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Dear readers,

the end of the year 2010 concludes the 5th year of publishing the scientific journal Science & Military, which has been increasingly drawing more attention of the expert public in Slovakia and abroad.

The journal was founded in 2006 as the first and only scientific periodical in the Slovak Republic with themes about military science. It created space for Slovak and also foreign authors to publish their articles, dealing with basic and applied research in the scope of national and international security, economy and management of defence and human resources, armament, machinery, communication and information svstems. military logistics, but also other areas, which are directly or indirectly related to military science.

By publishing journal Science & Military the Armed Forces Academy represents the results of scientific research. At the same time it creates conditions for a dialogue with other universities, scientific-research institutions, as well as experts from the practice, who actually are the main consumers of new information.

Since its formation the journal Science & Military has undergone several positive changes. It has adapted to the era, trends and it has responded to the current needs. The authors' team has grown with new contributors from Slovakia and abroad (Czech Republic, Poland, Hungary, Romania, Ukraine and Russia). The responsible work of the international editorial board and the reviewers' precious advise and recommendations have contributed to the higher quality of the presented results of scientific research papers.

In the year 2009 the journal Science & Military was included in the ProQuest Central database and got under the two-year supervision of Thomson Reuters Journal Selection Process with the goal to consider its arrangement into the database Web of Science. Including our journal in the Current Contents database remains the main and long-term goal of our edition. We realise, that reaching this goal is possible just with the help of shared effort, because a good journal is not created by the editorial board and not even the editor-inchief. A good journal – that means articles, which touch experts and also other people interested in the given issue and can initiate a discussion. So, dear contributors and readers, proficiency and quality of our journal is in your hands.

On behalf of the editorial board I want to wish the Science & Military journal profound scientific articles, readers' interest and a positive response of the expert community.

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MODELLING OF THE SURFACE MOVEMENTS IN GIS IN THE KOŠICE DEPRESSION FOR A PURPOSE OF HUMANS AND PROPERTY PROTECTION

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Abstract: It is necessary to understand the geo-tectonic recent movements and landslides and mining subsidence of the earth surface and the earth crust movements as a natural continuation of dynamic tectonic processes. Determined movements by means of using the geodetic terrestrial or satellite navigation technologies give information about displacements in concrete time information on the base of repeated geodetic measurements in the concrete time intervals. 3D deformation investigation of the point of the monitoring station stabled in Košice-city and the Košice Depression territory in East Slovakia is the main task of the presented paper. The obtained results are transformed into GIS (Geographical Information Systems) in a frame of the environmental and humans and property protection.

Keywords: GIS, ground movements, environmental and humans and property protection.

1 INTRODUCTION

The ground earth movements have a very important consequence on the environment and human lives and properties. Monitoring of ground earth movements especially in settled territories as a tool of the environmental and humans and property protection must be a priority programme of civil as well military security (Nečas 2009, Nečas & Andrassy 2009, Nečas & Kelemen 2010, Mikulenka et al. 2000, Mikulenka 2000). The terrestrial and GPS (Global Positioning System) measurements are realised on points of the geodetic network (GN) localised in the Košice Depression (Slovakia) (Fig.1 and 2). The aim of these measurements is determining recent geo-tectonic movements, landslides and subsidence of the earth surfaces caused by underground mine activity in the urban agglomeration of Košice-city.

The terrestrial and GPS measurements are periodically realised twice a year (spring and autumn). Altogether, 20 points of *GN* are measured by means of using the trigonometric and GPS kinematics method. The determined *GN* points are solved by double GPS vector technology always regarding two reference points, i.e. three GPS receivers are used for measurements.

The main tectonic fault in the Košice Depression, according to which two expressive geological faults of the Earth ground blocks should move, is assumed in the north-south direction along the river Hornád. The secondary tectonic faults of smaller extent are in the direction perpendicular to the Hornád fault, i.e. in the east-west direction. These secondary tectonic faults are mutually parallel. The landslides are expected in the territory of Košická Nová Ves closed to Košice-city. The mining subsidence is occurred in the Košice-Bankov forest park, which is situated in the magnesite underground mine Košice-Bankov (Fig.1 and 2) (Sedlák 2000, Sedlák et al. 2001, 2004, Sedlák 2005) The GPS receivers ASHTECH: ProMARK X-CM and the total stations TOPCON: GTS 6A were used for satellite and terrestrial measurements. The non-linear rotary matrix method was applied to the adjustment. After transformation, the coordinates were consecutively adjusted by an adjustment with constraints (Frajt & Mišovic 2001, Sedlák et al. 2001, 2004, Sedlák 2005).

2 DEFORMATION ANALYSE

The Košice Depression GN can be adjusted by two ways. If we consider datum parameters as absolutely accurate and we do not include them into an adjustment process, the adjustment with constraints is considered in this case. In fact, those datum parameters are also determined with a concrete accuracy that has an influence on an accuracy of adjustment parameters except for measurement accuracy. In this case a network can be adjusted by a free adjustment with consideration of datum parameters. Regarding the applied confinement adjustment in the Košice Depression GN a theoretic procedure of this adjustment is presented, which is the most convenient for our national geodetic (Frajt & Mišovic 2001, Sedlák et al. 2001, 2004, Sedlák 2005).

The least mean square method is chosen as an estimate principle, and the inverse solution is chosen as a mathematical principle (Gauss-Markov model), which is a standard procedure in an adjustment of the Košice Depression GN. After adjustment the position and form of GN are changed but the datum point positions are not changed (datum points are considered as absolutely accurate).

Analyse of deformations is realized in the following basic phases:

• Measurement of the *GN* points in the first - base period and determination co-ordinate estimates.



- Measurement of the *GN* points in the further period and determination co-ordinate estimates.
- Determination of the position differences and their testing.

Figure 1 The Košice Depression GN (GPS measurements)



Figure 2 The Košice Depression GN (terrestrial measurements)

The test decision procedure for appreciate the stability of points is demonstrated in Fig. 3. At first, the global test for reference points (points No.: 12, 13, 13Z, 01A) is made. If the test is positive, unstable points are transposed to the object points (points No.: KN2-KN5, A1, B10, 01B, C21, 6, 10, 22, 29, 33, 7D, 112, 220). The test of object points is similar. The stable and unstable points are determined by an individual test (Sedlák 2000, 2005).

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REFERENCE POINTS

OBJECT POINTS



Figure 3 Test decision procedure

2.1 Graphical representation and analysis of accuracy

The condition of observed points is transparently and completely displayed in individual periods by graphical representation in the following epochs:

- The isolines and vectors of movements (2D) in the period of two years since 1997 to 1999.
- The isolines and vectors of movements (2D) in the period of two years since 1999 to 2001 (Fig. 4).
- The isolines and vectors of movements (2D) in the period of the years since 1997 to 2006. It is evident, the biggest movement occurred in the Košice-Bankov and Košická Nová Ves territory. It was verified by the deformation tests.

The numerical values (*WGS-84*) of the horizontal and vertical movements of terrestrial and GPS measurements are shown in *Tab.1*. The points: KN2, KN3, 33, 112, 220, which changed their position according to the used test-statistics, are colour marked. The confidence ellipses, which cover nonrandom vectors parameter, were determined for each of the object points. The spectral analysis cofactor matrix of the co-ordinate estimate determines the structural parameters of the confidence ellipses.

2.2 GIS applications

GIS of interested area is based on the next decision points:

- Basic and easy data presentation;
- Basic database administration;
- Wide information availability.

The best viable solution is to execute GIS project as the Free Open Source application available on Internet. The general facility feature is free code and data source viability through the HTTP and FTP protocol located on the project web pages. Inter among others features range simple control, data and information accessibility, centralized system configuration, modular stuff and any OS platform



Figure 4 Isolines and deformation vectors, 1997 - 2001 epochs

Table 1 The deformation (2D & 1D) vector values and the vector bearings; δ_P – positional deformation vector, δ_Z – vertical deformation vector σ_{dp} – bearing of confidence ellipses (Sedlák 2005)

Object	1997 - 1999			1999 - 2006			1997 - 2006		
points	$\delta_{P}[m]$	σ_{dp} [^g]	$\delta_{Z}[m]$	$\delta_{P}[m]$	$\sigma_{dp} [^{g}]$	$\delta_{Z}[m]$	$\delta_{P}[m]$	$\sigma_{dp} [^{g}]$	$\delta_{Z}[m]$
KN2	0.006	80.6235	-0.0012	0.004	73.6583	-0.0013	0.010	77.6983	-0.0031
KN3	0.006	34.2141	-0.0009	0.006	29.5069	0.0004	0.012	31.8001	-0.0012
KN4	0.003	168.9086	-0.0016	0.003	159.5458	-0.0008	0.006	164.4653	-0.0023
KN5	0.002	27.4548	-0.0004	0.001	29.1307	0	0.00	28.1065	0
A1	0.003	315.0060	-0.0005	0.003	330.0773	-0.0003	0.006	322.7850	-0.0010
B10	0.002	65.2953	-0.0006	0.002	71.7866	-0.0004	0.004	68.7907	-0.0012
C21	0.001	81.4231	-0.0006	0.002	52.2829	0.0002	0.003	64.2709	0
6	0.003	351.6824	-0.0003	0.003	370.1831	-0.0003	0.006	361.2637	-0.0014
29	0.001	144.8129	-0.0002	0.004	139.8180	0.0003	0.005	141.2165	0
22	0.001	337.3384	0.0003	0.002	351.4133	-0.0005	0.003	345.6190	0
10	0.003	142.4283	-0.0002	0.003	134.8389	-0.0004	0.006	138.5027	-0.0009
7D	0.002	176.9814	-0.0007	0.002	180.8509	0.0002	0.004	179.0511	0.0008
33	0.008	134.2371	0.0011	0.007	130.4754	0.0010	0.015	132.5342	0.0024
112	0.006	123.0186	-0.0061	0.005	130.4708	-0.0017	0.011	126.6067	-0.0077
220	0.006	158.3338	0.0020	0.007	132.4913	0.0013	0.013	144.1060	0.0031
01B	0.001	102.3104	-0.0007	0.001	97.6472	-0.0005	0.002	100.3674	-0.0008

(depends on PHP, MySQL and ArcIMS port) (Frajt & Misovic 2001, Sedlák et al. 2001, 2003, 2004).

Network based application MySQL is in a present time the most preferred database system on Internet. It is because, that MySQL company is a member of Open Source (based on GPL license), the price of this product is less than the prices of others commercial databases (i.e. Oracle, MS SQL Server, etc.), it has high-speed responses, uses fast data storing (in a binary file up to 1 TB - in 1 single file, supports unlimited quantity of s data files) etc. This database is relational database with relational structure and supports SQL language. At the present

time MySQL 4.0 is released and supports transaction data processing, full text searching and procedure executing. PHP, which stands for "PHP: Hypertext Pre-processor" is a widely used Open Source general purpose scripting language that is especially suited for Web development and can be embedded into HTML. Its syntax draws upon C, Java, and Perl, and is easy to learn. The main goal of the language is to allow web developers to write dynamically generated web pages quickly, but you can do much more with PHP.

Database part of GIS for the mine subsidence Košice-Bankov application runs on

MySQL database, because it is free distributed for non-commercial projects (Fig.5). PHP supports native connections to many databases, for example MySQL, MSSQL, Oracle, Sybase, AdabasD, PostgreSql, mSQL, Solid, Informix. PHP supports also older database systems: DBM, dBase, FilePro PHP can communicate with databases with ODBC interface and this feature represents PHP to work with desktop applications supporting ODBC interface. PHP cans attend to another Internet services, because includes dynamics libraries of some Internet protocols (i.e. HTTP, FTP, POP3, SMTP, LDAP, SNMP, NNTP, etc.) (Sedlák 2005).

3 CONCLUSIONS

The results of measurements by GPS technology confirm a typical event of using this satellite measurement in GN with a spread application in geodesy. The applied

kinematics method of GPS measurements shows on a high accuracy of satellite measurements, which is also acceptable for some other geodetic measurements, for example: deformation surveying the earth surface and engineering structures. The chosen confinement adjustment by means of using the Gauss-Markov model is demonstrated as the most suitable mathematical model in an adjustment of GN in the Košice Depression locality.

The presupposed possible recent geo-tectonic movements in the direction of north south along the Hornád River are not confirmed. Also the points of GN in Košická Nová Ves, where landslides are expected, as well as the points of GN in the Košice-Bankov mmagnesite mine, where subsidence induced by underground activity are occurred, have fixed at the present. MySQL database is very convenient for many applications into GIS where land surveying, mine surveying and other geodetic data are occurred.



Figure 5 The mine subsidence: Košice-Bankov (GIS-MySQL) (Sedlák 2005)

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DETECTOR TUBE WITH PICRIC ACID USED TO DETECT IRRITATING CN AND CS AGENTS IN THE AIR

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Abstract: Description of methods used for the detection of irritating CS and CN agents in the air by the detection tube containing silica gel with immobilized picric acid in the presence of dimethyl sulfoxide and glass ampoule with 20% solution of sodium hydroxide. The presence and concentrations of CN and CS agents can be determined from the intensity of the indicator layer color. The method is sensitive enough (detection limit of 0.1 to 0.3 mg.m⁻³) even for the use in the field conditions. The work also describes the possibility of detecting CN and CS agents in organic solvents (limit of detection 10 µg.m^{-1}).

Keywords: CN agent, CS agent, detector tube, picric acid.

1 INTRODUCTION

In terms of military and toxicological classification, irritants belong among the incapacitating warfare chemicals. In the police and security practices they are used as the chemical means to suppress riots or for personal protection. They are characterized by the ability to cause rapid sensory irritation or disabling physical effects, which disappear within a relatively short period of time after the exposure ends. Availability of irritants facilitates their misuse in chemical terrorism or other criminal purposes. Typical representatives of the irritant substances are CN and CS agents, which have a tear gas effect and are irritating to skin and mucous membranes in the respiratory tract. Tab. 1 presents the selected physical and toxic properties of these substances [1].

Table 1 Selected physical and toxic characteristics of CN and CS agents

Characteristics	CN agent	CS agent
Structural formula	$C_6H_5C(O)CH_2Cl$	$ClC_6H_4CH=C(CN)_2$
Molecular weight	154.6	188.6
Melting point in °C	58	95 - 96
Boiling point in °C	245	310 – 315 (disintegration)
Solidity of vapor (in relation to air)	5.3	6.5
Evaporability, mg.m ⁻³	34.3 (20 °C)	0.71 (25 °C)
Threshold concentration, mg.m ⁻³	0.3	0.1
Incapacitating concentration ICt ₅₀ , mg.min.m ⁻³	80 ^a	$10 - 20^{a}$
Lethal concentration LCt ₅₀ , mg.min.m ⁻³	$7\ 000 - 14\ 000^{a}$	61 000 ^a

^a Toxic characteristics may vary depending on the size of particles and their distribution functions

CN agent (2-chloroacetophenone), which was discovered in 1869 by the German chemist Karl Graebe, was introduced in the military use at the end of the World War I. In the period after 1945 it was used as a police tear gas in virtually all countries of the world, although according to current knowledge it is not sufficiently effective. As a chemical substance for the warfare it is outdated and it is currently used for training purposes and testing of protection against chemical weapons.

CS agent (2-chlorbenzylidenmalononitrile) was synthesized and described in 1928 by the American chemists Ben Corson and Roger Stoughton (hence the code CS). During the 30s it was studied in the UK as a potential chemical irritant for the warfare and in the 60s and 70s it replaced the CN agent in the weaponry. In terms of military use the CS agent had achieved its peak in the Vietnam conflict. Today it is one of the most commonly used substances used by the police. Currently there are many analytical methods used in the analysis of CN and CS agents, including electrochemical [2] or the gas chromatography method [3-5]. Colorimetric and spectrophotometric methods are of considerable importance especially for military practice. Simple technical means used in the analysis, such as detection tubes and indicator papers, are usually based on color reactions [6].

Fast and simple detection and determination of the CN agent is most frequently obtained by the group reactions to substances with active hydrogen, the so-called Zimmermann [7] or Janovsky reactions [8]. This reaction usually uses 1,3-dinitrobenzene in a strongly alkaline environment as a reagent [9].

A similar response is also provided by picric acid [10]. Also known is a color reaction with 4-(4'-nitrobenzyl)pyridine [11] or condensation reaction with ammonia to indole [12], which can be demonstrated by 4-dimethylaminobenzaldehyde.

To detect CS agent we can use sensitive reaction with 1,3-dinitrobenzene [13] or with 1,3,5-trinitrobenzene in the environment of dimethylformamide [6]. For the field analysis it is suitable to use the reaction of CS agent with quinones (1,4-naphtoquinone, chloranil), which depending on the polarity of environment and the use of reagent provides us with products of different color tones [14-17]. Military practice also uses reactions of CS agent with sodium nitroprusside, ninhydrin [18], benzofurazan-1-oxide [19, 20], possibly with analogous reagents 5-chlorbenzo-furazan-3-oxide, 7chloro-4-nitrobenzofurazane or with 4-nitro-2,1,3benzothiadiazole [21]. CS agent condenses with formaldehyde in an environment of concentrated sulfuric acid (Marquis reagent) [22], reacts with 4-(4'-nitrobenzyl)pyridine [15] and with some organic disulfides [23]. For simple detection we can use oxidation of CS agent during the release of cyanides, which react with pyridine (or its derivatives) and compounds with active hydrogen during the emergence of polymethine dyes [24, 25].

This article is focusing on the analysis of one of the numerous polynitrocompounds - the picric acid. The objective of this study was to authenticate the possibility of detecting the irritating CS and CN agents in the air using the detection tube filled with an indicating layer of picric acid in the presence of a suitable stabilizer. In this rendering the method has not been published yet.

2 EXPERIMENTAL SECTION

2.1 Chemicals and equipment

Indicator fillings and solutions were prepared using the following chemicals: picric acid (Fluka, p.a.), dimethyl sulphoxide, sodium hydroxide (both Sigma-Aldrich, a minimum p.a.) and absolute ethanol (Riedel-de Haën). As a carrier we used 0.4 to 0.5 mm silica grain with a minimum of 98% SiO₂ and having a surface of 200 m².g⁻¹ (Grace). Silica gel was cleaned by boiling in a diluted hydrochloric acid (p.a.) and after rinsing with water to neutral pH it was activated at 130 °C.

To prepare tube detectors we used glass packaging tubes, sealing components and bodies and Tejas distribution elements (Jablonec nad Nisou), which produced the required number of prototypes. Testing of detection tubes was performed in the test chamber with steam and air mixtures and dispersing systems with a capacity of 0.617 m³ at the NBC Defence Institute in Vyškov (University of Defense, Brno).

To perform the tests, we were using the CN and CS agents (both 98%) manufactured in VOZ-072 in Zemianske Kostolany. Purity of CN agent was checked by the reaction with sodium thiophenolate and subsequent argentometric determination of

chloride released by titration with a standard solution of AgNO₃. Purity of CS agent was checked after the reaction with the excess of standard solution of KCN in the KHCO₃ environment, the unused cyanide was determined as $0.1 \text{ mol.} 1^{-1}$ by the standard solution of AgNO₃. Contaminated air was pumped from the chamber by the manual Universal-86 suction device (Kavalier Votice), which has a volume of $100\pm5 \text{ cm}^3$ in one stroke. The sample for the analytical control of CN and CS concentrations in the chamber was pumped by the XDS-10C dry pump (BOC Edwards) and spectrophotometric measurements were performed on the Helios- α spectrophotometer (Unicam).

2.2 Working procedures

Preparation of the indicator filling

A 100 g pile of purified and activated silica gel was impregnated in 100 ml of 1% solution of picric acid in ethanol. After thorough mixing and uniform saturation of all grains, the filling was freely dried into a loose condition in the air with the laboratory room temperature. Solvent content in the loose filling was no more than 10 %. The modified silica gel was then impregnated in 30 ml of dimethyl sulfoxide. The final indicator filling in a lemonyellowish color is directly suitable for filling into glass tubes, or it can be stored in a hermetically sealed brown glass flask.

Detection solution for ampoules contained a 20% solution of sodium hydroxide in the water-ethanol mixture (90:10).

Preparation of detection tubes

Detection tubes used for the detection of CN and CS agents in the atmosphere are structurally composed of a glass tube with internal diameter of 5 mm, which is filled with a 15 mm long layer of indicator filling. To prevent the movement, the layer was fixed with polyethylene stars and polyamide nets. A glass ampoule with a detection solution was inserted above this layer and the whole tube was hermetically sealed by melting both ends.

Testing of detection tubes

Test samples of the analytes were prepared so that the measured amount of the CN agent, respective CS agent with various concentrations in ethyl alcohol was evaporated in the test chamber, on a metal cup placed on a heating element, with the working temperature of 50 °C (CN agent) and 200 °C (CS agent). The sample was homogenized using a built-in fan. During the testing of tubes, the contaminated air was manually removed from the chamber by a manual suction device and after the breaking of the ampoule with the detection solution we have visually evaluated the color of the indicator filling. For comparison we also used a methodology which is based on dispensing of equivalent quantities of irritating substances dissolved in ethanol (after the dispensing the indicator filler was dried by the passing uncontaminated air).

The actual concentration of CN and CS agents in the chamber was determined by the spectrophotometrically unified methodology. The sample was sucked at the speed of 1 l.min⁻¹ through the wash bottle containing 25 ml of 0.5% solution of 1,3dinitrobenzene in ethanol for 10 minutes. 1 ml of 10% sodium hydroxide was added to 5 ml of the absorbate and after 5 minutes the value of absorbance was measured at 450 nm. Calibration curves were prepared by an analogical method.

3 RESULTS AND DISCUSSIONS

Reaction mechanism

The literature indicates that according to Zimmermann, the CN agent reacts with picric acid, as well as with other polynitrocompounds (Fig. 1). With CS agents the reaction comes from its hydrolytic products. The generated *o*-chlorbenzaldehyde probably reacts according to Zimmermann. Malononitrile creates condensation product by the substitution of nitro-group (Fig.2).

