Optimization of any wastewater treatment system in most cases should be choosing as the objective function economic performance, i.e minimizing costs within limits, beyond which you should not proceed.

2. Equation by which the optimization problem is solved, if the existing wastewater treatment system should be developed based on actual statistical results of research work that makes it possible to obtain the equations in the course within fairly accurately describe the system and those dependencies, while work takes place.

3. Drafting analytical equations can be recommended only at the design stage and the

results that can be obtained through them should be regarded as very approximate.

4. In preparing equations, both analytical and empirical in the first place should pay attention to the energy characteristics of water treatment processes, from which, as a rule, is largely dependent an economic efficiency.

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SPEED COMPARISON OF THE ADDERS IN FPGA

Michal TURČANÍK

Abstract: Security threats are affecting the evolution in cryptographic algorithms, and modular arithmetic is an important part of these algorithms, especially in the case of public-key cryptosystems. To obtain optimal system performance and not to lose physical security, it is desirable to implement cryptographic algorithms in hardware. However, many public-key cryptographic algorithms require the implementation of modular arithmetic, specifically modular multiplication, for operands of 1024 bits in length. Field Programmable Gate Arrays (FPGAs) are an appropriate option for achieving this goal. The targeted FPGA will have been designed with the architectural requirements for wide-operand modular arithmetic in mind in an effort to maximize system performance. This contribution analyzes existing FPGA architectures with respect to arithmetic operations. It also proposes a new FPGA realization of wide-operand additions required for modular multiplication.

Keywords: FPGA, public-key cryptography, adder.

1 INTRODUCTION

Nowadays, more and more reconfigurable hardware devices are used in applications due to their low cost, high performance and flexibility. These reconfigurable hardware devices are usually distributed in a large geographic area. Therefore, robust security mechanisms for remote control and configuration are highly needed. The RSA algorithm is a secure, high quality, public key algorithm. It can be used in these applications as a method of exchanging secret information such as keys and producing digital signatures. However, the RSA algorithm is very computationally intensive, operating on very large (typically thousands of bits long) integers. The RSA algorithm has been adopted by many commercial software products and is built into current operating systems by Microsoft, Apple, Sun, and Novell. Commercial Application Specific Standard Products (ASSPs) like the security processors offered by several vendors have a much higher RSA performance than software implementation. However, their solution is inflexible and expensive. With the exponential increase in FPGA size over time (Moore's law), it is possible to implement a relatively high performance, user parameterizable RSA at low cost on FPGA [8).

The adder and multiplier are very important modules of computer system and can be considered one of the fundamental arithmetic functions. In fact 8.72 % of all instructions in a typical scientific program are multiplies. However, multiplication is not as simple operation as addition or subtraction, because it takes more time to perform two subtasks, addition and shifting. Typically, a multiplication operation takes between 2 and 8 cycles. Therefore, using high-speed multipliers is a critical requirement for processors with a high performance. The multiplier uses the addition operation for all the partial products. The adder can be a ripple adder, a carry-look-head adder, or any other adder [1). However, using a fast adder for the multiplier improves the overall performance of the multiplication operation. VHDL, a Very High Speed Integrated Circuit Hardware Description Language, was used to model our adders designs. Several researchers had worked on the performance analysis of adders and other researchers on the performance analysis of multipliers. Sertbas and Selami worked on the performance analysis of classified binary adder architectures. They compared the ripple adder, carry-look-ahead adder, carry select adder and the conditional sum adder. They used VHDL in their comparison. Their study included the unit-gate models for area and delay. Other adders were not compared. The main goals of the paper are:

- Write hierarchical VHDL code for each type of adder.
- Use hierarchical design techniques to implement the adders.
- Synthesize the code in FPGA using the ISE tools.
- Study the synthesis performance parameters (delay, FPGA resources).

2 ADDERS FOR TWO OPERANDS

The analyzed adder topologies were Ripple carry adder (RCA), Carry look-ahead adder (CLA), Ripple-block carry look-ahead adder (RCLA), Block carry look-ahead adder (BCLA), Ladner-Fischer adder, Kogge-Stone adder, Brent-Kung adder, Han-Carlson adder, Conditional sum adder, Carry select adder, Carry-skip adder (fixed-block-size), and Carry-skip adder (variable-block-size). Each type of adder was described by VHDL and synthesised using the Xilinx ISE tools. Adders will be compared on the base of synthesis results and performance parameters.

2.1 Ripple carry adder (RCA)

The most straightforward implementation of a final stage adder for two n-bit operands is a ripple carry adder, which requires n full adders (FAs). The carry-out of the i^{th} FA is connected to the carry-in

of the $(i+1)^{th}$ FA. Figure 1 shows a ripple carry adder for n-bit operands, producing n-bit sum outputs and a carry out.

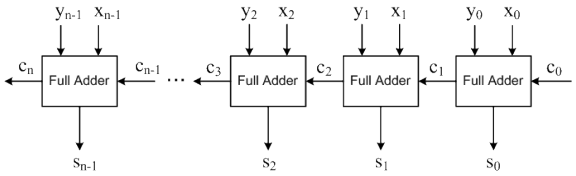

Fig. 1 Ripple carry adder (n-bit)

2.2 Carry look-ahead adder (CLA)

The main idea behind carry look-ahead addition is an attempt to generate all incoming carries in parallel and avoid waiting until the correct carry propagates from the stage (FA) of the adder where it has been generated. The carry, C_{i+1}, produced at the i^{th} stage is given as follows:

$$c_{i+1} = x_i y_i + (x_i \oplus y_i)\, c_i \quad (1)$$

The equation can be interpreted as stating that there is a carry either if one is generated at that stage or if one is propagated from the preceding stage. In other words, a carry is generated if both operand bits are 1, and an incoming carry is propagated if one of the operand bits is 1 and the other is 0. Therefore, let G_i and P_i denote the generation and propagation at the i^{th} stage, we have:

$$G_i = x_i y_i \quad (2)$$
$$P_i = x_i \oplus y_i \quad (3)$$
$$c_{i+1} = G_i + P_i\, c_i \quad (4)$$

for operand bit x_i and y_i and carry-in c_i. These expressions allow us to calculate all the carries in parallel from the operands. For example, the carries for a 4-bit adder are given as

$$c_0 = c_0 \quad (5)$$
$$c_1 = G_0 + P_0\, c_0 \quad (6)$$
$$c_2 = G_1 + G_0 P_1 + c_0 P_0 P_1 \quad (7)$$
$$c_3 = G_2 + G_1 P_2 + G_0 P_1 P_2 + c_0 P_0 P_1 P_2 \quad (8)$$
$$c_4 = G_3 + G_2 P_3 + G_1 P_2 P_3 + G_0 P_1 P_2 P_3 + c_0 P_0 P_1 P_2 P_3 \quad (9)$$

A 4-bit carry look-ahead adder is designed so as to realize the above expressions.

2.3 Ripple-block carry look-ahead adder (RCLA)

The idea of the ripple-block carry look-ahead addition is to lessen the fan-in and fan-out difficulties inherent in carry look-ahead adders. A ripple-block carry look-ahead adder (RCLA) consists of N m-bit blocks arranged in such a way that carries within blocks are generated by carry look-ahead but carries between blocks are rippled. The block size m is fixed to 4 in the generator.

The RCLA design is obtained by using multiple levels of carry look-ahead. If there are five or more blocks in a RCLA, 4 blocks are grouped into a single superblock, with the second level of look-ahead applied to the superblocks.

Figure 2 shows the parallel prefix graph of a 32-bit RCLA, where the symbol (solid circle) indicates an extension of the fundamental carry operator described at parallel prefix adders.

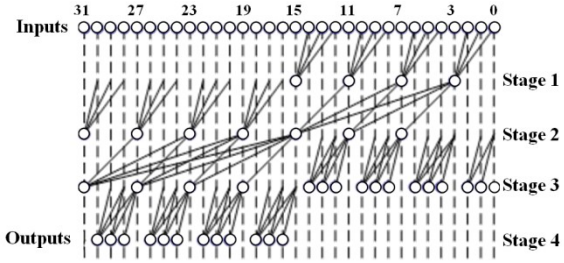

Fig. 2 32-bit ripple-block carry look-ahead adder

2.4 Block carry look-ahead adder (BCLA)

Another way to design a practical carry look-ahead adder is to reverse the basic design principle of the RCLA, that is, to ripple carries within blocks but to generate carries between blocks by look-ahead. A block carry look-ahead adder (BCLA) is based on the above idea.

Figure 3 shows the parallel prefix graph of a 32-bit BCLA, where the symbol (solid circle) indicates an extension of the fundamental carry operator described at parallel prefix adders.

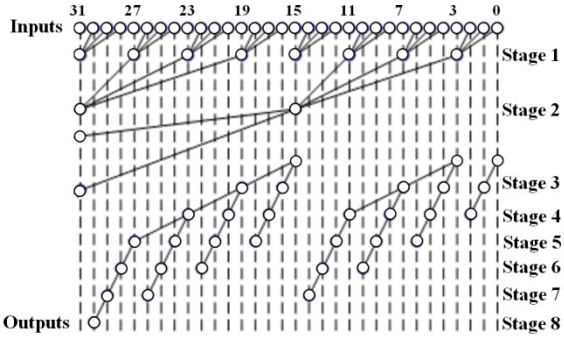

Fig. 3 32-bit block carry look-ahead adder

2.5 Parallel prefix adders (Ladner-Fischer adder, Kogge-Stone adder, Brent-Kung adder, Han-Carlson adder)

The parallel prefix adder employs the 3-stage structure of the CLA adder. The improvement is in the carry generation stage which is the most intensive one. The parallel prefix adder can be seen

as a 3-stage process (Figure 4). There exist various architectures for the carry calculation part. Trade-offs in these architectures involves the area of the adder, its depth, the fan-out of the nodes and the overall wiring network. Parallel prefix adders are constructed out of fundamental carry operators denoted by ¢ as follows:

$$(G'', P'') \text{ ¢ } (G', P') = (G''+G'\cdot P'', P'\cdot P'') \qquad (10)$$

where P" and P' indicate the propagations, G" and G' indicate the generations. The fundamental carry operator is represented as Figure 4.

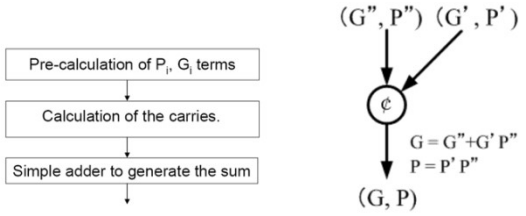

Fig. 4 Carry operator

A parallel prefix adder can be represented as a parallel prefix graph consisting of carry operator nodes. Figure 5 is the parallel prefix graph of a Ladner-Fischer adder. This adder structure has minimum logic depth, but has large fan-out requirement up to *n*/2.

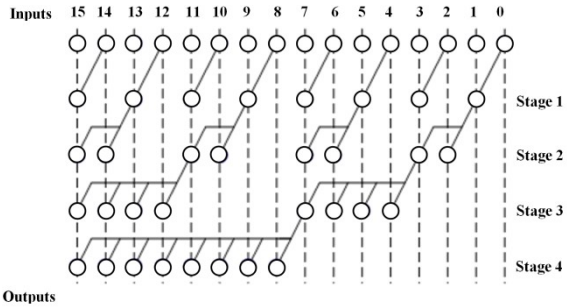

Fig. 5 16-bit Ladner-Fischer adder

Figure 6 is the parallel prefix graph of a Kogge-Stone adder. This adder structure has minimum logic depth, and full binary tree with minimum fun-out, resulting in a fast adder but with a large area.

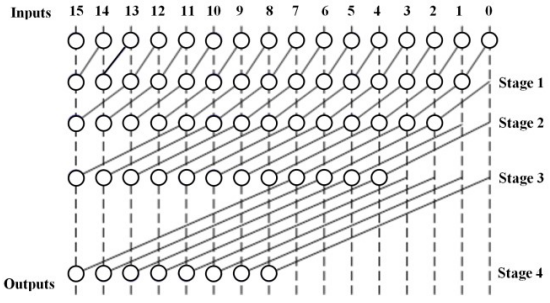

Fig. 6 16-bit Kogge-Stone adder

Figure 7 is the parallel prefix graph of a Brent-Kung adder. The Brent-Kung adder is the extreme boundary case of maximum logic depth in PP adders (implies longer calculation time) and minimum number of nodes (implies minimum area).

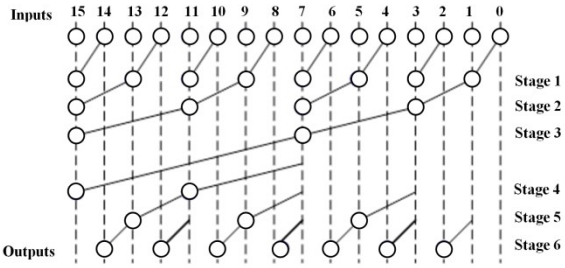

Fig. 4 16-bit Brent-Kung adder

Figure 8 is the parallel prefix graph of a Han-Carlson adder. This adder has a hybrid design combining stages from the Brent-Kung and Kogge-Stone adder. The Han-Carlson adder is efficient and suitable for VLSI implementation.

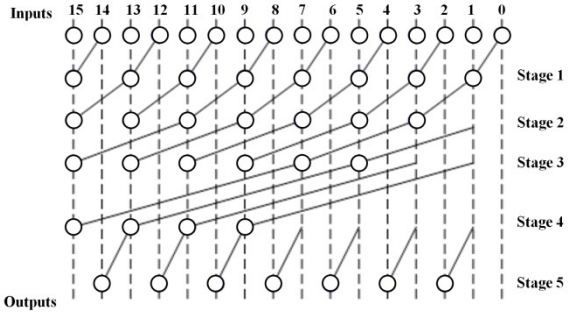

Fig. 4 16-bit Han-Carlson adder

2.6 Conditional sum adder

The basic idea in the conditional sum adder is to generate two sets of outputs for a given group of operand bits, say, k bits. Each set includes k sum bits and an outgoing carry. One set assumes that the eventual incoming carry will be zero, while the other assumes that it will be one. Once the incoming carry is known, we need only to select the correct set of outputs (out of the two sets) without waiting for the carry to further propagate through the k positions.

In this generator, we divide the given n-bit operands into two groups of size *n*/2 bits each. Each of these can be further divided into two groups of *n*/4 bits each. This process can, in principle, be continued until a group of size 1 is reached. The above idea is applied to each of groups separately. Figure 9 depicts a conditional sum adder for 4-bit operands.

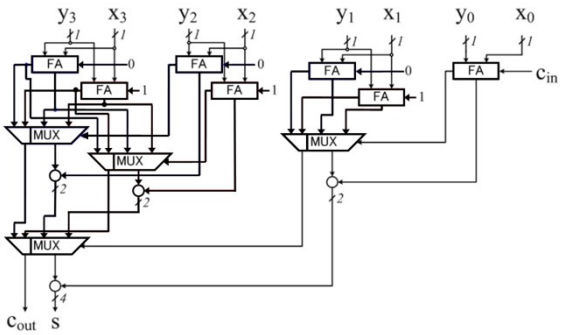

Fig. 9 4-bit conditional sum adder

2.7 Carry select adder

The underlying strategy of the carry-select adder is similar to that of the conditional-sum adder. Each group generates two sets of sum bits and an outgoing carry. One set assumes that the incoming carry into the group is 0, the other assumes that it is 1. When the incoming carry into the group is assigned, its final value is selected out of the two sets. Unlike the conditional-sum adder, the sizes of the k^{th} group is chosen so as to equalize the delay of the ripple-carry within the group and the delay of the carry-select chain from group 1 to group k. In this generator, the group lengths follow the simple arithmetic progression. Figure 10 shows a 16-bit carry select adder.

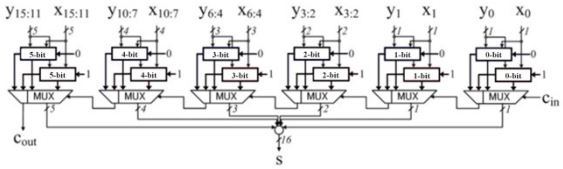

Fig. 10 16-bit carry select adder

2.8 Carry-skip adder (Fixed-block-size carry-skip adder, Variable-block-size carry-skip adder)

A carry-skip adder reduces the carry-propagation time by skipping over groups of consecutive adder stages. The carry-skip adder is usually comparable in speed to the carry look-ahead technique, but it requires less chip area and consumes less power.

In the carry-skip adder, any adder stage can be skipped for which $P_m = x_m$ xor $y_m = 1$, where P_m indicates the m^{th} carry propagate. The adder structure is divided into blocks of consecutive stages with a simple ripple-carry scheme. Every block also generates a block-carry-propagate signal that equals 1 if all stages internal to the block satisfy $P_m = 1$. This signal can be used to allow an incoming carry to skip all the stages within the block and generate a block-carry-out. Figure 11 shows an example block consisting of k bit positions $j, j+1, ..., j+k-1$.

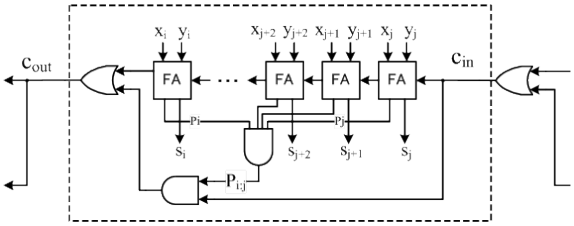

Fig. 11 Carry-skip block

Figure 12 shows an 8-bit carry-skip adder consisting of four fixed-size blocks, each of size 2. The fixed block size should be selected so that the time for the longest carry-propagation chain can be minimized. The optimal block size k_{opt} follows:

$$k_{opt} = \sqrt{n/2} \tag{11}$$

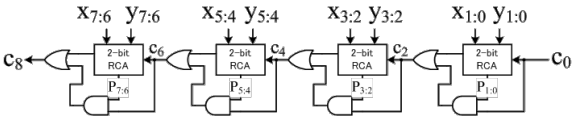

Fig. 12 8-bit Fixed-block-size carry-skip adder

Figure 13 shows a 16-bit carry-skip adder consisting of seven variable-size blocks. This optimal organization of block size includes L blocks with sizes $k_1, k_2, ..., k_L = 1, 2, 3, ..., 3, 2, 1$. This reduces the ripple-carry delay through these blocks.

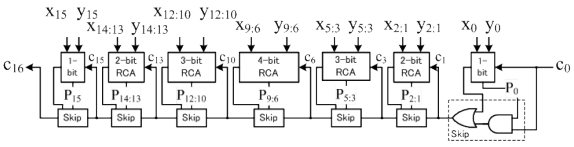

Fig. 13 8-bit 16-bit Variable-block-size carry-skip adder

3 PLATFORM FOR REALIZATION

Virtex®-5 as a platform for realization was used to compare all presented adders. Using the second generation ASMBL™ (Advanced Silicon Modular Block) column-based architecture, the Virtex-5 family contains five distinct platforms (sub-families), the most choice offered by any FPGA family. Each platform contains a different ratio of features to address the needs of a wide variety of advanced logic designs. In addition to the most advanced, high-performance logic fabric, Virtex-5 FPGAs contain many hard-IP system level blocks, including powerful 36-Kbit block RAM/FIFOs, second generation 25 x 18 DSP slices, SelectIO™ technology with built-in digitally controlled impedance, ChipSync™ source-synchronous interface blocks, system monitor functionality, enhanced clock management tiles with integrated

DCM (Digital Clock Managers) and phase-locked-loop (PLL) clock generators, and advanced configuration options. Additional platform dependant features include power-optimized high-speed serial transceiver blocks for enhanced serial connectivity, PCI Express® compliant integrated Endpoint blocks, tri-mode Ethernet MACs (Media Access Controllers), and high-performance PowerPC® 440 microprocessor embedded blocks. These features allow advanced logic designers to build the highest levels of performance and functionality into their FPGA-based systems. Built on a 65-nm state-of-the-art copper process technology, Virtex-5 FPGAs are a programmable alternative to custom ASIC technology. The Virtex-5 LXT, SXT, TXT, and FXT platforms include advanced high-speed serial connectivity and link/transaction layer capability [3, 4].

The Virtex®-5 LXT ML505 is a general purpose FPGA and RocketIO™ GTP development board. Provides feature-rich general purpose evaluation and development platform. Includes on-board memory and industry standard connectivity interfaces. Delivers a versatile development platform for embedded applications. Development board ML505 consist of XC5VLX50TFFG1136, DDR2 SODIMM (256 MB), ZBT SRAM (1 MB), Linear Flash (32 MB), System ACE™ CF technology (Compact Flash), Platform Flash, SPI Flash, JTAG Programming Interface, External Clocking (2 Differential Pairs), USB (2) – Host and Peripheral, PS/2 (2) – Keyboard, Mouse, RJ-45 – 10/100/1000 Networking, RS-232 (Male) – Serial port, Audio In and Out, Rotary Encoder, Video Input, Video (DVI/VGA) Output, Single-Ended and Differential I/O Expansion, GPIO DIP Switch (8), LEDs (8), and Pushbuttons (5), MII, GMII, RGMII, and SGMII Ethernet PHY Interfaces, PCI Express® Edge Connector (x1 Endpoint), GTP: SFP (1000Base-X), Header for 2nd Serial Port, 2nd Platform Flash PROM (32 Mb) for large device, Mictor Trace Port, BDM Debug Port and Soft Touch Port [5, 6].

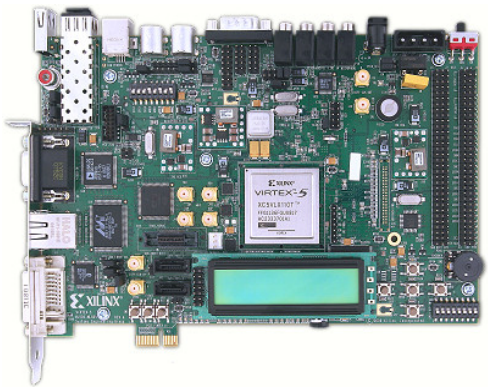

Fig. 14 The Virtex®-5 LXT development board ML505

VHDL (VHSIC hardware description language) is a hardware description language used in electronic design automation to describe digital and mixed-signal systems such as field-programmable gate arrays and integrated circuits [7]. VHDL was used to create description of all analyzed adders.

4 PERFORMANCE ANALYSIS OF THE ADDERS

To find the best suited adder for specific platform (Virtex5), analyzed adders were created and tested in the design tool Xilinx ISE 12.4. Development board ML505 with Virtex®-5 as a platform for realization was used to compare all presented adders. VHDL language was used to create a description of each adder topology. The tested adder topologies were Ripple carry adder (RCA), Carry look-ahead adder (CLA), Ripple-block carry look-ahead adder (RCLA), Block carry look-ahead adder (BCLA), Ladner-Fischer adder, Kogge-Stone adder, Brent-Kung adder, Han-Carlson adder, Conditional sum adder, Carry select adder, Carry-skip adder (fixed-block-size), and Carry-skip adder (variable-block-size). All of them are 64 - bits wide with carry input and carry output.

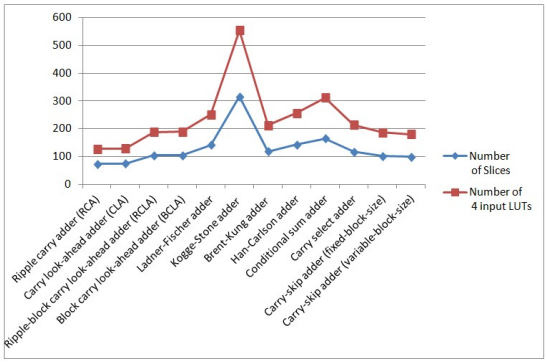

Fig. 15 Number of Slices and number of 4 input LUTs for analyzed adders

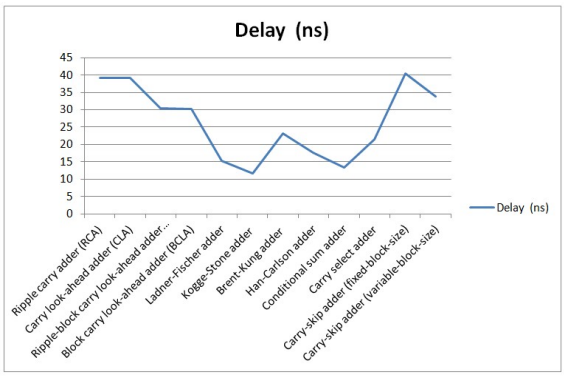

Fig. 16 Delay of the analyzed adders

5 SUMMARY

The main results are summarized in Fig. 15 and Fig. 16. Main parameters to compare were delay, number of slices and number of 4-inputs LUTs. Figure 15 depicts number of slices and number of 4 input LUTs for analyzed adders. The highest number of slices and 4-inputs LUTs has Kogge-Stone adder, the second highest has Conditional sum adder and the third has Han-Carlson adder. The lowest requirements have ripple carry adder and carry look-ahead adder. Delay of the analyzed adders is shown in Fig. 16. The fastest adder is Kogge-Stone, the second is Conditional sum adder and the third is Ladner-Fischer adder. The slowest adder is Carry-skip adder (fixed-block-size), the next slower adders are ripple carry adder and carry look-ahead adder.

6 CONCLUSION

Protection of the access to the critical communications networks is important in many areas. Security threats are affecting the evolution in cryptographic algorithms, and modular arithmetic is an important part of these algorithms, especially in the case of public-key cryptosystems. Hardware implementation of the cryptographic algorithms is a way how to obtain optimal system performance and not to lose physical security. However, many public-key cryptographic algorithms require the implementation of modular arithmetic, specifically modular multiplication, for operands of 1024 bits in length. Field Programmable Gate Arrays (FPGAs) are an appropriate option for achieving this goal. The targeted FPGA will have been designed with the architectural requirements for wide-operand modular arithmetic in mind in an effort to maximize system performance. This contribution analyzes architectures of the chosen adders (64 - bits wide), that are implemented a in VHDL. The results show that the fastest adder architecture is Kogge-Stone adder. Architecture of the Kogge-Stone adder could be used as a backbone for adder with 1024, 2048 and more bits wide operand width and we can achieve the best results.

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INCREASING OF MANET THROUGHPUT USING QUASI-OPTIMAL UAVs PLACEMENT CONTROL

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Sergei M. CHUMACHENKO, Pavlo I. KIRCHU, Andrei I. SEMENCHENKO

Abstract: The paper is devoted to development of new method for increasing mobile ad-hoc networks throughput based on quasi-optimal placement control of unmanned aerial vehicles in view of the rapid and unpredictable movement of mobile subscribers. Method application allows increasing of network throughput to 15-20 % in comparison with existing methods. Deviations of sub-optimal solutions from optimal, received by exhaustive method, are not more than 5-7 %.

Keywords: Mobile ad-hoc network, unmanned aerial vehicle, network throughput, placement control.

1 INTRODUCTION

Emergency natural and man-made disasters and military conflicts that are increasingly taking place in our world, resulting in complete or partial failure of the ground infrastructure, including telecommunications facilities (base stations of cellular communication, microwave and satellite stations, cable lines etc.). Operational connectivity in these areas is possible through the deployment of mobile ad-hoc networks (MANET) using telecommunication aerial platforms. It is particularly important today an application of aerial platforms based on miniature unmanned aerial vehicles (UAVs), which is more available and economical unlike large high-altitude platforms [1]. The development of such UAVs is active in many countries, including Ukraine. In particular the National Technical University of Ukraine "KPI" has developed its own prototype of a miniature UAV (Fig. 1), which can be used as an aerial relay. Networks based on such UAVs have a wide range of applications – rescue operation under the Ministry of Emergency, tactical military networks, border guard services, remote data collection from remote sensors, communication between vehicles and others.

Fig. 1 Miniature UAV prototype (developed in National Technical University of Ukraine "KPI")

Mobile subscribers (MS) of such networks are equipped with sensors for different purposes, are free to move in a given area and connect with each other directly - in the zone of radio visibility, or with relay packets through neighboring nodes (ie acting as routing), forming a so multihop networks of arbitrary structure (Fig. 2). Topology of such mobile radio networks is dynamic and constantly evolving and thus requires an effective control system (CS) that could quickly respond to structural and functional changes, providing certain control objectives. These objectives can be provision of structural connectivity, quality of data routes between subscribers (functional connectivity), increasing of network throughput, reducing energy consumption of nodes and others. Control parameters in this case may be the followings: transmition power, direction of ground and airborne antennas, load, position of nodes, etc.

Examine the increasing throughput of packet radio networks involved in many domestic and foreign scientists, including academics Ilchenko M. Y. and Mizin I. O, professors Bunin S. G., Voyter A. P., Romanyuk V. A., Tobagi F. A., Kleinrock L. et al. However, despite the significant contribution of these scientists, not solved problem today is the increasing throughput at the expense of UAVs placement control. Prof. Romanyuk V. A. was proposed functional model of UAVs network control system [2], part of which is a subsystem of network topology control. It determines the optimal UAV placement regulations under the chosen criteria and directs flight control subsystem for the specified purpose, that is, increasing of network throughput. Most of the currently developed methods that are laid in a subsystem of network topology control and based on the principles of cellular networks, according to which repeaters are placed around the largest cluster of nodes [3,4]. If there is enough number of UAVs to cover the whole territory of service, the problem of UAV placement is resolved. But in a lack of UAVs conditions (in case of limited funding or due to fighting) such principle of UAVs placement is not optimal because it does not take into account the structural and functional parameters of the MS network, and therefore subject to improvement. Besides the detailed methods of network topology synthesis [5] take a long time and not allowed to solve the problem of the UAVs

placement in real time. In the works of prof. Lysenko O. and Valuiskyi S. [6,7] established a methodology of quasi-optimal real-time UAVs network topology control to improve MANET throughput, the results of which will form the basis of this article and remove further development.

2 PROBLEM STATEMENT

The purpose of the work is increasing MANET throughput with simultaneous provision of structural and functional connectivity of mobile subscribers in view of its rapid and unpredictable movement. According to the purpose of the work it was treated and resolved the following interdependent tasks of study:

1. Analyze operation principles of MANET using UAVs.
2. Develop a method of increasing MANET throughput on the basis of UAVs placement control, which allows organizing the proposed and existing mathematical models and algorithms.
3. Improve the algorithm for finding quasi-optimal UAVs position, allowing to obtain real-time close to the optimal solution and implement operational UAVs placement control.
4. Evaluate proposed method effectiveness.

3 PRINCIPLES OF MANET OPERATION AND UAVs PLACEMENT CONTROL

This section describes the main aspects of the operation and UAVs topology (placement) control of MANET. An example of such a network architecture shown in Fig. 2.

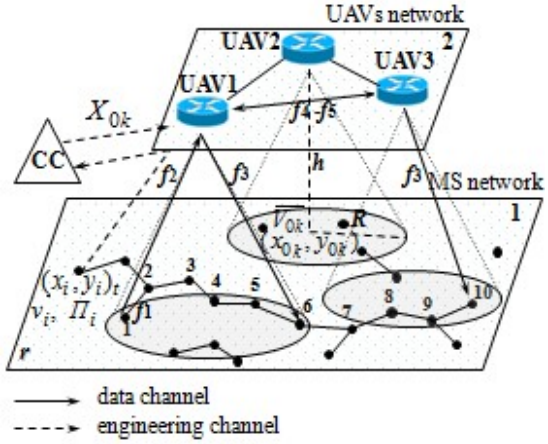


Fig. 2 An example of MANET architecture using UAVs

1-st level of MANET is the network of mobile subscribers, which can arbitrarily move in a certain area of size r. If there is direct radio visibility MS communicate with each other through a common broadcast channel at a frequency f_1, and the absence - apply the principle of switching (routing) packets through intermediate nodes. Thus, mobile terminals are multifunctional devices, working in one-half-duplex mode on the principle of «store-and-forward». To relay messages UAV each subscriber is also a second set of radio and memory, working in two frequency duplex mode at frequencies f_2-f_3. If case of sufficient spatial separation of cells generated by UAVs, the frequency can be repeated. To organize multiple access (MAC) to the shared channel resource in MS-MS channels (at a frequency f_1) in this paper was chosen Busy-tone Multiple Access (BTMA) protocol to solve the problem of "hidden subscribers." For MS-UAV-MS channel was chosen an adaptive protocol with reservation (APR), which allows you to send not one, but blocks of n packets and control the size of the block by the intensity of traffic generated by subscribers, during the stage of operational UAVs network control. Analytical models of these MA protocols parameters are reviewed in [3].

2-nd level of MANET is the network of aerial routers based on UAVs, which is moving at a height h in a minimum radius circle around the projection point of his optimal position $(x_{0k}, y_{0k}), k = \overline{1, K}$, where K – number of UAVs, using in the network and forming on the earth's surface cells of radius R. Subscribers that are in UAV radio coverage area can pass through UAV the packets to other subscribers of same cell or through cross-platform lines to other cell subscribers, reducing thus the number of relay in long routes. Thus, UAV airborne equipment is also multifunctional device with separate radio interface (for communication with MS and each other) that allows routing packets by their address information, relaying it in the middle of the cell or beyond it. Cross-platform connections (UAV-UAV) operates in duplex mode with frequency division multiplexing (FDMA), using a set of carrier frequencies (f_4, f_5,…, f_k), distributed by the cellular basis with separate demodulator for each [8]. With a single transmitter packets are sent to neighboring UAVs according to existing query using separation in time. It is assumed that on a board of each UAV there is information about its position and frequency distribution in cells, that allows in case of changing its position to determine which one to use at the moment.

Thus there are following variants of data routes between MS (for example, between MS1 and MS10), marked thickened solid arrows in Fig. 2) through MS network (MA1-MA2-...-MA10), 2) network UAVs network (MS1-UAV1-UAV3-MS10) and 3) by mixed way (MS1-MS6-UAV1-...-MS10).

For such routes threr are following requirements:

1. Requirements for connectivity (Ω_1):

a) Requirements for the existence of given distance of all hops of route m_{ab} between given pair of sender a – destination b: $d_{ij} \le d^0$, $D_{ik} \le D^0 (R_{ik} \le R^0)$, $D_{kl} \le D'$ $\forall\ ij, ik, kl \in m_{ab}$, $i, j = \overline{1, N}$, $k, l = \overline{1, K}$, where d_{ij}, d^0 – distance between i-th and j-th MS and corresponding upper bound, a D_{ik}, D^0 – slant distance between i-th MS та k-th UAV and corresponding upper bound; R_{ik}, R^0 – distance between i-th MS and nadir point of k-th UAV and corresponding maximum radius of k-th UAV stable coverage zone; D_{kl}, D' – distance between k-th and l-th UAV and corresponding upper bound. Values of d^0, D^0, R^0, D' determines, firstly, by power of radio link, secondly, by effectiveness of MAC protocols, that is studied in detail in [9].

b) Requirements for the duration of the connectivity of each hop ij of route m_{ab} between a given pair of sender a - destination b: $T_{зв\ ij} \ge T^0_{зв}$, where $T^0_{зв}$ – minimum time, during of which the UAV can work out a given position, set the route and transfer the minimum amount of information. The study of MS connectivity duration is discussed in [10].

2. Requirements for network operation parameters (Ω_2):

a) Requirements for throughput of route m_{ab} between a given pair of sender a – destination b: $s(m_{ab}) \ge s^0, a, b = \overline{1, N}$, $m = \overline{1, M}$, where N – number of MS in the network, M – number of routes in the network, s^0 – minimum acceptable level of route throughput, defined by requirements for a given type of traffic (voice, data, transactions, etc.).

b) Requirements for the transmission delay (or the number of relay) in the route m_{ab} between a given pair of sender a – destination b: $t_з(m_{ab}) \le t^0_з$ $(l(m_{ab}) \le l^0)$, де $t^0_з$ (l^0) – maximum delay in a route, defined by requirements for a given type of traffic. Analytical models of these parameters are determined by selected MAC protocols and reviewed in [3].

Route selection is based on the functioning of one of the known methods of routing [11]. For the convenience of UAV topology (placement) control is better to use tabularly oriented methods (eg, OLSR (Optimized Link-State Routing)), then each MS has its own routing table of shortest paths Π_i to all other network nodes.

For UAV topology (placement) control in a network control center (CC) is used, rendered outside of district r. Using a separate service channel (shown in Fig. 2 by dotted line), CC via UAV network can easily gather input data about primary network topology at some moment t, namely - the coordinates and velocity of each MS $(x_i, y_i)_t, \overrightarrow{v_i}$ and placed before UAVs $X_{0k} = [x_{0k}, y_{0k}, z_{0k}], \overrightarrow{V_{0k}}$, and also data about network operation Π_i (defined routes and their quality), and on the basis of proposed method below make appropriate control solution (for example, launching of new UAV or move one launched in some new position of space X_{0k}) to achieve the desired control objectives (ie increase of network throughput). It is assumed that at the time of UAV network planning control center is known about the distribution of traffic (load) between each pair of sender-recipient ab, defined by a matrix of gravity $\Gamma = (\gamma_{ab}(t))$. In this case, total subscriber load we can denote as $\gamma = \sum_{a=1}^{N} \sum_{b=1}^{N} \gamma_{ab}(t)$.

Then the *general formulation of the problem* can be formulated as follows: to locate group of UAVs to maximize network throughput S, ie $S = f(X) \to \max\limits_{X \in \Omega}$, where Ω – admitted region, defined by requirements for connectivity and operation of MANET; $X = [X_{01}, ..., X_{0k}]$, where $X_{01} = [x_{01}, y_{01}, z_{01}]$, ... , $X_{0k} = [x_{0k}, y_{0k}, z_{0k}]$, $k = \overline{1, K}$. Let's go to the formalization, ie the mathematical problem statement.

4 MATHEMATICAL FORMULATION OF THE PROBLEM

Let's represent the network as a stochastic non-directional weighted graph $G(V,E)$, which consists of a set of vertices (MSs and UAVs) $V = \{v_i\} \cup \{b_k\}$ and a set of edges $E = \{(i, j) \mid d_{ij} \le d^0\} \cup$ $\cup \{(i, k) \mid R_{ik} \le R^0\} \cup \{(k, l) \mid D_{kl} \le D'\}$, $i, j = \overline{1, N}$, $k, l = \overline{1, K}$ (Fig. 3), which determine the connectivity matrix $C = (c_{ij})$, where $c_{ij} = \{0,1\}$ – Boolean variable. As the weight of edges can be a distance of the radio links.

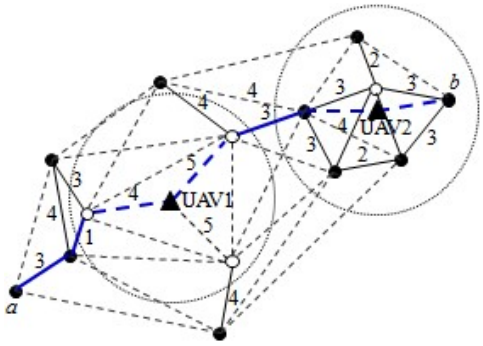


Fig. 3 Example of MANET graph $G(V,E)$, which consists of 14 MS and 2 UAVs

Under *network throughput* usually is understood the maximum value of traffic (load) γ, that network can serve per unit of time at a constant traffic matrix Γ [12]. Since packet is serviced, when it sent from one end to another end of route, network throughput is usually represented by the amount of throughputs of routes between all pairs of sender-recipient:

$$S(C) = \sum_{a=1}^{N} \sum_{b=1}^{N} s(m_{ab}) \, , a \neq b \, . \qquad (1)$$

Throughput of the route is usually defined as the minimum throughput of channel that is included in this route, ie $s(m_{ab}) = \min_{(i,j)\in m} \{s_{ij}\}$.

When channel throughput in this case is the average packet-transfer rate, ie the average number of packets, transmitted without conflict during time unit (in this paper, per time unit taken transfer time of one packet T). This value is determined by the selected MAC protocol in channel (discussed above).

Particularly for BTMA protocol (MS-MS channel using carrier frequency f_1) channel throughput is determined as follows [3]:

$$s_{ij}^{(1)} = \left(\frac{(\exp(2aG_{\Sigma}^{(1)}) - 1)}{G_{\Sigma}^{(1)}} \times \right.$$
$$\times ((5a + \tau + 0{,}5)G_{\Sigma}^{(1)} + \exp(-2aG_{\Sigma}^{(1)})) +$$
$$\left. + \frac{G_{\Sigma}^{(1)}(4a + \tau + 1) + 1}{G_{\Sigma}^{(1)}} \right)^{-1} , \qquad (2)$$

where a, τ – normalized maximum propagation time of radio signal and signal "busy"; $G_{\Sigma}^{(1)} = \lambda_i^{(1)} T$ - total intensity of traffic $\lambda_i^{(1)}$, that enters into MS-MS channel, normalized to packet transmission time T.

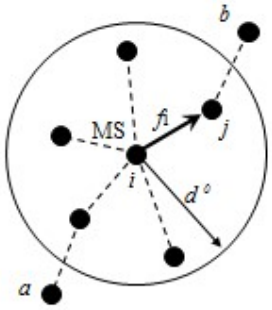
For APR protocol (MS-UAV-MS channel using carrier frequencies f_2-f_3) channel throughput is determined as follows [3]:

$$s_{ij}^{(2)} = \left(\frac{1}{G_{\Sigma}^{(2)} n \exp(-aG_{\Sigma}^{(2)})} + \right.$$
$$+ \frac{(n + b + 2a - w)\exp(-aG_{\Sigma}^{(2)})}{n \exp(-aG_{\Sigma}^{(2)})} +$$
$$\left. + \frac{b + a + w}{n \exp(-aG_{\Sigma}^{(2)})} \right)^{-1} , \qquad (3)$$

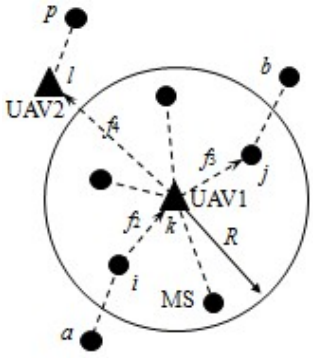
where n – number of packets in block; b – duration of reservation packet, sending by subscriber, and transmission permit packet, sending by UAV repeater in response; w – duration of time from receipt of the last conflicting packet.

Since for UAV-UAV channel was selected frequency compression by cellular principle, the packets transmitted on a separate frequency virtually without collisions and throughput of these channels is close to 1.

Based on telecommunication networks theory it was developed simple mathematical models to calculate the intensity of traffic channels in MANET (Fig. 4).



a)



b)

Fig. 4 Models for calculating the intensity of traffic in MS-MS channel (a) and MS-UAV-MS, UAV-UAV channels (b)

Using proposed model we can easily calculate the traffic intensity in each channel of MANET, as

the sum of intensities of flows between a given pair of sender-recipient γ_{ab}, routes of which pass through a given channel.

Then for single-frequency broadcast MS-MS channel traffic intensity can be defined as follows:

$$\lambda_i^{(1)} = \sum_{j \in N_i} \sum_{a=1}^{N} \sum_{b=1}^{N} \gamma_{ab}\ ,\ a,b : i \in m_{ab}\ ,\ a \neq b\ , \quad (4)$$

where N_i - set of *i*-th MS neighbors, including *i*.

For common MS-UAV channel and broadcast UAV-MA channel respectively:

$$\lambda_{ik}^{(2)} = \sum_{i \in N_k} \sum_{a=1}^{N} \sum_{b=1}^{N} \gamma_{ab}\ , a,b : ik \in m_{ab}\ ; \quad (5)$$

$$\lambda_{kj}^{(3)} = \sum_{j \in N_k} \sum_{a=1}^{N} \sum_{b=1}^{N} \gamma_{ab}\ , a,b : kj \in m_{ab}\ ,\ a \neq b\ , \quad (6)$$

where N_k – set of MS, which are within range of *k*-th UAV.

For duplex multi-frequency UAV-UAV respectively:

$$\lambda_{kl}^{(4)} = \sum_{a=1}^{N} \sum_{b=1}^{N} \gamma_{ab}\ , a,b : kl \in m_{ab}\ ,\ k \neq l\ ,\ a \neq b\ . \quad (7)$$

Now we turn to the mathematical formulation of the problem.

May set the following *initial data: N*; *K*; *r*; $(x_i, y_i)_t$, $i = \overline{1,N}$; d^0, D^0, R^0, D'; s^0; $t_з^0(l^0)$; $\Pi_i = (l(m_{ab}))$, $a,b = \overline{1,N}$; $\Gamma = (\gamma_{ab}(t))$.

Then we can formulate the following problem of UAVs placement control: find real-time coordinates of UAV position in space X_{0k}, $k = \overline{1,K}$ (connectivity matrix *C**), which provides maximum of network throughput $S(C)$:

$$C^* = \arg \max_{X_0 \in \Omega_{1,2,3}} S(C) =$$

$$= \arg \max_{X_0 \in \Omega_{1,2,3}} \sum_{a=1}^{N} \sum_{b=1}^{N} s(m_{ab})\ , a \neq b \quad (8)$$

at fulfilment of conditions on the set of control actions and network resources

$$\Omega_1 : \{\, d_{ij} \le d^0,\ R_{ik} \le R^0, D_{kl} \le D',\ T_{зв\ ij} \ge T_{зв}^0$$
$$\forall\ ij, ik, kl \in m_{ab}\ ,\ i,j = \overline{1,N},\ k,l = \overline{1,K}\ \},$$
$$\Omega_2 : \{\, s(m_{ab}) \ge s^0,\ t_з(m_{ab}) \le t_з^0,\quad a,b = \overline{1,N}\ \},$$
$$\Omega_3 : \{N \le 200, K \le 10\}.$$

To solve this problem (8) a method based on UAVs placement control was developed, which is considered below.

5 PROPOSED METHOD FOR INCREASING OF MANET THROUGHPUT

Method is based on the idea of increasing MANET throughput using UAVs placement control. The *main point of idea* is that the optimal placement of UAVs in space allows to create such network structure that has larger number of independent data-transfer routes between subscribers, and by Ford-Falkerson theorem it allows to increase the minimum cross-section and the maximum flow that the network can pass in unit of time, ie to increase its throughput.

The *essence of methodology*, that realize proposed idea, is that first proposed to combine mathematical models of structural and functional connectivity estimation (considered in detail in [13]), as well as an advanced search algorithm of quasi-optimal placement of UAVs (considered in detail below), into a single computational procedure, that allows to achieve near-extreme values of network throughput in the rapid and unpredictable movement of mobile subscribers.

The scheme-algorithm of developed method is shown in Fig. 5.

It includes the following steps:

Step 1. Gathering information about the initial network topology and initial data (in planning stage) (unit 1):

- MS parameters: *N*, $(x_i, y_i)_t, \vec{v_i}$, $i = \overline{1,N}$, and previously launched UAV's parameters: X_{0k}, V_{0k}, $k = \overline{1,K}$ (obtained through the data gathering system using separated engineering channel);

- allowable values of parameters: d^0, D^0, R^0, D', $T_{зв}^0$, s^0, $t_з^0(l^0)$, *r*.

- number of UAVs in operation *K*;

- MAC protocol and routing protocol parameters.

Denoted above parameters and conditions determine the initial network topology without the use of UAVs C_k, $k = \overline{1,K}$, where $k = 0$ - iteration number of finding solution (sequential number of UAV).

Step 2. Prediction of the duration of MANET nodes connectivity based on developed in [10] models of MS movement (block 2) and testing the conditions $T_{зв\ ij} \ge T_{зв}^0$ (block 3), which determines the possibility of UAV to fulfill solutions until significant changes in topology.

Step 3. Analysis of structural connectivity existence (blocks 3, 4):

1. Calculation of the parameters d_{ij}, R_{ik}, D_{kl} using developed in [9] analytical models.

2. Checking of conditions Ω_1 (block 5). If the conditions are met, then check the additional condition of network integrity $k = 1$, otherwise go to step 4. Under the network integrity will be understood the presence of only one connectivity component (connected sub-graph) of network graph. Checking the network integrity is possible by constructing a minimum spanning tree (MST) graph (for example, by Prima algorithm [14]) and testing each edge of tree on the condition Ω_1.

Step 4. Implementation of rule (procedure) 1 for the structural connectivity provision (block 6), which is part of an improved algorithm for finding of quasi-optimal placement of UAVs and is considered below.

In the case of existence of new solutions that meet the conditions Ω_1, UAV launches in a given position (deployment stage) (block 11) and fulfill the adaptation of MAC protocol parameters to actual conditions of operation (block 12) according to procedures specified in [3] (operating control stage).

Then there is the test of hardware resource existence (UAVs) (block 13). In the case of existence of UAVs ($k < K$), go to step 1, otherwise – END.

Step 5. Gathering information about network operation (block 1):

- Matrix of the shortest routes Π_i;
- Matrix of gravity Γ.

Collection of this information can be made at the planning stage in the case of existence of launched UAVs (via communication channel from control center as shown in Fig.1) or at the deployment stage by "reading" data from any ground node of MANET (using one of the routing protocols [11]).

Step 6. Analysis of the quality requirements for transfer routes (block 7,8):

1. Calculation of network operation parameters λ, $s(m_{ab})$, $\overline{t_з}(l(m_{ab}))$ according to the relations given in [3].

2. Checking of conditions Ω_2. If the conditions are met, then proceed to step 8, otherwise go to step 7.

Step 7. Implementation of rule (procedure) 2 for the route quality provision (blocks 9, 11-14), which is part of an improved search algorithm of quasi-optimal placement of UAVs and is considered below.

In the case of existence of new solutions that meet the conditions Ω_2, UAV launches in a given position (deployment stage) (block 11) and fulfill the adaptation of MAC protocol parameters to actual conditions of operation (block 12) according to procedures specified in [3] (operating control stage).

Then there is the test of hardware resource existence (UAVs) (block 13). In the case of existence of UAVs ($k < K$), go to step 1, otherwise – END.

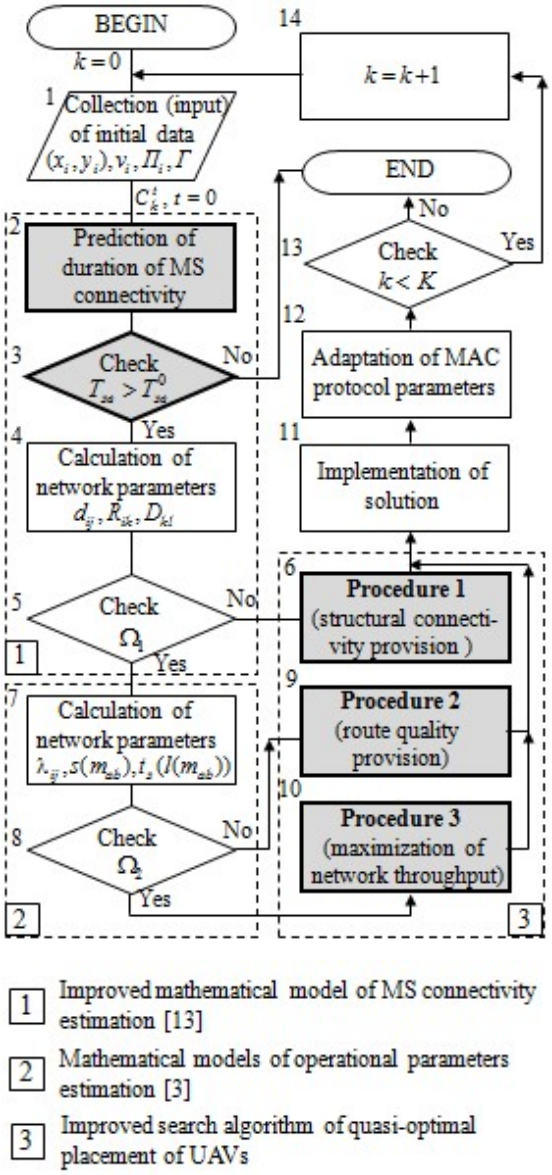


Fig. 5 Scheme-algorithm of method for increasing throughput of MANET using UAVs (continued in Fig. 6)

Step 8. Implementation of rule (procedure) 3 for the increasing of network throughput (blocks 10), which is part of an improved algorithm for finding of quasi-optimal placement of UAVs and is considered below. Then the same (blocks 11-14).

In case of launch of all UAVs each of them periodically on operating control stage tests discussed above scheme to verify the need to change their position (in this case all components of the network are fixed at a given time). And at that period of testing this method should be large enough to build routes and pass through them the minimum amount of data and also small enough that the network topology has not changed significantly. The frequency of testing this method is determined by the duration of connectivity between MS, which is

expected based on MS movement models, which are considered in [10].

Also assume that during time of source data collection, calculations and launching UAVs in a given position, the network topology does not change significantly.

6 IMPROVED ALGORITHM FOR FINDING OF QUASI-OPTIMAL UAVS PLACEMENT

Algorithm for finding a new position of UAV in general comes to search of all the possible variants of UAV's placement. However, this problem belongs to the class of NP-complete, so to reduce the exhaustive search of variants of UAV's placement is proposed to use pre-designed *set of rules* for selection of variants of such changes of network connectivity, that increasing its throughput and reduce the computation time. This enables to get real- time close to optimal solutions and use an algorithm for operative control of UAVs position. The scheme of improved search algorithm of quasi-optimal placement of UAVs using a set of rules (in case of increasing network throughput) is shown in Fig. 6.