Reaction conditions

Color reaction of picric acid with CN and CS agents occurs in the presence of alkali, ideally with

the addition of 0.05 ml of 20% sodium hydroxide to 0.1 g of impregnated carrier. Higher concentration of sodium hydroxide causes the coloration of the blank test. Lower concentrations of sodium hydroxide will cause a reduced sensitivity of detection and lengthening of the reaction time, or the color reaction does not occur at all.

Color intensity

Intensity of the indicator layer coloring (from orange to red) increases with increasing concentration or quantity of the tested agents (Tab. 2). This color intensity (I_F) can be expressed by a simple mathematical formula $I_F = k.c.V$, where *k* is the proportionality factor, *c* is the concentration of CN or CS agents (mg.m⁻³) and *V* is the volume of air sample (m³). The observed limit of detection at 3 dm³ of the air sampling is 0.3 mg.m⁻³ for the CN agent and 0.1 mg.m⁻³ for the CS agent. At concentrations below 1 mg.m⁻³ (3 µg of the substance) it is appropriate to compare the resulting color with the blank sample.

Stability of coloring

Coloring on the indicator layer occurs almost immediately after the breaking of the vial. The highest color intensity is reached after about 1 minute. Coloring is stable for at least several minutes; the color stability is directly proportional to the concentration (amount) of CN and CS agents.



Figure 1 CN agent reacting with picric acid



Figure 2 Reaction of malononitrile (a product of the CS agent hydrolysis) with picric acid

Table 2	Dependence of coloring on the quantity and	concentrations	of CN	and CS	agents	(concentration	applies	to the
	collection of 3 dm ³ of vapor and air mixture)							

Quantity,	Concentration,	Coloring of i	indicator layer
μg	mg.m ⁻³	CN	CS
48	16	Red	Red
12	4	Reddish orange, brown shade	Reddish orange
3	1	Orange	Orange
0.9	0.3	Noticeable orange	Well visible orange
0.3	0.1	-	Still noticeable orange

Interferences

Similar coloring as with CN and CS agents is also provided by a number of other compounds with active hydrogen. The same or similar coloring is also provided by sulfur dioxide, sulfide, hydrogen cyanide and aliphatic amines. Overview of some interfering substances is listed in Tab. 3.

Stability of indicator filling

Functionality of detection tubes was tested in a test chamber at regular intervals. When stored at temperatures of 30 °C and without access to direct sunlight the detection tubes retain its indicating properties for at least one year. Throughout this entire period of storage the indicative contents do not show any evidence of visual changes.

Applications

The limits of detecting the CN and CS agents in the air (0.3 resp. 0.1 mg.m⁻³) obtained with the use of the designed detection tube correspond to threshold concentrations of these substances in the atmosphere (Tab. 1). From this point of view the detection tube with picric acid can be used as successfully as other detection tubes with reagents that are still in the use today (Tab. 4).

In addition, the designed detection tube can be used to identify the CN and CS agents in organic solvents (methanol, toluene, chloroform). In this application, the detection tube is immersed in the analyzed sample and the saturation indicator layer is dried by the blowing of large amounts of uncontaminated air (minimum of 3 dm³). After breaking the vial, the indicator layer is evaluated by a usual method. Detection limit of CN and CS agents in organic solvents is approximately $10 \ \mu g.ml^{-1}$.

Agent	Coloring of indicator layer	Tolerance limit, mg.m ⁻³ (during the sampling of 3 dm ³ of air)		
Acetone	Reddish orange	200		
Acetylacetone	Reddish orange, turning brown	5		
Cyclohexanone	Reddish orange	2		
Acetophenone	Reddish orange	2		
Hydrogen cyanide	Orange	10		

Table 3 Coloring of the indicator layer by certain compounds and tolerance limits

Table 4 Overview of some reagents used in detection tubes for CN and CS agents

Reagent	Detection li	mit, mg.m ⁻³	Color turning	Ref.
	CN	CS		
1,3-Dinitrobenzene	0.1	0.1	W - V/RB	6, 9, 13
Sodium nitroprusside	-	0.5	G – R	6
Ninhydrin	-	0.5	W – R	6, 18
Chloranil	-	0.2	W – Gr.	6, 14-17
Benzofurazan-1-oxide	1.4	0.7	W - V	6, 19-21
KSCN, 4-benzylpyridine, dimedone	-	0.5	G – P	24, 25
Picric acid	0.3	0.1	Y–RO	6, 10

W – white (colorless), V – violet, RB – reddish brown, G – grey, R – red, Y – yellow, Gr. – green, P – pink, RO – reddish orange

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THEORETICAL AND METHODOLOGICAL ADVANCES TOWARDS AN EPISTEMIC COMPETENCY OF DECISION-MAKERS

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Abstract: The study proposes a paradigmatic approach of a social necessity that emerges in the process of managing organizations: the formation of a decision-maker's epistemic competence. The project implies that managers at any level of organizational hierarchy would be able to update their information processing capacity by assimilating a set of basic, but relevant metacognitive and epistemological principles. Starting from Lucian Culda's processual-organic theory of social existence, the author provides a transdisciplinary theoretical framework and some basic methodological guidance for managers willing to participate in such an undertaking.

Keywords: Paradigmatic science, processual-organic theory, epistemic competence.

1 INTRODUCTION

The problem of the correlation between theory and praxis is one that preoccupies and intrigues specialists from most sciences, and the field of organizational analysis is no exception. In general, the task of converting fundamental knowledge into useful information for the organization is usually left to specialists who advise the top decision-makers. Thus, starting from the acquired knowledge, the highest levels of decision initiate certain policies or procedures to be followed by lower levels of conception or execution.

The optics proposed by the present study is different and ought to be considered at least complementary to the strategies described above. The epistemic competence of managers implies a highly decentralized approach of the issues in question in the sense of recognizing that people, regardless of their hierarchical status, make decisions that affect the organization that incorporates them and, that it is desirable, that these decisions be as favourable as possible both for them and for the organization. In a certain respect, the study enlists itself in the research that tries to overpass the now most advocated truism, i.e. knowledge is crucial for the organization, in the hope of providing some kind of theoretical and methodological framework that would be truly useful for the practitioner.

In essence, the envisaged competence can be a useful tool that would allow decision-makers to update their information processing capacity by connecting to the results of scientific knowledge, via assimilating a set of basic, but relevant metacognitive and epistemological principles.

2 THEORETICAL FRAMEWORK FOR INVESTIGATING THE TOPIC

The concept of the research derives from Thomas Kuhn's interpretation of sciences' nature and dynamics, and of the epistemological developments realized by L. Culda. Hence, we first considered the concept of paradigm and second, the difference between the pre-paradigmatic stage and the paradigmatic stage in the evolution of science.

T. Kuhn has gained the credit for drawing the attention on the theoretical models and methodological notions specific to scientific disciplines and on their evolution, starting from the pre-paradigm stage to the paradigm one. Concerning the latter, Kuhn states the following: "Before it (the transition from the pre- to the post-paradigm period in the development of a scientific field) occurs, a number of schools compete for the domination of a given field. Afterward, in the wake of some notable scientific achievement, the number of schools is greatly reduced, ordinarly to one, and a more efficient mode of scientific practice begins [1]."

In Lucian Culda's perspective, the paradigm is a theoretical and methodological framework able to model *globally, unitarily and satisfactorily* a certain field of study [2]. Being inside the cone of explanatory possibilities risen by the before mentioned interpretations, we avoided disparate and reductionist approaches on the competence topic, in general, and on epistemic competence, in particular.

Thus, we were not interested in listing definitions and perhaps realizing a synthesis on them, but rather we are interested in identifying "horizons of information processing", which should deal with or even just allow the dealing with the issue of epistemic competence in a pertinent manner. Our beliefs are apparently the opposite of the ones adopted by most social science researchers, well expressed by W.B. Gallie's expression, "we must agree to disagree" [3], in hope that the consequence of the conceptual disputes will be an acceptance-synthesis, satisfactory for everyone.

Nevertheless, the attitude that we promoted is desired to be a middle means of epistemology (a Tao of epistemology), an acknowledgement of the inductive and deductive methods' necessity to coexist in the scientific-type investment. Field investigations, empiric studies and observations have a role and a purpose under the condition that these must be conducted by a well defined theoretical framework. But the latter might also undergo shape changes, even confutations from the empiric; therefore, the theoretic/empiric relation can only be one of a complementary nature.

A paradigmatic approach ought to track the problem of forming certain competences in a larger field of study concerning the explanation of the human being in all determinations that exercise influences on his becoming. In thismanner we have reached an extremely severe but fully sustainable conclusion: as long as it treats the human being starting from reductionist snapshots of its existence, sciences like psychology, sociology, anthropology, etc. are useful to us only if they provide guidelines compatible with the paradigmatic framework on which we chose to locate the research.

In what regards our research, we had two options of theoretical explanations able to globally, unitarily and satisfactorily model the issue of epistemic competence: the General Theory of Systems and the Processual-Organic Interpretation of the Human's Social Existence. Our option was for the second theoretical construction due to the fact that the Theory of Systems offers excellent methodological analysis guidelines, but it does not provide an adequate ontological framework. Regarding the latter aspect, the theory of systems, even by considering the two types of analysis – structural and functional – faces serious difficulties in the modelling of the investigated fields.

Our option is the processual-organic paradigm. Below we will briefly mention the fundamental theses for this approach:

 \checkmark Existence is info-energy. Information organizes energy and the latter serves as information support. The acknowledgement of this fact determines a centring of the investigations on informational processes.

 \checkmark Humans are interpreted as information processors, as a product and expression of two types of processors: bio-processors and interpreters.

 \checkmark Bio-processors are information processors that constitute the biotic dimension of the human being. Due to the fact that they direct towards relative balance states, bio-processors are complexities.

✓ Homo-interpreters are information processors that are created from the bio-processors' development (probably in the neocortex), from which they take over signals that are introduced in other types of processing. This is composed of the attribution of meanings to biotic-type signals, their introducing in a processing that uses more complex criteria and rules than the ones specific to bioprocessors. Due to the fact that the meanings operated by interpreters have an extraordinary plasticity, we can state that the interpreters are processualities, existences with the capacity to reconstruct themselves.

✓ Socio-interpreters are networks of homointerpreters who transcend the possibilities of the latter. Socio-interpreters are those who maintain social organizations (organization, families, markets, etc.) and who exercisea determining influence on homo-interpreters, especially through the socialization process. What we often call "knowledge" is, in the new interpretation, considered as a socio-interpreters' network with cognitive finalities.

✓ The inherent boundaries of the human being condition lack it in the beginning to have access to accurate interpretations on their space-temporality. However, the people's processors have the capacity to gradually approach the "good interpretation" of existence. The mentioned process takes place during several millenniums, especially as a consequence to the awareness of own proceedings.

✓ In a first stage, "more good interpretations" are reasonable to exist in all fields. As consequence of this fact's acknowledgement, but also of certain adjustment necessities derived from praxis, interrogative interpreters, specialized in the assessment of interpreted products are constituted in phylogenesis. Epistemologies are networks of interrogative socio-interpreters.

 \checkmark The recognition of the processual-like character of knowledge validates the thesis of "scientific revolutions" set out by T. Kuhn and draws attention on the possibility of the coexistence of several competing interpretations of the same subject, with non-equivalent praxiological opportunities.

✓ Within the processual-organic paradigm, existence is globally and unitarily modelled. Humans become *humans in socio-organizations* and socio-organizations are modelled in their complex relations. Also, the relations with abiotic beings ought not to be neglected. Any approach not modelling the "whole" can not be of any other kind than reductionist.

 \checkmark The need to consider successive remodelling processes specific to social existence, urges the explanatory studies to include at least four dimensions: appropriate ontological interpretations, a historiographical analysis considering the past states that characterize the becoming of subject, an futurology exploration focusing on the possibilities of the subject's development and, setting forth the conclusions emerged from the first three types of investigation, praxiological analyses, trying to update the identified positive possible developments.

3 THE NECESSITY TO DEVELOP THE EPISTEMIC COMPETENCE IN ORGANIZATIONS

In his work, *The Turning Point*, F. Capra explores the "perverse" consequences of locating mankind in an out-of-date information processing horizon (mechanism). The latter, by means of its premises, can produce severe effects that place humans in dramatic situations. Although the mechanism's criticism was not a revolutionary approach, Capra introduces a note of realism in his analysis, by pointing the adverse effects of a paradigm which apparently is designated only for scientists but, in essence, is often implicit in the management of areas particularly important for the human species (e.g. economy, medicine, psychology etc.).

In the attempt to explain the *de facto* state of mankind at the beginning of the 21st century, Capra states that: "...most academics subscribe to narrow perceptions of reality which are inadequate for dealing with the major problems of our time. These problems, as we shall see in detail, are systemic problems, which means that they are closely interconnected and interdependent. They cannot be understood within the fragmented methodology characteristic of our academic disciplines and government agencies. Such an approach will never resolve any of our difficulties but will merely shift them around in the complex web of social and ecological relations.." [4]

Actually, F. Capra's message is just a pleading for giving up on the causal, mechanism-type manner of information processing in the favour of the systemic interpretation horizon, a very convincing approach as it comes out of the sphere of abstract by exemplifying and thus enforcing the validity of the statements deduced from theory.

We interpret our study as being one that creates "a step forward" in the effort of certain thinkers, such as R. Boudon [5], F. Capra [6] or L. Culda [7], to improve the social processing capacities. The novelty of our approach consists in the following two aspects.

The analyses of the listed authors address scientists. R. Boudon sticks to analyses conducted in the field of sociology and shows that interactionist schemes have higher explanatory possibilities. F. Capra, through interviews with experts conducting research at the borders of certain disciplines such as Economics, Physics, Psychology or Psychiatry, composes a systemic global and unitary framework for the interpretation of existence, able to become a paradigm for the query of existence. L. Culda approaches the matter similarly, but the epistemic competence's "germs" exist only in the premises adopted by him.

The epistemic competence, as one expects from this approach, addresses not only philosophers or scientists, but also decision makers of organizations and, extrapolating, all the people who are put in a position to explain situations, objects, phenomena, problematic processes. Decision makers' epistemic competence is not a way to streamline a decision, but rather a capacity of people to inform their own actions with the best guidelines offered by scientific knowledge. This broadening of the beneficiaries' epistemic competence is determined by the acknowledgement of the necessity to actively and constructively involve people in the social organizations they belong to.

The epistemic competence allows the overcoming of the static nature views, such as "X Theory is the ultimate interpretation of Y object study". In our opinion, such an assertion is highly unsustainable. The subscription to the *Kantian* distinction between *the object-in-itself and the object-for-us* and the recognition of the process-like nature of "knowledge" requires the adaptation of such a position.

Next, we highlight the terms of the decentralization of knowledge within organizations, as expected, in terms of our research.

The processual paradigm revealed the centrality of individuals in the accomplishment of the social needs which the organizations undertake; this is due to the fact that they are the key in the functioning of organizations.

Gradually, especially in the economic field, one has recognized the need to use the creative potential of individuals, in order to improve organization performance. In this context, we have over passed the conception that considered people as mere "objects" within organization, in terms of approaching people as a valuable "resource".

As for the processual interpretation, any kind of approach, including the "human resources" are not satisfactory, as the domination relationships are still present, though highly modified, meaning that people are provided the necessary advantages, but they are still used in manners they don't understand. The alternative interpretation is represented by people as "subjects" of the organization, as factors directly interested in the "wellbeing of the organization" (stakeholders). Relations of "subjectsubject" type may not be characterized more or less explicit by domination, but by collaboration in searching for win-win strategies, useful for the individual and the organization.

The failure to recognize the necessity of building up the epistemic competence in organization would most likely deny the knowledge advantages described above. Also we find plausible the following disadvantages, identifiable in some present-day organizations:

 \checkmark lack of support from members of the organization vis-a-vis the constructive strategic options of the organization (eg bureaucratic sabotage);

 \checkmark downward pressure from the organization, which may affect people's private lives or their health (eg occupational diseases);

 \checkmark people's vague, incomplete, misleading interpretations on organizations and on their own situation within their organizations;

 \checkmark low organizational use of people's potential in terms of intelligence and creativity;

 \checkmark lack of flexibility in adopting the latest advances, in the field the organization is specialized or in management;

 \checkmark no voluntary involvement in solving problems facing the organization;

 \checkmark difficulty in discerning the rules which favor one side only and not the members of the organization as a whole;

 \checkmark establish relationships of power, dominance between members of the organization;

 \checkmark stimulate competition at the expense of working together;

 \checkmark duplicitous establishment of relations between members of the organization, opposed to the state of communication (affection, trust, honesty, etc)

 \checkmark a climate of immorality based on the pursuit of selfish interests and neglect the interests of group or community;

 \checkmark decisions based on superficial criteria, founded on uncritically analyzed experience or interest in the short-term at the expense of long-term interests of staff and/or organization.

All the identified issues are based on the premise of some incorrect interpretations on organizations and people. Of course, some of these situations may be overcome by means of using specialists. However, we do believe that the proper solution is to register a full contribution of the personnel, according to their role and status, in increasing the organization's functionality.

The organizations are integrated in the specialized socio-organizations, which together with other social organizations with lucrative, commercial or managerial specializations define the public space. People have also a private dimension of their life. Once this is acknowledged, the analyst

may spot the fact that part of the organizational culture is developed beyond inter-organizational space with ample effects on a long run. For instance, modern society is known as promoting the individualist values with consequences on the nations' morality or on the values supporting the families.

4 METHODOLOGICAL LANDMARKS FOR EPISTEMIC COMPETENCE BUILDING UP PROCESS

Next, we shape up some methodological landmarks on supporting and managing the epistemic competence. First, we mention the importance of benefiting from a "hardware" support. Thus, we take into account the normality of the main maturity and socializing processes which human beings undergo until reaching maturity.

These pre-terms provide the normal individual's state within all the undertaken actions. It is obvious that there are more or less deviations in a certain field, but it is also known that these mark the human being as a whole, which lead to the creating of noticeable difficulties, but extremely hard to explain.

In this context, we take into account the assessing/self-assessing of the normal state on the following directions, such as:

 \checkmark sexual dimension of the bio-processing;

 \checkmark affective dimension of the bio-processing;

 \checkmark esthetic dimension of the bi-processing;

 \checkmark the stocking capacity and the date and information 's updating;

 \checkmark ability to perform complex selective awareness;

 \checkmark ability to perform abstractions and abstract operations (conjunctions, disjunctions, implications, equivalences, affiliation, generation, denials etc.).

As a necessary premise to build up the epistemic competence we highlight the importance of the normality in the secondary socializing processes, of the ways in which human beings learn to accomplish their roles in the social organizations (family, organization, nations). The constructive involvement in the social organizations is a prerequisite for competence in every area.

As for the necessary cognitive premises, we do take into account the assessing /self/assessing of the evolution from *spontaneous thinking* (stage I) to *systematic stage* (stageII) and also to *knowledge on knowledge* (stage III).

In the event of the subject being "placed" in stage I or II, and the maturation and socialization being able to support the epistemic competence, we will take into account the providing for that "software" (interpretations) that cause the disruption of the lower status' and the organization of the interpreters on a higher stage.

This process must be one in phases, any jumps over certain stages are unlikely to produce the desired results and consequences. For example, a person located in the empirical horizon will not make the transition to higher stages of processing, say holistic thinking, directly by spelling out the benefits of the latter. It is plausible that this shift be performed by spelling out the limits of empirical thinking and by illustrating the causal analytical processing advantages. One must gradually make the transition to interactionist horizon and finally to the systemic one, and the so called "holistic thinking".

Also, one should consider the conceptual processing capacity and the characteristics of the "knowledge on knowledge" one has access to and, eventually, the facilitation of higher epistemic horizons, if the case. Concerning the last aspect it is essential for the individual to assimilate knowledge, to create networks of concepts, correlations and integrations of the information of epistemic nature, especially the following:

 \checkmark interpretations on "the nature and dynamics of knowledge", of science in particular;

✓ interpretations on knowledge horizons, including explicitly seeing the limits of empirical processing, and the changing nature of "truth";

✓ interpretations on scientific theories, on means of their understanding, assessing, implementing and improving;

✓ analysis algorithms of scientific studies;

 \checkmark interpretations on one's own processing capabilities, as well as ways to improve them.

Besides the mentioned "software", we do believe it is necessary to assess/self assess the means by which the social context develops/blocks the interrogative interpreters building up (cultural norms, financial resources, information, time, roles, status, relationships, interactions etc.).

The subject's motivation, the representations and images on himself and on the competence (the epistemic competence model) should be minded. Provision of "models of success" may be useful in such an undertaking.

The processual interpretation points to the importance of managing the epistemic competence. In this respect one will define a cone of possible competence developments, determine which of them are favorable to the subject and the social organizations that comprise him and, periodically, depending on the results and on the effects developed, make the necessary corrections.

5 FUTURE RESEARCH EFFORTS

The processual-organic approach of the epistemic competence has some advantages but also some disadvantages. The former category, remind us that this interpretation provides a trans disciplinary framework, a coherent perspective on an object of study "assumed", inaccessible to the senses. It represents a departure from the classical way to solve the problem within a single discipline or an interdisciplinary framework, and the results have been more profound, offering not a simplistic and narrow vision of reality, but a nuanced and holistic one.

Of course there are also disadvantages of such a way of raising the problem. These arise primarily from the fact that the processual interpretation has not yet been subject to profound criticism from the scientific community, so it is very likely that it contains errors.

At this stage, the interpretation set out is a set of working hypotheses derived from the latest findings in various scientific disciplines, but also in philosophy, which form a whole, but has not undergone rigorous testing in practice. In the latter idea we have tried to formulate and partially solve a "puzzle type problem", in Kuhn sense. Any corrections or nuances will only be welcomed in the idea of improving the theoretical and methodological framework proposed.