Order of use a set of rules (in case of increase of network software), as shown in Fig. 6, has the following steps:

Step 1. Finding a new solution (topology with the current UAV) C_k^{t+1} using some heuristic rules (and procedures of their implementation), providing maximum of network throughput *S*.

Step 2. Construction of route tables $\Pi_i(C_k^{t+1})$, which are defined by matrix of gravity and accepted method of routing. Redistribution of data flows λ_{ij} according to $\Pi_i(C_k^{t+1})$. Calculation of parameters $s(m_{ab}), \overline{t_з}(l(m_{ab}))$ for existing sender-recipient pairs by analytical models [3].

Step 3. Check the conditions Ω_2 for C_k^{t+1}. If Ω_2 are not met or $S(C_k^{t+1}) < S(C_k^t)$, then reject C_k^{t+1}, otherwise $C_k^t = C_k^{t+1}$.

A set of rules corresponds the rules of the production type, consisting of two components: the condition and action [15]. The condition determines the possibility of applying the rules in quantitative terms, but the action is used to meet the condition and describes the change of network connectivity, which leads to the achievement of one of control purposes:

$$\text{Rule}_i: \alpha_i \rightarrow \beta_i ,$$

where Rule_i – i-th rule; α_i – condition; β_i – control action. Control action in this case provides the placement (displacement) of UAV at some point in space.

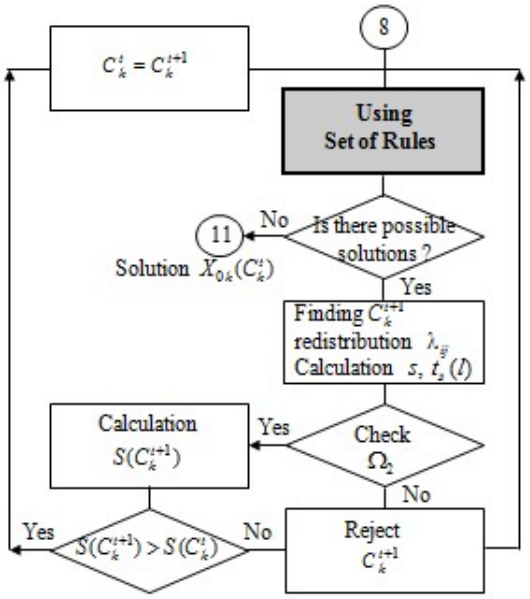


Fig. 6 Scheme of improved search algorithm of quasi-optimal placement of UAVs using set of rules (beginning on Fig. 5)

If several rules successfully matched with the facts, it is possible to use meta-rules that will choose one of the rules. Meta-rules define advantage of rules depending on the *p*-th network control purpose (MRule_i: $\text{Rule}_i \rightarrow w_j^p$). That rule, which to a large degree improves given parameters, will have more weight w_j^p.

As a result of experimental studies of network structure and the application of graph theory [16] received a lot of structural rules and published in [17]. These rules have been carefully researched and based on them have developed a new modified rules and appropriate control actions (for quasi-optimal placement of UAVs in space).

All rules are classified into three groups: 1) to provide requirements for network connectivity (Ω_1); 2) to provide requirements for the functional parameters (Ω_2); 3) to increase network throughput.

Here's an example of several rules (meta-rules) and procedures to implement one for each group.

Rule №1. *If the number of connectivity components (disconnected subgraphs) of network graph k>1, then the UAV should be placed so as to connect a larger number of connectivity components.*

Meta-rule №1. *If there are several variants for UAV placement, combining the same number of connectivity components, then choose the one that covers more nodes of these components.*

To implement this rule can be used procedure using lattice initialization (Fig. 7), which provides search of UAV placement variants in each lattice site and a choice that variant, which satisfies the rule or meta-rule.

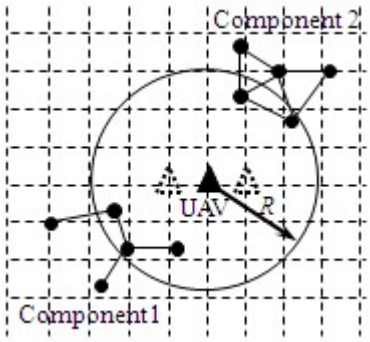


Fig. 7 Illustration of procedure for realization of rule №1 using lattice initialization

Rule №2. *If average transmission delay (number of relays) in some routes more than necessary, then the UAV should be placed so as to reduce average transmission delay (number of relays) in the route.*

Meta-rule №2. *If there are several variants of UAV placement, which equally reduces delay in the routes, you should choose one that allows to maximize throughput of routes.*

To reduce average transmission delay (number of relays in route) necessary to place UAV so that to cover given sender-recipient pair at the best or most distant pair (by number of relays) of nodes in the route.

For this purpose use the following simple procedure based on centroidal initialization (Fig. 8):

1. Define the route m_{ab} (routes) of network, for which the condition $\overline{t_з} \le t_з^0$ $(l(m_{ab}) \le l^0)$ is not met, and the number of relays belonging to it $l^0 = N'-1$, where N' – number of nodes in the route.

2. Build straight line segments that connect a given node i of the route (for example, i = 1, as shown in Fig. 6) with all other nodes j of the route, $i, j = \overline{1, N'}$.

3. Check availability of coverage of each segment ij by UAV's coverage area with radius R (for placement of UAV in the center of each segment): $d_{ij} \le 2R$.

4. For all segments, for which the previous condition doesn't meet, calculate the new number of relays in the route using UAV by the following formula:

$$l_{ij}(m_{ab}) = \begin{cases} |N-j| + |1-i| + 2, & i < j \\ |N-i| + |1-j| + 2, & i > j \end{cases}, \qquad (9)$$

$$a, b, i, j = \overline{1, N}.$$

5. Among all possible segments select the one that minimize the number of relays in the route, when UAV will positioned in its center.

Computational complexity of the procedure will be $O(N^2)$.

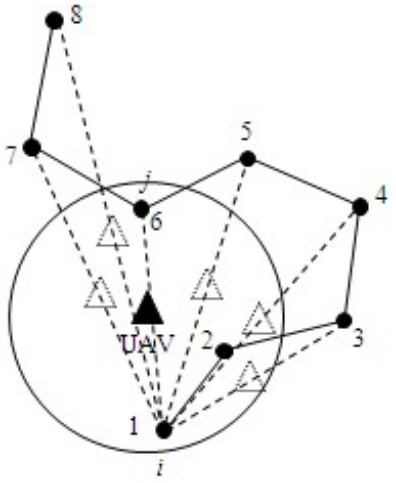


Fig. 8 Illustration of procedure for realization of rule №2 using centroidal initialization

In applying the above procedure UAV will be placed in the center of the segment 1-6, which will create a new route 1-UAV-6-7-8, which has 4 relays instead of 7 in the absence of UAV (route 1-2 - … - 7-8).

In the case where there are several solutions (regarding to the placement of UAV) that give the same number of relays in the route, you can apply certain meta-rules directed, for example, to achieve greater throughput of the route.

Rule №3. *If it is necessary to increase network throughput, UAV should be placed so as to cover the maximum number of overloaded nodes.*

Nodes can be overloaded when the queue of buffer is growing due to ultra-high intensity of arrival for service packets and/or when in great clusters of nodes increases the number of collisions in the organization of MA. In any case, we assume, that nodes are overloaded, if throughput of incidental to their channels does not satisfy requirement $s(m_{ab}) \ge 0{,}5$. Placement of UAV above such cluster of overloaded nodes (Fig. 9) will organize new data routes between nodes (at the functioning of one of well-known routing protocols) that will align the balance of load in the network and increase its throughput.

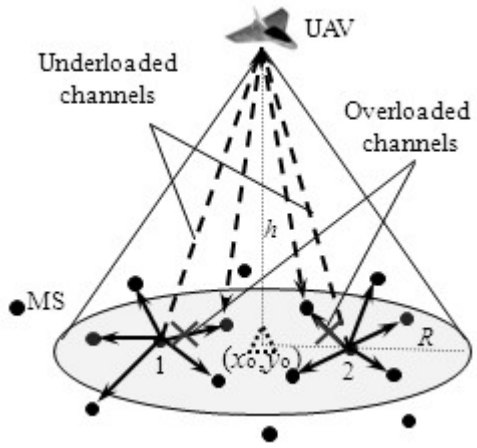


Fig. 9 Illustration of procedure for realization of rule №3 using centroidal initialization

To implement this rule can be used combined lattice-centroidal initialization:

1. Searching the maximum number of overloaded nodes according to lattice initialization.
2. Searching the quasi-optimal position of UAV in the center of mass of overloaded nodes according to centroidal initialization. Center of mass of overloaded nodes group can be defined as follows:

$$x_{0k} = \sum_{i=1}^{N^{nep}} \alpha_i x_i \,,\; y_{0k} = \sum_{i=1}^{N^{nep}} \alpha_i y_i \,, \qquad (10)$$

where $\alpha_i = 1/N^{nep}$, N^{nep} – number of overloaded nodes in group. Also note that $\sum_{i=1}^{N^{np}} \alpha_i = 1$.

7 EVALUATION OF PROPOSED METHOD EFFECTIVENESS

Modeling of MANET operation performed on a computerized environment Maple. It was used the following initial data: N = 140; K = 5; r =10000x10000 m^2; all MS have the same transfer radius d^0 = 600 m; all UAVs form on earth the same coverage area with radius R^0 = 1500 m; algorithm for finding shortest paths – Dijkstra; all MS moves at the same velocity v_i = 2 m/s, $i = \overline{1,N}$; MS movement model – random walk in a field, which is considered in detail in [10]; transfer rate per channel – V = 11Mbps; packet length is the same L = 1024 bit; all subscribers without priority of service, ie, traffic distribution matrix Γ – homogeneous; type of traffic – homogeneous Poisson (no priority of service); type of packet service in network nodes – with expectation without limitation of queue length.

Taking into account these initial data, it was studied three variants of UAV placement control system:

CS1 – control system (based on the principles of cellular radio networks, ie placing UAV in the area of the largest cluster of nodes);

CS2 – control system based on method of exhaustive search (full enumeration of all possible variants of UAV placement based on lattice initialization with step of grid Δ = 50m).

CS3 – control system based on proposed method (set of rules).

Order of assessing the effectiveness of proposed method was as follows:

1) Determination of initial MS network topology at some time moment t and placement of UAV according to CS1, CS2 and CS3 (Fig. 10);

2) Calculation of network throughput S(C) according to UAV placement by each CS. Determination of gain of CS2 and CS3 relative to CS1 and accuracy of results of CS1 and CS3 relative to exhaustive search (SC2) (Fig. 11-13);

3) Calculation of solution finding time for proposed method (CS3) and method of exhaustive search (CS2) and comparing values with duration of MS connectivity.

Analyzing charts of dependence of network throughput $S(C)$ from total load γ under different control systems can see that in the range of traffic 500 ... 2000 packets per packet transmission time T proposed system of UAV placement control (CS3) considerably prevails the base system (CS1) and in other ranges all CS are almost equally ineffective.

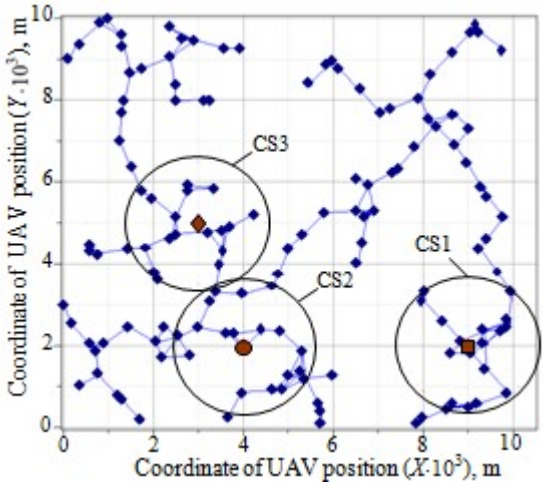


Fig. 10 The initial network topology with UAV placement according to CS1, CS2 and CS3

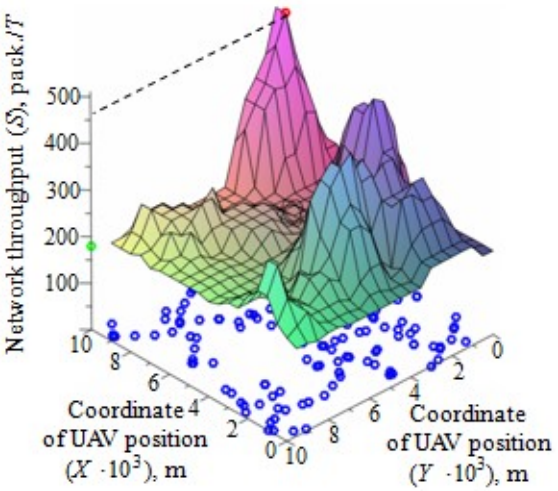


Fig. 11 Dependence of network throughput from placement coordinates of one UAV (according to CS3)

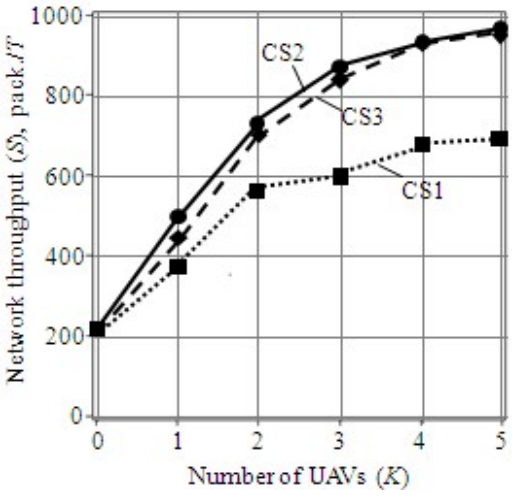


Fig. 12 Dependence of network throughput from number of placed UAVs according to different CS

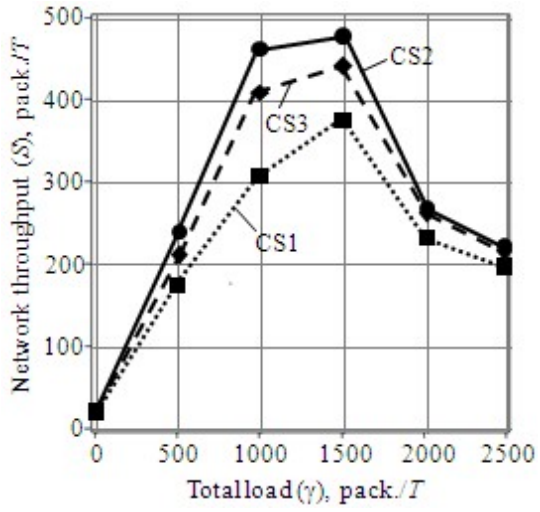


Fig. 13 Dependence of network throughput from total load according to different CS

Therefore evaluated effectiveness of proposed method allows the following conclusions:

1) Average gain of the proposed method (CS3 relatively CS1) under the random generation of 100 variants of initial topology is 15-20%;

2) Average deviation of network throughput value (for CS3) with respect to method of exhaustive search (CS2) is 5-7%;

3) Average solution finding time for CS3 is units/tens of seconds as opposed to units/tens of minutes for CS2, that under average duration of MS connectivity 348 s according to [10], allows control UAVs placement in real time.

8 CONCLUSIONS

The paper is devoted to development of new method for increasing MANET throughput using UAVs placement control in view of the rapid and unpredictable movement of mobile subscribers.

The difference of developed method from existing is that first proposed to combine mathematical models of mobile subscribers connectivity estimation, as well as an improved algorithm for finding of quasi-optimal UAVs placement, into a single computational procedure. Application of the method allows increase network throughput to 15-20 % in comparison with existing methods. Deviations of sub-optimal solutions from optimal, received by exhaustive method, are not more than 5-7 %.

The essence of algorithm improvement is that was managed to avoid exhaustive search of variants of UAV's placement because of ussing pre-designed set of rules for selection of variants of such changes of network connectivity, that increasing its throughput and reduce the computation time.

Modeling results shown that solution finding time using set of rules is units/tens of seconds as opposed to units/tens of minutes for exhaustive search, that allows controlling of UAVs placement in real time.

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THE ARMED FORCES OF THE REPUBLIC OF POLAND IN THE ACTIVITIES FOR SECURITY

Zbigniew GRZYWNA

Abstract: Presented action plans should be outlined in order to show how to integrate plans and works focused on technologies and systems related to the security issues. The use of some available units of forces, resources and means should be in place, depending on the thematic areas, these kind of tasks are inherent for the armed forces of the Republic of Poland. Changes in the security environment in Europe and around the world have contributed to decreasing the level of likelihood of military conflict. However, the possibility of non-military threats has not been eliminated. Their importance, the extent and type are showing trends in growth, being widespread on a regional and even continental scale.

Keywords: Security. Military and non military threats. Armed forces.

1 INTRODUCTION

The strategic objectives of our State derive mostly from the security interests and development of the Republic of Poland that is a member of the NATO Alliance for thirteen years and at the same time it is the State which belongs to the European Union. Widely understood cooperation and significant interdependence between countries simultaneously broadens economic interoperability which is supported by international contacts and causes closer cooperation and common strategies. The National Security Strategy of the Republic of Poland states that one of the overarching goals of State's action in the field of internal security is to maintain the capacity to respond in the event of threats to public safety and security. Moreover it is related with protection of legal order, life and health of citizens and national assets from illegal activities and the effects of natural disasters and technical failures.

Achieving this requires:

- ensuring the independence and inviolability of borders, the creation of a coherent legislative;
- creating conditions for the development of civilization, economic social attitudes and the development of the spiritual dimension;
- improvement of activities of all State and social actors, whose activity is connected with the internal security of the State;
- promotion of the Polish economy, supporting entrepreneurs, while ensuring the safe development of any national activity in the economic, social and intellectual;
- protection of the environment against its degradation along with protection against natural disasters;
- providing access to new information and technology.

Achieving internal security will be possible through:

- increasing the efficiency of public administration;
- incraising the level of professionalism of the officers and employees of public administration, implementing the tasks in this sphere of functioning of the State;
- dissemination of knowledge about the dangers of internal security state.

Actions in the field of ensuring of an acceptable by society, the level of internal security state should be addressed also for integration and consolidation of the activities of the NATO, the EU and the UN and other international organizations active in this area. The strategy emphasizes the possibility of threats including terrorism and the need to counter this acts. As that internal terrorism in our country does not occur and would rather not be it expected, the impact of the terrorist attacks should be expected from the outside, by facilitating the movement of people and goods – including opening borders with the countries of the European Union and the facilitation of communication tools like Internet, mobile telephony, etc. Economic globalization seems to give the same benefits but can be contained with factors conducive to breaches of internal security. One such internal security threats is terrorism or cyber-terrorism. You cannot remain passive, in consequence, for prevention are important:

- ability to proper behavior of the citizens in the event of a terrorist threat;
- professionalism in executing the laws facing the Administration;
- correct operation of the departments and bodies appointed for that.

The State has also prevented other activity detrimental to its internal security, that violate the constitutional order and the spreading the totalitarian ideologies, racial hatred or influence. Both ideologies and hatred on racial, national, religious, beliefs as to sexual minorities or to medical practices, do not recognize borders. Poland is still a fairly homogeneous ethnically and religiously country, but this state is changing, with increasing immigration and also with the possibility of free

movement of people and making them work in the area of our country and beyond. Along with a growing number of foreigners increases the probability of occurrence of acts of violence against them is increasing now there are few and isolated actions, however, attention should be paid to these problems.

The Council of Ministers is the supreme organ of executive power. Its task is to ensure, in accordance with the Constitution, internal and external security. As to public order, it is exercised by general management in the field of defense and in the framework of this obligation prepares general government, municipality and national economy to act during the state of emergency[1]. The competence of the Council of Ministers should, inter alia cover the implementation of statutory tasks at the time of the occurrence of the situation of the internal security threats. The work of the Council of Ministers headed by the President of the Council of Ministers, which ensure the implementation of a specific policy, outlines the ways of its implementation, coordinates and controls the work of the members of the Council. Underlining the fact that having the right camera, prime minister may meet all the management functions in relation to the management system. During the international crisis that does not bring a direct threat to our State, according to the ratified multilateral agreements Article 4 of the Washington Treaty sounds: **"The parties will consult together whenever, in the opinion of any of them, the territorial integrity, political independence will be compromised or the security of any of the parties"[2].** The Republic of Poland is obliged to participate in solving problems and bringing necessary aid to other countries of the Alliance and not only. In addition to the mentioned article, the Council of Ministers has concluded the international agreement, which obliges our State to participate in these activities, and the contract shall be subject to ratification (Art. 87.1). The sources of universally binding law of the Republic of Poland are: the Constitution, laws, ratified international agreements, and regulations[3]. In the new legislation about crisis management[4] the definition of civil emergency planning was simplified some new definitions were introduced in the process of crisis management concepts, i.e.. the cycle of planning, grid security, threat maps, risk maps and events on the nature of terrorism. At the same time the National System of Crisis Forces (NSPK), stopped existing due to the extension of the definition of crisis management (article 2), which in the new version also includes procedures determined in NSPK. Extracting NSPK tasks become the same unnecessary. This is consistent with the expectation the Ministry of national defense and it is related with changing the article. 7. 4, art. 9. 1, art. 11 paragraph 1. 2, art. 12 paragraph 1. 2 and art. 14 paragraph 1.2[5].

According to the new definition of civil planning, it was also adapted in the civil planning tasks (article 4). The rule actually regulate planning activities, which culminates with the emergency response plan, therefore for only one phase of crisis management. The essence of change concerns the introduction of:

- the task of preparation of crisis management plans, which shall include all phases of the process;
- new tasks, the implementation of which will enable the preparation (including training) and keeping the real forces and means provided for this plan, for use in certain crisis situations.

To serve this, there will also be the implementation of tasks which ensure consistency between crisis management plans and other plans, drawn up in this respect by the competent bodies of the public administration, and the obligation to comply with other provisions of the results. The above will lead to making real all planned activities and eliminating redundant projects, in particular by absorbing strength and resources.

Article 4. point 1. indicates the tasks of civil planning, which include:

- preparing crisis management plans in the armed forces;
- training and technical preparation of the structures that run personal crisis situations;
- preparing and maintaining the necessary resources to perform the activities included in the plan for crisis management;
- maintaining databases of the necessary crisis management process;
- monitoring of risks;
- preparation of the solutions in the event of damage to critical infrastructure;
- ensure consistency between crisis management plans and other plans, drawn up in this respect by the competent bodies of the public administration, service, inspections and the guards, whose obligation to comply stems from separate provisions.

[1] Konstytucja Rzeczypospolitej Polskiej z dnia 16 lipca 1997 r., Dz. U. z 1997 r. Nr 78, poz. 483. ze zm. art. 146.

[2] Available at: http:// www. geopolityka.org.pl Artykuł 4 Traktatu Waszyngtońskiego.

[3] Konstytucja Rzeczypospolitej Polskiej, Dz. U. z 1997 r. Nr 78, poz. 483, Rozdział III.

[4] Projekt z 04.12.08 r. o zmianie ustawy o zarządzaniu kryzysowym, Dz. U. z 2008 r. Nr 89.

[5] Ustawa o zmianie ustawy o zarządzaniu kryzysowym, Dz. U. z 2004 r. Nr 131, poz. 1076.

During the NATO Summit in Prague in November 2002, Poland together with the other Member allies, committed to developing and maintaining the capacity for immediate response to emerging security threats. Rising SON was and remains one of the key aspects of the Alliance's transformation and the armed forces of the Member States. Poland as a member of the international global community is subject to the laws and the changes of the modern world. Polish involvement in the SON is the manifestation of our activity, interest, responsibility and credibility on the international stage. In addition, the participation of Polish Armed Forces in the SON has tangible benefits in the form of promotion and to specific operational capacity. Is so, one of the highest forms of adaptation produced by the forces to the requirements of their destination. Since 2003, as part of this commitment, the armed forces of the Polish Republic shall progressively increase contribution to the SON. Through the involvement of the armed forces of the Polish Republic in the achievement of the following objectives, the SON is assumed to gain:

- the maintenance of the operational capacity of the national contribution to the Alliance to ensure the ability to respond quickly to emerging threats of a military and non-military nature in the interest of NATO;
- raising the capacity of the armed forces of Poland to participate in missions and the Alliance's operations and to defend the territorial integrity of Poland;
- persisting image of Polish as a reliable partner-Ally and raising of prestige in the international environment;
- improvement of national procedures for the separation and control of tasks outside the State;
- dissemination of NATO procedure and the implementation of procedures of the SON in the armed forces of Poland adopted in this regard.

In the process of the preparation and the participation of Polish Armed Forces following the assumptions adopted by the Alliance:

- the Member States shall make voluntary declarations to participate in NATO's SON;
- standby phase set of SON lasts 6 months;
- for achieving the capacity corresponding to the component framework State (Component Framework Nation-CFN)6;
- leading State (Lead Nation-LN) within the component itself or in conjunction with other countries, must provide sufficient capacity for the implementation of specific tasks eg. fire support, reconnaissance battalion contamination, detection of explosives, the extraction of water, etc.;
- combat forces should declare, an adequate number of combat support forces (Combat Support-CS) and security logistics (Combat Service Support-CSS);
- the use of the SON in the operation follows after the decision.

Before including of individual States to a specific set of SON, it follows the transfer of command (the Transfer of Authority-TOA) to the Supreme Allied Commander in Europe (SACEUR). This is after the decision on political levels of Government for their involvement in the operation of the SON. The command is specified in the TOA of individual elements of command over the forces of SON adopted. The relationship of command between commanders, and separate forces in determined before the TOA, which allows their proper preparation to the action, as well as the detailed implementation rules for transfer of command according to the plan of operation.

Requirements for rapid use of the multinational forces need to maintain efficient and flexible system of command. Maintaining high readiness forces in to action with minimal restrictions, has impact on the structure of national and command procedures.

An essential part of command SON created is based on the existing in each of NATO's operational headquarters, solid, capable of metastasis of a staff Component: Deployable Joint Task Forces Headquarters (DJTF HQ[7]).

The command of the Land Component (LCC[8]) is created based on the land-based components or commands NATO'S high readiness Forces Corps. To him, as appropriate, about the size of the force to a brigade along with support units.

Air Component command (ACC[9]) is created on the basis of one of the Components of the Air Force Headquarters and Component Headquarters declared National Air by Member States. The command of the Component can be deployed together with the land component Commander DJTF HQ, or Operational Bases in Developed (Deployable Operational Base-DOB).

The command of the Maritime Component (MCC[10]) created is based on the one with the Marine Forces high readiness to NATO commands. To him in the composition of the naval force with combat and marine amphibious forces group.