The necessity to develop the epistemic competence is obvious even at a basic, intuitive analysis. The major issue is on providing the informational context and the energetic one leading to a realist project. We cannot help wondering whether the organizations are intelligent enough as to encourage the cognitive development of the people, or whether the latter have the necessary resources and openings to such a development. These are only some of the questions coming as relevant to the success of a praxiological undertake that might be truly useful to people and organizations.

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ENHANCED TIRE MODEL FOR VIBRATION ANALYSIS OF VEHICLE

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Abstract: The simplified vehicle models for vibration analysis consisting of rigid bodies conected with springs and dampers are well known in car community. These models are efficient for simplified simulations of vehicle springing with minimal requirement for computation power yet they are in certain cases sufficiently accurate. The main problem for these models are tires which are modeled as a set of springs parallelly connected with dampers with the ends in contact with passing terrain. This way the fore-aft forces parallel with ground acting on the tire are completely neglected resulting in discrepancies compared to real tires. Also for terrain with discontinuities the results are poor. In this paper a Finite Element Method (FEM) model of tires is presented which can be directly used with existing simplified vehicle models thus eliminating the need for new modeling and simultaneously providing better contact handling and vibration response.

Keywords: Finite - elements, vehicle model, tire model, contact handling, dynamic simulation.

1 INTRODUCTION

Vibration response analysis of vehicle is an actual problem in many branches of research. For military vehicles the safety and comfort of operting personnel is most important but also the driving conditions for different terrain types have to be satisfied for example maximizing the possible speed for passing untouched landscape or certain obstacles.

For quick vibration analysis there are in long use with good tradition simplified models of vehicles consisting of rigid bodies which represent the car body and the wheels, connected with spring and damper elements [1, 2, 3]. These models can give good results for smooth irregularities on the ground, like speed bump etc. but the lack of forces parallel with ground in the models makes them inept for simulation of passing sharp discontinuities like for example curbstone [4].

Thus it was advisable to develop better tire model which would accurately model the behavior of tire running over obstacle vet the model should be lightweight in computation power for easy and quick analysis. After assessing more complex models still using simple rigid bodies connected with springs, even in torsional direction, the results were not satisfactory, thus the logical choice was an 2D FEM model which accounts for radial as well as fore-aft forces and also contains torsion stiffnes known as slipping. According to mesh size this model can be quickly scaled for required computation speed and accuracy of the solution. Of course 2D model represents continuous continuum along the vhole area of the tire, so the required stiffness of the tire has to be fitted to experimentally measured data. These data are well known among tire manufacturers and also it is possible to measure force-deflection curve for radial stiffness of the tire in ambient conditions. Another advantage of FEM model is relatively easy contact handling which occur between the tire and given obstacle and/or ground. As the tire model can be arbitrarily refined the resolution and handling of the contact point/surfaces

can be controlled to desired precision. The whole routine for FEM, contact handling/resolution and time stepping is as of now written in C++ code and runs in several thousand cycles per second for the time stepping procedure. On multi-core processors it is possible to obtain real-time speed of simulation at the expense of accuracy.

2 FEM CODE

For the description of continuum response it was chosen that the simplest elements give the best ratio for performance to accuracy and so the triangular elements with linear interpolation of displacement and constant pressure on the element area are used. These elements dispose by three nodes – one in each corner and there is no need to formulate stiffness matrix as the calculations of element forces are performed for each element individually.



Figure 1 Linear triangle element

Firstly it is needed to store the initial and current deformation tensor of any element. This is done in cartesian coordinates using arbitrary chosen vectors \vec{v}_1 and \vec{v}_2 (Fig. 1) which are fixed to the element thus defining its orientation in space. This is done for the initial (undeformed) state of the elements as well as for the current (deformed) state. All tensors are size 2 x 2 (rows x columns) and are calculated in a loop for each element. The initial deformation tensor is computed as follows:

$$\mathbf{F}_{\mathbf{I}} = \begin{bmatrix} v_{1x}^{i} & v_{2x}^{i} \\ v_{1y}^{i} & v_{2y}^{i} \end{bmatrix} = \begin{bmatrix} x_{N_{3}}^{i} - x_{N_{1}}^{i} & x_{N_{3}}^{i} - x_{N_{2}}^{i} \\ y_{N_{3}}^{i} - y_{N_{1}}^{i} & y_{N_{3}}^{i} - y_{N_{2}}^{i} \end{bmatrix}$$
(1)

where xⁱ and yⁱ are initial coordinates of particular node denoted in the subscript of the coordinate. The deformation tensor for current (deformed) state is computed similarly only the coordinates are for displaced/deformed nodes:

$$\mathbf{F}_{\mathbf{D}} = \begin{bmatrix} v_{1x} & v_{2x} \\ v_{1y} & v_{2y} \end{bmatrix} = \begin{bmatrix} x_{N_3} - x_{N_1} & x_{N_3} - x_{N_2} \\ y_{N_3} - y_{N_1} & y_{N_3} - y_{N_2} \end{bmatrix}$$
(2)

For the strain rate effects also the momentum tensor for deformed state is required:

$$\mathbf{L}_{\mathbf{D}} = \begin{bmatrix} \dot{v}_{1x} & \dot{v}_{2x} \\ \dot{v}_{1y} & \dot{v}_{2y} \end{bmatrix} = \begin{bmatrix} \dot{x}_{N_3} - \dot{x}_{N_1} & \dot{x}_{N_3} - \dot{x}_{N_2} \\ \dot{y}_{N_3} - \dot{y}_{N_1} & \dot{y}_{N_3} - \dot{y}_{N_2} \end{bmatrix} (3)$$

where dot represent time derivative of given coordinate thus the values in momentum tensor represent relative velocities of nodes in element.

All these tensors are derived in global coordinates but to efficiently handle element deformations it is necessary to convert the deformation tensor and momentum tensor into local coordinates tied to the element. This is made simple by matrix multiplication:

$$\mathbf{F} = \mathbf{F}_{\mathbf{D}} \times \mathbf{F}_{\mathbf{I}}^{-1} \tag{4}$$

$$\mathbf{L} = \mathbf{L}_{\mathbf{D}} \times \mathbf{F}_{\mathbf{D}}^{-1} \tag{5}$$

where F_{I}^{-1} and F_{D}^{-1} are inverse matrices of the corresponding deformation gradient. For small strains it is used Green – St. Venant strain tensor:

$$\mathbf{G} = \frac{1}{2} \left(\mathbf{B} - \mathbf{I} \right) \tag{6}$$

Where I is unit matrix of correspondent size (2×2) and **B** is left Cauchy – Green strain tensor:

$$\mathbf{B} = \mathbf{F} \times \mathbf{F}^{\mathrm{T}} \tag{7}$$

For strain rate effects like viscous damping of element it is necessary to calculate also strain rate:

$$\mathbf{D} = \frac{1}{2} \left(\mathbf{L} + \mathbf{L}^{\mathrm{T}} \right) \tag{8}$$

And now it is time to compute Cauchy stress which represent the stress state inside the element which is according to linear theory constant along the vhole volume:

$$\mathbf{T} = 2\mathbf{G}\boldsymbol{\mu}\frac{|\mathbf{F}_{\mathbf{I}}|}{|\mathbf{F}_{\mathbf{D}}|} + \mathbf{I}\boldsymbol{\lambda}\left(\frac{|\mathbf{F}_{\mathbf{D}}|}{|\mathbf{F}_{\mathbf{I}}|} - \frac{|\mathbf{F}_{\mathbf{I}}|}{|\mathbf{F}_{\mathbf{D}}|}\right) + \mathbf{D}\boldsymbol{\xi}$$
(9)

where μ and λ are Lame constants, ξ is damping coefficient and single vertical bars denote determinant of given tensor. The stress in the element can be imagined as pressure which acts on the sides of the element. Thus it is possible to obtain forces acting in nodes of element simply by projecting the pressure force into the normal direction of any side:

$$\vec{F} = \frac{1}{2} \mathbf{T} \square \vec{n} \tag{10}$$

where

$$\vec{n} = \begin{cases} n_x \\ n_y \end{cases} = \begin{cases} y_{N_1} - y_{N_3} \\ x_{N_3} - x_{N_1} \end{cases}$$
(11)

for the side v_1 given by nodes N₁ and N₃. So the normal vector is perpendicular to the given side of the triangle element and its length is equal to the length of that side. On each side are two nodes into which the force is equally distributed and this has to be done for each of the three sides of the element. The normal components are again derived in global coordinates and therefore also the force consist of *x* and *y* components in global coordinates. This way forces acting on all nodes are calculated and can directly be used in time stepping procedure for stiffness free formulation and allowing large rotations.

3 TIME STEPPING

The time stepping procedure also known as time integration is method that enables the simulation to advance forward in time. This is key procedure for advanced dynamic simulation. There is known huge number of different time integration procedures which are divided into implicit and explicit methods. During the making of the simulation code large number of both methods was implemented. The implicit methods show very good stability for stiff systems but are slower than explicit and require solving system of linear equations. The explicit methods are quick but require smaller time step for stability. As of now the main stability issue is the contact condition checking which is performed only between steps without forecasting and thus for large time step large penetration occur which give rise to large unstable forces. Thus the main advantage of implicit methods namely larger time step is nullified. This is true also for explicit methods of higher orders. For example Runge-Kutta method of fourth order was implemented only to see that the accuracy was slightly improved but at the cost of fourfold computation time to run the simulation compared to any 1st order method. After vast research it was found that the best ratio of accuracy to performance is achieved using semi-implicit Euler method where the velocities are stepped first and these are used to advance displacements as follows:

$$v_{n+1} = v_n + \frac{F}{m}\Delta t \tag{12}$$

$$x_{n+1} = x_n + v_{n+1} \Delta t$$
 (13)

where Δt is time step, F is the force acting on given node and m is the mass of given node. The nodal mass is computed from density of element material and utilizing determinant of deformation tensor which gives double fold area of any triangle element:

$$m = \frac{1}{6} \left| \mathbf{F}_{\mathbf{I}} \right| \boldsymbol{\rho} \tag{14}$$

where ρ is material density. The mass of element is uniformly distributed into its three nodes.

4 CONTACT PROCESSING

Each time step possible contact conditions are checked in two stages. First stage is bounding box type check and if the result is positive then penetration is checked on a per element basis. The bounding box check is only a rough estimation based on bounding the active parts by simple geometric objects (rectangle, square, circle, ellipse etc.) and only penetration of these objects is checked (Fig. 2). This way computational time is conserved as it is always easier to check few rectangles or circles than all possible combinations of elements. In the narrower phase also only combinations of elements are checked which overlap with bounding boxes.



Figure 2 Bounding boxes

When during the narrower phase penetration between the elements is detected, the contact penetration depth h is calculated as minimal value of node distance from each side of the element in direction normal to that side (Fig. 3).



Figure 3 Contact penetration

Afterwards the contact force is calculated as a simple penalty function using given contact stiffness *c*:

$$\vec{F}_C = hc\vec{n} \tag{15}$$

and is applied on penetrating node to push him outside of the penetration on the contact boundary. This force can be seen as an impulse force acting on the node for one time step in temporal discretization, thus the distance which the node travels during this time is:

$$d = \frac{1}{2} \frac{F_C}{m} \Delta t^2 + v_n \Delta t \tag{16}$$

where v_n is nodal velocity in normal direction at the beginning of the time step. To improve stability it is checked whether d > h, that is if the node is pushed too hard and above the contact surface, undesired jagged behavior can occur where the node jumps along the contact surface instead of sliding on it. To push the node exactly onto the surface in this case, the contact force is scaled:

$$F_C^* = F_C \frac{h}{d}.$$
 (17)

The friction during contact is also implemented in the form of Coulomb friction with one friction coefficient both for sticking and slipping conditions:

$$\vec{F}_f = f F_C \vec{t} \tag{18}$$

where f is the friction coefficient and \vec{t} is unit vector in opposite direction of relative sliding velocity. To prevent artificial change in momentum the friction force is capped by sticking condition:

$$F_f = \min\left(fF_C, \frac{\nu_r m}{\Delta t}\right) \tag{19}$$

where v_r is relative sliding velocity. The stability of contact algorithm is improved using this approach even for fairly large time step, but nonetheless the accuracy of simulations suffers so it is always better to scale the time step down even at the cost of computation time.

5 TIRE MODEL

The wheel consists of wheel disc onto which the tire itself is attached. The disc is simply a circle which is divided onto elements of required size. The tire is a circular area with hole for the disc also meshed for required size and accuracy. These meshes are built with compatible nodes along mutual boundary which are later joined together so the whole wheel is a compact part with different material properties for the disc and tire. An example of wheel is in Fig. 4 together with simplified model used until now.



Figure 4 Tire models

The node in the center of the wheel can be used as a link between the wheel and rest of the vehicle model. Forces, velocities and accelerations of the wheel can be directly applied and retrieved through this node. Also torque or brake forces can be applied on the wheel as a force couples acting on the rim of the disc. This way acceleration or deceleration of the vehicle can be simulated through the wheels in a way as it really happens.

The radial stiffness of the tire has to be determined from compression test by numerical experiment. Compression test of a tire comprise of measuring deflection of the tire subjected to normal force which pushes the tire to the ground. The radial stiffness is not only dependent on Young modulus but also on the Poisson ratio as can be seen in Fig. 5 where deflection curves for three different Poisson ratios are shown with constant Young modulus. The radial stiffness of the tire is calculated from the deflection curve through linear regression, or simply by dividing the final compression force by the final deflection. It was found that the radial stiffness is also influenced by mesh configuration. However it is not significant, as the deviation from reference mesh was only 10 % for finer mesh containing four times more elements compared to the reference mesh. But of course it is always for the best to determine new radial stiffness with change in mesh configuration.



Figure 5 Deflection curve

The Poisson ratio is related to volume preservation and it is known that for Poisson ratio 0,5 the volume is kept constant but numerical problems occur such as locking, which is artificially increased stiffness of the system. Thus for the next test it was chosen constant Poisson ratio of 0,45 and the stiffness was examined for various values of Young modulus. The relation of the radial stiffness on the value of Young modulus can be seen in Fig.6 where ten tests were performed and interpolated by a curve. From this graph material properties can be determined to match required radial stiffness for given tire profile.



Figure 6 Radial stiffness vs. Young modulus

It can be seen that the relation is quite linear and material properties can be readily obtained. For example tire profile in Fig. 4 is mounted on vehicle Aligator 4x4 and its radial stiffness was experimentally measured to be 639782 N/m. According to graph corresponding Young modulus used for the simulation is 295740 Pa. To show the main advantage of this tire model these values were used as an input to the simulation of tire passing a curb. Both models - FEM model as well as simplified model were subjected to load of approx. 1,5 t and passed through a curbstone with height of 0,2 m. Displacement of the center of the wheel is recorded against time in both cases to compare the behavior (Fig. 7).



Figure 7 Displacement – curb passing

It can be seen from the figure that the FEM model has proper timing and the simplified is delayed because the step function is applied directly to the tire when the center is passing the irregularity. On the other hand the FEM tire continuously roll over the step and deforms properly (fig. 8). Also it can be seen that there is loss in contact in the FEM model. The simplified model does not incorporate decoupling thus the tire is always in contact with the surface.



Figure 8 Deformed tire

6 CONCLUSION

In the paper a FEM approach to tire modelling is shown. The wheel consists of disc and tire coupled together where different material properties can be assigned to both. Until now a simplified model was used consisting of point mass connected to spring and damper which gives not particular results especially when passing through a large discontinuity on the terrain. The approach shown in the paper gives much more accurate results in these cases as is presented. Moreover the model can be coupled with any existing vehicle models through the center node of the wheel.

The radial stiffness has to be determined by numerical experiment and it can be seen that it is influenced mainly by Young modulus which has linear relation to mentioned quantity. The contact handling permit also decoupling of contact surfaces, in this case the tire can jump on the surface and it is not constrained in any way as was the case of simplified model. Different tire pressures can be modeled simply by varying the material parameters of the tire.

In the paper a simple example was presented for tire used on Alligator 4x4 vehicle, but there are no limits to the dimensions of the tire profile and also wheel disc can be of any size. The only requirement are compatible meshes on the joint boundary so they can be merged into one part.

Friction of the tire with passing surface is implemented into the contact hadnling routine thus it is possible to simulate slipping of the tire due to insufficient adhesion and related effects. The construction of the tire allows to apply torque or braking force couples so the vehicle can be continuously accelerated and decelerated on the run during simulation. In vehicle model any tire can be chosen to be accelerated thus it is possible to simulate front/rear drive and also four wheel drive and even more for special vehicles.

The computational cost is not that bad either and can be scaled through mesh configuration and time step to meet requirements on the speed or accuracy. Real time simulation can be obtained but only on multi-core processors.

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SOCIAL RELATIONS AND ACTIVITIES –PART OF THE CULTURE OF A MILITARY ORGANIZATION

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Abstract: The content of this article is theoretic analysis of the environment of social relations and social activities in military organization as main social components, which form the content of culture of military organization. Theoretic analysis is performed from the sociologic aspect. The emphasis is on defining social relations and social activities as two inseparable parts of each social bond in general and steadiness of culture of military organization in particular.

Keywords: Social bond, social relations and activities, culture of organization, military organization, culture of military organization.

The culture of an organization is, in general, understood as a set of values standards, patterns of behaviour and institutions in a given whole which determines the manner and forms of behaviour (the manner of performance of working activities), of its elements, their relations inside the social system of the organization and also relations outside.

- Outwardly (towards the surroundings) it manifests itself, either intellectually (immaterially) as an image, presentation of philosophy of a given organization, or materially, namely, by both, its products and material tools of its own identity: design, publicity, behaviour on the market and the like.
- *Inwards* (towards its own members) it also manifests itself either immaterially, namely: by interpreting its position on the market, in the style of management, information flows, climate, principles of personal work, etc., or by material manifestation of the quality of working environment and working conditions forming the basis of working climate in the given organization.¹

In a military organization (armed forces), the culture of the organization is defined mainly in military documents (doctrine, strategy, basic rules and regulations, orders and directives, etc.). They must fulfil the basic philosophy of given armed organization, particularly, forces. A military outwardly manifests itself by rites, and also by material symbolic artefacts. An exact definition and description of social standards and patterns of behaviour of every member of armed forces (military activities) is one of essential signs of military organization.² Social institutions in a military organization are hierarchically arranged, thev have exactly defined their social

positions function) and corresponding roles (functional duties).

It should be emphasised that the culture of any social system (not excluding armed forces) is based on the culture of higher systems which determines the manner of inclusion in a higher whole, and, thus, it is an expression of social reality. Specific features of the culture of concrete social systems (the culture of an organization), which are integrated in higher social systems and become in conformity with it should be understood not as distinguished and different, but as modified and defined in a more specific and detailed way, or as elements filling the space that, in general, has not been yet filled and also is not the content of any patterns of behaviour. This, however, means that every culture of a lower system (the culture of an organization) is a subset of the culture of a higher system and at the same time it is a wider circle of elements (components) which are based on specific conditions of functioning of this lower system. Also the social system of armed forces is generally controlled by the culture of higher systems a component part of which is also the culture of organization, with the dominant culture being the culture of a higher social system – that is the culture of the social system of a society- social culture. In practice it means that a military professional is under influence of the pressure of the culture of society in general – as a citizen and under the pressure the culture of the given military organization (armed forces) - as a member of armed forces (employee or soldier).

This unity (synergetic effect) strengthens the pressure on its members with the only aim - to effectively fulfil the set target of a concrete military organization. Therefore, it is necessary to create the culture of armed forces in such a form which would make possible and facilitate the achievement of its target.

¹ NOVÝ, I. a kol.: Sociologie pro ekonomy. (Sociology for economists) Praha : GRADA a.s. 1997. s. 55-58. ISBN 80-7169-433-9.

² POLONSKÝ, D. , MATIS, J., MALÁTEK, V.: Sociologický pohľad na armádu. L. Mikuláš : VA SNP, 1994. s. 24. ISBN 80-8040-019-9.

A spontaneously arisen (not controlled by anybody) culture of an organization will, that is to say, conserve and constantly reproduce all uncertainties, incongruities, conflictsand undesirable behaviours, which participated in its creation. A change of such spontaneously created culture of a given military organization is then a longer-term process which requires an extraordinary endeavour and much larger means.

By the entry of the Slovak Republic into the NATO, the dominant culture for our armed forces is becoming the culture of the military organization – NATO and for the Slovak Republic the culture of advanced states of Europe (the European Union). Therefore it is necessary to pay an increased and continuous attention to the reforming of the old culture and also to the formation of a new social culture and culture of the armed forces, namely, to both, the theoretical and methodological-empiric aspect, as well as the legislative, but mainly the practical-realization aspects. We assume that the bases of every concrete organization culture are formed in four ways:

- The culture is formed by "leaders"of a given organization, mainly by those who formed this organization in the past (the so-called visionary leaders, leaders who have some ideas visions).
- The culture of an organization is formed by the so-called "critical cases", significant events in which people find teachings of desirable or undesirable behaviour.
- The culture is formed on the basis of the need to maintain effective working relations between members of an organization, which creates and consolidates values and expectations.
- The culture is fortified by the organization's environment. The external environment may be relatively dynamic or invariable (constant).

The culture of an organization is learned by people in the course of time. There exist two basic ways of this learning:

- traumatic model: in which members of an organization learn to face a certain threat by creation of a defensive mechanism;
- model of positive strengthening of consciousness: in which the rooting and fixed setting of procedures which can function occurs.

The learning occurs when people adapt themselves to outside pressures and face them (interaction) and when they gradually create successful approaches and mechanisms to manage internal stimuli, problems, processes and technologies in their organization. Where the culture was formed in the course of a long period of time and rooted deeply, it may be more difficult to change it quickly, provided that no traumatic events have already taken place.³

The culture of a given organization is created on the basis of the need to constantly fortify the social tie (band) of the given organization, which is performed as a continuous process of social activities (interactions). In this process interpersonal and social relations are created the basis of which is the establishment of social contact. That can be considered as a basic precondition for formation of every social bond/tie.

The concept which reflects the action of people, whole groups and societies on each other, which expresses their social activity and also the fact that an individual, group or the whole society exert influence on others and at the same time experience the action from their side is called as social bond (tie). Most frequently it is understood as intersection (conjunction) of *social relations* and *social activities* (social interaction understood as an aspect of social intercourse), whereby:

- *social intercourse* reflects the form and manner of activity, which means the processual (dynamic) aspect of social bond;
- *social relation* expresses rather the content–structural (static) aspect of social bond.

It is assumed that the social bond is created primarily by interpersonal relations, which are the result of social relations. These are realized in the course of social intercourse in activity, which means in social interaction (see Figure 1). Figure 1 emphasizes the fact that social interaction creates in the system of social bonds one aspect of social intercourse which together with social relations creates the basic component of social bond. The social bond is expressed as a conjunction of social relations and activities. Social relations (primarysecondary and formal-informal) express its static (structural) aspect. Social activities (social intercourse. formed from by, each other interaction, inseparable. communication and perception aspect), express its dynamic (processual) aspect. Social bond can also be a short-term one and irregular (not filled) one. Such type of social bond is called social contact. It expresses the first intercourse in which interpersonal relations occur only potentially, because it was not possible for them to be really created. They only start to be created in mutual interaction (concrete activity). Social contact is only a precondition (basic

³ AMSTRONG, M.: *Řízení lidských zdrojů*. Praha : GRADA PUBLISHING a.s. 2002. s. 201. ISBN 80-247-0469-2.

condition) of social bond. It can, but need not necessarily, be transformed into it.

In Figure 1 its place is defined in this complicated system. Social contact cannot be

identified neither with social intercourse, because it is only the first intercourse and even that in its substance exceeds it by social relations (potential).



Figure 1 System of social bonds

It can neither be identified with social band, because even if it includes in itself social relations, it is only potentially. It is however considered to be basic condition for formation of every social bond. Figure 1 also shows graphical representation of basic types of social bond, namely: *traditional, affective, rational and pragmatic.*⁴

The fact that these types of social bond are understood as its layers indicates also mutual connection among them. In practical activity, these defined types though operate always together, but in the complex of relations and activities various role belongs to them. The decisive is the fact which form of motivation is dominating to such degree that it determines:

- the behaviour of individuals (members of organization) and whole groups in a concrete organization or also of individual organizations within higher organizational wholes of coexistence;
- which of the basic types of bond in a given concrete situation prevails in the organization.

Social interaction is generally perceived as subject-object relation, as a process of constant mutual effect and influence of at least two elements (man, social group) of a certain social grouping (group – organization or institution, society), where the action of one element is the reaction on the action of the other element, is performed in practice on two basic levels: on *micro-* and *macro- level*.

On micro-level it is performed as a direct, intermediate interaction of individuals and on macro-level as an interaction of subsystems of society (social group, organization, institution).⁵

Social interactions take place in everyday life of people who come into intermediate intercourse as members of various social groups or into accidental contact. They mostly take place according to certain patterns and rules valid either in social groups, or in the whole society. Social interaction cannot be understood:

 either as spontaneous and creative process which goes by exclusively material aspect of social intercourse,

⁴ VYHNAL, M., MATIS, J., TUČEK, J.: Sociológia I. Lipt. Mikuláš : Vojenská akadémia, 1998. s. 158 – 159. ISBN 80-8040-074-1.

⁵ KOŠTA, J.: Sociológia. Bratislava : EU, 1996. s. 29 a STRIEŽENEC, Š.: Slovník sociálneho pracovníka, 1. vydanie. Trnava : Vydavateľstvo AD, 1996. s. 84.

• or as a process in which unreservedly respects the social position of the participant.

If the social interaction took place exclusively spontaneously, its course could in many cases break already existing social relations and structures. I fit, however, took place in such a way that it would respect exclusively the social position of participants, it would significantly hamper (retard) the dynamic of social (group and individual) life and it would become in many cases useless. Therefore, both these extremities in the comprehension of social interaction should be avoided.

Opinions of sociologists on the classification of interaction processes are not unified in sociological literature: From the methodological point of view they can be divided into:

- Approach to its classification from a strictly *dichotomic* (polarizational) aspect⁶, according to which, on the basis of contrastive (polarizational, dichotomic) differentional signs two types of social interaction can be defined, namely: *intentional and unintentional.* The author of this classification is American sociologist E. Goffman. The substance of his approach is the classification (differentiation) of all kinds of interactions into those in which the participating parties do not achieve (even do not want to achieve) any targets, and those in which the participating parties want to achieve concrete real goals.
 - intentional interaction is the one, where the participants pay attention to their manifestations, and at the same time they express their endeavour to achieve a certain target (group of targets), where the basic unit of this interaction is, according to Goffman, "meeting", because most of everyday life of people consists of a series of such meetings (social contacts);
 - *unintentional interaction* is the one, where the meeting (social contact) happened unintentionally (non-purposefully), without sighting any concrete target, namely by way of gathering a number of people in one place, where at least one non-verbal (extralingual) communication takes place and its participants leave with one another at least a certain impression, namely by their appearance, movement, gestures and the like.⁷

- Approach to its classification from a mixed *dichotomic-layered* aspect enables us to divide social interaction into interaction forms of processes: *integration* and *disintegration*. Interaction is not reduced only to the above given basic opposed processes, because in practice both the opposites exist always simultaneously, but in their mutual action only one prevails. It is therefore more convenient to define individual types of interaction rather according to the targets of participating parties and according to similarity of coordination between them in achieving these targets that is in a layered way.
 - the process of integration is the one in which relations of attraction arise and which has these basic forms: solidarity (mutuality, two sociability), cooperation and coordination (harmonization) in which the mutual relationship itself results from harmonic (apolarized), that is layered approach and they can be included into several categories: 1. drawing together - the process of gaining favour, mutual confidence and attention; 2. assimilation - the process of mutual fusion (it also includes accommodation - the process of learning something, getting accustomed to something and also adaptation – the process of adaptation to conditions, situation or stimuli); 3. conformity – the process of mutual adaptation with the aim of gaining sameness, unity (unifying);
 - the process of disintegration is the one in which relations of repulsion arise and among its basic kinds may be included the following: competition (a form of opposition, contending or fighting) and antagonisms (a form of social contradiction or social conflict), where disintegration is incorrectly identified with the concept of disorganization which is the opposite of organizing and it expresses decomposition of a system (a whole) and not separation of parts (components) of this system from each other, with a possibility, however, of the disintegration being an impulse, beginning of disorganization, which means that the disorganisation will become the result of the process of disintegration.⁸
- Approach to its classification according to harmonic, the so-called pure layered approach enables social interaction to be differentiated into

⁶ VYHNAL, M., MATIS, J., TUČEK, J.: Sociológia I. Liptovský Mikuláš : Vojenská akadémia, 1998. s. 162 – 166. ISBN 80-8040-074-1.

⁷ KOŠTA, J.: *Sociológia*. Bratislava : EU, 1996. s. 34 – 37.

³ VYHNAL, M.: Základy sociológie. Lipt. Mikuláš : VVTŠ, 1991. s. 111.

- individual types understood as layers (levels) of a certain whole. According to concrete situation one layer acquires in point of importance (prevails) and characterizes momentarily concrete type of social interaction. By this approach the dichotomy in classification of social interaction is partly eliminated and its individual types are thereafter divided into *basic* (main) ones a part of which includes *specific types* that have a certain relative independence.
 - the basic types of social interaction include: coexistence (existence together, living side by coordination (harmonization) side). and cooperation (working together, harmonious combination). The coexistence is taken as an interaction which its participants in (individuals, social groups, various societies) operate side by side essentially without regard to each other, where tolerance is symptomatic for its favourable course. The coordination is understood as an interaction in which its participants act relatively independently, the reason of harmonizing their activities is because the reaching of a target by one of participants is subject to the reaching of the target by other participants, however, this presumes giving respect to each other. The cooperation is defined as an interaction whose participants cooperate with each other, which means that they perform such activities in which they help each other and at the same time they mutually complement and exchange these activities in order to reach the common target as effectively as possible.
 - the specific types of social interaction are considered to be part of its basic types and include: contest (rivalry); competition and social conflict. The contest (rivalry) is an interaction which consists in the assertion of an opinion, idea, value or procedure by one participant of interaction towards the other (one's own opinion to in prejudice of another), where the winner can be only one participant of interaction. The competition is an interaction which involves the enforcement of a certain opinion, idea, value or procedure of its participant, but not to the detriment of another (it means that there exist side by side even several competitive opinions), where the objective can be accomplished by several participants of interaction even simultaneously. The social conflict is an interaction in which the participating parties want to reach various opinions, values and objectives. It is

experienced by its participants as discord or lack of understanding and can have most different manifestations, where the attainment of a goal by one participant excludes the attainment of the goal by other participant, sometimes even its very existence.⁹

Opinions on the definition and description of the structure of social interaction are not uniform. In the history of sociology (Weber, Sorokin, Parsons) and social psychology (Jung, Freeman) existed several attempts to define its elements and describe possible structure of their mutual action. The common denominator of these attempts was the effort to catch some components of mutual action of people and their bond. The task was formulated as a search for dominating factors of motivation of activity in interaction, mainly its individual act. Therefore it would be good to have a closer look at what forms the basis (the substance) of individual attempts, with concentrating on only some characteristic conceptions.

Talcott Parsons attempted to outline a general categorial apparatus for description of the structure of social activity, namely in contrast to an orientation in which the structure of human activity is analyzed first and then individual acts are specified in it as its components. The structure of an individual act (interaction) is then a component part of the overall activity structure which is social by its content.

In his concept, the basis of activity involves interpersonal interactions taken as individual acts on which the human activity is built which, in the long run, is the result of individual acts. An individual act is understood separately in terms of a theoretically created abstract scheme in which as elements appear: 1. actor (subject); 2."the other" (object, to which the act is oriented); 3. standards (according to which interaction is organized); 4. values (that are recognized by each participant in interaction); 5. situation (in which the act of interaction takes place). In relation to "the other" the actor develops a system of orientations and expectations characterized, on the one hand, by efforts to achieve objectives and, on the other hand, by efforts to respect probable reactions of the other.10

Parsons' scheme of activity showed to be so abstract that, for an analysis of various kinds of activity in experimental practice, it had no significance. Without an analysis of overall activity (as is the case in most approaches), it is, namely, not possible to carry out an analysis of individual

⁹ VYHNAL, M.: Základy sociológie. L. Mikuláš: VVTŠ. 1991. s. 111-112.

¹⁰ ANDREJEVOVÁ, G. M.: Sociální psychologie. Praha : Svoboda, 1984. s. 116 – 117.

components. There became the need, except for elimination of the too much of abstraction of his approach to interaction, to change his concept (interaction is component part of social activities and not the other way round), which was attempted by Polish sociologist J. Szczepanski.

Jan Szczepański joined the construction of the structure of social interaction with the description of individual degrees of his development, Notwithstanding that the social interaction is not divided into elementary acts (elements, components), but into individual stages through which it goes.

The main concept with him for the description of social behaviour is "social bond", which he understands gradual accomplishment of: intercourse in space; psychical bond (taken as mutual arousing of interest and understanding); social intercourse (social activity); mutual action or interaction taken as a systematic and permanent performance of activity aimed at arousing the corresponding reaction with the partner, social activity (mutual connection of systems of activity). This arrangement is, however, not considered to be too exact.¹¹

Even if this attempt of his refers mainly to the characteristic of "social bond", it is just that form of its, which he called interaction, that is described the most completely. This description contains the shortcomings of the previous attempt (detached from practice). A shift took place in the definition of the position of interaction, as part of social intercourse, which is understood in it as common (social) activity.

Classification conception expresses an attempt based on construing of classification of various kinds of social interaction, into which people enter during their life. It has several approaches of which the most famous is *the approach of symbolic interactionalism* and the so-called *contentual organizational approach*.

- Approach of "symbolic interactionism" is base on the fact that social interactionalism is a special trend in social psychology which considers interaction to be a point of departure of every psychological analysis. He holds G. H. Mead who named it "symbolic interactionism" (also called "social behaviorism") to be the founder. The main idea of "interactionistic conception" consists in that personality is formed in interaction with other personalities and the mechanism of this process is the creation of control of activity of personality, namely on the basis of ideas that other get of it. However, this theory has, except for the main weakness of

reducing the problems to an individual interaction and thus to its simplification, two substantial methodological gaps: 1. inappropriately big importance in this conception is attributed to the role of symbols (reflection of personality is then subordinate to the world of symbols and also others evaluate personality through symbols adopted in a given group); 2. separation of communication aspect of interaction from the content of activity at issue, so that the whole richness of communication aspect of macrosocial relations of personality is in fact ignored - the only representative of social relations remain only the relations of intermediate interaction owing to which a conclusion of interaction a group set in advance, and that is evidently insufficient.¹² The basic shortcoming of this approach as well is the fact that social interaction, though already conceived as an aspect of social intercourse, analyses in a manner detached from social activity.

contentual organizational approach analyses interaction as a term that characterises those components of social intercourse which are linked to mutual action of people, to immediate organization of their common activity. This approach eliminates the above mentioned shortcomings of the previous approaches, because it joins interaction with real activity. It does not reduce it only to interpersonal or abstract (symbolic) interaction. It includes social interaction in the whole context of activity as its organized form and characterises (defines) it as mutual influence of acting and behaviour of a subject and object, as a complicated process which includes: communication, conceived as a means of orientation of an acting subject, as a means and form of delivery of information, internal (emotional) aspects, understood as processes of attraction, indifference (neutrality) and repulsion, and finally objective (external) aspects, ensuing from inclusion of its participants in a concrete social environment.¹³

Social interaction is characterized according to organizational-contentual approach as subjectobject relation, arising in organized activity, taking place in a certain defined concrete social environment (given social relations and activities). The structure of social interaction is formed by: *subject* and *object* (individual, social group – social organization or institution or also the whole

¹¹ SZCZEPANSKI, J.: Základné sociologické pojmy, Praha : NPL, 1966. s. 63 - 71.

¹² ANDREJEVOVÁ, G. M.: Sociální psychologie. Praha : Svoboda 1984. s. 126 – 129.

¹³ VYHNAL, M., MATIS, J., TUČEK, J.: Sociológia I. Liptovský Mikuláš : VA, 1998. s. 169-173. ISBN 80-8040-074-1.

society); *communication* (verbal, non-verbal and other); *internal conditions of object and subject* (the interest and need of the subject and also reactionand response of the object) and finally by *external conditions* (social relations and activities).

The disposition (layout) of these basic elements (components) and relations among them can also be expressed graphically. It should be realized that every graphical representation reduces relations and activities that are the content of social phenomena and their development (dynamics). However, for our need of analysis of the structure of social interaction, such graphical representation is quite sufficient, because it shows layout of these basic elements of social interaction which will be dealt with in more detail (Figure 2). In the graphical representation of the contentual-organizational approach to the structure of social interaction, the social interaction is defined as part of a concrete social activity. Social activity with social relations form *social environment*, influencing given external conditions.

Individual types of social interaction (basic - coexistence, coordination and cooperation; specific – competition, contest and social conflict) are conceived as its layers. Which type of interaction will prevail, depends on many factors and individual components forming the interaction, namely starting from environment and ending with internal conditions of subject or object.



Figure 2 Structure of social interaction

Subject and object of social interaction may involve individuals (individual, interpersonal interaction), social groups (group interaction) or individual societies (social, global interaction). The course and type of interaction are influenced by, except for whom the subject or object are formed by, also the facto f what position and prestige these have in its structure.

Internal conditions of social interaction are formed by: with the subject, need for and interest in an interaction with a given object; with the object, response (reaction) to this need or interest of the subject.¹⁴ These conditions influence to a great

extent the type and kind of interaction and are influenced pretty much, except for the already

finally standards expressing how an individual, group, society must behave if it wants to be part of a whole.

The prestige of a subject or object of social interaction is the result of a certain manner of their positive evaluation by the social whole of which they are part. In its substance this is the case of an evaluation of their social roles, which contains the following components: social (group)benefit of activities that they perform; attractiveness of these activities performed; level of creative character of their activities and the degree of their education (preparation) needed for these activities to be realized.

¹⁴ Note: Social position of subject or object of social interaction is expressed by their place in a given social system with which they are joined: rights that express how will expectations of individual, group, society behave in respect of one another; obligations and duties expressing expectations how an individual, group and society will behave if it wants to be part of a whole and

The social role of a subject or object expresses a relatively stable and internally interconnected system of behaviour (activity, social intercourse), the aggregate of reactions to the behaviour of others, which is carried out according to more or less fixed patterns of behaviour. These are either expected or required by standards.

mentioned position, roles and prestige, by external conditions as well.

External conditions are formed by a concrete social activity and social relations. Social relations that arose beyond direct social intercourse and are a precondition for interaction are defined as *formal*. Relations that arose in direct social intercourse as a result of social interaction are defined as *informal*. These relations are, in the process of interpersonal interaction (micro-level), also defined as *personal* (informal) and *impersonal* (formal).

Communication is an aspect of social intercourse which forms also an element of social interaction. It expresses the tendency and ability to communicate (exchange) certain contents among participants of interaction (object-subject) in processes of not only direct, but also indirect social intercourse. This ability intrinsic to all living beings however evolved with people in the course of their historical (phylogenetic) and psychic (ontogenetic) evolution into a richer in terms of content and more varied in form communication than with other living creatures known so-far – into the so-called *social communication*.¹⁵

Social communication (communication among people) can be defined as a process of delivery and acceptance of meanings (information transfer) in direct and indirect social intercourse, with the transfer being on individual, group, society, but also on inter-society (global) levels

From the sociological aspect social intercourse is not only an interpersonal process in which information (meanings) is/are delivered or exchanged as social intercourse is often explained, but it is also the basic social activity, the basic element of social action – social intercourse (social interaction) on its individual levels. On an individual level the communication is called interpersonal, on a group and whole-society levels we speak about group and mass (the so-called mass-media) communication.

Social activity and social relations form social environment influencing given external conditions not only for the prevailing type of social interaction, but also for forming a concrete culture of a given organization. It is therefore necessary to pay attention to a brief analysis of *activity* and in particular to *military activity*, which participate in the formation of the culture of military organization and strengthening its social bond.

When solving the relation between human and military activity on may start from the fact that military activity is a specific form of human activity. For the targets and content of military activity to be understood correctly, it is necessary in general to briefly characterize human activity as well.

Human activity can be defined as a mutual action of man and nature, as an interlink of connection of theory with practice. Activity is for man a specific manner of relation to the external world that can be characterized in the most rendering way as adaptation of oneself to the nature and simultaneously adaptation of the nature for oneself with the help of tools. It expresses the process of reformation and conquering of the nature to satisfy human needs and interests. It expresses most adequately the activity of man, his biological activity and his social (specifically human) activity.

By means of activity the internal unity of the biological and the social in individual development of man. By means of activity, the internal unity of biological and social in individual development of man is realized. By means of activity, man engages in the system of social relations and by their mastering he forms his social substance. In the broadest sense of the word, activity means, on the one hand, the creation of conditions for existence and development of a social subject (it can be society as a whole, social groups – organizations or institutions and also individuals), and on the other hand, the process of reformation of social reality in conformity with interests, needs, targets and tasks of society, group and individual.

A human activity possesses various *forms and kinds*. From different aspects (point of views) we can determine following:

- way of implementation point of view:
 - is theoretical (mental) activity which is a subject of all mental processes resulting in intangible (spiritual) works as an assumption (project) of material activity,
 - is material (physical) activity which is a subject of all material processes resulting in material works as a result of project implementation originated in theoretical (spiritual) activity;
- outcome of activity point of view:
 - is a constructive activity the result of which is a creation of a new or recreation of already existing spiritual or material human work,
 - is a destructive activity the result of which is a destruction of already existing spiritual or

¹⁵ Note: In sociological and psychological literature the following form of social communication are mentioned: *verbal communication, non-verbal communication* and *other forms of communication.*

BOROŠ, J.: *Základy sociálnej psychológie*. Bratislava : IRIS, 2001. ISBN 80-89018-20-3.

KOLLÁRIK, T.: *Sociálna psychológia*. Bratislava : SPN. 1993. ISBN 80-08-01828-3.

FRK, V., KREDÁTUS, J.: *Komunikácia v personálnej a sociálnej praxi*. Prešov : Akcent Print . 2005. ISBN 80-969274-5-0 etc.
- material human work and also existing animate
- and inanimate nature (environment) of which the man is an integral part of.
- differentiation of society into particular spheres point of view:
 - is an economic activity inherent in all intangible and material processes carried out in economic field (e.g. activities in production as management, material supply, or project implementations, etc.),
 - is a political activity (military activity including) inherent in all processes enabling to gain and enforce power (the right to control relations in society, e.g.: preparation of acts, election, parliamentary activities, sovereignty and state interest protection, etc.),
 - is a cultural activity inherent in all processes of material and mental nature ensuring transfer and creation of new findings, cultural traditions and material work (e.g. education and training, science, art, technology, etc.);
 - is a social activity inherent in all processes of mental and material nature resulting from positions and roles of man in various social groups (organization and institution) and in society (e.g.: family – parent, child, etc.).
- time point of view:
 - is a constant (regular) activity which is inherent in regularly repeating processes (e.g. work, education, etc.),
 - is a occasional (irregular) activity inherent in processes the duration of which is short or occurs irregularly (e.g. court sweeping, car repair, dish wash, etc.).
- *subject of activity point of view (who carries out activity):*
 - is individual activity the subject of which is individual,
 - is group activity the subject of which is social group,
- is social activity the subject of which is society.
- form of activity point of view:
 - play is a form activity when the subject orients in given surroundings (social, cultural and natural) and thus gains experiences, knowledge and skills,
 - learning is a form of activity when the subject adjust to the surroundings, whereby social learning is an adoption of behavior and simulation of certain models in given social surroundings,
 - work (work activity) is a form of activity when material and spiritual values are created, it is considered the one of basic life needs of a man existence.