6 The framework is defined as a state command-generating components: land, sea, air and special forces, alone or in conjunction with other States.

7 DJTF HQ – Deployable Joint Task Forces Headquarters.

8 LCC – Land Component Command.

9 ACC – Air Component Command.

10 MCC – Maritime Component Command.

Command of special and combined forces Component (CJSOCC[11]) is done by the framework States that are declared.

An important component of the SON is the Joint Logistics Support Group (JLSG[12]). The main task of this group is the integration of the whole logistics command headquarters and to ensure security at all levels of command of the logistics structure of SON. Command of the multinational battalion of defense against weapons of mass destruction-wbOPBMR (MN-CBRN Def Bn[13]) implemented by the framework states that are declared. They give off the staff to command the battalion, sub-units of the battalion command and security, essential subunits of the diagnosis and removal of contamination, laboratories and officers to the analysis and evaluation (JAT). In order to force to the crisis, because the operation, are kept in readiness forces and strategic transport.

The NATO response force can be used to carry out tasks that require a rapid response. Range operations can include territories up to 5 000 km from Europe. SON operations should be sanctioned under United Nations Security Council resolution (UNSCR[14]). They are carried out in close cooperation with the United Nations, the Government of the State on whose territory are carried out, the Governments of the neighboring countries and interested international non-governmental organizations.

SON carries out tasks in full respect of international and local law, including international treaties and agreements on arms control and in accordance with the restrictions resulting from the received mandate and mission. Territories and boundaries (including marine and air) of neighboring countries cannot be violated without prior authorization from their side and the necessary coordination. Member countries taking part in the SON operations are obliged to ensure the deployment of their own arms which shall be required in accordance with the approved by all the forces detailed deployment plan. The SON operations in the crisis times require the necessary distance and the use of the strategy and army actions of the diversion may be conducted in difficult climatic conditions and terrain. One must reckon with the difficulties caused by the destruction of infrastructure and the poor economic conditions of the state on whose territory the operation will be carried out. On the basis of the decision of the North Atlantic Council (NAC), individual states taking part in the operation are responsible for funding their own troops. NATO does not grant advances and other states grant the future or ongoing activities. SON are provided to participate in different types of operations:

The evacuation of civilians from the crisis or conflict region.

This operation is led in order to displace people from the affected areas. Among evacuated people there are in particular: the staff of the United Nations and of various international NGOs, citizens of NATO countries, and other people shown in the decision of the NAC. Usually this type of operation takes place at the time of loss of the control by the authorities concerned in the operation of internal stability. There also some ethnic conflicts might take place. Participation of SON in the evacuation of civilians from the region is regulated by the NATO document "GCOP 10460 AGILE FALCON-Non-Combatant Evacuation Operation (EV-Evacuation)-the evacuation of civilians from the conflict region".

2 THE SECURITIZATION OF THE ENTRANCE OF FORCES

The securitization of the entrance of forces is made on the basis of the developed scenario for the situation as described in the document "GCOP 10401 AGILE FOX-Initial Entry Force Operation-securitization of the entrance of forces". The essential task of the SON will be to create favorable conditions for the adoption and development of the major forces in the area of conduction of operations. Strategic objectives will be achieved through:

- demonstration of the determination and will of the NATO Defense area of responsibility;
- support in a short time provided by the Alliance for concerned States in crisis;
- ensuring the proper conditions for a smooth transfer of troops, their adoption and development in the areas of operational destination.

3 SUPPORT OF ANTI-TERRORISM

The challenge for the threats of the modern world is a demonstration of the readiness of the Alliance to fight global terrorism. In the situation as presented in the document "GCOP 10461 AGILE ARROW-Support of counter terrorism operations-Support by the SON of anti-terrorist" the use of the SON in combating terrorism is provided. This operation will be a result of terrorist attacks in Member States of NATO. It will include the use of offensive measures in order to reduce the ability of groups and individuals associated with terrorist groups to conduct activities against countries, organizations and civilians. In the expected scenario it is assumed the identification of terrorist groups

[11] CJSOCC – Combined Joint Special Operations Component Command.
[12] JLSG – Joint Logistic Support Group.
[13] MN CBRN Def Bn - Multinational Chemical, Biological, Radiological, Nuclear Defence Battalion.
[14] UNSCR – United Nations Security Council Resolution.

responsible for the acts of terror, as well as the likely location of their training camps and places of manufacture and storage of weapons, including chemical and biological. According to the primary purpose, this operation will be held to neutralize threats of terrorist organizations. Key tasks will address:

- identification, diagnosis, neutralization of terrorist groups;
- deprivation of any weapons by dismantling their production and storage sites;
- psychological and information operations;
- ensure the protection of the army;
- the security and protection of important communication lines and nodes.

4 PARTICIPATION IN HUMANITARIAN OPERATIONS

The main tasks carried out in this type of operations will be associated with the support from Government, international organizations and others, to help the civilian population in the event of emergencies and crisis situations. Participation of SON in humanitarian operations is governed by the NATO document, "AGILE HAND of GCOP 10466-Support Consequence Management by the NATO Response Force-using SON in humanitarian operations".

5 DEMONSTRATION OF FORCE

Tasks will be associated with a display of strength and combat capability of the troops of NATO forces and their presence through the displacement in order to change the situation, which may be critical to the interests of the Alliance or allied members in the region of crisis. This type of operation is carried out in order to:

- demonstrate the links between the countries of the Alliance;
- deter potential aggressors;
- gain or increase the influence over the course of the situation in the crisis;
- support of diplomatic activities.

Participation of SON in humanitarian operations is governed by the document: “GCOP 10466 AGILE Force Package to Support FIST Diplomacy to the NATO Response Force-Using SON to the demonstration of force in order to support diplomatic action".

Participate in crisis response operations including peace-keeping.

Operations of this type might take different forms: from the support for the civil agencies to military action. The intention of crisis-response operations is to demonstrate the Alliance's determination to restore peace, security and stability in the country or the territory of which a crisis has appeared.

Early conveyance of task and reconnaissance forces in the area of operations is a key principle, allowing the main forces the coordination of the movements and the smooth entry into the area of operations. Strategic objectives in crisis-response operations can include:

- the creation of adequate conditions for the peaceful resolution of the crisis;
- providing conditions for the smooth flow of forces in the area of operations.

The assumed final state in the types of operations is related to the restoration of security and stability in the region in the crisis. Issues of participation in this type of operation is governed by the SON’s document "GCOP 10463, AGILE JAGUAR-the NRF in Crisis Response Operations, including its Peacekeeping (PK-its Peacekeeping), Utilization of SON in the crisis response operations and in the maintenance of peace".

6 ENFORCING THE IMPOSED EMBARGO

The operation is carried out in order to comply with the prohibition of the import or export of goods to or from a specific country and compel the Member States and the organization or group of people, to respect the international law or UN resolutions. In this regard, the task of SON will be:

- monitoring and enforcing compliance with the embargo;
- support of other forces and supervising organizations in compliance of the embargo;
- monitoring and control of trade routes and communications.

It is developed on the basis of the scenario for the situation as described in the document ' the AGILE GIANT GCOP 10465-For the Embargo Operations by the NATO Response Force. The use of the SON to the forcing imposed the embargo ". Types of operations outlined above will be implemented in the following stages, which can vary slightly between each other based on their specificity:

Phase I - Planning and activation.
Phase II – Conveyance.
Phase III - Action.
Phase IV - Withdrawal.

In operation, the ssecuritization of the entrance of forces, starting from phase III enters major stands out:

Phase III - Entrance in the area of operations.
Phase IV - the reception of major forces.
Phase V – actions within the main forces.

In addition, for each type of operation separate listings of the required forces (CJSOR) are prepared.

They are located in individual operating plans for each type of operation listed above (GCOPs).

It is assumed that logistics security of SON should ensure the conveyance and the deployment in the area of crisis operations, continuity of action and withdrawal. Especially important is having at the time of the peace resources, equipment and inventory stock for the smooth arrival of the SON's main force to the crisis or operation.

The main objective of the logistics activities of the armed forces of the Republic of Poland in the stage of preparation, maintenance and possible participation in operations of forces and resources produced by the SON is:

- ensuring the continuity of logistical support in terms of technical, medical and material, in accordance with the required level of readiness and with the priorities of operation;
- ensuring the implementation of tasks by the armed forces of POLAND participating in the operations of the SON;
- training and replenishment of logistical personnel;
- re-stock of material and weapons of warfare and military equipment in co-operation with logistics multinational.

The main effort of the logistics support system according to the phases of the participation of the armed forces of the Republic of Poland in crisis situations will be focused on the preparation and maintenance of standby forces and resources necessary for the usage of the logistics security in each of phases of the preparation of projects, maintenance of the readiness of forces and the potential participation in operations of SON soldiers. The scope of the planning and organization for the participation of Polish Armed Forces in crisis or carrying signs of the crisis situations requires multiple organizational units, the Ministry of National Defense some coordinated actions. A clear definition of the needs, and then specification of the necessary measures for the implementation of this process allows to raise the standing level of its efficiency.

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[11] CJSOCC – Combined Joint Special Operations Component Command.

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[13] MN CBRN Def Bn - Multinational Chemical, Biological, Radiological, Nuclear Defence Battalion.

[14] UNSCR – United Nations Security Council Resolution.

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ETHICS OF ORGANIZATION CULTURE AS AN EXISTING CONDITION OF SECURITY CULTURE

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Abstract: The main goal of this article is to show the role of ethics in organization culture. For this purpose the author uses specific perspective – securitology, that is the science about security. This point of view is very important, because it combines inter- and multidisciplinary character.

Keywords: Organization culture, security culture, ethics.

While thinking about security culture, one cannot overlook the importance of philosophies and theories of the law. Also it is important to note that there are a lot of different legal and organizational orders. Our European, continental legal system is only one of them. Knowing other legal systems is as important as knowing other various elements of philosophic and religious systems, forms of organizational and legal orders that are specific to particular cultural heritage. These are described by the comparative law [TOKARCZYK 2000a, 2000b]. European law, also described as continental law, is based upon codified principles, contrary to systems known as common law which are based upon leading cases. As opposed to continental law, common law has been created by judges of higher Royal Courts of Justice. Whereas continental law is intellectualized directly from the Roman law. Ancient Roman Empire was a real birthplace of law. As we mentioned earlier, there are lots of instances that show that overall generalization which affirms linear historical progress is incorrect. In the course of history, between the 5th and 10th centuries, law, so well developed in the ancient Roman Empire, was slowly forgotten. The Roman way of legal thinking was partially rebuilt in the Holy Roman Empire and in the University of Bologna [NOEL 1998]. It is important to remember that in the case of continental law, principles codified by legislature or legislative authority are the primary source of law. The administration of the state is governed by the executive (that is to say, the government). The third branch of the government in Montesquieu's tripartite government division[1] is judiciary.

Looking at the history of the law, it seems obvious that in the ancient cultures, from Egypt to Israel, Greece, Rome, India, Tibet, China and Japan, teachings of the law were always connected to teachings of religion. Studying the law separately from learning the rules of religious laws is a Roman invention.

It is important to note that statutory law is created by the system to fulfill certain social functions. Below are listed the **functions of the law.** They impact both our daily lives and the development of civilization as a whole.

1. **Stabilizing-regulatory function**: the law establishes order in areas such as social order, economy and politics; a working system creates order and security.
2. **Protective function**: the law protects values that the society views as important for its majority, which provides wellbeing for all citizens.
3. **Educative function**: the law teach the citizens proper behaviors that are in line with the codified law. By applying preventive means, laws improve the quality of life, whereas by the use of sanctions, they discourage all illegal activities. This function also engages the citizens in public affairs and forms a sense of connection with public authorities [GRZYBOWSKA 2003]. "A sense of relationship between citizens and public authorities – according to promoters of the decentralized model – [can be] seen as a factor contributing to the consolidation of the state and nation" [Grzybowska 2003]. It is important to remember that "educative function of local government acts as a forum for fostering active citizens, when it is adequate representation of local interests" [WASIUTYŃSKI 1927, p. 5, for GRZYBOWSKA 2003, p. 35].
4. **Dynamic function**: in a social sense, the law uses legal tools to implement – also in accordance to the stabilizing-regulatory function – changes that are necessary at a particular time and in certain areas of life. For instance, when Poland changed its political structure, after deliberations of the Round Table (1989) a a decision to create new administrative government was made.

[1] Montesquieu's tripartite government division – division of functions of the state, popularized by the French Enlightenment thinker, Montesquieu (1689–1755). According to him, government was divided into: 1) the legislature that is currently constituted mostly by parliaments, which create laws, 2) the executive power which is in the hands of the king (monarch), president or the government, which puts the law into effect, 3) the judicial power exercised by the courts and tribunals, issuing judgments on the basis of the law. All three types of power should be equal, independent and subject to peer review. It is now the most widely used system of government in the world.

5. **Distributive function:** law distributes specific goods and load factors that are necessary for the functioning of the state.
6. **Repressive function:** administrative government establishes punishments in cases of acts against the law that qualify as misdemeanors or crimes. At the same time, this function serves as prevention – it deters or demobilizes potential criminals.
7. **Monitoring function:** system of the law clearly defines what is lawful and what is against the law. In other words, the legal system is a tool of social control that establishes proper social behavior.
8. **Organizational function:** the legal system creates an organizational framework for operators of public authority and the organization of society.
9. **Culture-forming function:** it integrates people of a particular state by using its system of laws and taking care of the preservation of historical continuity, the nation's tradition and the development of arts and culture. This function, alongside the protective function, promotes the cultivation of values and of a sense of identity that are important for members of the society.
10. **Warranty and regulatory function:** it defines the limits of the powers of the state administration – representing the common good and individual rights that define its freedom. Legal regulations also cover the opportunity to reach a compromise as a form of resolving certain social issues.

The questions of efficiency and the implementation of the law and these functions are very important and interesting for securitologists [SKVRDA 2005, p. 41; HOFREITER 2006, p. 19; KORZENIOWSKI, PEPŁOŃSKI 2005, p. 243; KORZENIOWSKI 2007, p. 186; JANOSEC 2007].

The mere potential existence of these functions is not enough. To maintain a good quality of life and secure existence, these functions must truly and effectively work real. The theory of effective action known as praxeology deals with this issue.

A Polish scientist and philosopher, Tadeusz Kotarbiński (1886–1981) contributed a great deal to praxeology, the science of operational efficiency [KOTARBIŃSKI 1955]. His writings also include an important ethical component.

Let's get back to that philosophy, because administration is characterized by the fact that it **operates under the law and within the limits of what the law defines** and has a significant impact on the implementation of the functions of the law, also in the objective sense. This refers to "administration", which concerns the broad sense of personal fulfillment for each of us. Herein also lie the roots of autonomous safety philosophy.

Philosophy, the mother of all sciences is almost synonymous to theory and its important functions (descriptive, explanatory, applications, predictive and evaluative). We also believe that practical philosophy is synonymous with the concept of reason. Philosophy indeed means "the love of wisdom" (from the Greek *phileo* – love, *sophia* – wisdom). According to Tatarkiewicz, philosophy is a science that "gives view to a world. (…) It's a science whose scope is the most comprehensive of all sciences and which uses the most general terms. If philosophy selects from its great range some particular part, for example the fields of law and administration, it happens because of the special importance and value of said fields. Philosophy is the science of what is most important and most valuable for people" [TATARKIEWICZ 2005, p. 13]. This is how Krzyżanowski sums up his reflections about values:

1. Value is directly connected to the act of valuation, assessing judgments.
2. Judgments boils down to differentiating between the good and the negative. This judgment can be expressed aloud or not. In the latter case it's just a thought.
3. The subjects of judgment can be both individuals and human collectives, with different sizes, features, for instance teams of experts, family or local communities and bigger subjects.
4. The objects of judgment can be both concepts and actual components of reality – from ideas, relations, events, to specific characteristics of persons and objects.
5. Therefore you can say that value is the result of a judgment of a certain object, made by a subject, according to the judgment of the subject, by valuing.
6. It should be further noted that in the case of judgment it's only about positive notion, not as it is in the case of evaluation, where it can be negative, neutral or positive. The concept of value is thus linked to the term of the hierarchy of needs, where one chooses something in relation to existing alternatives.
7. It should be emphasized also that the judgment seeking to determine the value can be individual as well as collective. Creating value is related to the operation of the rational as well as emotional intelligence [KRZYŻANOWSKI 2006, p. 206].

"Values which one seeks to realize affect both the individual goals and collective, common objectives, either directly or through attitudes and motives for behavior, including the actions of people and the selection criteria," [KRZYŻANOWSKI 2006, p. 206].

When values are fully incorporated into a particular community's system of values, they produce and cultivate a complete form of organizational culture, one that shapes the very

atmosphere of a working environment. It makes it easier to create appropriate conditions to introduce the following elements that contribute to the establishment of safety culture:

1. The identity of the professional community (or another sense of the community), a sense of security and satisfaction in the efficiency and Achievement of common goals. Organizational culture has an internal but also external stabilizing effect (**function of perception and stabilization**).
2. A self-perpetuating system, a kind of a positive wave allowing for educating new employees in the spirit adopted by the influence of organizational culture and consistent examples of interaction in a professional environment, including habits that are the source of "pride" of the profession (function of socialization, education).
3. Organizational culture protects its values from "intruders", those who do not respect it and want disassemble it (protective function).
4. Organizational culture, through certain indigenous ideas [compare: COLLINS J., PORRAS J.I. 2008] may be "proud" to enter a phase of change and avoid being "lost in the fog", which allows innovation boost while maintaining the core values and identity of the organization (function of adaptation and dynamism).
5. Intruders who dare to tread on the organizational culture of the institution or company are exposed to "repressions", at the very least a moral sanction – the loss of honor, and when it no longer exists, they still run the risk of social ostracism and ultimately becoming outlaws (repressive function).
6. Organizational culture integrates a team of professionals, offering benefits such as a common identity, shared beliefs, vocabulary, rituals, values, work style, etc. (function of culture-forming and integration).
7. Organizational culture determines which attitudes in people, assemblies and subassemblies are appropriate from the point of view of consistent customs, with the need for taking action for the common good, while also specifying what is wrong (function of control and self-control).
8. By adhering to its customs, organizational culture constitutes a natural hierarchy (function of guarantee). The natural hierarchy contains a lot of formal and non-formal competences, which in many cases are consistent and at the same time they are formal powers associated with duties of officials. A natural hierarchy is a hierarchy of powers. The most transparent, and yet possessing one of the most well-established axiological support systems, is the concept of Military Houses of the Empire of Japan. Analogous concepts and their respective traditions were built in Europe; unfortunately, somewhere along the line their continuity was destroyed. However, that kind of continuity is still maintained in Japan in the concept which can be defined as Shin Bushidō (Modern Bushidō). First, this concept recognizes the simple fact, one that is truly visible in all human groups: the one who stands high up in the hierarchy is even more of a slave than a person who is on the lower levels of the hierarchy. Secondly, the well-being of one is pursued by contributing to the common good – in actuality, not declaratively. Thirdly, sabetsu byodo,"diversity is equality", as Mokurai Shimaji said in his essay from 1879 [VICTORIA B. 2005, p. 39]. Elaborating on this idea, it can be said that equality is understood as equal to the force majeure, represented by the natural law [HERVANDA J. 2011]. At the same time the subordinate (one not equal to his superiors at a given time) by its reliable service over time is able to obtain the same position now occupied by his superior. The hierarchy is a conveyer belt of development, based on authorities and accompanying transfers of knowledge and skills. With no hierarchy, there is either no need for progress, or no possibility of developing progression. We do have equal chances if we work for common good with real (and profitable) self-sacrifice in an organizational culture climate, which provides that the leader (manager, director, supervisor) would have to hold arrogance in contempt, and the subordinate would be compromised if he could not show the same respect as his supervisor **(function of organization).**
9. Another good custom characteristic of organizational culture is to retain relevant parities in the distribution of the type and weight of the responsibilities and "privileges" between employees, resulting from the operation of the organization **(function of distribution).**
10. Organizational culture in its humanistic dimension "remembers" about the appropriate balance between ethical requirements of the commitment to the organization and the needs of autonomy, necessary for personal development and self-fulfillment, through raising the quality of life of individuals **(function of guarantee)**.

It is worth noticing that the proper functioning of organizational culture in an institution, thanks to a strong ethical factor, would make the legal system largely redundant, because functions that would serve as the rules are already fulfilled and often exhausted by a properly internalized model of the institutional (organizational) culture [BUGDOL M. 2006].

To sum up our reflections about the phenomenon of organizational culture that is identical with culture of safety:

1. Organizational culture is, in the light of these observations, a great asset of any organization. It should also be present in the administration, operating under the law and within its limits. Functions of the law that are used in external motivations, are superimposed on the analogous functions related to internal motivation, represented by the culture of the organization.
2. It is important to remember that the significant factor in the consolidation of attitudes is the inner motivation. More importantly, internal and external components of consolidating mechanism attitudes -–hopefully appropriate – conventionally make for 100 % of the motivation in this regard. Even more importantly, "blowing up" the external motivational systems (unfortunately) destroys the internal motivation, which is the most important component of creating and perpetuating moral stance. Aristotle warned that "the law is for nothing if people do not get used to it." [ARYSTOTELES 1982] Thus, the growth and, more generally – the variability of systems of law, including laws for firms and institutions (together with this unfortunate ad hoc ethical code) generate wrong attitudes, because morality is simply not a decree [PIWOWARSKI J. 2012, p. 9]. An excess of external motivation can only destroy it, which is confirmed by Festinger's theory [FESTINGER 1957; ARONSON E., AKERT R. M., WILSON T. D 1996] of cognitive dissonance phenomena or the effect of "over-justification" described by researchers from the circle of social psychologists [ARONSON E., WILSON T. D., AKART R. M 1996, pp. 80–121; WILSON T. D., LASSITER D. 2007, pp. 811–819].
3. Through observing discussed functions, organizational culture is strongly embedded in the sphere of internal motivation, for instance thanks to the "influence of authority" [Compare: MILGRAM S., 1974] which reinforces appropriate attitudes in certain professional environments, at the same time working towards "the common good". Stabilized organizational culture relatively easily counteracts the phenomenon of hypocrisy. This relative ease comes from the moral abuse of external motivation factors, characteristics of modern civilizational excess. We must remember: **morality is not a decree** [PIWOWARSKI J. 2011a, p. 7]. If someone tries to enforce it, such acts should be seen as a moral-ethical sabotage (whether conscious or not). Organizational culture based on values and tradition transforms into security culture. It is the primary basis to express (but not require) the codification of ethics, reinforcing what already exists in a genuine way (providing the intentions are pure, and the necessary effort has been made). Nowadays, the so-called "new culture" [and in fact counter-cultural affirmative chaotic anarchist "freedom"] tries to convince us that [traditional] Western culture and traditional [orderly] curriculum is racist, ethnocentric and patriarchal, and therefore politically unacceptable. [But] the universalist [traditional] vision is part of the legacy of Western culture and the reason why we should nurture this culture and pass it on to young people. Western culture is our most precious moral treasure in the world, and it got us to modernity [often verging on barbarism. Tradition] contains knowledge about what to feel in a world where feeling constantly threatened loss of the road" [SCRUTON R. 2010, pp. 105, 106]. Feelings represent our emotional intelligence, which allows us to find the meaning of life, self-improvement and the motivation to work. Work that is not easy to do reliably and so perfectly that all those who depend on its effects feel secure and fully satisfied. Perfectionism and integrity rarely go hand in hand with the affirmation of anarchist freedom, manifested in a careless fashion, forgoing authority and adhering to sloppiness instead of a lifestyle that is trying to find extremely valuable deep meaning of human existence.
4. Organizational culture built as a specific tradition is part of the culture in the full scope of that word [SCRUNTON 2010], a phenomenon of established, material and non-material human achievements. Strong organizational culture in a group of people, for example, government officials, meets the needs of security, belonging and predictability (both within the team, and in its external offer linked to the honor and the effects of service). It is worth noting that management teams, when they are managerial and their control operations are performed with dedication and honesty, become the source of the transmission effect filling analogous needs among community members that interact with the management or command institutions. Negligent, unethical aberrations within the administration or command assemblies, cause dysfunction not only in the organization, but also in the community that this institution *de facto* generates. This can cause a sense of lack of belonging and genuine social participation in persons served by the defective administration and led by an incompetent commander. The author deliberately uses the word "sterile" (rather than low), because our traditions

are excellent resources of ethical culture, a derivative culture of honor characteristic of the upper class, whose chivalric ethos, however, permeated all social groups. An example of this transfer was the attitude and the associated ethics defined as "chivalry", penetrating the once mighty Scout Movement[2], with all its affirmation of the law and fairness[3]. This tradition is analogous to honor culture of Far East. The latter differs from West, though, because of its longevity and stability. For example, the most ingenious revolution in human history, the Meiji Reform (1868) [PIWOWARSKI 2011b], where triumphed the predominant consensus and the self-sacrifice of the Samurai - *gisei (jikogisei)* for the common good, as well as the primacy of higher values instead of selfishness and the desire to promote centrifugal tendencies of destruction. It was a revolutionary change built in the spirit of *yin-yang,* where continuity and change are both support[4]ed.

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RESOLUTION OF CONFLICTS IN CROSS-FUNCTIONAL TEAMS

Application of Hackman's model of intractable conflicts to the process of Integrated Business Planning

Peter JUREČKA

Abstract: If not managed properly, issues based on misaligned incentives and expectations from representatives of various business functions within the process of business planning may evolve into intractable conflicts. This article deals with analysis of such dissents. On the application of Hackman's model of effective teams, potential remedial measures for conflict mitigation or avoidance are demonstrated. The example illustrated on the case of Integrated Business Planning can be also viewed as application of general management theory related to cross-functional teams to the business process environment.

Keywords: Integrated business planning, sales and operations planning, S&OP, conflict resolution, cross-functional teams.

1 INTRODUCTION

Ongoing globalization and growth of competitiveness on most markets has been pushing companies to increase the effectiveness and efficiencies of their operations. Planning, as one of the key business management processes, has also undergone significant development reacting to these changes. In operational planning, it has been the concept of Sales and Operations Planning (S&OP) that has gradually transferred from industry best practice in 70-80' into industry standard practice towards the end of the past century. With inclusion of strategic initiatives, portfolio reviews and more robust financial integration, S&OP has further developed into what is nowadays recognized often under the term Integrated Business Planning (IBP).

For most production companies, IBP can be defined as a regular cross-functional business management process that structurally links together strategic aspects of Marketing, supply feasibility of Operations and Supply Chain, customer view of Sales and value perspectives of Finance. Under the ownership of top management of the firm, the gaps amongst various functional plans are being identified, discussed and reconciled usually within regular monthly planning cycles. Furthermore, mid-term sales demand scenarios accompanying the base case forecast are discussed amongst the key business functions interacting in this process. As various process stakeholders may have different perceptions about the future business outlook and can even be motivated by partially antagonistic incentives, conflicts often appear.