Basic function of the man activity in general is to preserve and continuously develop human society. The existence and further development of human society markedly determines (conditions) the existence and development of person itself – his personal qualities. Classification (enter) of the individual into society is not a single act but long term process defined as socialization. This process is progressive adoption of social experience in the widest sense.

Social (specifically human) activity includes not only the way (style, method) of transformation of the nature on the basis of human needs and interests, but also humanization of the world by man factor and creation and continual enhancement of human society. It is also process which objectifies self substance of a man who in this process retires from nature and gains the social qualities. He becomes a part of human society (social group – organization or institution) and becomes its member – personality. Human activity acquires more consciousness and creativity during development still whereby grows independence of each individual (his individuality and subordinated differentiation of his activity). At the same time the need of cooperation of individuals and interlink of all activity kinds within the given society (social group) increases. The base of human activity represents a way of creation of own material and spiritual life which determines general social rules of its development. Social rules are substantial links and relations which occur in various spheres of human activity and above all in its basic form in material production. Existence of objective conditions more or less favorable for social subject itself creates only certain possibilities for development though these possibilities are performed by real people having consciousness and will, affecting in accordance with their needs and interests. Activity acts as power renewing and changing system of objective and subjective conditions (social relationships, activities and processes and corresponding system of ideas) - socalled whole way of life, thinking and performance of people.

Human activity is historical phenomenon. If originates, changes and improves together with development of social relationships formed and continuously changed by it. Through human activity social processes are being implemented. People are grouped to various types and social group forms which create social structure of the society. The task of these social groups in social formation of personality (so-called special socialization) is not equivalent. Acts of these social groups are specific, multilateral and not underlie mechanic determinism principles (relativity). That means that external reason never evokes in affecting some system a direct and instant effect but the results of this affect occur on the basis of harmony of external reasons and internal conditions or codes and regularities of particular system, the reason refracts via internal conditions. Social activity can by understood as necessity in front of which stands each individual who in integration to the human society (socialization) by play, learning and work adopts given social experience which is only specific form of generically experience.

The brief analyses of certain aspects of activity make us to think about the relation between social (specifically human) activity and military activity. Military activity can be considered an activity in one of the sphere of human society – social-politic field. Its formation is a result of historical development of human society when the human activity gradually differentiated. Process of differentiation of human activity in its basic and the highest form can be characterized as division of labor. The division of labor assigns from individual types of social activity its special kind – military activity. Carrier of this activity is an army (forces) which the society (its institution - state) formed for own protection.

Military activity can be defined as unity of material and mental activity, as unity of military work, learning and play, the unity of constructive and destructive activity. Military activity is special kind of activity in society. It has specific status and task comparing with other social processes. It is a policy mean. It creates one of above mentioned kind of social (human specific) activity and differs from others by following:

- it has significant socio-politic content,
- uses mass military violence means,
- its strictly organize in all stages,
- significant restriction of all the components disturbing the goals of army activity (military organization).

Military activity is substantially the kind of work activity, its characteristic is therefore close to the characteristic of military work.¹⁶

It has following *features*:

- significant social focus necessitating different incentives for individuals as current civic activity (e.g. solders incentive system – wages and penalties),
- bilaterally or multilaterally destructive activity, there are two or several militant sides (states,

coalitions) with one goal to defeat an opponent even to destruct him,

- multilateralism and variability of activities for individual and groups (defensive and offensive activity, transfers, etc.), at the same time high activity specialization according to weapon types and military qualification what necessities various level of education and qualification what have to be ensured by forces themselves,
- dependence of militant side power regenerations on specific situation and not on current needs (determining is current situation, not army distress and fatigability),
- impossibility to prepare new battle conditions in army training even if it was generally valid that the more the training conditions proximate to the battle ones the better the individuals and groups are prepared.

The one who implement the military activity is an army (forces) created by society (its political institution – state) for self protection. In this connection there is a necessary to note that the notions military activity and activity of army (forces) are not the same.¹⁷ Army carries out also non-military activities, the activities which do not have pure military character. To speak about military activities in peace beyond army is also not very precise. Therefore from all various activities carried out by army its possible to specify three basic *aspects:* military-professional, socio-political and generally-social.

Military activity is specified in military work activity (military work) which is one of many kinds of human activity in society. In detailed investigation many elements reveal between which had spread the net of relations. Except of *subject and object* these elements form a *goal* coming out

¹⁶ MATIS, J., HAMAJ, P., MARTINSKÁ, M.: *Sociológia armády*. Lipt. Mikuláš : AOS. 2008. s. 117. ISBN 978-80-8040-361.

¹⁷ Note: In terms of conditions under which the military activity is carried out it can be basically divided into activities: A) in peace conditions where is characteristic: 1. to master the war methods with emphasis on mass army violence conducting rules; 2.to maintain the continuous fight and mobilization emergency and 3. military education and training of democracy army members (citizens of democratic country) in spirit of modern battle requirements; B) in war conditions where is characteristic: 1. obligation to participate in early fulfillment of country mobilization tasks with emphases on mobilization of country forces and 2. conduction of mass army violence with the aim to achieve victory, protect state interests and sovereignty of the country and its area integrity.

from interests and needs, means, matter and the result of this activity. 18

Military work activity character can not be defined without clarifying the sense and the content of the notion "character". The notion character indicates the set of substantial properties, features of somebody or something, certain individuality, nature of the person, event or process. If we want to set character of military work activity we have to come out from the fact that this notion will reflect the features, signs and properties characteristic for this activity and express not only substantial and internal relations but also its peculiarities and specific manifestations.

Military work activity content can be defined as summary of elements, aspects and relationships of human activity. In specific form it expresses what man really does, what is the content of his activity. It includes structure and scope of work functions and activities which he does in current work process fulfilling work tasks. It is defined: by level of requirements on human work activity in work process, by the scope of his responsibilities and decision possibilities, by application of physical and intellectual abilities and also by diversity, universality and difficulty of work activities.

Work activities of soldiers can not be understood scholastically and dogmatically. They are only specific base of already mentioned content of military work activity, but only in peace conditions. In war, in real fight situation these activities would be modified and the main kind of soldier activity would became fight activity (army battle) assigning other activities.

Conditions of the military work activity express character of the environment where the activity is implemented and generally are classified as:

- *materially-technical* formed by the level of material, technical and rear ensurance of army members (forces),
- *organizational* formed not only by army organization structure but also by the environment description where is specific military activity conducted, e.g. activity description (reglement), setting interrelations, determination of positions and roles etc.,
- *social* formed by elements of complex social ensurance of the army members not only during army service but also after the end such as e.g.:

wages, health and pensioner ensurance system, relaxation, etc.,

- *health-hygienic* formed by elements of health and hygienic ensurance of specific work activity such as e.g.: safety work system, hygienic facilities, lighting, ventilation, etc.,
- *culture esthetic* formed not only by esthetic, material and spiritual works, but also by cultural environment elements such as army traditions, behavior standards, army songs, style of accommodation and catering, style of language use, dressing discipline, etc.

Relation to the military work activity is formed in specific conditions by influence of specific factors of this activity and other specific characteristics of army members. This relation the most significantly expresses itself as a relation of soldiers to military work activity which includes all spectra of various relations classified in following levels:

- relation to work activity generally in this level it is expressed as the relation to the mean of ensurance of: basic (primary) life interests and needs, human self-fulfillment and ensurance of other cultural (secondary) needs and interests,
- *relation to military profession* in this level is expressed as the relation to peculiarities and specifics of military work activity in society and also as relation to wider social conditions under which the activity is done,
- *relation to military service* in this level is expressed as the relation to specific military activity (activities) done in certain army troop in specific army position, thus in specific (local) conditions.¹⁹

The goal of military activity is to ensure the protection of country interests and sovereignty. Understood as kind of work activity (military work) it forms the content of military profession this content is changed by the creation of professional army, but do not fade, on the contrary becomes more important.

The notion "relation" express the fact that between two or several subjects exist certain connection (link, join). The basic notion reflecting mutual social contact or people (social groups or societies) affecting themselves is the notion "social

¹⁸ MATIS, J., HAMAJ, P., MARTINSKÁ, M.: Sociológia armády. Lipt. Mikuláš : Akadémia ozbrojených síl 2008. s. 237 – 240. ISBN 978-80-8040-361.

¹⁹ <u>Note:</u> Presented levels of relation to the military work activity do not exist separately, but are interlinked as various aspects of the same social process. Relation to military work activity is formed mainly through the relation to military profession and army service understood as specific operation. Military activity is understood as dynamic aspect of this complex social phenomenon, which the military profession represents.

relation". Social relations are permanent, organic parts of social activities which in these social activities occur and influence them. They connect individual (group) activity and express the fact that individual has influence on others and at the same time under their exposure. Between them is formed *social link*.

Social relations can be defined as historically changeable forms of social contact with certain content, formed and transformed by active society members (society group) in compliance with overall development and conditioned by society (social group) organization. Social relations are closely connected to *social structure* of the social group and its *activity*. They in certain way express the kind of social contact, the kind of social link. They are determining for definition of the level and form of people grouping and are connected with *social interaction*.

Relations between people can be classified according to various aspects (point of views). According to origin character we recognize spontaneous and inducing relations. According to permanency the relations are: regulative, informational, managing, communicational, etc. Investigating the relations in army (forces) we can meet various kinds of relations. Social structure of the army (forces) and social relation system inside is internally divided into two basic types of social relations. There are relations *institutional* (in literature presented often as formal) and *relations personal* (also informal).

 Institutional (formal) relations form system of relations between soldiers defined in official documents (acts, army orders and regulations, captain commands, etc.). Their character is significantly influenced by the content of school (army) functions and requirements on education. Formal relations are precisely described (reglement) and embodied (codified): in exactly determined ways of performance and behavior of army members; in authorities, responsibilities and duties resulting from functional classification in army organization structure and finally by position in work division system in army (military work and specialization and at the same time coordination of military activity).

Institutional (formal) relations can not objectively cover all forms of social contact and activities of such complex social system as the forces represent. Not the broadest and the strictest formalization do manage to really comprehend all real existing relations in the army (in army unit).

Despite of this fact formal relations have irreplaceable importance because they ensure central, coordinated and rational functioning of army (army unit) as whole. They affect positively only providing there do not occur unwarranted modifications or deformation which can inhibit soldier activity and existence of personable selective (informal) relationships.²⁰

Personable selective (informal) relations are formed within formal, institutional structure largely spontaneously on the basis of socialpsychological factors (sympathy, antipathy, confidence, social activity, etc.). Initial moment of occurrence of informal relations is a choice of individual with whom there is willingness or interest to carry out certain activity. These relations do not have only emotional aspect. They lean primarily on experiences (rational and empiric aspect). Among soldiers occurs complex net of links, which can not be officially predicted and therefore neither set in standards. However this net objectively affects their performance and behavior and activity of classes (military units). Therefore may not be ignored or even eliminated. Informal relations occur and develop mainly under conditions where formal structure do not enable to satisfy personal needs and interests of soldiers to the required extent, do not harmonize them with social (group) goals, interests or needs and do not direct them desirably. In such case the interest of individuals and groups and its satisfaction can meet with legal and moral standards. They affect dysfunctional to the sense and the goal of functioning of social group (army, military unit). Informal relations play also relaxation function. Through them student (soldier) abreacts from formal links, their severity and uniformity and renews, gains and finds out certain spiritual balance. These factors have influence on this fact: age and approximate accord of the structure of interests, life experiences, feelings and moods; social environment and long term communication and collective (team) activity character, also the need of confidence and help; structure of personality identification of emotional individuals (temperament), focus, adaptability, intellectual level, etc.

Formation of good relations in military organization is a main problem of each organization. Sociological investigation primarily its results play an important socio-technical function in this field. Basic factors which to the considerable extend influence the quality of relations in organization belong: effectiveness and

²⁰ MATIS, J., HAMAJ, P., MARTINSKÁ, M.: *Sociológia armády*. Lipt. Mikuláš : Akadémia ozbrojených síl. 2008. s. 83 – 84. ISBN 978-80-8040-361.

character of implemented activities; value unity of social group (army, military unit) and finally social cohesion of social group (army, military unit). For soldiers the quality of relations is in military organization and its parts conditioned by social and demographic profile of soldiers, knowledge level, opinions and positions and also socio psychological characteristics. Except of presented factors the quality of social relations in military organization (military unit) is influenced mediate by its material and personal conditions and not in small rate also relation of army and society, thus prestige of military profession in society.

To the basic assumption of formation of relations in military organization (military unit) belongs: *commanders* (management of all levels); *organization level* (military regime); *socio-demographic factors* (army composition, unit) and finally group atmosphere (public opinion).²¹ The result of commander activity is firmly agglutinated military groups (military unit), where prevail relations of understanding and good cooperation in fulfillment of current tasks. This however assume that commanders know except of mentioned military and not-military activities also basic differences between military formal organization (army, military unit) and informal social group (Figure 3).

Resume: The article follows on the fact, that the culture of every social system, including military organization, starts from culture of higher systems. That means that the culture of society in general and culture of organization in particular create pressure on the professional soldier. Military

High cohesion is characterized by the fact that the group functions with support of manager but do not depend on his role. Here are manifested evident proves of mutual support. The members of this social group believe to each other and this social group good handle conflict situations.

organization intensifies the pressure on its members in order to fulfill the given goal. Spontaneously arisen (uncontrolled) culture of organization namely conservates and continuously reproduces all discrepancies and conflicts, ambiguities and undesired behavior that have participated in creating it. Change of such spontaneously created culture of a given military organization is a longterm process which requires extraordinary effort and much bigger means.

Culture of a given organization is created following the need to constantly fastening social bond of the given organization, which is performed as a constant process of social activities (interaction). In this process there are interpersonal and social relations created, which is the basis for arranging social contacts. That can be considered the basic assumption for the rise of each social bond.

²¹ Note: Cohesion of social group can be low, middle and high.

⁻ Low cohesion of group is characterized by the fact that group members generally do not know each other yet by names, because frequency of meetings of members is very low. Rules and group norms are in the stage of development and the manager has not started to regulate the group.

Middle cohesion of the group is characterized by the fact that rules and roles are easily distinguished.
 Function of manager is clear, meet and respected.
 Rules provide to the group members protection. The space for openness is safely determined by clear idea of confidence and positive feedback.

KARNSOVÁ, M.: *How to Build Good Relationship Between the Teacher and the Student*. Praha : PORTÁL 1995. p. 82-83.

CHARAKTERISTICS OF MILITARY UNIT		CHARAKTERISTICS OF INFORMAL SOCIAL GROUP			
To the position is appointed by superior to whom he responds and who can call him off;	GROUP MANAGER	Determined on the bases of dominant status in group (natural leader) or democratically elected, responds to all group members;			
Is precisely determined and organized, it features by risk elements, therefore assumes: readiness, discipline, initiative and interest;	MAIN ACTIVITY	Is done voluntarily, on the basis of interest, often spontaneously, while it is a key, agglutinated factor of social group;			
Are set directive and informally, not meeting them is sanctioned;	TASKS, GOALS, NORMS, PENALTIES	Result from accord of interests and needs, can or can not be precisely expressed, deviation are tolerated;			
Are formal and determined on the principle of superiority and subordination, at the same time formally occur informal relations characterized by antipathy or indifference.	RELATIONS	Are largely informal and friendly, based on mutual satisfaction of interests and needs, reciprocity and performance and finally understanding and tolerance.			

Figure 3 Military unit and informal social group

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THE ROLE OF INFORMATIVE ENVIRONMENT IN ECONOMICEL SECURITY OF ENTERPRISES

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Abstract: Some aspects of the informative process management of enterprises' economic security related to structuring of the informative environment on the basis of the balanced system of indicators and employment of this methodology in the construction of the complex system of the economic security of an enterprise are considered in the article.

Keywords: Economic security, management.

1 THE GENERAL ISSUE

On the modern stage of Ukrainian economic development the problem of economic security of any enterprise becomes an informative problem, which consists in providing management processes of the whole enterprise and its separate departments by the high-quality information. The necessity of the economic security of enterprises place a wide range of new essential demands upon quality of the information to be met with the aid of the modern information technologies.

Analysis of the last researches and publications. A large number of researches concentrated on the determination of the economic stability indicators of enterprises and directed on the calculation of the level of the financial stability and its limits are devoted to the informative problems related to the economic security of enterprises [3]. The level of the financial stability connected with a forecast of the costs in the economic risks, risk management and antirecessionary management [2].

Part of the general issue unsolved earlier. Traditional approaches to enterprises' economic security researches based on the separate calculations of the indicators of financial stability. They do not link up with the general informative environment, the part of the internal and external environment of this enterprise, regardless of the introduction of the informative systems on the base of modern information technologies by the most enterprises.

From the other side, existing approaches to the estimation of the efficiency and significance of the information technologies, firstly, are linked with characteristics of the certain functional components: productivity of the network equipment, efficiency of the systems' development and introduction process, etc. P. F. Drucker asserts that a large and prosperous enterprise is not a business yet, and that business shows itself in marketing and innovations [2]. Innovations are that by what the product of the certain enterprise may interest buyers more than the product of its competitors. If there is no clear information on clients on the enterprise, it is unknown who it works for, what goods or services buyers need, what price clients are ready to pay and what they will need tomorrow. Thus, there is no marketing on the enterprise, and there is no business as well, so it is impossible to guarantee the economic security of the enterprise.

Problem positing (objectives of the article). The problem of the informative process management of the economic security of enterprises the informative environment of which needs appropriate structuring has been studied in the given scientific research.

Topicality of the research study. Introduction of the informative systems in activity of enterprises is related to the receipt of the considerable volumes of information which can be effectively used only on condition of appropriate structuring and coordination. Up-to-date informative systems require considerable charges from the enterprise, which will not create an additional cost, not be repaid, and can become an additional breakdown factor of the enterprise's economic security in the case of unwise, economically unjustified approach. Thus, the problem of informative process management of the economic security of enterprises is doubly topical one.

Novelty of the researches. In this work it is suggested to consider the problem of the economic security of enterprises within the limits of general informative environment of this enterprise. It is first suggested to use the idea of the balanced system of indicators to systematize and construct the informative environment of the economic security of enterprises.

Exposition of the basic material. Modern business distinguishes by the high level of competition and terms of the management changing constantly. Competition at all sales markets rose so that the extensive factors of business development in most companies had been already realized. Therefore factors allowing directing business development by an intensive way began to interest medium size business and even small business.

Information and information technologies take special place among the factors of the intensive business development. At present, world trends in the development of information technologies change their role cardinally in the companies' business development.

The processes of the informative providing of any activity or decision of any problem on an enterprise can not take place spontaneously and without control. Absence of the mutual understanding between business and information technologies, when there are no clear criteria of estimation of the contribution of the introduced informative systems in the activity of the enterprises is a basic problem. In reality, economic security of the enterprise, in the authors' opinion, is the primary purpose of every enterprise aiming at provision of the effective functioning in any terms. Therefore, exactly to this purpose the forming of its informative environment must submit.

On the base of the modern informative systems and technologies creation, development and employment management of the enterprise's informative environment is one of the main tasks of the management of any enterprise in the sphere of its economic security.

In this work the informative process management of economic security of enterprises is offered to provide it in the following directions:

- planning of the processes of the informative providing in the sphere of the enterprise's economic security;

- organization of the informative environment of the enterprise, i.e. structuring of the informative base, distributing of the informative tasks solving in separate departments and their co-ordination;

- motivation of the personnel in the sphere of search and defense of information;

- qualitative control of the informative environment of the enterprise.

The conception of the complex system of providing of the economic security has been laid in the basis of the informative processes of the economic security of enterprises. Creation and providing activity of the complex system of the economic security of enterprises, implementation of its tasks, principles of its activity, providing strategy and tactics is the purpose of this conception.

Minimization of the external and internal threats to the economic position of the enterprise, including its financial, material, informative, staff resources, carried out on a basis of the developed and realized complex of measures of economic, legal and organizational character is the objective of the complex system of enterprises' economic security. It must be kept in mind that the largest significance in providing of the economic security of an enterprise belongs to primary measures – economic, legal and organizational measures providing foundation, the basis of the security system, unlike the secondary measures – technical, physical and other. The decision of the concrete tasks combining all directions of the economic security is carried out in the process of achievement of the set goal.

The management of the given enterprise is the subject of the informative process management of the economic security of the enterprise.

In the authors' opinion, in the complex system of the economic security of the whole enterprise stable economic position of the subject of activity in a current and perspective period indicates the object of the informative process management. Resources consider being concrete objects of defense: financial, material, informative and personnel.

In the given work the process management of the informative providing in the sphere of economic security of an enterprise has been proposed to carry out on the base of methodology of the balanced system of indicators (BSI), offered by D. Norton and R. Kaplan [4].

Methodology of the balanced system of indicators represents the rules of balancing of the objectives and indicators of the enterprise development. Basic idea of this conception is to give organization management major information for realization of effective processes of management in compressed, structured form, as a clear system of indicators.

The balanced system of indicators of the economic security of the enterprise forecasts forming of strategic schemes that represent a grouping of objectives and indicators in four following categories (prospects):

- finances: financial goals in development and ultimate results of an enterprise: turnover, profit, profitability, estimations and forecasts of financial risks, financial stability etc.;

- clients and markets: objectives of presence at the market and indicators of quality of customer servicing – developing markets and sales territories, time of the order fulfillment, "ideal order", estimation and forecasting the risks of clients' losses or sales markets, or risks of developing new product, sales market, estimation and forecasting competition risks etc.;

- business-processes: process effectiveness requirements, i.e. cost, time, amount of errors, riskiness etc.;

- workers: development objectives and qualification improvement of personnel, risks related to the personnel.

Thus, the balanced system of indicators in the informative process management system of economic security of an enterprise gives possibility to the manager, like the pilot of airplane, to see before his eyes «system of devices» and to carry out management, oriented on the significance of the indicators grouped in the four interdependent blocks. Undoubtedly, direction of the financial indicators in BCI is basic since the sold goods and services are valued exactly at money, and exactly money is a universal mean in purchase of resources, raw materials and components, machine-tools, human resources, information, etc. Therefore, planning and forecasting control and optimization of financial flows are vitally important tasks of the economic security of an enterprise.

It should be noted that traditional indicators of the financial stability used for determination of the enterprise's economic security level are not enough. For this purpose western companies employ the whole complex of facilities based on up-to-date information technologies. They are as follows:

- budgetary control systems including building and control of the enterprise's budget by types of activity, by products and services and their groups, by centers of financial responsibility, by income and expenditure items;

- clearing, i.e. working out and control in implementation of the schedules of origin and repayment of the debit and credit debts, determination of payments' priority and fulfillment of payments;

- drawing and allocation of financial resources, i.e. short-term crediting of the current activity, investment of free financial resources;

- accounting, i.e. drawing up and consolidation of the financial reporting of the holding enterprises, drafting of balances, including reports in accordance with international standards;

- control of the financial and economic activity, i.e. calculation of different ratios describing structure and dynamics of assets and capital;

- optimization of financial flows, tax planning;

- financial document flow, i.e. organization of documentary registration of financial activity of the enterprise;

- analysis and forecasting of the financial state of the enterprise, i.e. the multilateral analysis and forecast of financial state of the enterprise, depending on the courses of currencies, prices on raw materials and finished products, volume of production etc.;

- business cost, i.e. business cost management, analysis of the influence of different parameters on the value of shares, attractiveness for investors, decision-making in the management by these parameters;

- investment planning with employment of business-planning systems.

The effective complex analysis of all above mentioned directions of researches of financial stability foresees the use of modern information technologies.

There are the interrelated casual influences of the balanced system of indicators. We will mark that in general this logic consists in the following. The higher qualification of the personnel and more improved technology, the simpler the support efficiency of the business-processes is. In turn, this facilitates high-quality customer servicing and realization of competitive advantages, and the latter results in the planned financial indicators, and all of it is the guarantee of the economic security of the enterprise.

Thus, on the whole, financial indicators are the ultimate goal of the functioning and basic indicators of the enterprise's economic security, while other prospects determine potential of the company on future periods and give ability to form economic security of the enterprise in the future.

Authors suggest that it is possible to define the key factors of informative process management of the economic security of an enterprise by the same way, i.e. set the prospects of the information technologies development in the sphere of the economic security. Thus it must be kept in mind that it is really difficult to define the basic result as financial indicators for the reason that influence of the information technologies on the financial indicators of the company is in the best case indirect. Information technologies charges should be examined from the point of the payment for the information technologies contribution to the business development.

In the authors' opinion, solving the problem of process management of the informative provision in the sphere of the economic security of an enterprise requires the following verifications: the sphere of information technologies of the enterprise passes from the role of informative accompaniment in status of partner able to give qualitatively new abilities for the business conducting and realization of the competitive advantages at the market. It means that:

- firstly, planning of the information technologies development on the enterprise must be closely associated with the development plans of the enterprise;

- secondly, introduction of the approaches allowing provision of a unified understanding of the role of information technologies in the business development, to plan its development and provide control after achievement of the set objectives;

- thirdly, approaches to the estimation of the efficiency employment of information technologies change cardinally.

These suggestions based on the growing strategic role of information technologies and on that the informative infrastructure and its context must persistently come out from the structure of the enterprise's business-processes and their cost filling and controlling.

So, the balanced system of indicators estimating qualitative level of the economic security of

enterprises taking into account the efficiency of information technologies functioning is required. The following main requirements should be met:

- connection with the development strategy of the company;

- presence of the operative "leading" indicators providing current monitoring and control;

- necessary accent on the importance of innovations and technologies and personnel development processes.

As the authors see it, a similar approach allows converting information technologies development into more conscious process directly related to the requirements of the core business, particularly with monitoring of the economic security level. The role of information technologies in the improvement of market positions of the company and increase of its financial results has become clearer.

2 CONCLUSIONS

The informative environment of the balanced system of indicators can considerably change approaches to the determination and forecasting of the economic security of enterprises. In fact, totality of information, sufficient for making a judgment about a concrete process, phenomenon, fact or situation related to the economic security of an enterprise, is characterized by the balanced system of indicators specifying basic directions of the effective introduction of up-to-date information technologies in the activity of enterprises.

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LOGISTIC APPLICATIONS IN RECEPTION, STAGING, ONWARD MOVEMENT ACCOMPLISHMENT

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Abstract: The Strategic deployment & Reception, Staging, Onward Movement and Integration functionality includes full spectrum of military operations going through all levels of military structure – strategic, operational and tactical. Strategic deployment is considered as a fully strategic mission level due to current capabilities of countries involved. Reception, as a most comprehensive period, constitutes an interfacing between the strategic and the operational level. The process is aimed at combat power generation, which means not only accomplished transport of soldiers, equipment and into-theatre movement, but soldiers' integration process as accomplishment of military command "end state" status. In this research is analyzed current RSOM process planned by Czech and Slovak European Union Battle Group (CZ/SVK EU BG) in 2009. Results show the logistic infrastructure as a critical factor for a successful operation execution and the applications of the operational research approaches to logistic assessment.

Keywords: Deployment, operation research, critical path, lessons learned, life support.

1 INTRODUCTION

The end of the Cold War and following terrorist attacks compelled fundamental changes in the international security environment [7], [8]. Nowadays, Central Europe has become a relatively stable region but on the other hand, the military situation in the Balkans, Middle East, Central Asia and Africa is still rather unstable and unpredictable.

The North Atlantic Treaty Organization's (NATO) expansion wave of newly independent countries (1999 Czech Republic, Poland and 2004 Bulgaria, Estonia, Latvia, Hungary, Lithuania, Romania, Slovakia, Slovenia) fundamentally affected their military strategy. Current strategy to build a new, small and young army with expeditionary capacities constitutes requirement to redirect Army of the Czech Republic's (ACR) roles and missions. Till 1989 and following ten years the ACR was concerned to defend territory of the Czech Republic. Forces structure and command and control structure, equipment, policies and procedures were directed towards common goals [1], [5]. The ACR was instituted on heavy weapon systems and surplus war stock. The Czech Republic did not have a plan for a transfer from the Czech territory to the theatre on strategic distances: even after the establishment of the 4th Rapid Deployment Brigade the army was still changing slowly to expeditionary forces.

Due to close cooperation with successor states and because of different political and military goals there are states handling some of the latest generation of weapons. NATO countries and their armies are pressed to re-define adversary forces; deal with many potential hazards and use widely divergent capabilities and operational methods. Due to unpredictable political and military situation the ACR posture has changed from forward deployment to power projection.

The ACR must be capable to accomplish whole spectrum of missions from demonstrative of non-combatant operation/show force to evacuation operations [4]. The into-theatre deployment per Strategic deployment & Reception, Staging, Onward Movement and Integration (RSOM&I) process is often referred as the "Achilles heel", see Figure 1. Reductions in ACR organizational structure, especially in logistic areas pressed responsible officials to define ACR ability to deploy forces as same as to find adequate solution and balance between military and commercial capabilities. The expeditionary units ought to be moved to tactical assembly areas using logistic lines of communication, medical service and engineer support [1]. Last but not the least are intelligence achievements incorporated to operational planning process thereby bringing info to critical commander information requirement.

The process of RSOM is not only a single deployment of soldiers and military equipment into the theatre but first of all an objective to efficiently receive and transfer forces to concentration area and then to tactical assembly area with an ability to be ready for mission accomplishment. In order to accomplish strategic and tacticalmovement the incoming forces are divided to several incoming waves of different stages. The most important Operational bodies are the Liaison and Reconnaissance Team (OLRT) and advance parties.

The original motivation for this paper was the design of multinational logistics (Figure 2) and all the potential benefits it promises. The multinational logistics solution has created many challenges but also many opportunities for Troop Contribution Nations. The most important above all is sharing common abilities and saving local and scarce resources. Based on author's findings planners still miss a generic study of the RSOM&I which may provide new approach and understanding.

RSOM&I cover a wide spectrum of activities in multinational environment and the logistic support to RSOM&I is one of several logistic functions recently conducted by a coalition. A successful RSOM&I till Tactical Assembly Area process depends on Host nation and contract support, asset visibility and properly accomplished Intelligence Preparation of Battlefield. Authors conducted research in order to compare current procedures and design new ways for RSOM&I processes.



Figure 1 General model of RSOM&I architecture Source: AJP 3-13, 2005 Legend: National Support Element (NSE) Sea Port of Embarkation (SPOE) Air Port of Embarkation (APOE) Sea Port of Debarkation (SPOD) Air Port of Debarkation (APOD) Transfer of Authority (TOA)



Figure 2 Operational Logistics: A Multinational Perspective Source: MURATLI, 2010

The assumed NATO into-theatre supply chain is going to be an outline of a national chain elimination effect for all types of operations from humanitarian assistance to full combat operations. It's purpose is to reduce the in-theatre logistic footprint, the size of overall logistics pipeline utilized to support operations including defence systems, resources and time constraints.

2 MATERIAL AND METHODS

The accomplishment of movement and transport on strategic distances and the following power projection in the final destination within RSOM process is limited by logistics lead role nation's ability to apply all relevant RSOM elements from national resources or ability to share responsibility with other troop contributors and host nation sources. The initial process depends on an ability to get relevant information, to implement local resources and as much as possible to pre-deploy all units capable of accomplishing each RSOM phases in designated areas. The ability to rapidly deploy RSOM units, combat forces and necessary combat should be based on information support management flow, followed by material flow and ended by combat forces deployment.

This research analyzed current RSOM process planned by Czech and Slovak European Union Battle Group (CZ/SVK EU BG) in 2009. Research approach is based on operation research [2], [11] grounds for decision support in logistic applications and RSOM. Critical path method (CPM) was used as a core approach [11]. CPM analyses the shortest total project duration, and also relationships between project activities. CPM supports successful realisation of RSOM process and intent in the framework of reorganization, relocation of activities and resources.

While many of the issues related to RSOM&I are of a joint character, the focus of this article presents the role of the CZ and SVK armies in the conduct of this process during CZ/SVK EU BG stand-by period. CPM calculates the longest path of planned activities to the end of the project, and the earliest and latest that each activity can start and finish without making the project longer. This process determines which activities are "critical" (i.e., on the longest path) and which have "total float" (i.e., can be delayed without making the project longer). In project approach, a critical path is the sequence of project network activities which adds up to the longest overall duration. This determines the shortest time possible to complete the project. Any delay of an activity on the critical path directly impacts the planned project completion date. Fundamental principles of project approach are implemented into RSOM of CZ/SVK EU BG.









Legend: Pax – personnel Source: TOMŠÍČEK, 2009

Deployment concept comes from exercises executed under Joint Force Command Headquarters according to the deployment scheme (Figure 3).

Duration of movement is based on real figures. The CZ/SVK EU BG deployment concepts were elaborated in two possible variants (Courses of Actions). The first Course of Action was designed by the Joint Force Command and supposed the use of air and sea transport. The deployment was designed for the use of two waves and force generation was as follows:



Figure 3 The CZ/SVK EU BG general deploymen plan Source: TOMŠÍČEK, 2009

The second wave was designed by MoD Support Division/Support HQ Command and supposed the use of air and sea transport assets. The second Course of Action was designed in order to deploy containers and heavy equipment and POE deployment responsible personnel (Graph 1, Graph 2 and Table 1).

Table	1	Modelling	of	the	deployment	process	of	а
potenti	ial	(core) CZ/SV	/K]	EU E	3G force pack	ages		
		Source	· T(ЭМŠ	ÍČEK 2009			

Week	FFT	Advance	Main
		party	Body
1st	20	0	0
2nd		0	0
3rd		115	0
4th			280
5th			560
6th			840
7th			1120
9th			1400
9th			1680

Legend: Fact Findings Team EU (FFT) / NATO (OLRT)

3 RESULTS AND DISCUSSION

The EU BG was never launched which means there has been used an official pre-planned deployment and redeployment concept in this research. Initially the authors filtered desired processes, tasks and actions. These so called activities were processed in the CPM method scheme in order to evaluate and manage the whole process and ensure time management compatibility. Joint Force Commander, as a combat commander is officially responsible for the RSOM&I.

Based on author's search through accessible written resources the responsibility is delegated to logistics experts and in this case the Joint Force Commander is understood as a user.

Activity	Start	Finish	
-08.02.01 Units coming to POE	8.7.10	16.7.10	GB.02.01 Units coming to POE
-08.02.05 Activities in waiting area	16.7.10	21.7.10	08.02.04 Activities in waiting area
Check	21.7.10	23.7.10	check
-08.02.06 Activities in marshalling area	23.7.10	27.7.10	08.02.06 ac <mark>w</mark> ivities in marshalling area
09.02.03 Cargo area setup, crane c	26.7.10	27.7.10	09.02.03 cargo area v etup, crane check
-09.02.04 Arrival of contractors, ve	26.7.10	27.7.10	09.02.04 arrival of contractom vehicles and containers
-09.02.05 Personel arrival and boar	26.7.10	27.7.10	09.02.05 personel awival and boarding
-09.02.06 Strategic transport	27.7.10	17.8.10	
-10.02.01 A/S POD-APOD/SPOD	17.8.10	18.8.10	
-10.02.02 Start of Convoy Support	17.8.10	18.8.10	
10.02.04 POD clearance	17.8.10	18.8.10	
~10.03.02 Transit camp construction	6.7.10	13.8.10	10.03.02 Transit camp construction

Legend:

Critical path

Figure 4 Gannt chart of RSOM - model proposal screenshotSource: Authors

On behave described circumstances the logistic infrastructure is a critical commanding factor creating framework for a successful operation execution. The research showed that the intelligence preparation of battlefield, host national support, RSOM&I, primary mission aspects [3] and third party logistic support should be consistent part of a planning process and understanding of the importance of above named areas is fundamental to the mission success.

The new scheme (Figure 4) of understanding and close cooperation deals with options when sending nations (lead nation) as same as troop participation nations do not have sufficient capability, knowledge and skills to accomplish all SPOE/APOE operations and SPOD/APOD complex activities are thus dependent on commercial companies. Mentioned issues, contained asset visibility, access to host nation and contract support and equipment interoperability are key elements of RSOM&I and could be accomplished military or/and commercial way.

The multinational logistics demonstrates universal quality of logistics support and also a good will and intent during peacetime created short reaction time and sophisticated approach to the expeditionary operations.

New ideas came from understanding that connectivity between findings and deployment timeschedule had not been solved and created new possibilities for finding both time and consequent financial savings.

3.1 Lessons learned: Details for Life Support

To minimize the risk and in preparation of further EU-led Crisis Management Operations the

following options should be elaborated for Real Life Support and compared with already existing options (e.g. lead nation, national stand-by options):

- 1. EU/ troop contributors (TC) stand-by contracts for Real Life Support (comparable to strategic airlift – Strategic Airlift Interim Solution.
- 2. Establishing an EU field camp component.
- 3. National first entry packages by TCs.

The findings assume that general lessons learned could be concentrated into following statements:

- 1. (Re)deployment should be coordinated by NATO/EU/UN via Multinational Joint Logistic Group (MJLG) and EU Movement Coordination Centre and executed under responsibility of the Multinational Joint Logistic Centre (MJLC)/Logistics Lead Nations.
- 2. The multinational approach coordinated by MJLC/Lead nation proved very efficient in arranging allocating strategic resources.
- Multinational solutions 3. for logistics coordinated by MJLC/Logistics Lead Nation could be a relevant solution to manage logistic support and establish (i.e. Support Combat Battalion/Combat Sustainment Support Battalion, POL, ammunition storage, outsourced logistic services). The multinational approach reduces national footprints; improves the overall economy and limited resources handling.

- 4. Real Life Support using public and private cooperation requires sufficient preparation time (clarification of standards, service quality evaluation).
- 5. MJLG/EU standards for logistics and especially for Real Life Support have not yet been clarified, are necessary for MJLG/ EU-led operations and have to be set.
- 6. MJLG/EU Standard Operation procedures (Logistics) have to be developed into a complete and functional basis for logistic operations.
- 7. Logistic requirements ought to be identified/pre-planned (potential logistic bottlenecks identification)
- 8. Pre-arranged logistic contracts (Stand-by forces are given access to Contractor support, Mission funding provided for critical assured access contracts).
- 9. Early integration of contractors (Logistic operational planning, Early Contracting Authority).

4 CONCLUSIONS

The CZ/SVK EU BG cooperation has been preidentified during almost two year preparations based on the normal complexities associated with military operations. The aim was to achieve joint interoperability. Due to close cooperation between two formerly united countries and a language similarity the common preparation was not based on ad hoc improvements and did not require comprehensive coordination. Besides the mentioned similarity (language, procedures, and historical aspects) the authors examined a necessity to improve commitment during peacetime military operations preparation to obtain advantages of the multinational political "end-state" the Czech Republic fully participates on the campaign against terrorism and is logistics approach. In order to fully integrate multinational logistic approach to a planning process and mission accomplishment there is a government commitment to select long term coalition partners inconsistent with the CZ approach to the foreign global and our contribution to war against terrorism. Due to changes in the current military approaches to local inhabitants, military and together with its partners creating new, productive, international relationships and redefining existing logistics support stereotypes in order to meet the challenges of the twenty-first century".

The planned support and author's observations of multinational logistics highlighted that successful result was framed within a bilateral military relationship. We can predict that multiple partners may only add further complexity and the benefit that multinational logistics offers.

What becomes apparent is that processes in POE, POD and RSOM process almost dissolve the Role specialization nation or Logistics lead nation due to continuous implementation of the Joint Logistics Support Group and the role commercial agencies play towards the POE/POD complex activities. Giving POE/POD complex of activities into Joint Logistics Support Group competency and commercial agency's responsibility means to focus commander's mind onto certain military objectives which are to be accomplished in the combat zone. Described approaches allow troop participating nations to concentrate on their competence in logistics support level 1 and 2 while performance in multinational operations is done using multinational means and resources and Third party Logistics Support.

POE/POD complex activities, including RSOM are great challenges because of obvious shortfalls in national capabilities and proposed solutions that have been discussed within CZ/SVK EU BG are based on the planned CZ/SVK EU BG RSOM performance and NATO/EU lessons learnt. The expressed intent of the ACR is to develop the capability to conduct contractor support in POE/POD complex and concentrate on predeployment and deployment coordination complicity using contracted support with main aim to accomplish 1st and 2^{nd} level logistic support. To achieve described aim and retain the ability to be fully integrated to a multilateral cooperation for possible future crises the coming defence resort representatives should prioritise middle and long term vision not only in ACR structures and abilities but also in the military education branch. Due to current changes in foreign policy, role of commercial companies involved in RSOM should primarily need a redefinition.

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PARADIGMS OF PEDAGOGY

Ildikó SZELEI

Abstracts: The education is a strongly controversial issue; I believe it cannot be determined easily and clearly,only ideas and philosopys can be created but these are necessary if we want to deal with people However education influences our life in many aspects regardless of position, rank. Therefore it is important to develop and extend our pedagological culture and knowledge. Through this study I would like to designate the boarders at the field of philosophy of pedagogy and education methodology and determine what we mean under education.

Keywords: Pedagogy, Inheritance, socialization, inclination, genetics.

Many have written, on several occasions, about the commander-junior relationship and this paper is intended to bring to surface the commander's skills and look at what this "raw material" is made of, and what processes the people the commanders need to deal with have gone through. The issues of accepting all kinds of differences and the acceptance of the other person - at all - have become increasingly problematic in our age. In our opinion, this topic should be looked at from pedagogical aspects, since the commanders have quite large a responsibility. Let us start with the paradigm of education as worded by László Zrinszky, saying that education is in fact the influencing of behaviour, in the course of which the commander tries to direct his subordinates toward things that are considered by the commander to be values. Obviously, a commander who considers punctuality, precision and formality to be important values, will require the same from his subordinates. But the question may be rightfully raised: is it possible to educate an adult person? In other words, what makes a may-bug (to use a Hungarian idiomatic phrase, meaning what makes a good soldier)? Can you still remember what determines the character of a given subordinate? And to what extent have we stereotyped them?

In this paper we would like to help commanders to brush up things they learnt in the past, about what factors make certain subordinates easy or difficult to educate, and we would also like to examine the issues of the possibility of education and heredity, so that we may look differently at our subordinates in the future.

The question of the possibility of education is a fundamental one, and there are essentially two attitudes toward it. Pedagogical optimism is the name of the approach in which we assume that man may be changed or developed through pedagogical means, in other words education is an efficient personality-shaping factor. Pedagogical pessimism, on the other hand, has doubts as to the possibility of education, due to the hindering factors, and questions regarding the efficacy of education. In the most general formulation, the question is this: can a subordinate be educated and developed through pedagogical means? A negative response t o this question usually stems from failures of the commander's influence, which belong rather to the scope of efficiency of the commander's work and not to the discipline of pedagogy.

1 A HISTORICAL OUTLOOK

We know well that education existed in every age, since even prehistoric man also recognised that his successors will need to be taught the ways of gathering seeds and using various tools. This is interesting, because this way males discovered always new areas, and got further away from their home place, but they still had to find their way back, and so their spatial orientation capabilities became better than those of women. On the other hand women stayed with the kids around the home place, and they talked to them a lot, therefore their verbal capabilities became more developed. Later on, the educators and thinkers of ancient societies (Socrates, Plato, Aristotle) also believed in the power of education, since in their environment they could actually experience the impacts and results of their educational efforts on intellectual and moral development. The practical evaluation of the possibility of education finally found its way to the mainstream of thinking on education through the ideological and social obstacles of the Middle Ages. The humanists, Montaigne and Erasmus, professed the possibility of man's extensive development. As schoolwork became more successful, as the number of literate persons increased, all these development suggested that education had an extremely great potential, and the only thing one needed for this was the ability to manage people.