On the following chapters it is demonstrated, how to identify, categorize and consequently mitigate various types of conflicts that may emerge as a result of cross-functional character of IBP.

Via the application of Hackman's model of effective teams it is showed, how the change related to IBP implementation can be successfully managed. Once that IBP process stakeholders view themselves as a team rather than group of individuals representing and fighting for interests of their own business functions, likelihood of emergence of intractable conflict is significantly reduced.

2 INTRAGROUP CONFLICTS IN GENERAL

Conflict may generally be defined as perceived incompatibilities between the parties involved or as their perceptions that they hold discrepant views or have interpersonal incompatibilities (Boulding, 1963). The classical differentiation between conflicts distinguishes two basic types – task and relations conflicts (Guetzkow and Gyr, 1954). Task conflicts are based on the substance of the task that the group is performing whereas relationship conflicts are based on the group's interpersonal relations. This split is being followed with minor adjustments also by several other authors (e.g. Pelled, 1996; de Dreu and Beersma, 2005). Task or cognitive conflicts emerge when there are different opinions concerning the best way to attain specific goals.

By contrast, a relationship or affective conflicts are not focused on the task. Instead, they ensue on the basis of emotional tensions amongst the group members and the experience of negative feelings (Gebert, Boerner and Kearney, 2006). Relationship conflict exists when there are interpersonal incompatibilities among group members, which typically includes tension, animosity, and annoyance among members within a group (Jehn, 1995).

To complement the conflicts typology, the both task and relationship conflicts can be further distinguished from value conflicts. While task conflicts pertain to dissent regarding the most appropriate way to pursue a goal, value conflicts ensue when the team members have different values and attitudes with respect to what the outcome of the group's efforts should be (Jehn, Northcraft and Neale, 1999).

3 CONFLICTS WITHIN IBP PROCESS

In order to better understand the source of potential conflicts within IBP process, Figure 1

outlines the key IBP stakeholders and their most common objectives and incentives. Each group representing individual business function tends to develop its own understanding of the IBP process content and its deliverables and act according to its individual functional experience, objectives and perceptions. These are especially relevant for newly established IBP processes when the company is in the transition phase from rather independent into integrated planning, or when the implementation of IBP has neglected the corresponding alignment of incentives. The picture may become more complex within matrix organizations or in the large organizations with multiple hierarchical levels of planning consolidation (e.g. country, regional, global).

Business Function	Finance/ Controlling	Marketing	Operations/ Supply Chain	Sales
Type of Independent Planning	Financial Planning and Reporting	Strategic Planning	Production and Distribution Planning	Sales Planning
Focus	• Transparency • Compliance • Costs	• Market mng. • Porfolio mng. • Product mng.	• Agility, flexibility and reliability of supply	• Customer • Product availability
Typical Performance Measure	• Forecast accuracy • Financial indic.	• Time to market • Brand value	• Inventory turns • Delivery reliab. • Asset utilization	• Customer retention and profitability

Fig. 1 Example of IBP functional stakeholders
Source: author.

One of the typical areas for conflicts is the inventory management and the range of safety stock flexibility. In case of misaligned incentives, Sales tends to claim that they need sufficient product flexibility to be able to react quickly on volatile demand patterns. On contrary, extra flexibility may lead to excess inventories representing problems for both Supply Chain and Finance. If there exists at least a common understanding on the objective of the IBP process and ultimately of the entire firm, e.g. maximization of profits, such dissent would be an example of task conflict. Where Sales would see the way of achieving company's target via boosting of the revenues, Supply Chain and Finance may see in rather via better cost control.

Another type of conflict may arise especially when further investments related to product development are conditioned to growth in demand for respective product. In such case, Marketing may tend to push the anticipated sales forecast artificially up towards the best case scenario. On contrary, Financial forecast may reflect rather conservative tendencies especially if it stands for financial commitments of management. This example represents one of the possible value conflicts, where there is no clear alignment in what the deliverables of IBP process should be, e.g. the realistic sales forecast accompanied with contingency scenarios.

Figure 2 outlines the sources of potential relationship conflicts amongst various functional subgroups within IBP process. Personal conflicts may further lead to elimination of mutual trust and ultimately to the emergence of intractable conflicts.

It can be distinguished between two basic types of initial triggers representing the root causes for intractability within IBP – subject matter conflicts and social categorization processes. Company culture framing the overall behavioral and communicational environment for employee relations may further serve either as moderator or accelerator of these conflicts.

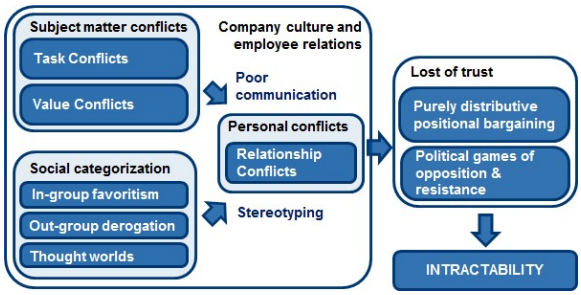

Fig. 2 Intractable conflict model
Source: author.

3.1 Subject matter conflicts

The occurrence and resolution of subject matter conflicts may be explained on the concept of effectiveness and efficiency of IBP process. Value related conflicts are more related to the question of effectiveness as they deal with general purpose of IBP and its outcomes. On contrary, task related conflicts within IBP process are more related to the topic of efficiency. As will be discussed further, once there is a common understanding on the overall goal and objective of the IPB process, i.e. the value conflict is not an issue; the resolution of task conflicts may actually support cross-functional cooperation.

However, one dilemmatic aspect of cross-functional characteristics of IBP is that task conflicts often give rise to relationship conflicts (Gebert, Boerner and Kearney, 2006). Task conflicts may evolve into relationship conflicts even when the process stakeholders are strongly identified with the task. Open task-related dissent means that there is no social validation of one's own position. Participants on the cross-functional IBP process may view this as a questioning of their competencies. If they link this threat that they perceive in a communication to the source of this communication, emotional tensions and relationship conflicts are likely to ensue among the team members (Simons and Peterson, 2000).

Typical example appears in strongly sales driven organizations or in companies where new products represents strong portion of overall portfolio. Here the commercial functions like Sales or Marketing have usually the leading voice in the decision-making within IBP process. Their strong presence

leading in extreme cases into relationship conflict may hamper the constructive feedback from other supporting business functions.

3.2 Social categorization

Another effect of cross-functionality is that it enhances social categorization processes which negatively impacts relationship conflicts (Caldwell and O'Reilly, 2003; Hogg, Abrams, Otten, and Hinkle, 2004) and these in turn hampers cooperation within IBP process stakeholders. Cross-functionality in the IBP process further implies diversity and this implies dissimilarity amongst the participants. Group members tend to prefer the interaction with those persons whom they perceive as similar to themselves. They ascribe an in-group status to these similar others) on the basis of specific characteristics, e.g. attire and appearance, verbal style or usage of technical terms (Brewer, 1996).

Thus participants from the same functional areas are likely to form informal subgroups. As an example of such in-groups can be commercially and external customer or market oriented Marketing and Sales vs. operationally and internally oriented Finance/Controlling and Operations/Supply Chain.

When the categorization of others as in-group or out-group members becomes more salient, the resulting relationship conflicts among members of different subgroups are likely to arise. Consequently, the synergistic cooperation among the members of different functional sub-groups within a larger group of IBP process participants will decline (Caldwell and O'Reilly, 2003).

Apart from the in- and out-group categorizations, various business functions differ also with respect to their interpretive schemata known also under the term departmental thought worlds (Dougherty, 1992). These though worlds represent the aspects that individual business functions view as relevant and decisive in a long-term perspective which enable their cognitive orientation concerning the assigned tasks within IBP process. If different consolidated thought worlds collide, value conflicts and, possibly also relationship conflicts as well are likely to ensue, and it becomes less probable that the views of others will be regarded as justified and acceptable. As typical example from IBP process may be the though world of high-level strategic thinking representatives from Marketing versus rather detail focused one of Finance/Controlling.

Once the value or tasks conflicts or social categorizations grow into relationship conflicts, decline of mutual trust is often reflected in the presence of purely distributive bargaining in negotiations and occurrence of various political games with hidden agendas. Participants of IBP process will consider the potential conflicts as win-lose situations with limited ability to move forward into finding a compromising solutions e.g. in form of generation of multiple scenarios. Without further external interventions the intractability is then almost inevitable.

The following chapter illustrates how may the relatively simple idea of forming an IBP team help to resolve the described conflicts.

4 CONFLICT RESOLUTION – AN EFFECTIVE TEAM APPROACH

Hackman's model of effective teams may be applied as a tool for analysis and mitigation of dissents leading to potential intractability within cross-functional IBP process outlined above.

Redefining the IBP process as regular exercise of specialized team rather than of a group of mutually independent individuals is proposed to successfully deal with the issues rooted in the cross-functionality described in previous chapter.

The following key performance conditions need to be in place in order to allow the effective functioning of a team: Compelling Direction; Real team; Enabling Structure; Supporting Context and Expert Coaching (Hackman, 2005). Mutual relations between these indicators which are analyzed further in more detail are depicted on the Figure 3.

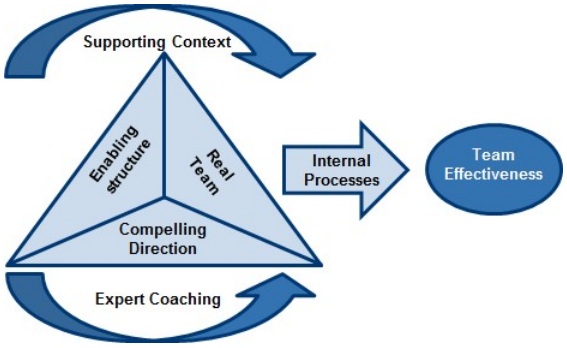

Fig. 3 Hackman's model of effective teams
Source: adopted from Hackman (2005).

4.1 Compelling direction

In order to fulfill the assumption of compelling direction, the specifications of the team's objectives and purpose should be clear, challenging and consequential, i.e. engaging all the talents of team members (Hackman, 2005).

The intention of aligning the views and plans of representatives from various business functions represents a challenging task for most of the organizations as such, so the first pre-condition is fulfilled almost automatically once the IBP implementation is launched in the organization.

Especially when the project or initiative of IBP implementation has high visibility in the company

and is sponsored by senior executives and when the consecutive implemented IBP process has the ownership of top management, the nomination for participation in it is highly valued and motivating for the process stakeholders.

4.2 Real team

A real team is characterized by clear boundaries, a degree of stability and interdependence of team members for some common purpose (Hackman, 2005). Establishment of a notion of one real IBP team instead of heterogeneous group of participants representing the interests of different business functions helps to create a common social identity of this group in addition to the business functions they belong to.

If there exists a common social identity, in this case the notion of IBP team, it is more likely that the team members will subjectively define the situation as cooperative and not as competitive (Alper, Tjosvold and Law, 2000), so that the otherwise substantial positive relationship between task and relationship conflicts becomes less pronounced (Simons and Peterson, 2000). Hence, it will be less likely that task-related dissent will lead to interpersonal tensions – or be misinterpreted as a personal attack.

There are in principle two possibilities of fostering a common social identity (Gebert, Boerner and Kearney, 2006). The first is to establish a win-win situation, which is defined as a situation in which the gains of one person are commensurate with the other team members' gains. Set-up of common incentives based on IBP process performance for all its participants may well serve the purpose.

Secondly a common social identity can be promoted through interactional measures. This could be achieved through a leadership style that provides background information (McGrath, MacMillan and Venkatraman, 1995) and emphasizes a common vision and common objectives. If the team leader communicates and continually reiterates the team objectives in an inspiring way, these objectives can serve as the common ground for all team activities and become the basis of a shared social identity.

In larger organizations, establishing a managerial position specifically for running S&OP/IBP process, with experienced person leading it is becoming common practice nowadays.

4.3 Enabling structure

Hackman identifies three structural features as key for fostering the competent teamwork: task design with motivating potential, right team composition and definition of core norms of conduct (Hackman, 2005). The last point related heavily to company culture will limit the possibility that task conflicts would turn into relationship conflicts.

Although an open task-related dissent is not a necessary condition for synergistic communication to occur, it can serve as its trigger (de Dreu and Beersma, 2005) and thus lead to and thus increase the efficiency within company's decision making.

4.4 Supportive context

There should be sufficient level of organizational support to enable effective teamwork, including at least the following three aspects: firstly, the incentive system should also offer rewards for excellent team performance, not only for individual performance; secondly, the organization should offer training and education where necessary for team members to being able to acquire additional skills required and thirdly, the data and information required should be made available to the team (Hackman, 2005).

The first point emphasizes the necessity of performance and incentive system review to accompany the implementation and launch of IBP concept in the organization. As mentioned earlier, emergence of conflicts, especially the value conflicts is often based in the potentially antagonistic motivation of various process stakeholders. Definition of the common group targets for IBP process participants independently on their underlying business function will motivate them for seeking for win-win solutions.

Following the second point, the establishment of job-rotation training program may help to develop more generalist perspective for the IBP process participants, which may serve as effective moderator of diverging though worlds (Geber, Boerner and Kearney, 2006). Generalists trained in this or in a similar way will have learned to distinguish and integrate different thought worlds (Gruenfeld and Fan, 1999), which enables them to view a problem concerning cross-functional planning more flexibly and holistically by taking into account several different thought world perspectives.

4.5 Expert coaching

Coaching can serve as a helpful tool to enable a "stepping back" for receiving an outsider's opinion on how a team is operating. This may help with so called "chicken and egg conundrum" (Edmondson and Smith, 2006) which can be seen in new assembled teams, where there is no foundation of trust to build on.

Furthermore, professional coaching may help to build common social and personal identity of the IBP participant which serves as important moderator for separating task and relationship conflicts (Gebert, Boerner and Kearney, 2006). Expert

coaching may also steers the communication and conflict resolution and may thus become a catalyst for mitigation of trust issues once they appear.

As illustrated on the previous examples, adoption of Hackman's model of effective teams may successfully address all the issues leading to intractability within cross-functional IBP process. Emphasis of creating a unique team is thus important lever for managing the challenge mindset change while implementing and executing the IBP concept in any organization.

5 CONCLUSIONS

Implementation and execution of Integrated Business Planning brings about several issues resulting from its cross-functional nature. Task and value conflicts combined with other accompanying effects of cross-functionality like social categorizations may further evolve into relationship conflicts. These are negatively impacting trust amongst the IBP process stakeholders that may in extreme case lead to intractable dissents.

Building the notion of coherent IBP team, instead of group of independent functional stakeholders defending particular interests within planning process, is proposed as solution for management of such situations.

Adoption of individual aspects of Hackman's model of effective teams turns out to be especially suitable for this purpose and can serve as guidance for managing change related to IBP implementation.

This approach is not limited to IBP only, but is applicable also for other cross-functional processes in the companies like new product development or definition of strategy execution roadmaps.

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DANGER - A SUBJECTIVE EVALUATION OF OBJECTIVE REALITY

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Abstract: The article is devoted to the ground of term «danger». Existent today numerous determinations of this term substantially differentiate on sense and are not general. In the article, taking logical and philosophical approaches, a new determination of this term is formulated. That was basic pre-condition, that danger, as well as safety, are notions subjective, which can change because of practical activity of man, development of science and society. These notions ascend to notions well and it is badly, which can be perceive even at an instinctive level. The decision of question of formulation of base terms is of not only interest from point of theoretical science, but it has an important practical aspect. In history there are the enough examples of good actions, including directed on the rise of safety, which turned around, farther more, by the calamities, catastrophes and etc.
The new definition of "danger" is as follows: danger - a subjective concept that refers to the possibility of circumstances in which the matter field, information, energy, or a combination thereof may affect the way a complex system, it would lead to consequences that are perceived and valued stakeholders (at the level of thinking, feeling or instincts) at a certain stage of development of the perceiver as negative until after the implementation of the risk or occurrence of adverse effects.

Keywords: Danger. Determinations. Circumstances.

1 INTRODUCTION

To this day, scientific and educational environment, which deals with security, have a free interpretation of the fundamental terms "risk", "security", and as a consequence many derived from them. Lack of a common science-based terminology is not only and not so much to prevent the extensive development of the science of security in general, and human security and human (science of security) in particular, but also promotes the wrong approach to the solution of a number of theoretical and practical issues of security.

The need to streamline and rationale used in security terms acute with the development of many fields of research in the field of security: international, political, environmental, human, social and technical systems, information, business and the like. The terms "risk", "risk", "security", and especially "life safety" are increasingly used by politicians, environmentalists, economists.

The analysis shows that today's society, science and practice use the dozens of interpretations of any term in the security industry. Often, these definitions are wrong on the approaches used, are private, and not general in nature and related to specific areas of science and technology and society, making the impossibility of unification and the creation of a unified system of terminology in the security industry. As a result, in the legislative, regulatory documents, dictionaries, scientific and educational literature used dozens of interpretations of the same term.

Question the validity of the terms and wording of the risk, security, and their derivatives are not just important - it's a matter of understanding the problem, the issue of protection from the risk strategy and to achieve security.

A detailed analysis of the most widely used definitions of the term "risk" has given the opportunity to identify existing deficiencies and, based on using logical and philosophical approaches have a new definition of the term. The basic premise was that the hazard as security, are a subjective concept that may change as a result of practice, the development of science and society.

The issue of formulating the basic terms is not only interesting from the point of view of theoretical science, but it has an important practical aspect. Throughout history has many examples of good actions, including those aimed at improving the safety who turned around later, disasters and catastrophes.

2 THE FORMULATION OF THE TERM "DANGER"

The basic notion of all the terms and definitions in the security industry is the concept of "danger". After all, talk about human security, any object or system without terms of danger is impossible. The danger is a fundamental term of all science of security and safety.

A number of authors, determining the term "danger", justified it as a certain characteristic of one or other external factors. In particular S.V. Belov and others [1, 2] defines danger as a negative property of living or non-living matter, which could cause loss of matter itself: people, environment and material value. Following this definition, we must recognize that in every element of nature has some negative property. However, whether the drop of water, sand, flower have negative property? And here we are faced with a dilemma because on first sight any danger, for example, from the flower can not be, but then remember the many poisonous plants, and thus come to the conclusion that in some cases there may be a danger. But whether we are talking at the same time about the negative properties of matter of the same poisonous flower?

Of course not, because in certain circumstances it may even be beneficial, such as medicines or as an object of aesthetic pleasure, etc. Come take another example - flooding. What in this situation is the danger? Water? No, the water itself is not serious danger, the danger is many of water on the certain territory. Thus, in the water, we also find no negative properties.

Perhaps the author of the formulation of this thesis was referring to potential adverse properties of matter and objects, in this case, these potential negative properties must be objective and be an integral part of every object of the universe. But nothing like we have not seen. The danger is not the result of internal negative potential of the environment. Thus, talking about the negative properties, much less about the aggressiveness of a subject is pointless. Using the formulation of danger as the negative characteristics of the living or non-living matter, the person opposes himself against nature.

Sergey Belov believes that the danger is common to all systems that have the energy, chemical, biological, or other components that are not compatible with human life. At first glance, this definition seems quite convincing. However, it should be rephrased basis of the above, namely, that the danger may have all systems that have the energy, chemical and biological components. Actually except of the information all material objects up to an electron or even smaller particles have energies. So the dangerous is potentially any material object in the universe. Dangerous exept of matter can also be a field and information - the latter does not have the energy or chemical or biological components. This leads to the conclusion that, first, the danger is not a property of objects or systems, it can result from their actions, and other output - can be dangerous not only material objects, but also information and field.

Third point, which is to find out what the author meant by the words ".... incompatible with the life of man». If you use the argument that the danger can threaten only human, so it is a subjective concept. Then the question arises whether it is possible to speak of the danger to anything but human. Naturally this concept is used not only for the person, but also for technical systems, the environment, etc. Therefore, the use of the phrase "... incompatible with the life of man" in the formulation of danger would be too narrow. Besides it is necessary to justify what is a proper human life, and what is meant by incompatible with her influences.

Yaroshevska V. M. et al [3] in the formulation of the term "danger" except of the concept of incompatibility also introduced the concept of adverse human factor that is much more correct. In formulating these dangers authors started from the concept of influence. As a result, the concept of "danger" is defined as an event or adverse effects on human or even incompatible with life factors.

Šimák L., Horáček J., Novák L., Németh L., Míka V. formulate the definition of danger: "Danger: The Hidden property of the system or its components, which can cause unexpected negative developments that violate security, threaten the stability and functioning of the system, and possibly its environment" [4, 5]. This definition is in some features similar to the definition given Belov S.V, because the authors in determining the danger use the thesis of hidden properties of system or its components, but they do not talk about the negative characteristics, but the property itself, which is quite acceptable. Each system has a number of properties inherent to it is that it is characterized. Depending on the characteristics of the system properties, it interacts with the environment, as well as undergoing internal changes. These properties or property may be obvious and hidden until a certain time, because the thesis of the hidden properties used by the authors would have extended to all properties (explicit and implicit). From the definition should be excluded thesis unexpected manifestations, because quite a number of hazards anticipated, and some just expected. Excluded from this definition as the thesis of the breach of security, as illogical to formulate a basic definition, which is the danger of using the derivative, which is the term in relation to the security. Consequence of the danger registered authors satisfactorily. This definition would benefit greatly if the stability and functioning of the added development. We will return to this point later.

Pistun I.P. [6] in the formulation of the term "danger" is not just talking about a phenomenon or effect, but also the specific conditions under which they operate. The term " danger ", according to his definition, - the central concept of life safety, which combines phenomena, processes, objects that can in certain circumstances cause damage to human health. The disadvantage of this definition is the "fuzziness" of the concept, since the author has included in the definition of processes, phenomena and objects. This indicates a few liberties with the language. According to the Dictionary of Russian S.I. Ozhegov and N. Shvedova object is "... that which exists outside us and independently of our consciousness, the phenomenon of the external world». The second definition of the object: "The phenomenon, the subject of which is aimed at someone's work, someone's attention". [7] The phenomenon, according to the same dictionary - "manifestation or expression of essence, what she found. In general, any detectable manifestation of something. " The process as defined in the same dictionary, " the course, the development of some

phenomenon, a succession of states in the development of something».

Thus, based on the definition of danger, which is formulated by Pistun I.P. is not clear what is, after all, the danger - the subject or process, that agree is principle point. This definition has the same drawback as the definition of S.V. Belov, since the author formulates the danger through the possibility of "cause damage to human health," thus eliminating not only the technical, biological, and other systems, but also significantly curtailing impact on the livelihoods person, limited only by his health.

As for the term "certain conditions" which used Pistun I.P., its use without additional interpretation does not allow to understand will develop or not these terms and what they actually mean. That is why the formulation of the term "danger" to introduce the concept of the possibility and / or the reliability of the onset of these conditions. After all danger - an action that has not happened yet, but it may happen in the near or distant future, or not implemented at all. The danger is only a possibility (probability) influence on a person or a particular system. About in this context formulate a definition of danger in modern dictionaries, some editions of scientific literature.

In Big Dictionary of modern Ukrainian language, the term "danger" is treated as an opportunity to some trouble, misfortune, a disaster, harm, and the like. Figuratively - a condition where someone or something is being threatened. [8] In practice, the same wording find in the explanatory dictionary of the Russian language S.I. Ozhegov and N. Shvedova [9] - a possibility threat of something very bad, some misfortune. The adjective "dangerous" - one that is able to cause, any harm, misfortune.

Lipcan A.V. [10] in the textbook science of security ("Bezpekoznavsto" in Ukrainian, approx.'s) Gives the following definition of danger - this is possible or actual phenomena, events and processes that can harm a person, social group, people, society, the state, the planet or even destroy them, to harm their well-being, to destroy the material, spiritual or natural values, degrade, close the road to development. This definition first cumbersome. Lipcan A.V. when formulating did the same thing as Pistun A.R. while introducing the concept of phenomena, events and processes. Event in accordance with the wording contained in the dictionary of the Russian language S.I. Ozhegova and N.Y. Shvedova - "... what happened, or other significant event, the fact that public and private life.

"Thus, the definition of the concept of nature is present, the process and complete the process (the event), which further blurs the concept of danger. Use in determining the possibility and reality can not tell what is the danger - is performed or completed action or possible occurrence of such. By the formulation of the concept of risk includes not only the person as an individual and his life, but also a social group, people, society, the state, the planet. He says he is not just about the negative effects and degradation, destruction, destruction of property, termination of development, thus significantly expanding the investigation to the danger of the threat level. However, the question is whether the author takes into account all the manifestations of danger, would it not be an exception error of biological, technical, and other systems. Restricting what or systems narrows the concept of danger.

The dictionary reference to life safety Karmazinov F.V, Rusak O.N, Grebennikov S.F, Osevkova V.N [11] hazard is defined as a situation (in the nature or the technosphere), which may cause events or processes that are able to infect humans, cause material damage, destroy the environment of man. This definition differs from the previous ones, because it determines thedanger is not a phenomenon, object or process, but as the situation. Actually, the situation has to be understood as "the totality of the circumstances, the situation of the situation," according to the dictionary, S.I. Ozhegova and N.Y. Shvedova, or as "the situation, the situation is created in the result of a combination of circumstances," according to the dictionary Ephraim T.F. [12] or the "totality of the circumstances," according to the dictionary S.I. Ozhegov. The concept of danger is thus transferred from the material objects, and the field of information on a system that includes the aforementioned components. Actually, such a system should also include and the victim. As a result, the term refers to the circumstances of danger is, that is, the relationship and interaction, not just the objects themselves, the field of energy or information.

Zhelibo E.P., Zaveruha N.M., V.V. Zatsarny [13] in determining the danger of adding more to the situation and conditions. In their work they give several determination of dangers. One definition of these authors borrow from S.V. Belov several expanding it: "Danger - negative property of living and non-living matter capable of causing damage to the fabric of: people, environment, and material values». The second is stated as follows: "Danger - this is a condition or situation that exists in the environment and can lead to undesirable release of energy, which can cause physical harm, injury and / or damage».

Considering this definition, we determine first whether you want to be entered in a specific situation, except for another condition.

Condition, according to the dictionary, S.I. Ozhegova and N.Y. Shvedova means: "The circumstances by which exist in which there is something». Comparing this with the definition of

the situation, we conclude that the meaning are very close. Because in the definition would be sufficient to one, in principle, any of these terms. Recalling in danger suggested by these authors, significantly narrows the concept of danger, limiting its release of energy. Do not forget that danger may also be information functionality that is not directly related to the release of energy. They also narrowed the results of the danger - limiting the definition in the first matter, in particular people, the natural environment, objects, and the second physical harm, injury and damage. What Zhelibo E.P. and others used in their work are two definitions indicates significant problems with the formulation of the term danger.