Several thinkers of the Enlightenment also voiced the opinion that society or even the world could be shaped through education. The teaching of Comenius confirmed this, as he promoted the "art of teaching everything". The theorists of the modern age did not stop at practical and experience-based optimism, but were advocates of exaggerating generalisations created through the enlarging of possibilities. Just think of Leibnitz who said: "give us control over education and we will change the nature of Europe in less than a century." Helvetius,

same path, pronounced the following the omnipotence of education. Based on the professed equality of the natural capabilities of men, he concluded that the differences observed among men could be explained only by the differences in their education. By the 19th century the unity of optimistic standpoints was shaken by the emergence of a number of pessimistic views. They included social and scientific explanations, and at this time the emphasis shifted rather to the question of heredity and environmental influence. It was mainly Schopenhauer, who denied the possibility of education. He believed that heredity only played a role in the shaping of a character. It is here that the advocates of biological determinism must be mentioned, as they are the ones who saw man's development as a hereditary process.

As Hall put it, according to the theory of biogenetics, man essentially repeats the development of the race through his psychic development, and so education plays only a secondary role. At the same time, the so-called "milieu" pedagogy regarded man as fully dependent on the environment. Opposing this view, the socio-genetic researchers professed only the role of society in the changing of man. Socialist pedagogy on the other hand gave an optimistic response to the question of the possibility of education from the very beginning. This concept regarded development and the possibility of developing as fundamental attributes of man, inseparable from social progress. Makarenko is a well-known example for this belief.

In the process of education one should take into account the biological, physiological and nervous system-related endowments as internal conditions of the personality that are passed on through biological descent, but still the psychic factors – acquired and built in by man through his individual life – must also be taken into consideration. These internal conditions influence the factors determining the personality's activity and self-development.

2 A GENETIC OUTLOOK

We know that our bodies are made up of organs and tissues, each consisting of the same common basic component, the cell. Within the cell, in the nucleus, a basic aggregation can be found. During the process of cell division, the chromosomes of typical size and shape develop from them. The chromosomes contain the substance responsible for heredity, and their number is characteristic of the individual species and are constant. Man's 46 chromosomes consist of 23 pairs (fine threads). These threads are made up of proteins and nucleic acids. The functional unit of heredity, the gene, has been known as a concept for quite some time. Gene is in fact a specific section of the DNA molecule, that is why a man is born always from the union of human gametes, and never an elephant or a mosquito. The law of base pairing and the DNA's capability to double itself will ensure the specificity and relative consistence of species and cells.

Mutations (changes) may be traced back to variations in the base sequence. In the old days, a birth defect was seen in a mystical light and interpreted as a divine punishment, while many living organisms have also become extinct due to the lack of their adaptive capabilities. For instance, it is known that in the preceding ages there were shortnecked giraffes as well, but since the trees grew always higher, and the giraffes could not reach the leaves, they adapted to the environment in such a way that in response to the changed environment, long-necked giraffes started to appear.

Galton tried to distinguish and define some human personality characteristics, such as intellect, temperament, character and creativity etc. He examined 111 highly gifted people and realised that these people had 222 very highly gifted descendants. What explained this? - he raised the question; is this due to heredity or the environmental impacts? These people included the Mozart family as well. But what explains the fact that in this family many good and musicians were raised? Heredity? famous Obviously, they had to have some kind of a talent, but those who have been touched by the love of music, will obviously help their children also to make progress in this direction. People are different and unequal with regard to their characteristics. Such differences may arise either from the environment or from heredity. One must definitely strive for creating equal environmental conditions, and those coming from disadvantaged circumstances, definitely need increased social support. But one should expect that such rebalancing efforts would eventually balance out the intellectual gifts, and eliminate the mental handicaps. The hereditary impacts reproduce differences, this is a fact. All living beings and their environments vary greatly. One should not regard difference as the basis of any standardised value-sets and perform any ranking on that basis! Only those will survive who are able to adapt to their environments. Populist geneticians claim that all our capabilities are genetically determined, and environmental impacts (family, school, society) do not or only slightly modify the traits we are born with. Populist sociologists on the other hand stress that man is born with a blank page, which is then written over by the impacts of family, education and society. Unquestionably, many talents have been lost and are still being lost, because their social and family situation did not favour their development. If everything depended on the environment, then the children of the ruling classes would all be congenial,

while those of the lower layers of society would all be retarded.

Therefore, heredity gives only a potential endowment that may be significantly influenced by external circumstances. Detrimental impacts usually exert their effects more frequently. In the life of each man, only those skills may be realised (unfolded) whose talents are engraved in their genes' DNA codes. The environmental impacts, thus the family and the social influences determine what of these endowments will be realised, and to what extent they will be realised. Therefore, heredity has three main forms: *biological heredity* – when the parents pass on their genes and half of their chromosomes to their descendants; - the "pattern" for heredity (integration of the examples seen or learnt from the parents); socio-cultural heredity, such as speech, language development and the handling of differences etc.

3 THE QUESTION OF BIOLOGICAL DETERMINATION

The presumption that man's mental properties are in fact of biological origin, and are inherited traits, is one held for a long time in history. This was important in feudal societies. They considered every negative or positive characteristics that resembled either of the parents, as inherited. Thus, for instance alcoholism or musical talents. Just think of how many idiomatical phrases, proverbs have originated from this belief, such as "Like the father, like the son - Such as the tree, such is the fruit - Blood will tell"- etc. But you may think of the Polgár girls (chess world champions!) also. Obviously, they were not born like that, they did not ask for a chess set for their very first birthday, in order to show what they can do. They needed a daddy, who oriented the girls toward chess at a very early age, and then later the play turned into a contest. But you have also counter-examples, like alcoholism and aggression etc. We are not born with these properties, but still, these people often claim reassuringly: "We can't do anything, as father was also like that". Every man has some kind of a disposition, which gives him/her a certain stability (reaction modes, sensitivity). The bodily constitution of the person was regarded as the physical carrier of the disposition. Naturally, it is important to know what the person has brought with it (the pregnancy, the delivery etc. are important), and we can inherit a lot of things, but the environment is the determinant factor, too, e.g. the diseases of infancy and childhood or the chronic diseases may influence behaviour. The lack of relationship with the parent will damage for instance bodily growth. It is not the biological mother, who is important, but the fulfilment of maternal functions itself, since the new-born baby needs contact, and if this is there in

adequate quantity, then the child's development will be undisturbed, and could be the basis for the development of a balanced personality. In most families children are surrounded by a healthy network of contacts, which, on the whole, is capable of facilitating appropriate psychological development. Early parent-child relationship is therefore important as a whole, as this will guarantee the pre-conditions for the development of self, and the person's sense of security depends on this, as this is the basic pattern for future relationships, as well. Just think of socio-cultural heredity, such as the acquisition of a language, the development of speech and writing skills. But this field also includes the polygamy of the Arabic world, or we may consider the schooling of women, which is still a problem in Arabic culture, while it is a natural thing in the European civilisation. And let us look at our country, for instance the judgement about femalemale chances. We might say that there is an equality more or less, but we must also consider the example of - for instance - asking a woman in the countryside: "where is your husband", the answer will be: the man (the "human being" in Hungarian) is in the pub. And if a baby-boy is born, people will say, a "child" (instead of a boy) is born. This is also part of our socio-culture. But the fact that we today witness a significant positive change in the human parameters is also part of our socio-cultural heritage. For instance, body height has increased based on data of the past 100 years (by 0.9 cm every 10 years), and we may also reasonably refer to the increase in physical performance and intellectual capabilities.

4 THE ROLE OF ENVIRONMENT AND EDUCATION

Seeing the development of wildlife or nature, the performance of the human species seems to be an unparalleled peak performance. There were probably two conditions for this: our inherent value, in other words the individual, intellectual endowments, and our community-creating capabilities. So far, the collective intellectual efforts of mankind brought about the greatest achievements. The hindrance in this respect is that people created a lot of shameful things also. The scorning of difference - for instance - is a terrible sin, and racism is one of its farreaching manifestations, of which anti-Semitism and the gypsy issue are special expressions. Let us now look back a little into human history! Linnaeus believed that there were as many species as the number of different figures or shapes the infinite mind had created initially, and these figures or shapes created yet others, very similar ones, according to the law of procreation. The empirical facts refute this thesis.

Linnaeus distinguished between strain, class, family, order, genus and species. He divided the human genus into three races: homo sapiens, homo ferus (savages) homo monstrauosus (the distorted ones with severe abnormalities).

Within the category of homo sapiens he mentioned four variations: 1. American, 2. Eurpean, 3. Asian and 4. African. Later on, the term varietas was replaced by race. Bernier, in his book titled "A New Division Of The Earth" published in 1684 divided mankind into races. By race he meant larger human-categories within the human species, which had combinations upon the impact of the geographical environment and the lifecharacterised by a consistent circumstances. distinctive feature. Their typical marks are passed on from generation to generation in an unchanged form. and the races can be distinguished from each other based on these. In Hungarian mass media, the concepts of race and species are confused. They term racism consistently as "race theory, racialism, racial discrimination" (using the Hungarian term: "species" instead of "race"), although this relates to the social-political conflicts of large and small race groups within the human species, in other words all these groups belong to the same species. In a biological sense, only mosquito control measures can be termed "racial persecution", because an individual belonging to a species will destroy individual beings belonging to another species. But in South Africa white people oppress black people, and so this is not a conflict between species but races. Evolution, and within that, evolution into man is currently explained by two main factors. On the one hand the radiations, chemical effects and virus infections, as well as accidental errors occurring during the replication and duplication of the hereditary substance, the DNA, bring about change in genetic information, which is called mutation. On the other hand, the biological diversity developing this way, will result in varying aptitudes for adaptation to the environment, in order to ensure the sustenance of the individual species, races and single organisms. Thus, humanity forms a single species. In the development of the typical marks of the races, one should reckon with two determinant factors, the hereditary adaptation developing and becoming fixed in the chain of generations, as well as the individual adaptation acquired after birth. Mutation allows for a wide range of variability, of which predominantly those who are able to adapt best to the environment will survive. (E.g. white skin colour in the North and dark skin colour in the equatorial zone.) The sun will tan everybody's skin, and so its permanent impact may play a role in the development of pigmentation. Therefore, dark skin could develop in hot belts, upon the impact of bright sunshine, while the white skin colour could

develop in the cold areas. A substance called melanin is responsible for skin colour in the organism, as this substance is present in greater quantity in dark-skinned people than in whiteskinned ones. This is true, but at the same time the acquired attributes will not be inherited (despite so much sunbathing). Skin colour is determined by the genes of 4 different loci of the chromosomes. In the equatorial belt dark skin means protection against the intensive ultraviolet radiation of the sun. Since European man has no such protection, the strong sunshine impacting his skin is harmful. On the other hand the poor sunshine could be fatal for the darkskinned prehistoric man who found his way accidentally to the cold areas of Europe. This is because the poor sunrays could not penetrate the thick pigment layers of the skin, and so the Vitamin D production became insufficient, and so fatal development disorders developed in children on the one hand, and childbirth became impossible due to the pelvic distortion that developed in women.

Mutation and geographical isolation made living in a different zone possible. Racism, as a quasiscientific political demagogy appeared in the 19th century. But the roots of the history of ideas take us back to the times when man started to exist. Xenophobia, that is pathological fear from other people, especially strangers, could be traced back to as early as the epoch of prehistoric primitive societies. But this was not a groundless fear, since foreigners broke into the territory always with the intention to conquer and kill (they always had more and better things etc.) - but as we know, this is a kind of infantilism. Added to this were the religious prejudices, since every community was convinced of its unsurpassable uniqueness of divine origin, and that is why they feared the influence of foreigners. Initially, they could explain the development of the races by referring to differing geographical conditions. Thus, Hippocrates professed that: "the human genus is one in terms of physiology, and peoples are distinguished by the climate, the waters and the geographical environment, the food and the morals". He considered the white race as highest ranking. In the United States, intelligence tests were widespread and admissions to school and to the military were normally based on the results of these. Thus, they noted quite early that the intelligence quotients of the whites were higher than those of the blacks in most cases. The average IQ of Europeans of matching age was really by 15 to 20 points higher than those of African origin. The explanation came as natural: the social-economic level of the blacks and, in connection with it, their level of education was commonly lower than those of the whites, and therefore the difference is explained primarily by their cultural backlog. Jensen (1969) thought he was able to prove the hereditary determination of the

difference in intelligence levels between whites and blacks. He argued that the whites were normally born with better intellectual gifts than Africans, and so the two races were unequal. Some did not refrain from trying to implant these theses into practice. Noble prize winner Shckley, for instance, wanted to sterilise blacks, and wanted to do this in a very "humane" way. He suggested money rewards to those blacks who volunteered for sterilisation, and the sum was proportionate to the extent by which they failed to meet the average IQ value of 100.

USD 100 was proposed for every IQ score below 100. Thus, a black person with an IQ value of 80 would have been paid USD 20,000.

Unfortunately, we need to sweep in front of our own door as well, because we have, for instance, the gypsy problem at our hand. The gypsy population in Hungary is increasing year after year, and so Hungary today belongs among the European countries with the highest gypsy population. Based on their mother tongue, gypsies may be classified in three large categories – the Hungarian (71% of the gypsies), the gypsy (21%) and the Romanian (8%) populations. In 1970 the number of live births per 1000 citizens was 32, which is more than double of the national average (15). The average weight at birth of the gypsy new-borns (2860 g) is significantly lower than the national average (3150 g). The premature birth ratio is much higher, in which both their endowments and socio-cultural legacy play a role. 24.1% of the mentally handicapped people are gypsy, and this indicator is rising. What does not come as a conclusion from these statistics is that gypsies have lower intellectual potentials than Hungarians. The explanation, in fact, is this:

- Low level education of the parents;
- Poor income;
- Disadvantaged economic and cultural situation;
- Deficient fluency in Hungarian;
- Prejudices;
- Different socio-cultural heritage, customs;
- Lack of family planning;
- Their rise from self-effort and with the support of society.

Research into genetics provides an increasingly accurate picture about the structure of the chromosomes, genes and the DNA. The properties passed on through heredity, such as the body shape and nervous system type, temper and inclinations define only the broad setting of the potentials, and numerous factors influence their development. External conditions influence man's development and education.

Society, that is the most important external condition, with its economic and political

arrangement, fundamentally defines the general conditions for education and schooling, as well as the education possibilities of the social classes and layers. The educational institutions are important components of the social environment from the perspective of education. The question is: to what extent external conditions impact the development of personality. Two extreme standpoints can be distinguished in this debate. One is the functional and the other is the intentional approach to education. This "broader" concept of education regards all impacts affecting the individual fundamentally as education, or educating influence, since they all play some kind of a role in the development and socialisation of the individual. Thereby education is deemed a function of the entire environment. "Life educates", and everything educates everyone. They are therefore the representatives of the functionalist pedagogy. The advocates of the other standpoint claim that only intentional, goal-oriented impacts could be called educational influences. This means that they exclude all spontaneous impacts. The controversy could be resolved only if the aspects of purposefulness are applied to the "pedagogical organisation" of the direct and broader environment as well. Education that is purposeful, planned development – naturally contributes to the development of personality subject to the external and internal conditions, and familiarity with the specific possibilities.

5 MILITARY IMPLICATIONS

The number of people subordinated to the commander gives us the number of the types of personal education strategies he must apply.

No two persons are identical. Many deny the importance of education today, but they are wrong. Those who have – so to say – walked the triumphant way of warfare, know that with listening, focusing, custom tailored tasks, by good example, even during the period of the compulsory regular service, remarkable achievement could be made in the 1970s and 80s. Naturally, appropriate pedagogical skills were required for this, and these people gradually ascended the ranking ladder. They always acquired the experience and skills that serve as a good basis for fulfilling the more and more complicated leadership tasks. The commander must therefore become acquainted with the capacities of the individual soldiers, their limits of load-bearing capability, and must also make effort to reduce the risks of burn-out due to stress. Naturally, today the military personnel must be educated differently, since their responsibility and the requirements related to them are different. While in the past, caring for the soldier and focusing on him was done almost uninterruptedly during his entire service,

today the garrison is almost fully emptied by the end of the working day.

A commander can say that his educating activities have been successful, when his subordinates continue to behave in a disciplined and civilised manner even outside the garrison, and the sustaining of military order and the aptness to serve are not in danger even for a moment.

Discipline, compliance and commitment to the observance of obligations are all based on the quality of organisation.

And organisation is the responsibility of the commander. Organisation is one of the features of military life, and a determinant segment of socialisation within the military.

To sum up, the commander's situation is not an easy one. With the emergence of contracted military personnel, we continue to have the education of people into good soldiers as a crucial task. The appropriate treatment of "difference" is of key importance and it offers many positive impacts, for instance because of the appearance of women in the military in great numbers, more civilised speech and behaviour is now gaining ground within the military, and should still continue to enjoy further support. At the same time a more liberal attitude toward military order and discipline might also arise as a negative impact sometimes.

This paper was intended as a means to draw attention to this issue, and to allow the commanders to utilise the points contained herein. In order for a commander to do a good job, he must know what makes a may-bug, in other words, how a human being works. In this paper, with a few theoretical contributions, we wanted to draw attention to these questions.

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LIFELONG EDUCATION AS THE BASE OF CARRIER OF MILITARY PROFESSIONAL

Lenka KURHAJCOVÁ, Lubomír BELAN

Abstract: In these days the main idea of education is whole – life education. Every organization needs to have a conception of learning organization. The necessary assume of carrier development not only of military professionals but each other is lifelong education. The aim of this article is to show like convenient chosen methods have better influence of further education, and have better satisfaction with education.

Keywords: Lifelong education, military professional, courses, key competence of manager development.

1 INTRODUCTION

The term of lifelong education was defined in Memorandum of European committee about lifelong education like target, continuity activity, which scope is improve knowledge, skills and competence. The main scope in Strategy of lifelong education document and lifelong guidance is to build up system of lifelong education and the system of lifelong guidance in the way; that easier approach to the repeated and flexible acquirement of new qualification during the quality education in formal and non – formal education by the system of informal learning.

The necessary assume of carrier development not only of military professionals, but each other is lifelong education. In this article we fixate on the carrier education of Academy of Armed Forces of gen. M. R. Štefánik, which makes it possible to have carrier to people, who worked in resort of defence. The main target of this article is courses realization on the Management department in Academy of Armed Forces of gen. M. R. Štefánik.

2 INQUIRY

The course of Key competence of manager development in year 2007 consisted of six modules. Each module ran three days. Duration of course is 24 lessons (each lesson is 45 minutes long). The maximum of course participant is 20. Between each module is one month break.

The first module was called *"Effective manager*"and in this module participants made acquaintance of management and of its each function (planning, organizing, decision making, manage and control), and with managerial competencies, managerial environment, roles and skills. This module is basic orientation in management, generally.

The second module was called *"Communication skills of manager*"enriched knowledge of course participants from the area of social communication, renaissance of rhetoric, verbal communication, its principles, managerial

communication, too. The specifications of discussion manage dialogue and market negotiating. The third day participants of course made acquaintance with specification of written and electronic communication and with principles of manager presentation.

The third module with name *"Building up and manage of work team*"contents problems of team work, personality ofmanager, organization culture, work motivation and leadership – like new trend in managerial praxis.

The fourth module called "*Stress manages in managerial praxis"* was integrated in this course like necessary of nowadays. To know the problematic of stress and crisis situation is necessary assume of these days.

In the fifth module named "*Etiquette of manager*" participants attended problematic of etiquette from the way of the base of etiquette, employee etiquette, social place, dine and image of men and women.

The sixth module under the name "*New trend in manager education*" participants have possibilities to obtain knowledge from area of key competencies in European dimension, development of military education in Bologna process and from project management.

On the base of theoretical input of lectors in the various methods and forms of education for example: inquiry, tests, model situations, case study, and experience teaching consider on dialogue form of education. On the base of discussion of participants and lector, like between each other solved participants various problems and saw interactive way of learning. Theoretical approach combined with practical exercise develops creative and innovative thinking, and that is sense of these courses and practical input in theory of management.

Each participant after finished course got a certificate about education attending. In the end of the course participants tick inquiry which serve as feedback about course, for example form of teaching, approach of lector, and so on. Return of inquiry was good between 85 - 100%. The result of

valuation is public and interpretation of course is part of annual report of Academy of Armed Forces of general M. R. Štefánik Table 1 shows structure

Table 1 Structure of courses participants

of courses participants of Key competence of manager development in year 2007.

Modul	Year	Count of	Count of	Average	Prof.	Employee	University	Secondary
e	2007	register	participants	age	soldier		education	school
								education
1	19 21.1.	20	17	34	12	5	11	6
2	26 28.3	21	16	31	14	2	10	6
3	23 25.4	22	12	32	8	4	11	1
4	18 20.6	21	17	33	12	5	14	3
5	17 19.9.	24	15	35	9	6	11	4
6	2628.11.	15	9	36	6	3	9	0
Whole	6 modules	123	86	33,5	61	25	66	20

Table 2 Courses analysis

	1. module	2. module	3. module	4. module	5. module	6. module
Course organization	87 %	81,2 %	80 %	94,3 %	85,7 %	87,5 %
Time utilize	82 %	83 %	75 %	96,2 %	86,8 %	88,8 %
Study manual	87 %	76 %	72 %	88,8 %	89,8 %	93 %
Exchange of knowledge	84 %	82,2 %	78 %	97,7 %	91 %	87,5 %
Methods of teaching	86 %	81,2 %	80 %	95,5 %	90,5 %	88,8 %
Knowledge and approach of lector	81 %	87,5 %	83 %	91,1 %	94,9 %	97,2 %
Feasibility of chosen theme	80,5%	75 %	71 %	96,3 %	86 %	88,8 %
Enlargement of theoretical skills	76 %	62,5 %	61 %	96,3 %	89 %	97,2 %
Enlargement of practical skills	68 %	71 %	70 %	90,3 %	89 %	83,3 %
Course addition for praxis	76 %	68 %	62 %	83,7 %	85,4 %	87,5 %
Whole satisfaction with course	76 %	86,8 %	84,2 %	93,6 %	90,9 %	95 %





On the Graph 1 we can see whole satisfaction of participants with course "Key competence of manager development" in 2007. In the first module *"Effective manager*" was satisfaction with course abreast 76%, the lower from whole modules. The highest satisfaction was with the sixth module *"New trends in managerial education*" till 95% and the

fourth *module* "*Stress manage in managerial praxis*" 93,6%. In generally we can say that except the first module was a whole satisfaction with courses in the higher level above 80 %.