The precise formulation of risk requires one parameter, namely the definition - the ability to influence what exactly is the danger. For the formulation of this concept the authors, as already mentioned, different approaches, present some variants of the ones mentioned above definitions:

- damages of matter itself: people, environment and material value. (Sergey Belov and others)
- negative manifestations. Breach of security threat to the stability and functioning of the system, and possibly its environment. (Šimák L., Horáček J., Novák L., Németh L., Míka V.)
- damages to human health. (Pistun I.P)
- defeat people, causing property damage, the destruction of the human environment. (Karmazinov F.V, Rusak O.N, Grebennikov S.F, Osevkov V.N)
- trouble, misfortune, some catastrophe, damage, etc.
- cause harm to a person, social group, people, society, the state, the planet, or even destroy them, damage their well-being, the destruction of material, spiritual or natural materials, the occurrence of degradation,sing the road to development. (Lipcan A.V.)
- unwanted release of energy, which may result in physical harm, injury and / or damage. (Zhelibo E.P., Zaveruha N.M., Zatsarny V.V)

None of these statements can not be used successfully in scientific theory and practice, because such definitions require additional parameters, for example, specify what kind of "some catastrophe," or what is meant by a loss of matter itself, because the matter does not disappear, it just converted from one form to another, as becomes a mountain in the sand on the wind. In order to generalize the influence of dangerous consequences appropriate to use the term "negative impact which partly entered in its definition Šimák L., Horáček J., Novák L., Németh L., Míka V. The concepts of negative and negatory most common, and combine all of the above formulation of the negative impact, damage, disaster, etc. In Russian, the two words are used interchangeably. [14] Choosing from two similar terms "negative" and "negatory" in the dictionary, we use the definitions of S.I. Ozhegova and N.Y. Shvedova “Negative - the same as the nugatory”. From the German or French negativ (négatif), comes from the Latin. Negative - contains a denial, rejecting anything. Have poor characteristics, qualities. In mathematics: is the value taken from the "minus" (-), less than zero. Tracing the Latin scientific term negativus, compare Latin negativus 'denies, rejects'".

Widespread use of the term negative in other languages gives it a particular priority in the use. However, for a more convincing, consider the use of these terms in other languages, in particular, in Ukrainian. Here synonymous negative (negative, in Ukrainian. Approx.'s) Also have a negative word (*vid'emny*, in Ukrainian. Approx.'s) Are more explanatory dictionary of the Ukrainian language [15] gives a definition of the concept of "negative": "Bad to the properties, characteristics, destination, etc., which is not approved and should be condemned, which does not cause the approval or positive attitude to someone-or something, poor». The term "adverse" in the same dictionary is formulated as one that is not conducive to someone, something, inconvenient for someone, something. The term "negative" is defined as bad, negative, the negative of less than zero, the same thing as negative. "

Analysis of the use of the term negative in other languages has shown its wide distribution, so in English it sounds like - negative, in Slovak - negatívny, in Czech - negativní, French - négative, in Spanish - negativo, in Italian – negativo, in German - negativ, in Polish - negatywny.

Given the characteristics of word negative and negatory, used in determining the danger of harmful effects and the best word negative, with particular on the basis of the wide spread of the term in other languages.

The conduct of subsequent negative term phraseological research shows that it is often formulated using the word "bad». The dictionary of Ozhegov [16] gave the following interpretation of the word "negative" - "one that has poor properties, one that has in itself an objection, which discards anything». This leads to the need to define the word "bad", in fact it is a fundamental characteristic of speech is negative. According to the Big Dictionary of the Ukrainian language [15] the word "bad" means:

- one that has no good qualities, properties, not the same as it should, which causes a negative evaluation;
- their unpleasant qualities, properties (tasteless, smelly, etc., etc.);
- useless or harmful, adverse, gloomy (weather, day, etc., etc.);

- one that does not meet the necessary conditions, does not meet the specific needs, made perfect, clumsily;
- inept;
- one that does not meet the normal standards of changes from the normal (on the state, feeling, vital body functions, and so on);
- unhealthy, sick (of body organs, body);
- one that does not bode well, foreshadows trouble, danger or a nuisance;
- disconsolate, sad, unhappy;
- cruel;
- one that portends trouble, danger or a nuisance;
- one which is characterized by a negative moral qualities (of a man);
- one that is worthy of condemnation (of manners, behavior, actions, etc., etc.);
- one that shames, spot someone (a man);
- rude, obscene;
- what is reprehensible;
- one that causes condemnation, disapproving, negative;
- unattractive, ugly or disgusting in appearance;
- dirty, unclean;
- one that causes hatred, bloody;
- worthless, vile.

As we see from the definition of the word "bad", the wording and the wording as a consequence of the term "danger" is based on people's perceptions of right and wrong (good and bad). The concept of good and evil can not exist without certain conditions, and the most transparent, there is no man. Therefore, the concept of danger exists as a concept that shows some people's ideas about the bad (negative). It is based on a world view, views, developed over the centuries, research, and always meet certain conditions of human existence, the level of civilization, ideas, moral principles, and the like.

Consider the situation from a different angle. In nature there are various processes of destruction and creation, not affecting the person. These processes could be qualified person as good and bad or dangerous and safe. Arise and are destroyed mountains, planets, stars, life arises, there are new forms of it and go with the evolutionary arena old. What is in these processes, good or bad, safe or dangerous? For example, if the mountain by the wind, sun, temperature and other meteorological parameters turns to sand, is there any sense to talk about the danger to the mountain itself. Yes and no. If we assume that the mountain has feelings and trying to maintain their individuality and then maybe we could talk about the danger to the mountains, and if the mountain does not have feelings, and the process of transformation is an objective set pattern then is meaningless to talk about the danger.

Is it dangerous the death of a living organism or an entire species, the loss of an entire planet? This question can be answered only by knowing the purpose of the universe, and then the danger is relative to this. Thus, the danger appears as a subjective concept that can be applied only to the goals, interests, etc. It is logical to consider the danger as a subjective concept in relation to man. Concept of danger arises only when there is a feeling, but it is inherent in man. It can be assumed that the plant and animal world too there is some notion of risk, respectively, but at our level. After all, plants and the more animals react to certain effects that may be harmful or beneficial for them not only to our own, but from their point of view.

Natural question arises, what a feeling of man lies in the basis of the concept of danger. One of the key is self-preservation, it is often treated as a natural instinct. In this case, the danger is inherent in the concept of the common wildlife, including elementary, plants and animals. Sense of self - a desire to save himself or one or another system in the same state or in a state of a certain direction of development. Usually we talk about the danger only when it comes to a person or certain of its interests. Hurricane in desert or on Jupiter for us only a hurricane, it's only a natural phenomenon, but it is turning into a dangerous, if will take place in the territory in which the activities of people, where they were doing or which depend. Now it becomes clear why there are so many different formulations of the concept of danger and why most definitely say it was a man.

Needs to be clarified, one more thing. Is it correct to speak of the dangers of this or other technical systems, environmental hazards, etc.? Usually justified. The concept of danger is used when it comes to any object (mechanism, construction, etc.), with which somehow interacts people and with respect to which a person has certain desires.

Such an approach to the concept of risk accurately determine which case, the risk is and where it is absent, and in the future to assess the level of security. For example, if we destroy the old house to build in its place a new best. This is not dangerous, it's a welcome and controlled process, but the same destruction of, say, an explosion, even if the house was people already treated as a danger.

As a result, it can be concluded that the term "risk" is expedient to use only in cases when the impact (negative) is directed to an object or a subject to which a person has some kind of relationship, or is interested in it, and in those cases, when

considering the impact in terms of the other systems: animal, plant and other biological objects, or even inanimate objects. As a consequence, we can talk about the danger of the destruction of the same mountain, if we consider the process "in terms of" the mountain itself.

Thus, we conclude that the danger - the concept of the subjective and do not exist without regard concepts (principles or properties) of danger. The concept of risk is always associated with certain feelings, goals, ideas, people, animals, plants, or other complex systems which are capable of it, and thus will be different for each of the above categories. For example, water is as dangerous to humans as air for fish, Haloxylon will not grow in the tundra and moss will die in the desert.

Danger - the possibility of a certain negative impact. That is why, for the definition of the term " danger " to clarify a number of issues. What exactly can make this effect? What quantitative and qualitative features have a negative impact, how it differs from the positive (positive) and can be the effect of neutral?

What can affect the complex system (and of course the person)? Can affect everything that exists in Nature - any material object, field, information, energy, and their combination. The definition of risk, which was formulated by the author in previous works in this way: "The danger: it is the possibility of emergence of the circumstances under which the matter, field, information, or a combination of them may influence the complex system, it would lead to a deterioration or failure of the operation and development ", in particular in [5, 17], there was no one of the most important elements, namely energy. Energy - a scalar physical quantity that is a common measure of the various forms of motion and transition measure of the movement of matter from one form to another. [18] In this case, the energy can not exist by itself, it must always have a tangible medium. Actually because it is often the energy impact and interaction in the material world. It is possible that in nature there is something unknown, so far, the basic elements, but to date, we introduce into the concept of danger 4 elements: matter (in the sense of objects, objects), field, information and energy in all their possible combinations.

Actual impact, according to the dictionary of the Russian language [19] - "action exerted by someone, something to someone, something, the impact». Impact - it is only the effect, this term does not describe the quality (negative, neutral, positive) and to assess its possible effect on the results of a system, respectively, from the point of view of a person or other systems. Depending on the results of the effect may be different: negative or positive. If the result could not be fixed using existing techniques or tools, or the result will manifest itself directly or indirectly, to estimate its direct action or long-term effects is not possible then we can talk about a neutral impact.

Speaking about the impact, we usually are referring to external (exogenous effects) environment. But the system (in particular the person) carry a very strong influence of endogenous factors (the physical condition of the body, the mind, the psyche, and the like). Today, science has not given a clear answer, whether all the changes associated with the consciousness and psyche are directly or indirectly related to environmental factors. In other words, can occur in humans any changes, occur ideas, desires, and so on, the cause of which is not in the external world, that is, they are generated solely by the man himself? This issue is so complex, the reasons so many relationships that allow it in this work is not possible. Therefore, leaving the question open, we assume, for simplicity, that any change in one or the other system do have external causes, and appeared as a result of these or other external influences. Often some external influence is in the system processes of internal transformation that directly begin to change its state. During the study of such phenomena, it is easy to take the internal processes of the root cause (and that they characterize as the basic risk), which leads to erroneous conclusions, and, therefore, erroneous actions to protect. For example, kidney stones in a man are but a consequence, even though they are dangerous, but the primary dangers caused by their emergence could be food or water used by man, life and the like. The deeper causes are analyzed, the greater the accuracy of the identified core, primary danger. Namely protection from it can fundamentally solve this or that problem of security of the system.

The term "adverse effect" has previously been formulated by the author in "The terminology of the science of security" [17], as an action on a complex system (human), which leads to the deterioration of its development, operation, or its complete destruction. From the standpoint of modern science the negative impact of such a definition is not acceptable. For example, for the road is required to destroy the mountain, or to destroy the old house to build a new one, cut the tumor, destroying bacteria or viruses in the body during illness or destroy harmful insects, kill the enemy, etc. What should be the consequences to them to recognize negative? Obviously, they are those that we believe are negative because of our understanding, development, mentality and level of development of science and society, the possibility of predicting long-term outcomes. Further development of the science and society will give more opportunities to establish relationships between different phenomena, to predict not only the immediate consequences, but also very, very distant. Based on the foregoing, we formulate a new concept of "adverse effect" –

it is such an influence on a complex system, which leads to consequences perceived, evaluated and predicted as negative, at this stage of development of society and science. Using the formulation of the term "negative impact" state the following derivative term "negative consequences" - the result of a specific effect which is perceived, evaluated and expected to be negative, at this stage of development of society and science. It should be borne in mind that the negative effects and therefore the negative impact can be treated (perceived, evaluated, predicted) in different ways, depending on the set of external conditions and internal factors.

Using the term "danger" we do not mean the inevitable negative impact on the complex system (human), that is, the terms "hazard" and "adverse effect" are two different things. The negative impact it is a process when the danger passes to the actual manifestation - namely a negative effect. The danger, in turn, is understood not as an influence, but merely as a definite possibility of such influence. Moreover, the formulation of the term danger is not necessary to specify the value of danger - its magnitude or likelihood of exposure. The danger is the subjective perception of the possible negative processes in the direction of the objective reality.

For the final definition of "danger" let us give the definition of other key concepts in accordance with the explanatory dictionary [9], which are used to describe the danger:

- Threat - a possible danger.
- Ability - a means, conditions, circumstances are necessary to carry anything.
- The condition - a circumstance from which something depends. Situation in which there is something.
- Object - something that exists outside of us and independently of our consciousness, the phenomena of the external world. Phenomenon, a subject on which someone directed activity, someone's attention.
- The process - the process of a phenomenon, the consistent change in the state in the development of something.
- The Happening - manifestation or expression of the essence, what it is. In general, any detected manifestation of something.
- The situation - set of circumstances, position, situation.

More detailed look at some of these statements and the potential and feasibility of their use in the formulation of the term "danger".

The term "threat». The term in its meaning is very close to the term danger. Detailed definition of the term "threat" leads Korzeniowski L. [20], considering it as a potential cause of an unexpected state. The threat, in his view and that of Świniarski J. [21], Kaczmarek J., Skowroński A. [22] is not a separate category, it is always related to a specific subject, for which is destructive. The threat may be significant (negative) for life, existence, stability, improvement and development facility. It is through the concept of "threat" Korzeniowski L. formulates the concept of "security". In this context it is necessary to establish whether the concept of "danger" and "threat" is synonymous. The term "threat," according to the explanatory dictionary [9] is a possible danger. According to the dictionary of the Russian language [20]: "The threat is a promise to cause any harm, nuisance. The possibility of the danger of a disaster, misfortune, bad events. One who (or what) can cause harm, trouble. "" Threat "in other dictionaries considered as bullying, promise to cause anyone harm, evil.

A comparison of the term "threat" to the above formulation of the term " danger " indicates that the concept of danger is much wider and it points to the possibility of adverse effects in principle, therefore, to use the term " danger " is better in general terms.

For example, you can say, "for this man there is a danger," without specifying what kind of danger exists or what its consequences. The term "threat" is usually used with the definitions of the danger that threatens the proper, for example, sick, fall, etc. or indicate that it is a threat, for example, the threat of a storm, earthquake. Often the term "threat" is used to show that the probability of an adverse event is high enough or dramatically improved. Thus, the term "threat" appears as a definition of a derivative of the term danger.

Further logical premises put us in front of her with one very important issue, namely the need to define what is actually dangerous. Based on the above danger is the possibility of a certain impact. To this effect could carry out the necessary conditions. Almost equal number of terms that denote the complex existing in time and space relationships, "conditions", "situation", "circumstances" will choose the term "circumstances».

With a view of the final wording of the term "danger" consider Fig. 1, in which all the components necessary for the formulation of the concept. These is: a complex system, an object that with the flow of energy, matter, fields or information affects the system, the probability of occurrence of certain circumstances in which this impact can not only occur, but will be negative.

Based on this, we formulate a common definition of danger: "Danger - a subjective concept that refers to the possibility of the circumstances under which the matter, field, information, energy, or both of them may influence the complex system, it would lead to consequences that are measured or perceived as negative at this stage of development of science and society.

Would it be a universal definition? From a philosophical point of view, no, because it is formulated with respect to human. If we assume the existence of certain concepts among animals, plants and other highly complex systems, which are living organisms. In this case, a danger assessment will sound a little differently: "Danger - a subjective concept that refers to the possibility of the circumstances under which the matter, field, information, energy, or both of them may influence the complex system, it would lead to consequences that are, or valued stakeholders (at the level of thinking, feeling or instinct) at a certain stage of development of the perceiver as negative. "

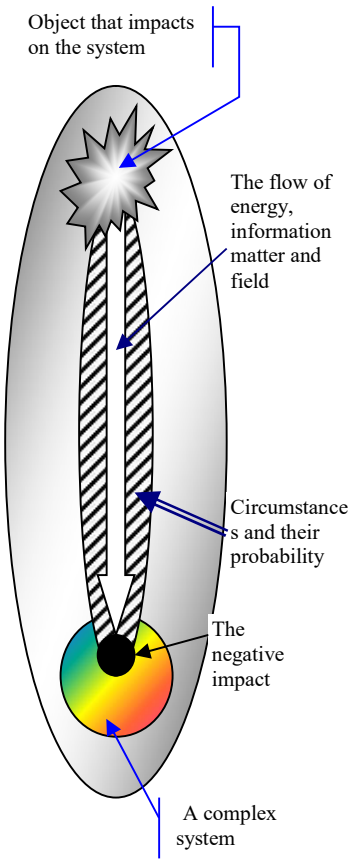

Fig. 1 Schematic definition of danger

This definition of risk can be successfully applied in all areas. With this definition we can explain why in China at the time killed sparrows as pests fields, why were widely used hazardous substances in agriculture, such as DDT, which are now banned. This all happened just because at some stage in the development of science and society has long-term negative effects could not be assessed or received.

With this definition it is easy to explain, for example, why the children do not understand and do not feel the danger. Children are at an early stage and have them compared with older, long-term forecasting is much weaker due to lack of experience and knowledge, which means that they can not evaluate the possible long-term effects of various processes. However, the real danger to the child can exist even if he does not feel and do not perceive it. In that case, a risk assessment has a major drawback, and should sound different, because the criterion of danger appears negative consequence, which can occur much later and will not be understood or assessed at the time of its implementation, and in the near or distant future. Then the definition of danger will be as follows:

"Danger - a subjective concept that refers to the possibility of the circumstances under which the matter, field, information, energy, or both of them may influence the complex system, it would lead to consequences that are, or valued stakeholders (at the level of thinking, feeling or instinct) at a certain stage of development of the perceiver as negative".

This eliminates the need to anticipate danger, and it can already serve as an objective reason for the negative consequences that can assess both before and after its occurrence.

A feature of this definition is that, first, it defines danger as the subjective evaluation of objective reality. Second, formulated not only for the person, but with respect to any complex system, which is endowed with certain feelings and in our understanding of a living system. Apply this definition can also concerning any complex system, which can only contain a living, such as ecological community and the like, and in theory, even a relatively lifeless feeling of replacing it (understanding) of their ideas.

Third, the wording says that dangerous can be all that exists in nature, because the world is a combination of matter, fields, energy and information.

Fourth, danger is defined as a possibility. There is a danger is not seen as a real action or influence, but as a potential course of action.

Fifth danger is the possible negative impact not only on the person, society, government and the like, and in any complex system.

Sixthly, the negative effects as the main criterion in the decision on the assessment of possible actions (impact) and the definition of its dangerous, are considered not only from the standpoint of the present, a theory, regulations, institutions and individuals but with the position of any entity that is currently estimated hazard or can appreciate it in the future.

Seventh, especially the concept of danger is that its evaluation is not in compliance with certain of its properties, and in accordance with the possible future impact. Therefore, the evaluation of hazards to be more accurate, the better you can predict future impacts. In addition, the criterion of danger serves

the negative consequences that can occur much later than the time of hazard and will not be understood or will be assessed at the time of its implementation, but only in the near or distant future. Thus, the possibility of a specific effect can be described as a threat not only to or at the time of its implementation, but after the negative effects.

The above definition of danger can be successfully applied in all fields of science and practice. By this definition can be explained by the small and big mistakes made in the development of every person and of civilization in general. Just at a certain stage of development, there was not enough knowledge to anticipate the effects of early and changed development priorities.

Using this definition of danger is easily explained, for example, why children often do not understand and do not feel the danger that adults understand. Children are at an early stage of development, and they have as compared to adults, long-term forecasting is much weaker due to lack of experience and knowledge, which means that they can not evaluate the possible long-term effects of these or other processes. However, the real danger to the child can exist even if he does not feel and do not perceive it.

3 CONCLUSION

The new definition is somewhat complicated, but in general satisfactorily defines the term. The definition takes into account almost all details related to this term. Danger, based on this language does not appear as something permanent, but as a subjective concept that can change depending on external and internal conditions of the "expert». So-called experts can not act any complex system but only that which is endowed with certain abilities or instincts that, somehow, to assess the possible consequences of an action. Today, such complex systems should include all biological objects, but does not exclude the possibility of existence is not biological (in today's sense) life.

The new definition of the term "danger" in the future will be the basis of formulating a number of derivatives, such as "security", "risk" and many others.

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PROCESS AND METHODOLOGY OF APPRAISAL OF OFFICERS OF THE POLICE OF THE CZECH REPUBLIC

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Abstract: This paper provides information about setting of appraisal processes for officers of the Police of the Czech Republic. For each organization it is fairly important to have feedback to the applied appraisal methodology and in that way the organisation becomes aware of the way the appraisal system is perceived by individual officers. This goal is reached in practice by conducting specific research projects.

Keywords: Police offices, appraisal methodology, work performance, feedback, research.

1 INTRODUCTION – ORGANIZATION DESCRIPTION

The Police of the Czech Republic was established as an armed law-enforcement service of the Czech Republic by Act No. 283/1991 Coll., on the Police of the Czech Republic, as amended. Its position is currently codified in Act No. 273/2008 Coll., on the Police of the Czech Republic. The Police serves the public. Their mission is to protect security of persons and property and public order, to prevent criminal incidents, fulfil tasks according to the Criminal Procedure Act and further tasks in the area of public order and security that are under its area of competence according to legislation, directly applied regulations of the European Union or international agreements, which form an integral part of the legal system.

The Police of the Czech Republic (hereinafter referred to as the police) are subordinated to the Ministry of the Interior of the Czech Republic. The Police in its development went through series of reforms. The first and so far the latest large scale reform of all its service units was carried out in 1993 in connection with the split of the country and formation of the Czech Republic. In the course of the years to come the police had to reflect, in adequate manner, the impulses coming from both their own ranks as well as from the outside, and ensure that it is still perceived in the eyes of the general public as a credible, modern institution. In connection with the above mentioned the police had to be innovative in dealing with daily tasks, which was among the priorities of the top police management (officers of the Police Presidium of the Czech Police Force headed by the Police President and regional chief officers). Currently the police employ 40,000 police officers and civil employees. Police officers work under a service contract which is regulated by Act No. 361/2003 Coll., on service contract regulation for members of law-enforcement agencies, as amended. Work contract of civil employees is regulated by Act No. 262/2006 Coll., Labour Code, as amended.

1.1 Tasks and expected results of appraisal process for the organisation – general outline

Performance of service tasks is a tool to fulfil basic requirements, but at the same time it is also offering education, career progress perspective and self-fulfilment. Job performance of every employee in an organization is stimulated not only by motivation, but also by other factors, for instance, work conditions, duties at the relevant position, atmosphere at the workplace, organizational culture, interpersonal relations, personality and work style of the superior, access to information. The essential task for every organization should be in stimulating synergy between the needs and interests of employees and goals of the organization and, furthermore, to enhance motivation in order to pursue the organizational goals. From that perspective it is crucial to acknowledge the value of human resources and their management, which determine to what extend the organisation will be successful and also the level of satisfaction of employees. The concept of work performance management (M. Armstrong, 2002)[1] emphasises the link between performance, appraisal, remuneration and education, as well as personal development of an individual employee in an organization. In practice and under the current conditions the implications are that management of employees must take into account new features, for instance, level of education and personality development. This all necessitates a need for democratic processes of dealing with people and a certain form of employee cooperation, a form of agreement between the employee and the organization (represented by the superior). From this perspective a new role of a manager is focused not on supervision but on leadership (creating conditions which lead to effective performance of employees) – in other words to assist, facilitate and give example. In this framework the application of job performance concept is an uninterrupted and flexible process. Managers and their directly subordinate employee function as partners under conditions which stipulate how both sides should perform their duties in order to reach the anticipated outcome. This process tends

to focused more on planning and gradual enhancement of job performance, than on appraisal of current job performance. Its orientation is more to the future than to the past and creates basis for regular and frequent dialogue among managers and employees on the job performance constraints and possibilities for further development.

It is focused on:

- Job performance improvement.
- Employee development.
- Satisfaction of needs and fulfilment of expectations of all organizational parts involved.
- Communication and involvement of people in discussions and management.

The whole concept of job performance management is perceived as an ongoing and evolutionary process during which the job performance increases and supports organisation employees in their independent management of their own job performance (self-management and self-monitoring). An important condition for employees to manage individually their job performance is the setting of standards (formulating standard job performance requirements for tasks and performance criteria at the occupied post). These standards are set by the superior officer (manager) and employees should have a chance to express their opinion on these standards and, consequently, the employees should identify with the standards and respect them. Final assessment and appraisal of job performance, which is a phase of formal assessment, considers and assesses job performance for the whole period highlighting the achievements, progress and formulating setbacks. It is the starting point which leads to adjustments in job performance based contracts and plans of personal development. It might also lead to classification of job performance, being it necessary for any reason. Job performance appraisal of an employee entails the integration of identification, assessment, improvement efforts and setting of goals and objectives regarding the individual job performance. It is considered, managers including, to be an efficient tool of appraisal and leadership of employees in an organization. In fact, it does not consider only what is usually understood under the term of performance (i.e. work achievements), but performance is, for the purpose of appraisal, perceived in wider context, and that being the unity of work achievements, behaviour at work and even abilities and personal characteristics that are having influence on completion of work duties, and furthermore, taking into consideration conditions and environment in which the work is performed (employee competence for work at the given position and group, team).

In prosperous companies and modern organizations the whole process of appraisal is an important tool for clarification of objectives, work standards and also for motivation of future individual job performance. We can say without exaggeration that well-set employee job appraisal process is an indispensable condition for well functioning organization and provides output information about what and how the employee does (appraisal of performance and achievements of their work) and who the employee is (assessment of abilities, skills, achievements in their post). The output analysis of employee appraisal should be used for further purposes:

- Decisions about salaries (remuneration – link between the job appraisal and remuneration should be direct and significant)
- Setting of future career progress (job appraisal is used by evaluator in the process of leadership, in activation of employees and in managing their future career progress)
- Motivation of employees to reach higher job performance
- Improvement of mutual relations and understanding among superiors and subordinates. This atmosphere is affected by – mutual trust between management and employees, communication style of management and employees, openness in communication, interest in tackling conflicts, high level of participation and loyalty of employees (satisfied employee gives an outstanding job performance).
- Boosting the efficiency, and productive potential of employees respectively (appraisal provides the employee with information about job results, possibilities for further career progress and identified suitable areas of their expertise, or on the contrary, informs about their weak points, what could be done better and what to be improved).
- Specifying needs for further training and career development (information for HR manager and management).

1.2 Appraisal process of police officers

In the context of officer appraisal there is used a term job performance and this concept plays a key role.

As a starting point for a detailed definition of job performance of officers we must take the fact that each officer holds a certain position ranking, which is specified in description of the given post and those officers who have subordinates are entrusted with a set of competences associated with their position. Job performance is described as a set all activities, behaviour and conduct during the fulfilment of service duties, which leads to effective use of all necessary means with the intent leading to a successful completion of required tasks as they are regulated by Act on the Police for each officer.

Officers should be informed about these objectives regardless their rank or managerial position within the police. The underlying concept of job appraisal is that this document is a basis for decision in service contract related matters. Job appraisal does not have direct, legal implications, being for instance a transfer to different position or dismissal, unless it regards an officer serving on a fixed term service contract. The crucial role the job appraisal plays is in tenders for a higher service position and further will be used by superiors in HR management regarding future career progress. However, be it that the offers is repeatedly having unsatisfactorily results in job performance, they might, taking into account the breach of service contract, be dismissed form service as a result of disciplinary penalty and face being stripped of their service rank.

Profound changes in job appraisal of officers came together with introduction of job appraisal concept, which was first tested in the form of pilot project on selected services of the police since the year 2000 and after detailed analysis there came a decision to implement this system across the board for the whole police force (as of 2002), enacted in the form of the Police President Order and the set methodology became a legally binding norm, which should be observed in job appraisal matters by all managers who assess work performance of their junior officers on regular basis. Service performance appraisal contains for the most part assessment of expert knowledge, in the context of which there are evaluated eighteen selected areas. Further, there are assessed the following: quality of service duty performance and level of theoretical knowledge, including ability of applying it to the performance of their duties. Service performance appraisal is based on an on-going annual appraisal, which is carried out by officer's direct superior during calendar year and is approved by evaluator. Methodology of job appraisal and of an on-going appraisal is the same (Jedinák, P., 2010)[2].

1.3 Methodology of officer's appraisal

Process of officer's job performance appraisal is issued in the legally binding form of Mandatory Instructions of the Chief of Police No. 79 from 26th June 2009, on the implementation of job performance and on-going appraisal of officers of the Police of the Czech Republic.

The content of appraisal methodology contains five methods, where the fifth method is taken as a general assessment of the first five methods.

Appraisal methods:

1. Assessing expert knowledge, quality of all duty-related tasks and level of theoretical knowledge, including ability of applying it to the performance of officer's duties.
2. Self-appraisal by the appraised, if the appraised participates and processes the self-appraisal.
3. Interview between evaluator or direct superior and appraised, which assists the clarification of appraisal outcomes, or if it is the case, to compare the self-appraisal with outcomes of the processed appraisal, an evaluator tutor could also take part in this interview.
4. Evaluating special events or circumstances; these records are filed just in cases of those appraised where there was indentified an incident of significantly sub-standard or significantly outstanding job performance; a record of a significant work-related incident serves to further processing and future appraisal of both substandard or outstanding incident
5. Appraisal conclusion; if the appraised officer is the one whose performance is classified as showing good results with reservations or classified as unsatisfactory, a plan is proposed outlining further steps of professional training; this plan sets tasks and deadlines for the appraised leading to finding solutions to the identified drawbacks in their service performance; the content of the plan is mainly based on the outcomes mentioned under point (1) and from the outcomes of the interview (point 3).

As far as the method mentioned under point No. 1 and 2 is concerned, the appraisal of individual areas is done on scale 1 to 5 (standard being appraised as mark 3). Out of the total number of 18 areas the manager should pinpoint key areas for the individual officer they appraise, with regards to service classification, set priorities and conditions for duty performance.

Appraised areas:

1. Further self-education.
2. Organisational skill.
3. Expert knowledge and skills.
4. Management.
5. Representation of the police force.
6. Stress endurance.
7. Professional training.
8. Responsibility for state assets used by the police.
9. Responsibility for performed service.
10. Openness and initiative.
11. Team spirit.
12. Communication.
13. Decisiveness.
14. Self-control.
15. Asserting authority.
16. Respect towards superior.
17. Fulfilment of tasks assigned by latest appraisal.
18. Administrative skills.

Job standard for individual areas are stipulated and if the need arises the evaluator updates the content of job standard bearing into mind:

- service post ranking,
- setting of priorities – fundamental priorities are formulated by the Police President for a fix, usually one year period, they are applicable for the whole police force, and consequently managing police officers elaborate on them and adjust them on individually basis while taking into account concrete conditions in administered job section and security situation in the given area,
- service conditions.

1.4 Benefits of the management system

There is an expectation that every new innovative project which is implemented into the organisation will provide benefit which should be put under an on-going evaluation and further improved. In the case of the whole system of appraisal, which is carried out in accordance with the given methodology and under the condition that the appraisal is taken by the top management and all managing officers with all respect, and at the same time if the appraisal is prepared and carried out with due responsibility, only after than it brings to all participating parties (appraised, appraiser and the whole organization) higher operational efficiency (Jedinák, P., 2009)[3].

Possible befits for the appraised:

- Gaining general feedback to individual abilities and performance.
- Platform for discussion, standpoint clarification, brainstorming, etc.
- Improvement of relations between the appraiser and the appraised.
- The appraiser is aware of their strong and weak points.
- Possibility to reconsider the workload, work environment and opportunity for further career and personal development.

Possible benefits for the appraiser:

- Basis for differentiation of remuneration.
- Feedback to existing management style, process management etc.
- Clarification of information in the area of processes, jobs.
- Intensify communication with subordinates.
- Precisely formulate subordinates' expectations and goals.
- Comprehensively appraised job performance standards during a long, appraised period.
- Identify career development routes for the junior (appraised) officer.

Possible benefits for the organization:

- Total increase in performance, starting with the individual organizational units and going up to the whole police force.
- Providing feedback to the management system.
- Complex audit of existing potential of the police as a state organization.
- Ensuring adequate deployment of officers.
- Effective tool of police management policy.
- Tool for open communication across the whole police force.
- Means of upgrading culture of communication.
- Means to upgrading the whole workplace environment.
- Tool to identification of future educational needs, for influencing the career route of police officers.
- Tool to attracting and stabilize well-performing police officers, to personnel planning respectively.
- Boosting the positive image of the police.

1.5 The role of management in the process of appraisal

An absolutely irreplaceable role in the whole process of management of job performance has the close superior, the superior officer who is at the same time processing the formal appraisal of the subordinate (on-going appraisal and performance appraisal). During the appraisal process the superior should observe all principals of moral and ethical nature. Important managerial skill is the ability of a managing officer to encourage strong performance characteristics of the appraised officer and consequently match them with such service tasks which are administered by junior officer in the concrete position (so called tailoring). Well set system of officer appraisal provides the managers with the relevant information about (Jedinák, P., 2012)[4]:

- the employee's performance of their duties,
- whether the employee meets the requirements of the post held,
- the behaviour of the appraised employee,
- about employee's relation to their colleagues (is the employee a team player),
- employee's representation of the police in public,
- the way the employee treats clients of police (injured parties in criminal proceedings, offenders, other disinterested persons, etc.).

Manager must know how to fairly assess job performance of their subordinates. In the context of their job appraisal managers should avoid discouraging people and be ready to stimulate their positive job performance attitudes. Good managers are the real asset of every organization, police not excluding. Managers, trying to effectively stimulate their own efficiency as well as efficiency of their subordinates, must understand what efficiency is, must have tools to promote it and have relevant

managerial tools for ensuring its constant improvement.

2 FINDINGS OF PERFORMED RESEARCH

The whole process of appraisal must be constantly evaluated and adjusted to new circumstances, which influence the police as an organization (the most frequently used forms are research projects under which the data is acquired from respondents through questionnaire survey). In this process an important role is reserved to feedback, in other words, how it is perceived by individual police officers. For this purpose we use various techniques and instruments which are put into practice mainly in the form of research projects.

Presented data were acquired in the framework of a research in which a sample group was composed of combined course students at the Police Academy of the Czech Republic in Prague. The questionnaire survey was carried out in the year 2011. Sample group was composed of 502 respondents, chosen based on availability (Šugár, J., Jedinák, P., 2010)[5].

Table 1 Characteristics of sample group

Sample group	***502 respondents***	***100 %***
Male	*375*	*74.70 %*
Female	*127*	*25.30 %*
Superior officers	*99*	*19.70 %*
Regular officers	*403*	*80.30 %*
Number of years served in the organisation		
Up to 4 years	*150*	*29.90 %*
5 to 8 years	*119*	*23.70 %*
9 to 13 years	*116*	*23.10 %*
14 and more years	*117*	*23.30 %*

2.1 Processed data from the performed research

In the following pie charts there are findings based on answers of respondents to given questions.

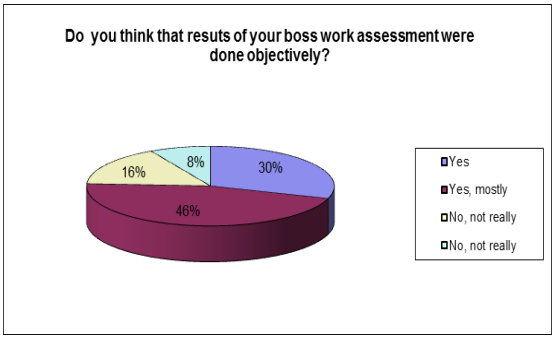

Fig. 1 Objectivity of appraisal

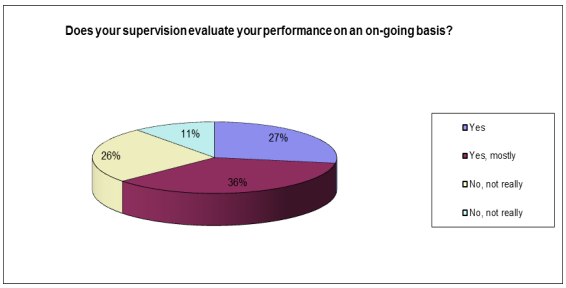

Fig. 2 On-going appraisal of job performance

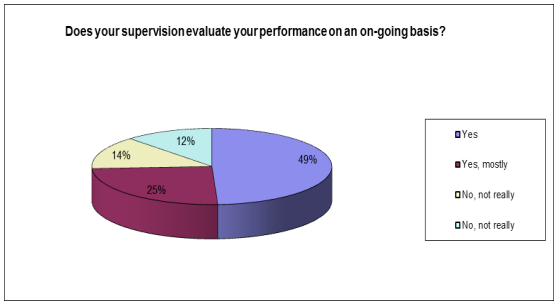

Fig. 3 Awareness of methodology of appraisal

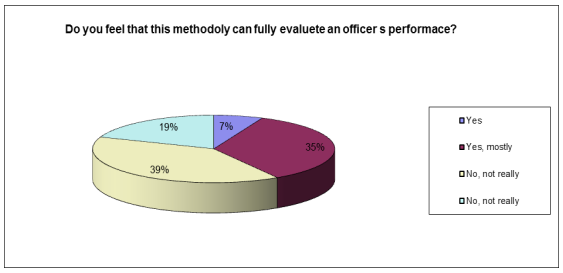

Fig. 4 Relevance of appraisal methods

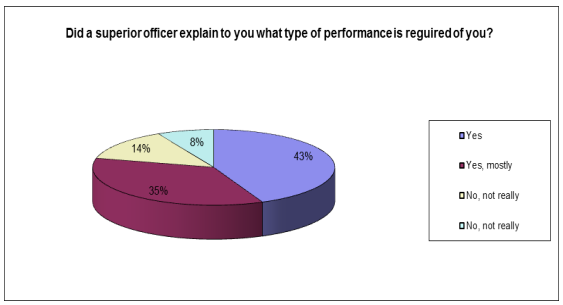

Fig. 5 Setting of required job performance (standard performance)

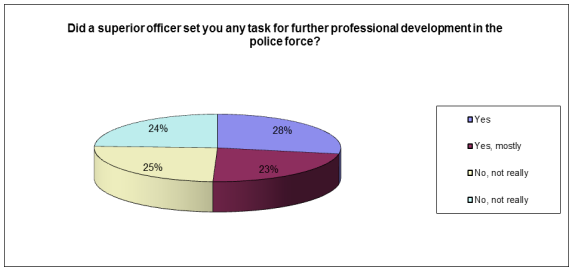

Fig. 6 Setting up upcoming tasks in the context of professional development

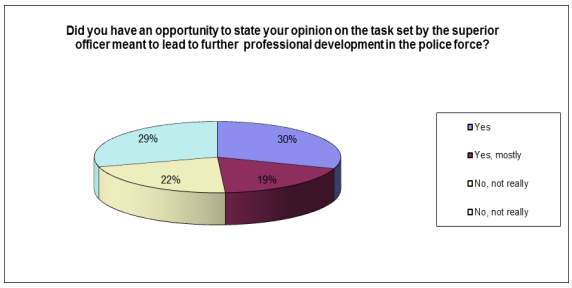

Fig. 7 Participation of the appraised on future tasks

2.2 Recommendation for practice based on research outcomes

Based on analysis of the acquired data from the performed research we can come up with some conclusions and consequently take such measures which would lead to upgrading quality of the officer appraisal process in the whole context of the police force (Jedinák, P., 2012)[6].

An example of one out of many outputs and recommendations for the police force.

Factual differences were identified in the case of selected questions, in particular in the case of officers with the shortest service experience, and therefore police officers with limited service experience require more attention from the site of managers in their appraisal monitoring, then officers with longer service experience.

Recommendation for practice – in the framework of basic service training for newly recruited officers (the whole process of basic service training lasts for one year) there should be more focus concentrated on actual methodology of officer appraisal and practical training in the police force.

3 CONCLUSION

Job appraisal is one of many crucial instruments to motivate police officers to meet the goals which the police have set and which have an obliged to guarantee. The police need to know who are the serving officers and for what organization these officers work. On the other hand, each officer needs to know how their service performance is perceived and if there is satisfaction with their job performance. The appraisal should also present job achievements and perspectives for the appraised officer, show how they work, inform about possible mistakes or shortcomings and give them a real career perspective for further service at the police force. The aim of the appraisal is to assess the level of professional knowledge and skills, job initiative, independence, qualitative and quantitative aspects of job performance, adaptability to changes and its management, level of possible psychological and physical stress exposure and ability to deal with it, management skills competence, steam spirit and team work skills, ability to deal in a assertive manner with people and other officers. The process of appraisal must be based on such methods of assessment that are fair to all police officers in order to avoid any suspicion of discriminatory treatment and to prevent decrease in motivation productivity and at the same time there must be sufficient assurances that it is not contravening any legislative regulation in force. The essential is also to have feedback concerning the fact how police officers perceive in the appraisal process. This all is put into practice in the form of conducting research which is consequently assessed and new modifications and changes leading to higher quality of appraisal process are introduced.

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COST ANALYSIS OF TRANSPORT

Michal ZELENÁK

Abstract: The Army of the Czech Republic in its structures retains the elements securing the activities necessary to ensure its operation. One of these activities is the transport of oversized objects by the units of the Logistics Division. This text identifies some of the costs and related expenses connected with the preservation of own mobility. The obtained data are compared with the price of identical activities provided by external carriers.

Keywords: Analysis, cost, compared, military, repair, transport, value.

1 INTRODUCTION

The Logistics Division has a crucial role in the process of securing the smooth operation of all units of the Army of the Czech Republic (ACR). [1] Without members of the Logistics units, it is not possible to secure the continuous fulfilment of tasks during combat preparation. The members of Logistics units supply the armed forces not only during combat operations, but also in times of peace. In recent years, the requirements on the quality of used weapons and technology are significantly increasing, technical equipment of ACR is being renewed and modernized. In combination with the ongoing modernization and increasing requirements on technology, the demands on the logistical specialists increase too, as they must be able to handle, repair and transport the new equipment. [2] With the gradual introduction of new technologies and after the professionalization of ACR, there is, among others, a gradual restructuring of individual elements of the Logistics Division. The structure of Logistics Division is fully adapted to the objectives and tasks specified for ACR in the Military Strategy of the Czech Republic. [3] For this reason, the units of Logistics Division are not identical for all troops of the Czech Army. For identification and subsequent cost analysis, this work used data of the Tank Battalion.

In the training year, the main task of the Recovery Team of the Logistics Division was the logistical support of preparation of troops and transportation of tanks. The Recovery Team secured the training of tank and mechanized units:

- military exercise Desert Training;
- military exercise Flying Rhino;
- military exercise with Bundeswehr;
- military exercise of military reserve;
- military exercise Shark 02;
- military exercise Shark 03.

Members of the Recovery Team also secured the transport of military technology for demonstrations and events organized for the public:

- BAHNA;
- NATO days;
- Cihelna;
- Hlučín – Darkovičky;
- Mosty.

In the reviewed period, 6,891 km of transports of oversized cargo were made.

2 ANALYSES OF THE ACTIVITY AND COSTS OF THE RECOVERY TEAM

The Recovery Team is an integral part of the Repair Units of the Logistics Division. Its main activity is the technical securing of the combat, and the transport and recovery of any damaged equipment. Its task is to extricate the stuck or damaged technology and move it to a location where it can be repaired or further transported for repair by the superior level of the Logistics. The structure of the Recovery Team, including technologies, is shown in Figure 1. ´

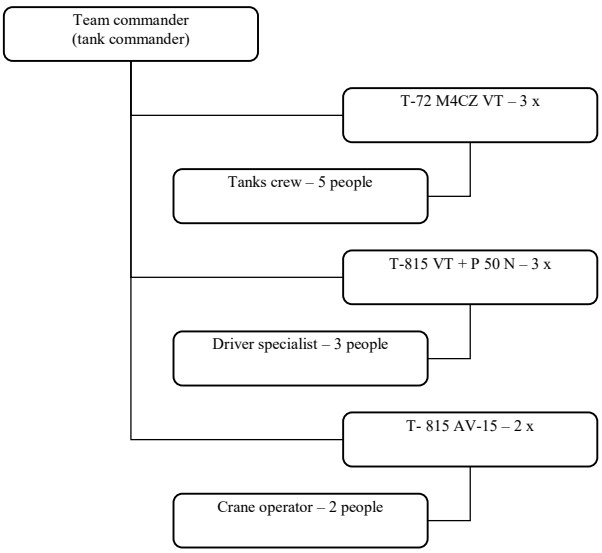

Fig. 1 The structure of the Recovery Team

In times of peace, the tasks of the Recovery Team are connected with the transport of oversized cargo

and securing of training of tank and mechanized units. The Recovery Team consists of eleven persons and ten pieces of recovery equipment. The key means of securing the transport are towing vehicles T-815 VT and technology transporters P 50 N.

2.1 Analysis of the costs of wages of soldiers

When analyzing the cost of salaries of soldiers, it is necessary to consider not only the salary requirements of the Recovery Team, but it is necessary to calculate also the salaries of the mechanics who secure the repair and maintenance of the technology of the division. The financial cost of the salaries of members of the Recovery Team are for better clarity and easier usability averaged for all individuals in the same function. The summary of costs calculated for the calendar year is shown in Table 1.

Table 1 Cost of wages of soldiers

Position	Number	Gross salary	Net salary
Team commander	1	316,200	247,200
Commander of tank	2	597,600	444,000
Driver of tank	3	584,400	424,800
Older drivers	5	1,684,800	1,173,600
Summary		**3,183,000 CZK**	**2,289,600 CZK**

In the tables above, the most determining is the gross salary of older driver for the calendar year. For further calculations will be used only salaries of three older drivers of T 815 VT, which equals to 1,010,880 CZK.

2.2 Analysis of the costs of wages of mechanics

The analysis of the cost of work of mechanics in the Repair Unit of the Logistics Division who are used for repairs of equipment of the Recovery Team was based on data from the Logistics Information System (LIS). LIS sets the hourly rate of the mechanics needed for all such calculations to be 520 CZK per 1 man-hour (MH).

Figure 2 shows the possibilities of LIS and displays the data on the number and types of repairs executed during the analyzed period.

Overview of repairs carried out in the analyzed period is shown in Table 2 with data about the output in terms of worked man-hours.

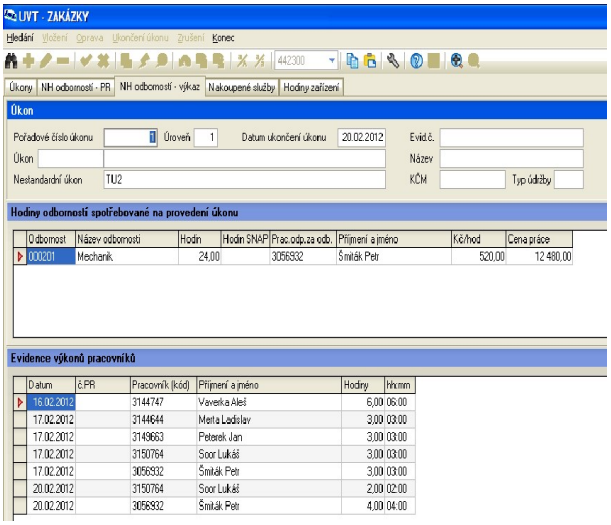

Fig. 2 Possibility of LIS

From Table 2 it is clear that eleven routine repairs (RR) of technology allocated to the Recovery Team were made, while technical maintenance (TM) of the technology was executed five times. In total, 225 MH were spent on the technology of the Recovery Team. All repairs and maintenance were performed on the wheeled technology.

Table 2 Overviews of repair

Cars	Repair	Man-hours
T 815 VT	RR 1	12
T 815 VT	RR 2	12
T 815 VT	RR 2	12
T 815 VT	TM	46
T 815 VT	TM	46
P 50 N	RR 2	24
P 50 N	TM	28
P 50 N	TM	10
P 50 N	TM	10
P 50 N	TM	6
T 815 AV 15	RR 1/2	12
T 815 AV 15	TM	3
T 815 AV 15	TM	2
Summary		**223**

The calculated cost of repairs of T 815 VT and P 50 N was calculated from the tables above and equals to 206 MH. During the monitored period, the cost of these repairs was 107,120 CZK.

The resulting amount includes only work of the mechanics, new spare parts and used material are not included.

2.3 Analysis of non-military repairs of use vehicles

In the analyzed period, four pieces of the monitored equipment were repaired in the civil sector. The amounts paid for the repairs of individual pieces of equipment are shown in Table 3. The resulting cost of repairs of the analyzed equipment in the civil sector is 840,819 CZK.

Table 3 Repaired in the civil sector

Cars	Value of repairs in civilian sector
T 815 VT	3,849 CZK
P 50 N	188,030 CZK
P 50 N	151,733 CZK
P 50 N	497,207 CZK
Summary	**840,819 CZK**

Technical inspection and measurement of emissions of vehicles T 815 VT by the operator of the Vehicle Testing Station equalled to 9,150 CZK.

2.4 Analysis of cost of consumed fuel

The acquisition prices of fuel purchased for the needs of the Czech Army in the monitored period were set in the following amounts:

- price of diesel (NM-54) – 29.38215 CZK per litre,
- price of petrol (BA 95N) – 28.20221 CZK per litre.

Only the price of fuel was considered in the calculations. Price of lubricants is not taken into account. Due to the fact that vehicles T 815 VT were operated both with attached trailer and without, fuel prices calculated per 1 km of operation are not absolutely accurate. The found values are summarized in Table 4. Special columns in Table 4 represent booster cars heating (BCH).

Table 4 Cost of fuel

Cars	Quantity of fuel	BCH	Price of fuel
T 815 AD20.2	1804		53,005 CZK
T 815 AV 15M	1424	10	41,840 CZK
T 815 VT	3584		105,305 CZK
P 50 N			
T 815 VT	5134		150,847 CZK
P 50 N			
T 815 VT	871		25,591 CZK
P 50 N			
VT-72M4CZ	216	30	6,346 CZK
VT-72M4CZ	172	10	5,053 CZK
VT-72M4CZ	237	15	6,963 CZK
Summary (except tanks)			281,745 CZK

The cost of fuel for T 815 VT equalled to 281,745 CZK in the analyzed period.

2.5 Additional costs

The operation and maintenance of equipment allocated to the Recovery Team of the Logistics Division requires securing of further accompanying activities that bring in other connected financial costs. In particular, these expenses include:

- garaging of the equipment,
- security guard services in the technology park,
- the cost of operation of an accompanying vehicle when transporting oversized cargo,
- training of drivers,
- leasing of the training space,
- costs connected with travel arrangements of soldiers sent on a work trip.

The above costs are difficult to quantify, since the activities are spread over all equipment allocated to the army division.

3 COMPARISON OF THE COST OF OPERATION OF OWN MEANS OF TRANSPORT WITH THE COST OF OPERATION OF EQUIPMENT LEASED FROM THE CIVIL SECTOR

The Army of the Czech Republic does not have sufficient means for transport of heavy equipment, such as tank T 72M4 CZ. In case of need to secure transport of more pieces of equipment (for example in the tactics training), the units have to deal with lack of the necessary means of transport.

3.1 Costs of use of a civil carrier

Due to the lack of own equipment, it is necessary to buy transport services from external road carriers. The lease contracts are administered by the Administration of Military Transport (AMT) which is responsible for the planning, coordination, management and securing of military transports and movements of ACR in the territory of the Czech Republic and abroad, for the planning and management of military transports and for the movement of foreign troops in the territory of he Czech Republic by all means of transport. AMT is also responsible for the purchase of transport services from non-military suppliers and concludes contracts with fixed prices for a given calendar year with these carriers.

Prices of non-military transport are:

- rate for shuttle transport - 55 CZK / km,
- rate for a single transport – 82.50 CZK / km,
- rate for waiting - 25 CZK / 15 min,
- rate of an accompanying vehicle – 11 CZK / km.

The rates based on long-term contract between actually non- military transport firm and Military Transport Centre.

For transport of oversized cargo, the Tank Battalion uses the services of an external company, T 72M4 CZ and BVP.

3.2 Analysis of overall costs if own forces and means are used

The partial results of the aforementioned analysis are taken to determine the cost of operation of the analyzed technology. Only the most important expenses connected with the operation of the analyzed vehicles were included. The purchase price of the vehicle was not reflected in the calculation due to the large distortion of the resulting costs of operating the technology.

Table 4 Total cost analysis

Costs	Total price
Wages of soldier	1,010,880 CZK
Military repairs	107,120 CZK
Repairs in civilian sector	840,819 CZK
Fuel (NM-54)	281,745 CZK
Vehicle testing station	9,150 CZK
Summary of costs	**2,249,714 CZK**

Based on the identified data, the cost of operating the technology securing the transport of oversized cargo (vehicles T 815 VZ and P 50 N) equalled to the amount of 2,249,714 CZK. Combined costs of transport and the cost per 1 km are shown in Table 5.

Table 5 Summary of cost of transport

Cost of transport	2,249,714
Number of kilometres	6,891
Total cost per 1 km	**326,50 CZK**

On the basis of collected data, the cost per 1 km in case of transport by own means was 326.50 CZK.

4 CONCLUSION

The analysis of all available data showed that the costs per 1 km of operation of military equipment securing the transport of oversized cargo (T 815 VT and P 50 N) during the analyzed year amounted to 328.85 CZK.

In case of using a civil carrier, the cost per 1 km is 55.00 CZK when driving vehicles without load and 82.50 CZK when driving a vehicle loaded with technology. Table 6 shows the combined costs of transport of oversized cargo and their mutual comparison.

Table 6 Comparison of transport

	Cost per 1 km	Number of kilometres	Cost per year
The cost of transport our own equipment	326,50 CZK	6 891	2,249,714.00 CZK
Cost civilian transporter	82,50 CZK	6 891	568,507.50 CZK
Saving from using civilian transporter			**1,681,206.50 CZK**

It is clear from the table that the use of services of only a civil carrier would reduce transport costs by more than 1.6 million CZK. The identified costs per 1 km by own means would be much higher if the calculation included also the purchase price of vehicles and the accompanying costs of operation and maintenance of military equipment. Acquisition prices of technology were not used in the calculations due to the vaguely specified lifetime of the analyzed technology.

Despite the fact that the use of some equipment allocated to the Logistics Division seems rather wasteful, it is necessary to preserve it in the structures of individual battalions to a limited extent. We can say with certainty that ACR will always need it. Yet, it would be advisable to reduce the number of reserved equipment.

A detailed processing of all the operating costs of the technology used in the Army of the Czech Republic can clarify if the operation of used technology included in the ACR calculation tables is economical. In this way the Logistics Information System provides a number of relevant data; its applications enable to track not only the cost of fuel, cost of military and non-military repairs, but also draws the attention to the necessity of the technical maintenance of individual vehicles. The Logistics Information System is a very useful tool which is becoming an indispensable part of the whole logistical process

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PSYCHO-SOCIAL ASPECTS OF STADIUM HOOLIGANISM

Janusz ZIELINSKI, Wojciech BAJOREK

Abstracts: Objectives: The main aim of the research was to present the difference in personal preferences in the groups of football fans "K" and hooligans "H".
Method: The author of SUI using the theory of interpersonal functioning, created a test allowing the diagnosis of functioning and malfunctioning of personality. According to the answers provided by 70 respondents, 12 scales showing a profile of a person were created. They are as follows: managing – authoritarian, over protective – patronizing, cooperative-friendly, dependable, withdrawing – masochistic, rebelling- suspicious, aggressive – sadistic, competitive- narcissi, self – accepting, lie, reliable, hopeless. This tool allowed the measurement of groups' attitude. 120 respondents (aged 19-28) where 60 were hooligans, the so called pseudo-fans (basic group) calling themselves the fans of Rzeszów football teams and 60 students of Rzeszów University - declaring to be football fans.
Result: Using the SUI procedure allows to capture the similarities of interpersonal functioning of two groups: football fans and hooligans. It turns out that in the majority of life situations the representatives of these groups react differently, which confirms the similarity of created profiles (rps = 0.16). We already know that hooligans seek actions that would allow them, even on a minimal, to satisfy their need of strong experience. Analysis of particular SUI segments showed that the respondents in the group (K) in contrast to the respondents (H) are characterized by the so-called pro-social syndrome. The average score in the scales 2, 3, 4 means that these respondents will be represented by behavior socially acceptable based on meeting the needs of the common environment. Hostility syndrome (scales 5, 6 and 7, often 8) is arranged differently than in the previous scales. In this case, hooligans are the leaders. Distrust, suspicion and overt aggression are traits that are characteristic for individuals with higher values in these.
Conclusion: The interpretation procedure used by the author of SUI allowed to assess the research group profile. Analyzing the behavior of hooligans, pseudo fans and football fans of respondents with neurasthenia, depression and hysteria, it turned out that there is a high probability concerning football lovers and people with mental disorders. In contrast, hooligans represent a strong anti-social attitude.

Keywords: Stadium hooliganism. Scale SUI. Pro-social syndrome.

1 INTRODUCTION

From the psychological and sociological point of view sport shows should be perceived positively by both competitors and viewers as they provide them with emotionally satisfying esthetical and social experience (Pięta, 2004). Since the beginning of the 60s in the 20th century, stadiums have been transforming into rigs where fighting between the participants has been taking place. Violence and aggression of football fans has become so omnipresent that the society started accepting them as a constant and indisputable element of sport competition. (Urban, 1998)

According to J. Pięta (Pięta, 2004) the specific character of different behavior of the sport audience can allow us to divide the football match viewers into two categories. One of them consists of regular viewers (football fans, consumers) who take part in a show and enjoy it without causing any problems. The other consists of football fans who identify themselves with their club and can function as ultras, supporters and pseudo-fans who highlight the victory in a provocative, noisy way. They are interested in winning outside the football pitch and not in the game. Pseudo-fans would compensate their team's losing the game with aggression in the stadium and outside it. There are also hooligans (the name comes from Holley – a 19th century leader of a London gang) who are not interested in watching the game but searching for and satisfying carve for extreme emotions. They can be characterized by aggressive behavior aimed at people from outside the group or stadium equipment, window displays, etc. The mixture of those two groups evolved into people who prefer vandalism acts to watching sports.

The reasons for behaviour which is socially unacceptable have been explained in numerous ways. K. Lorenz – social etiologist- proved that aggression in animals is evoked instinctively, in particular circumstances (Lorenz, 1967). Similarities in functioning of humans and animals on a limited area as well as when leading instincts arise have been found.

Being anonymous (Zimbardo, Ruch, 1994) in subculture caused by wearing a mask – similarity of clothing, a scarf, a hood – is an easy way for antagonistic – destructive behavior to appear.

Gender influences the behavior as well. Men, more often than women, while dealing with problems prefer physical force and they break a functioning social order (Fukuyama, 2004). Yet all the reasons for aggression come from family background (Kunowski, 1996). In disorganized, non-functioning or pathological families the personality of a young person is more susceptible to anti-social behavior.

With so many factors determining the personality of a football match viewer, his/her attitude to the outside world still remains a question. What is the level and interdependence of friendly, hostile or leading style towards the surrounding reality? J. Stanik (1980; 1994; 1997) concluded that every man

can be characterized by a specific style of social functioning according to group belonging. It is intriguing whether there is a differentiation of social attitudes between pseudo-fans and football fans? If there is, how are they different? Using SUI (Scale of Interpersonal Relations) a research tool created by J. Stanik an attempt to answer the question can be undertaken.

1 MATERIAL AND METHOD

The author of SUI (Scale of Interpersonal Relations) (J. Stanik1980; 1994; 1997) basing on the theory of the interpersonal functioning of a personality, created a test allowing the diagnosis of social functions and differences of personality disorders. According to the answers to 70 questions, 12 scales forming personality profile were formed in the following categories: over protective, cooperative – friendly, conformable – dependant, aggressive-sadistic, competitive – narcissi, self-acceptance, lying, resourcefulness, helplessness. The tool allowed the measurement of interpersonal attitudes of the surveyed group.

120 respondents (aged 19-28) whereas 60 were hooligans, the so called pseudo-fans (basic group) calling themselves the fans of Rzeszów football teams and 60 students of Rzeszów University - declaring to be football fans. Table 1 presents details of age.

Table 1 Age of respondents

Age	Hooligans		Football fans	
	N	%	N	%
18	0	0,0	0	0,0
19	3	5,0	0	0,0
20	5	8,3	15	25,0
21	7	11,7	23	38,3
22	11	18,3	12	20,0
23	12	20,0	8	13,3
24	6	10,0	2	3,4
25	0	0,0	0	0,0
26	10	16,7	0	0,0
27	4	6,6	0	0,0
28	2	3,4	0	0,0
Total	60	100,0	60	100,0

The group of hooligans is mostly represented by people who are 23 years old (20,0 %), while football fans are 21 years old (38,3 %) (Table 1). The smallest number of pseudo-fans – 2 aging 21 (3,4 %) and 24 years old football fans took part in the survey. Research groups were not represented by 25 year olders.

Table 2 Accommodation of respondents

Local environment	Hooligans		Football fnas	
	N	%	N	%
Village	0	0,0	14	23,3
Town	0	0,0	5	8,3
City	60	100,0	41	68,4
Total	60	100,0	60	100,0

The division into village, town (up to 12000) and a city showed a proportion of accommodation within the research group. Pseudo-fans – 100 %, 64 % football fans. (23,3 %) of respondents come from the rural area.

Table 3 Education

Education	Hooligans		Football fans	
	N	%	N	%
Primary	0	0,0	0	0,0
Voccational	13	21,7	0	0,0
Secondary	29	48,3	60	100,0
Higher	18	30,0	0	0,0
Total	60	100,0	60	100,0

The majority of pseudo-fans constitute people with secondary education – 48,3 %. Smaller group of respondents-21,7 % are pseudo-fans with vocational and higher – 30 % education. The contrast group consisted of respondents with secondary education.

The observation proved differences in the family structure of respondents, shown in Table 4. Some of the hooligans come from broken families (26,7 % broken family, 13,3 % missed one parent). A slight similarity of social structures of the two surveyed groups coming from full families is worth noticing – pseudo-fans (60 %) and football fans (86,7 %).

Table 4 Family structure

Family structure	Hooligans		Football fans	
	N	%	N	%
Full	36	60,0	52	86,7
Broken	16	26,7	3	5,0
One parent missing	8	13,3	5	8,3
Total	60	100,0	60	100,0

In the Rother group only 5 people declared to be brought up by one parent (8,3 %) and came from a broken family (5 %).

Table 5 Number of children in the family.

Number of children	Hooligans		Football fans	
	N	%	N	%
1-2	42	70,0	39	65,0
3 and more	18	30,0	21	35,0
Total	60	100,0	60	100,0

There is a similarity between the number of children in the family within the two groups of respondents (Table 5). 42 hooligans and 39 football fans come from families with no more than 2 children. The comparable percentage concerns respondents from families with more than 3 children. (30 % hooligans and 35 % of football fans).

Table 6 Economical status of the family

Economical status	Hooligans		Football fans	
	N	%	N	%
High	10	16,6	2	3,3
Middle	43	71,7	52	86,7
Low	7	11,7	6	10
Total	60	100,0	60	100,0

The data show a comparable economical status of the surveyed families. The majority (71,7 % hooligans and 86,7 % of football fans) declare their status as middle while 11,7 % form the basic group and 10 % from the contrast group as low. Only 3,3 % of football fans and 16,6 % of pseudo-fans declare their family status as high.

Table 7 Bringing up style in the surveyed families

Bringing up style	Hooligans		Football fans	
	N	%	N	%
Autocratic	13	21,7	11	18,3
Democratic	32	53,3	44	73,3
Liberal	15	25,0	5	8,4
Total	60	100,0	60	100,0

Bringing up style was one more aspect taken into consideration in the surveyed group. 73,3 % of football fans come from families where problems are solved together as a norm, 8,4 % had a "free" style of being brought up. In the main survey group 53,3 % of respondents had a democratic style of being brought up while 25 % declared liberal style of certain personality. The only similarity can be noticed in the autocratic style - 13 hooligans and 11 football fans.

Table 8 Parents as role models for the respondents

Parents as role models	Hooligans		Football fans	
	N	%	N	%
Yes	21	35,0	37	61,6
No	39	65,0	23	38,4
Total	60	100,0	60	100,0

The biggest percentage – 61 % of football fans regarded their parents as role models. Pseudo-fans (65 %) claim that their parents have never been important people while tackling complicated issues and this declaration seems to be worrying.

4 RESULTS

A thesis about differentiation of social functioning between pseudo-fans and football fans can be suggested. It can be said that hooligans, more often than football fans, will be characterized by antagonist-destructive behavior in social relations. Due to results from SUI test by J. M. Stanik (1980; 1994; 1997) the attitude towards the outside world of the two research groups could be compared. According to the author, all styles of human functioning consist of two dimensions : "dominance-submission" and "love – hostility".

From the results contained in Table 9 it can be concluded that there are significant differences between groups of hooligans (H) and supporters (K). Significant discrepancies in the statements of participants shows (K) and hooligans (H) may be arbitrarily assumed as initial verification of hypotheses.

Table 9 (K) Comparison of middle figures in scales in the groups of hooligans and fans

	Scale middle											
Group	1	2	3	4	5	6	7	8	9	10	11	12
H	7,8	4,3	5,5	6,8	4,4	5,7	9,3	9	3,8	2,4	5,0	5,1
K	5,3	6,5	6,8	8,3	3,2	1,2	2,1	4,2	4,2	3,0	6,8	1,8
p	0,004											

Table 10 The standard deviation in the particular scales in groups of football fans (K) and stadium hooligans (H)

	Scale standard deviation											
Group	1	2	3	4	5	6	7	8	9	10	11	12
K	2,9	2,8	2,1	2,2	2,9	1,7	2,3	2,5	3,8	1,8	1,7	2,0
H	2,7	3,0	2,5	2,4	2,4	2,5	2,6	2,1	3,2	2,7	2,5	2,9

For purposes of this work, for each group standard deviation was calculated for particular scales, which are summarized in Table 10

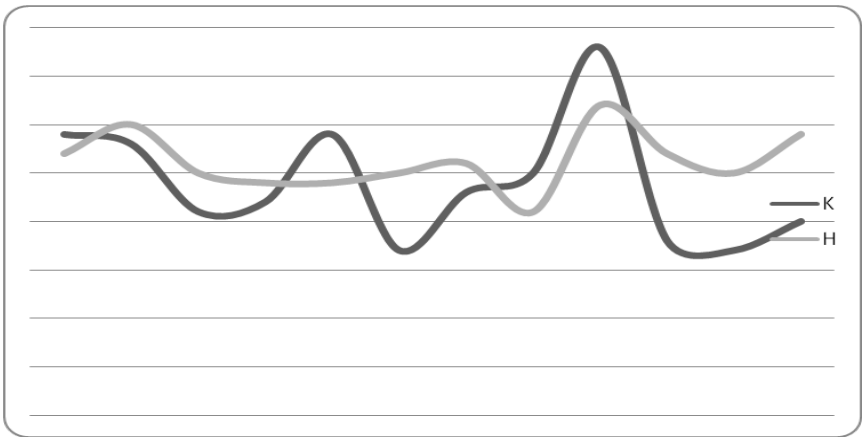

Fig. 1 SUI profiles for groups of football fans (K) and stadium hooligans (H)

In order to clarify the differences between the two groups I used the eight-scale conversion for each distribution of SUI, in which J. M. Stanik (1980, 1994, 1997) assumed that the distance between the two octyl covers 12.5 % of the population. Verbal assessment was assigned to each oktyl. (J. M. Stanik 1980, 1994, 1997).

Profiles for extreme sports enthusiasts, young offenders and students were prepared using measures of central tendency for each scale - the median, as shown in Table 11.

Table 11 Measure of central tendency for the individual scales in groups of football fans (K) and stadium hooligans (H)

	Scale (mediana)											
Group	1	2	3	4	5	6	7	8	9	10	11	12
K	6	6,5	6	8	3	0	1,5	4	2,2	2,5	7	2
H	8	4	5,5	6	4	6	10	9	4	2	4,5	4

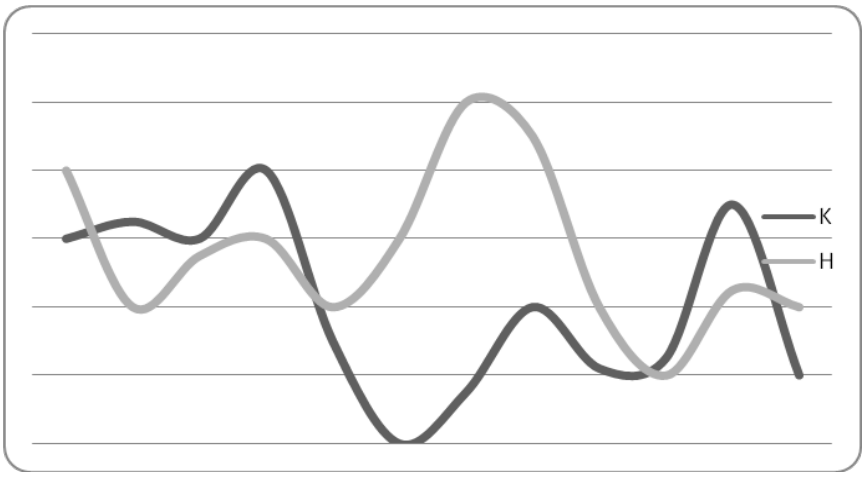

Figure 2 SUI profiles for groups of football fans (K) and stadium hooligans (H)

Using the conversion table the values of the individual SUI profiles with division into basic and comparative groups were obtained. Comparing football fans with hooligans, it is o bserved that in most scales different results can be found. The similarities are apparent only in the scales: 3 and 10, in combination of the two researched groups. This is reflected by the draft.

Table 12 Converted results in the individual scales in the group of football fans (K) and stadium hooligans (H)

	Scale analyzed results											
Group	1	2	3	4	5	6	7	8	9	10	11	12
K	6	4	2	5	4	1	2	5	2	4	4	4
H	7	2	2	3	5	7	8	8	4	4	2	5

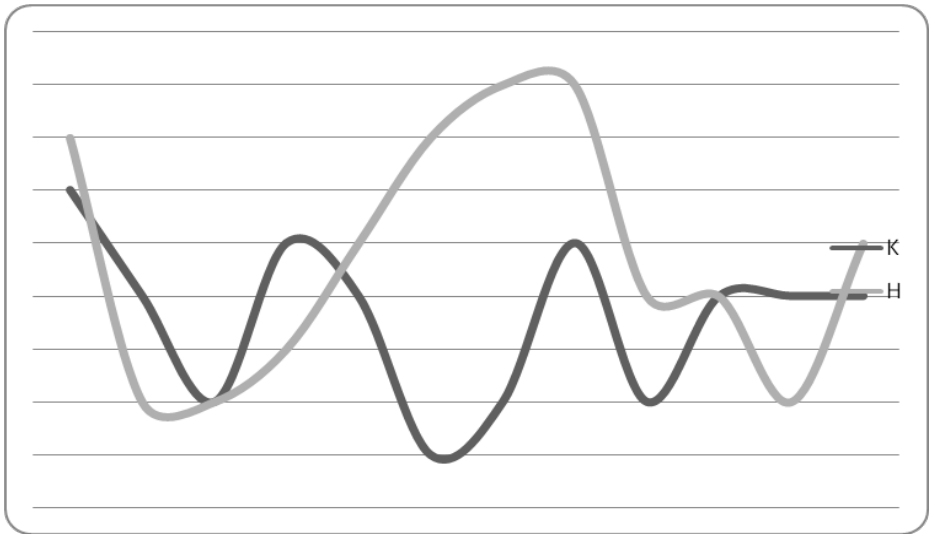

Fig. 3 SUI profiles for football fans (K) and stadium hooligans (H)

To interpret the results, according to the procedure by J.M. Stanik (1980, 1994, 1997), Du Mas test was applied (J. Brzezinski, 1999), which allowed to calculate the similarity index of the obtained profiles.

Rating scale indicators rps Du Mas:
0.75 - 1.00 - very high similarity
0.50 - 0.74 - high similarity
0.25 - 0.49 - moderate similarity
0.00 - 0.24 - low similarity

The resulting index value rps (KH) = 0.16, indicates a low similarity of created profiles, which is confirmed by the draft. When you take into account the interpretation by J.M. Stanik (1980, 1994, 1997), it appears that the respondents from the contrast group (K) are characterized by moderate style, while the respondents form the main group by the higher-autocratic-leading style (scale 1), which may reflect the irrational, the increased sense of competence in collaboration with others as well as leadership trends. These individuals will often show restrain in relation to others being particularly sensitive to being assessed by other people.

Persons from groups eager to view sports performances (K), in comparison to individuals seeking thrills outside sport (H), occupy the lower level on a scale of values (a value of 6, what J.M. Stanik (1980, 1994, 1997) defines as the norm).

Scale 2 indicates the social functioning style called over protective (J.M. Stanik, 1980, 1994, 1997). In the case of hooligans, the profile is on a second level of octyl (extremely low), suggesting that they are restrained at the start of the exaggerated manifestations of responsibility for others, looking after others or self-sacrifice. Hooligans are not particularly interested in the good of others. It turns out that the fans (4 octyl) are characterized by commonly existing social attitude towards life.

Comparison of profiles of the key group and the contrast one on the scale 3 (cooperative-friendly style), shows that for the fans and hooligans curves remain at second octyl. For the respondents of the questionnaire, this system explains the lack of willingness to compromise in the situations of non-compliance and negative attitude devoid of positive feelings for a partner. People from such a group do not care about friendly, normal social relations. Presented values of the groups on this scale create a negative picture the respondents.

Scale 4 refers to the conformable-dependant style. It turns out that the curves are diverse for research groups. Persons with a low score (3 octyl), hooligans were qualified in the group, are characterized by a lack of submission and the difficulty in submission towards others. Unwilling to conform to social life they avoid interpersonal contacts expressing the desire to be faithful, subordinate.

According to J.M. Stanik (1980, 1994, 1997) scale 5 describes the style of social functioning called retreating - masochistic. Among the spectators of sport events and non-sport thrill seekers (K. Pospiszyl 1992) the results are at the fifth and fourth octyl, and this is the level of a norm. Aggressors (H) have described themselves, which was converted, in the case of scale 6 (rebellious - suspicious style) on the seventh octyl (high level), and observers (K) ranked at a low level (first octyl). Hypothetically we can assume that the respondents (H) are characterized by antisocial and hostile behavior. They are emotionally cold towards others, suspicious, and not agreeing with the external social order, they conspicuously fail to comply with all rules and regulations. According to J.M. Stanik (1980, 1994, 1997) the hooligans' higher than the result than in the second research group, at the scale of 6 points, explains the continuing tendency to show defensive behavior, being distrustful, suspicious, and in some cases, the appearance of hostility syndrome.

Using scale 7, according to the author of the research tool, you can specify the level known as aggressive-sadistic. Respondents (H) are placed at the highest eight level while respondents (K) at second octyl. Such system of a curve is characterized by a person with excessive criticism, hostility towards themselves, and above all, treating oneself as an individual better than others in some respects . The individuals (H) - scale 8 (competitive -narcissistic style) can be characterized by a higher (8 octyl) than the (K) respondents (5 octyl) result. Higher result in the main group shows a tendency to express the sublime, and an exaggerated manifestation of their independence

The apparent discrepancy between curves was shown on a scale 9 - complacency and self-acceptance. Football fans represented the regression of curve to the level of second octyl. Such a results on this scale indicate, as determined by J.M. Stanik (1980, 1994, 1997), mean social passivity. Pseudo-fans reached even a higher level – the 4th octyl.The results obtained in the scale 10, of the two groups of respondents are within norm limits. According to the author of this scale (J.M. Stanik, 1980, 1994, 1997) It can provide meaningful information about the intentions (conscious or subconscious) of the respondents of the survey. Respondents tried to answer the questions on a SUI scale honestly. Overstating the results on this scale may be a conscious falsification of test results to hide a negative truth about oneself.

Envy, the realism and the relative autonomy are determined in the 11th scale It turns out that the self-description of respondents (H) than respondents (K) is divergent and the only football fans are in the standard norm(fourth octyl). Basic and comparative group are characterized by optimal sense of values, the average assessment of their own place in life, their own capabilities, which is shown the scale 12 (Stanik, 1980, 1994, 1997).

4 DISCUSSION

Both Polish and world literature contains numerous analysis dealing with the diagnosis of interpersonal functioning in different social groups (Wylleman 2000, Smith 2003, Wlazło 1999). However, none of them contains a tool which could be applied to measure different interpersonal relations within the group of football fans.

The interpretation procedure, suggested and implemented by the author in the dissertation, of SUI scale (J. M. Stanika 1980; 1994; 1997) allowed to assess the research group profile. Analyzing the behavior of hooligans, pseudo fans and football fans of respondents with neurasthenia, depression and hysteria, it turned out that there is a high probability concerning football lovers and people with mental disorders. In contrast, hooligans represent a strong anti-social attitude.

The analysis of hostile syndrome (scales 5,6 and 7 and often 8,9) in particular groups showed similarity of profiles within the groups researched by Stanik and hooligans (H). It is a strong confirmation of hooligans' negative approach towards the outside world. They are usually suspicious and manifest open aggression.

The syndrome of egocentrism was shown by higher values in 1 and 8 scales and lower in 9 and 12 profiles which became characteristic for hooligans. This, similar to Machiavelli form of syndrome, is characteristic for authoritarian contacts with other people. The respondents assess the world from their own perspective wanting to force their own ideas and not willing to make new contacts (scale1). They want to lead but due to a lower self-content and self-acceptance they are sensitive to social opinion. (scale10).

The knowledge gained through the research allows the recognition of the phenomenon, differentiation of football fans' and hooligans' profiles as well as understanding of antagonistic-destructive behavior of people from social risk groups.

5 CONCLUSIONS

1. Using the test procedure, proposed by J.M. Stanik (1980; 1994; 1997), allows to capture the similarities of interpersonal functioning of two groups: football fans and hooligans. It turns out that in the majority of life situations the representatives of these groups react differently, which confirms the similarity of created profiles (rps = 0.16). We already know that hooligans

2.

seek actions that would allow them, even on a minimal, to satisfy their need of strong experience

3. Analysis of particular SUI segments (J.M. Stanik, 1980; 1994; 1997) showed that the respondents in the group (K) in contrast to the respondents (H) are characterized by the so-called pro-social syndrome. The average score in the scales 2, 3, 4 means that these respondents will be represented by behavior socially acceptable based on meeting the needs of the common environment.

4. Hostility syndrome (scales 5, 6 and 7, often 8) is arranged differently than in the previous scales. In this case, hooligans are the leaders. Distrust, suspicion and overt aggression are traits that are characteristic for individuals with higher values in these profiles. Scales 1 and 8 are taken into account when the selfishness syndrome must be determined. Higher score in these scales with correspondingly low values in profiles 9 and 12 indicate a Machiavellian variant of this syndrome. It turns out that hooligans are people who consider themselves experts in discussions with other people. They evaluate the world from their own perspective, with a desire to enforce their own good and do not aim at any cost to make new contacts (scale 1).

5. Calculation of the level of significance p for pairs from profiles created on basic and comparative groups, helped to confirm the above reasoning based on the interpretation of J.M. Stanik (1980, 1994, 1997). It turns out that there are significant differences in interpersonal relations in the two study groups. Significant similarity is noticeable in the case of profile 3 and 10.

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