In the year 2008 was realized all 6 modules of course "Key competence of manager development, "in *innovative form* in some modules.

The first module "*Effective manager*" was realized in following subject syntax: the base of management, managerial function, managers of 21. century, managerial environment, roles and skills and managerial competencies (the newest knowledge).

The second module was called "Communication skills of manager" and enriched knowledge of participant from area of social communication, renaissance of rhetoric, verbal communication. principles, its managerial communication. too. The specifications of discussion manage dialogue and market negotiating.

The third day participants of course made acquaintance with specification of written and electronic communication and with principles of manager presentation in English language, too.

The third module called *"Building up and manage of work team"* was considered on the knowledge from area of team work, organization

culture and leadership – new knowledge from leadership.

The fourth module was called "*Manager and social contact*" enriched knowledge of participants from area etiquette from the way of the base of etiquette, employee etiquette, social place, dine and image of men and women and diplomatic protocol.

The fifth module *"Stress manages in managerial praxis"* was about stress problematic, change management, risk management and crisis situation. The third day was consider on the training of practical stress situations oriented on managerial competencies, like on the training of relax methods.

The sixth module "*New trends in managerial education*" participants had possibilities to obtain knowledge from area of key competencies in European dimension, development of military education in Bologna process, knowledge management and learning organization. The last day was oriented to the project management.

Modul	Year	Count of	Count of	Average	Prof.	Employee	University	Secondar
e	2008	register	participa	age	soldier		education	y school
			nts					education
1	14.1 16.1.	21	20	32	20	0	18	2
2	11.2 13.2.	23	20	33	20	0	19	1
3	17.3 19.3.	27	23	31	23	0	21	2
4	12.5 14.5.	23	21	37	19	2	16	5
5	13.10 15.10.	22	17	34	17	0	15	2
6	24.11-26.11.	17	16	36	16	0	13	3
Whole	6 modules	133	117	33,8	115	2	102	15

Table 3 Structure of courses participants

Table 4 Courses analysis

	1. module	2. module	3. module	4. module	5. module	6. module
Course organization	87 %	84,9 %	82,9 %	92,4 %	77,6 %	86,4 %
Time utilize	80 %	88,2 %	90 %	92 %	80,5 %	89 %
Study manual	89 %	92 %	87 %	91,2 %	89,8 %	93 %
Exchange of knowledge	84,8 %	82,8 %	76 %	92 %	86 %	93%
Methods of teaching	88 %	83 %	82 %	94,8 %	88 %	90,5%
Knowledge and approach of lector	85 %	88 %	85 %	90,6 %	87 %	96,6 %
Feasibility of chosen theme	81%	89 %	80 %	91,2 %	82,3 %	90%
Enlargement of theoretical skills	79 %	72 %	73 %	90 %	78 %	89%
Enlargement of practical skills	69 %	83 %	75 %	90,5 %	73 %	88,2%
Course addition for praxis	73%	90,1 %	92 %	89,5 %	81,2 %	87,9 %
Whole satisfaction with course	80%	90,5 %	88,5 %	89 %	82,7 %	92,8 %



Graph 2 Whole satisfaction with course

On the Graph 2 we can see whole satisfaction of participants with course "Key competence of manager development" in 2008. In the first module "Effective manager" was satisfaction with course in the level of 80 %, the lowest from the all modules, but opposite the same module realized in year 2007 growth about 4 % and accordingly with the fifth module "Stress manage in managerial praxis" 82,7%, which observe against year 2007 slump about 10,9%. The higher satisfaction was the same like in year 2007 with the sixth module "New trends in managerial education" till 92,8 % thought against year 2007 satisfaction slump about 2,2 %; and the second module "Communication skills of manager" 90,5 %, which observe increase of whole satisfaction about 3,7 %. In generally we can say that all modules had whole satisfaction with course above 80% what is quite higher satisfaction.

The feedback from courses participants we recognized following motion, notice and valuation:

- Module No. 3 "Building up and manage of work team" participants rated the most theoretical knowledge from leadership and team work too, coz of interactive teaching of chosen problematic.
- Module No. 4 "Manager and social contact" participants higher rated module, which is enriched by video - projection of practical demonstration target on social behaviour, designed organization of practical lessons "dine" in cooperation with catering of AOS.
- Module No. 6 "New trends in managerial education" participants from the way of the higher effectiveness of following courses organized course in duration 5 days, more practical training and model situation, like communication with expert with whole – resort praxis. The main interest was about problematic of project management in education and about problematic of knowledge management.

In the year 2009 was in the Management department realized 6 modules of course "Key competence of manager development"

The first module *"Effective manager"* had content base of management, conception of management, organize, planning and control. The third day of course was target on decision making and decision making process in praxis, too.

The second module *"Effective manager – leader"* enriched participants about knowledge from the problematic of manager and managerial environment, personality and perception of manager, leadership, managerial etiquette and self – manage of manager time.

The third module *"Communication skills of manager"* participants were acquainted with problematic of verbal communication and rhetoric in managerial praxis, conversation manage, dialogue and briefing. The third day was about written communication and presentation of manager in the reason of minutely needs of evaluate of managerial communication.

The fourth module *"Team work and stress manage"* enriched knowledge of participants from team work, organization culture, work motivation, structured interview and stress like its practical training.

The fifth module *"Manager and social contact"* enriched participants of knowledge from the base of etiquette, dine, social place, employee etiquette, diplomatic and state protocol and its application in armed forces.

The sixth module "*New trends in long – life education of managers*", which advised participants with problematic of education. Implementation of new trends in military education, knowledge management and learning organization, auto evaluation of manager was some of many themes of this module.

Modul	Year	Count of	Count of	Average	Prof.	Employee	University	Secondary
e	2008	register	participants	age	soldier		education	school
								education
1	12.1 14.1.	15	13	36,2	13	0	11	2
2	26.1 28.1.	18	18	36,6	18	0	16	2
3	9.2 11.2.	19	19	39,2	19	0	19	0
4	6.4 8.4.	20	20	35,9	20	0	18	2
5	22.6 24.6.	13	13	36,1	13	0	13	0
6	23.11-25.11.	13	12	36,9	12	0	12	0
Whole	6 modules	98	95	36,8	95	0	89	6

Table 5 Structure of courses participants

Table 6 Courses analysis

	1. module	2. module	3. module	4. module	5. module	6. module
Course organization	85,6 %	88 %	89 %	91,6 %	90,1 %	88 %
Time utilize	87,2 %	89,2 %	90,2 %	91,2 %	90,0 %	91,0 %
Study manual	91 %	85 %	87 %	80 %	89,6 %	88,4 %
Exchange of knowledge	86,3 %	89 %	95,2 %	94 %	89%	91,5%
Methods of teaching	90 %	81,2 %	94%	92,6 %	93,5%	89,2%
Knowledge and approach of	84.8 %	89 %	973%	92 %	90.1 %	93 %
lector	04,0 /0	07 70	77,570	JZ 70	70,1 70	75 70
Feasibility of chosen theme	83%	82 %	90 %	89,2 %	94 %	90%
Enlargement of theoretical	77 %	78 %	88 %	86 %	85 %	88%
skills	// /0	78 70	00 /0	00 /0	05 70	0070
Enlargement of practical skills	90,5 %	89,5 %	89,5 %	88,5 %	78 %	88,5 %
Course addition for praxis	82,5 %	80,5 %	86,5 %	82,5 %	84,2 %	85,5 %
Whole satisfaction with course	90,5 %	90,5 %	93,5 %	91,5 %	90,8 %	91,5 %





On the Graph 3 is shown whole satisfaction of participants of courses Key competence of manager development"in 2009. In the first module *"Effective manager"* was satisfaction with course on the rank 90,5%, it is increased about 10 % with the comparison of the year 2008. The higher satisfaction was with the third module *"Communication skills of manager"* 93, 5 %, this module is most successful from all modules which was realized in three year period. Like the second

most successful module in three year period was module *"New trends in long-life education of managers."* In generally we can say that whole satisfaction with courses is in the higher level above 90 %.

Arithmetic of trend function for each module:

Module\Year	2007	2008	2009
1. module	76	80	90,5
2. module	86,8	90,5	90,5
3. module	84,2	88,5	93,5
4. module	93,6	89	91,5
5. module	90,9	82,7	90,8
6. module	95	92,8	91,5

Table 7	Whole	satisfaction	of courses	by	modules
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Arithmetic of trend function for individual module:

Table 8 Trend function of whole satisfaction with course -1. module

Function	Trend	Index of
	function	determination
Linear	y= 7,25x +	93,72%
	67,667	
Polynomial	$y=3,25x^{2}$ -	100%
	5,75x + 78,5	
Logarithmic	y= 12,399	84,46%
	$\ln(x) +$	
	74,762	
Exponential	y=	94,63%
	68,815e ^{0,0879x}	

Table 9	Trend function of whole satisfaction with
course -	2. module

Function	Trend	Index of
	function	determination
Linear	y= 1,85x +	75%
	85,567	
Polynomial	$y = -1,85x^2$	100%
-	+9,25x +	
	79,4	
Logarithmic	$y=3,58 \ln(x)$	86,68%
-	+ 87,128	
Exponential	y=	75%
-	$85,601e^{0,0209x}$	

Function	Trend function	Index of determination
Linear	y= 4,65x + 79,433	99,81%
Polynomial	$y=0,35x^{2} +3,25x + 80,6$	100%
Logarithmic	y=8,2217 ln(x) + 83,823	96,3%
Exponential	$y=$ 79,834 $e^{0,0524x}$	99,92%

Table 10 Trend function of whole satisfaction with course -3. module

Table 11	Trend fi	unction	of whole	satisfaction	with
course - 4	4.module	e			

Function	Trend	Index of
	function	determination
Linear	y= -1,05x	20,79%
	+93,467	
Polynomial	$y=3,55x^{2}$ -	100%
	15,25x +	
	105,3	
Logarithmic	y= -2,4203	34%
	$\ln(x) +$	
	92,812	
Exponential	y= 93,444e ⁻	20,21%
	0,0113x	

Table12	Trend	function	of	whole	satisf	action	with	course
– 5. mod	ule							

Function	Trend	Index of
	function	determination
Linear	y = -0.05x +	0,01%
	68,233	
Polynomial	$y=8,15x^{2}$ -	100%
	32,65x +	
	115,4	
Logarithmic	y= -1,3551	2,56%
	$\ln(x) +$	
	88,943	
Exponential	y= 88,145e ⁻	0,01%
-	0,0006x	

Function	Trend function	Index of determination
Linear	y = -1,75x + 96.6	97,84%
Polynomial	$y=0,45x^2 - 3,55x + 98,1$	100%
Logarithmic	y=-3,1846 ln(x) + 95,002	100%
Exponential	$y = 96,65e^{-1}$	94,63%

Table 13 Trend function of whole satisfaction with course - 6. module

Prognosis of progress of satisfaction with courses

Table 14	Whole average	- satisfaction	with courses
	whole average	- satisfaction	with courses

Year	Whole average satisfaction with
	courses
2007	87,75
2008	87,25
2009	91,3
2010	99,9
2011	100

Whole satisfaction with courses by period of years 2007 - 2013 we count with trend function, we used polynomial trend function secondary place value, which showed the highest rate of reliability, the highest index of determination 100 %.

Function	Trend	Index of
	function	determination
Linear	y=1,775x+	64,62%
	85,217	
Polynomial	$y=2,275x^2$ -	100%
-	7,325x + 92,8	
Logarithmic	y= 2,8057	49,83%
-	$\ln(x) + 87,091$	
Exponential	y=	64,39%
-	85,298e ^{0,0198x}	

 Table 15
 Trend function for whole satisfaction with courses

In the table no. 15 we can see function and their trends formula like index of determination, which show reliability of each function. For the arithmetic of prognosis of whole satisfaction with courses we use polynomial trend function secondary place value, forasmuch as the highest rate of reliability. For the variable x we put to the formula number 4 (for year 2010), 5 (for year 2011), arithmetic of whole satisfaction with course for period 2007-2011 show increase character, which in 2011 have to be 100% satisfaction. However, this number can be influenced by many factors; like chosen theme for each module, chosen good lector and especially subjective attitude of course participants to the chosen problematic and to the personality of lector in each course, who has the main responsibility for course.

92 91 Celková spokojnosť s kurzami 90 89 88 87 $y = 2,275x^2 - 7,325x + 92,8$ $R^2 = 1$ 86 85 84 1 2 3 Rok

Graph 16 Polynomial trend function of whole satisfaction with courses

3 CONCLUSION

In the European politic of education is the main target consider on to the responsibility of human not only for the basic education and profession preparing, but accordingly to the care of principle knowledge during the whole work life. Tempo of changes in many aspects of work and work environment support the general competence of learning. Competencies of standings and knowledge of each is regarded like the base of nationality development by the informational participation on democratic decision making – what I need to know, what I have to learn, and what I have to improve in my nowadays work position. Some people are unconscious with this situation.

On the base of prediction by the polynomial function we find out increase satisfaction with courses, but prediction of this variable is influence with many others factors. From the many factors which influence satisfaction of participant in courses we chose in main psychological factors like state of mind of course participant, interest about recitation theme; let us say availability of chosen theme and availability of enlistment to the course. Not least, that participant is paid his education alone, or this education is paid by organization. Nothing what we have free it isn't quality and in education it obtain twice.

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ASPECTS REGARDING THE USE OF INNOVATIVE DECISION SUPPORT SYSTEMS IN MILITARY APPLICATIONS

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Abstract: The sustained progress in ICT represents an opportunity to develop new models for military decision making, more accurate, more robust. The interest is to build a flexible framework capable to support decision makers in military applications.

The complexity of force planning and operations planning is influenced by the high uncertainty and the new dynamics that affects an extended set of factors (political, military, economic, social, information, infrastructure). The response based on different type of instruments (diplomatic, information, military, economic) should be supported by a new framework, capable to offer the power of selection is given by the limitation of resources. The use of modeling and simulation offer a better understanding of the concepts and solutions for commander's decision making.

The new paradigm to adopt a flexible, adaptive, and robust solution is totally different from the classic planning and is focused on the exploitation of the strengths elements of the human creativity and knowledge. New analytical framework will offer also effective instruments in real time, capable to support the optimal decision making.

Keywords: MDMP (military decision making process), DSS (decision support systems), modeling and simulation (M&S), military applications.

1 AN INTRODUCTION IN THE ANALYSIS OF INNOVATIVE DSS FOR MILITARY APPLICATIONS

Military decision making is very complex and is influenced by risk and uncertainty. The interest is to select and adapt different analytic instruments inspired from decision theory to modern military systems.

The normative study of decisions should be viewed as an interdisciplinary and multidisciplinary task based on management, mathematics, statistics, politics, economics, sociology, psychology. Standard decision theory is characterized by an attempt to decontextualise decisions. The interest is on the relative probabilities of the outcome of decisions, described in the terms of their impact on a person's total utility, not from the point of view of a particular gain/ loss in the decision situation. A paradigm in decision theory is attributed to the Prospect theory (Kahneman-Tversky, Nobel Prize in Economics, 2002), a descriptive theory of making risky choices, via an innovative reintroducing of the contextual information as relevant to real rather than normative decisions.

In the typical framework of a high-level DSS, consistent with an uncertainty, sensitive, top-down approach is important to transform the vision about dealing with risk and uncertainty, and providing a dynamic recognized picture of the battlefield, the comparative potential of actors and their logistics, equipped with zoom capabilities. DSS are based on advanced analytic instruments capable to build a robust framework for high-level decisions. In military applications, risk mitigation should be covered effectively and multiple mechanisms capable to create dedicated flexible, adaptive and robust (FAR) strategies are needed. The focus is on the ways to mitigate the risks in the context of FAR strategies. The application for commanders should offer more intuition in the design of different solutions, by incorporating all relevant factors in a dynamic manner.

In the modern military systems there are different types of decisions, from analytic to intuitive/ naturalistic to rational/analytic. DSS designers tend to favor rational-analytic methods, but real-world commanders often lean toward intuitive methods, arguing that models and simulations could not respond to the FAR strategies.

But, in the modern literature, it is recognized that the top-down decision support should accommodate both types of thinking, attempting to exploit the strengths and mitigate the weaknesses of each and is based on the both lines: rational commanders are aware that the options presented to them may lack creativity, imagination; intuitive commanders are aware that risks exist in executing their strategies. A mix between the two types of thinking could be interesting. One candidate for this mixed framework is based on the portfolio-style method, inspired from economics, and capable to balance the risks, and the foresight exercises method, inspired from psychology, that addresses the need to include human factors in dealing with high risk and uncertainty.

The new framework to adopt FAR's style decisions, is different from planning for the bestestimate future and should include both innovative rational models like agent-based models, issues taken from control theory, game-theoretic simulation, the operations research, applied to military systems, but also human-intensive methods (war-gaming, foresight exercises, Red-teaming, assumption-based planning), based on creativity, expertise and intuition, but poorly structured. This new framework should offer a better understanding of the mechanisms of high-level military decision making, based on an innovative mixing of the emerging analytical methods and the instruments from the intuitive decision making style that capture the strengths of the components.

2 THE INTEGRATION OF CONCEPTS OF RISK AND UNCERTAINTY IN MILITARY DECISION MAKING

The classical concept of defense planning should be related to the need to identify areas in which the decision makers search for more risk (Henry, 2006), in order to identify gaps in capability areas and to find activities that can be supported by less funding in order to pay for the gap-filling. This is in fact a new way to implement the classic concept of the challenge of programming and budgeting (Hitch, McKean, 1965). The actions needed to balance budgets intelligently involve risks and the concept of balancing risk, inspired from the economic analysis express the ability to take more risks in some areas to pay for filling capability gaps in others.

In classic military organizations, subordinates salute the plan too uncritically, rather than helping the commander to identify and avoid problems inherent in the plan. There are strong-willed commanders who resist suggestions, and are intuitively inclined to participate actively, but also commanders who are always saluting political level directions.

The battlefield and military systems are represented by enormous and deep uncertainties, and this implies risks but also signal potential opportunities. The concept of deep uncertainty (Knight, 1921) cannot be adequately treated by using simple random processes and cannot realistically be solved in near real time. Deep uncertainty should be acknowledged in the planning process by considering alternative courses of action (CoA) and by implementing a better understanding of the possible effects of operations.

High-level decision making is responsible for establishing and pursuing suitable visions and formulates the basic operational objectives. The focus is to obtain a framework capable to offer a proper design of operational objectives and actions. In addition is necessary to identify detailed and more specific objectives expressed this time in the language of effects. Commanders analyze the documents offered by the analyst, focused on the relative ability of CoA to achieve all objectives and related effects, and extend the vision over the core subset offered initially. In the new complex scenario-space typical in recent conflicts, characterized by deep uncertainty, are not enough understand the probability distribution. In an imaginary strategy of a future adversary, the entire framework is hypothetical and unknowable. The deep uncertainty about the adversary's strategy is expressed by the lack of knowledge, in a similar way of the treatment in PMESII (political, military, economic, social, information, infrastructure) domains and attempts different DIME (diplomatic, information, military, economic) instruments.

The basic methods for analysis the future uncertainties (Davis, 1994, 2002; Davis, Gompert, Kugler, 1996) are focused on a better understanding of the concept of the capability to adapt the networked forces (Gompert, Lachow, Perkins, 2005; Tilson, 2005) in the context of mixing FAR strategies (flexibility the ability to perform different missions; adaptiveness the ability to adjust readily to diverse circumstances; robustness the ability to withstand both foreseen and unforeseen shocks, such as surprise attacks or the loss of an important battle).

The treatment of deep uncertainty in the operational risk could be also proceed by using the Adaptive Planning (Bankston, Key, 2006; Hoffman, 2006), a concept oriented primarily toward normal periods, for the conception and the development of operations plans in terms of capability packages, in a proper manner that can enhance the adaptability. In analytic decision making, the treatment of uncertainty could be expressed by using alternative CoAs. Based on its intuition, the commander is then focused on improving the basic plan and providing staff evaluations of options (most-likely, best-case, worst-case). The commander reviews quickly the underlying analysis and try to be synchronized with the analyst's thinking and matched with his own character (conservator/ risk-avoiding vs. ambitious/ risk-taking.

In conclusion, military DSS should better address the quantitative elements of uncertainty, risk, and choice, hierarchically, at different levels of abstraction, in a more effective way, capable to encourage the development of FAR strategies. The mix framework to evaluate and improve CoA in an uncertain environment is realized by using analytic methods (war-gaming, human gaming, Red-teaming, assumption-based planning, agent-based models, exploratory analysis) and agent-based models, that should be more focused on human methods and should be better adapted for a simple use by commanders. DSS support should include the credibility of estimated confidence levels as a function of process. If the assessments are based only on in-group judgments the credibility is low, but if the judgments reflect Delphi or other techniques, the judgment is more credible.

3 THE DESIGN OF THE ARCHITECTURE OF A MILITARY DSS FRAMEWORK

Defense spending is characterized by cyclicality, and in crisis periods, like the period 2008-2010, budget crunches could put pressure on important programs, could exacerbate the under funding of other programs and could stop the recapitalization process of materiel used in recent operations. For all styles of defense planners, DSS should facilitate the economic selection, but for commanders, the resource issue is less focused on budgets, but more focused on the survivability of people and materiel.

The portfolio management is an approach inspired from economics, is an effective instrument for the treatment of risk, based on a top-down mechanism evaluation equipped with costeffectiveness analysis and the mathematics of aggregation. In strategic decision-making, the use of orthogonal strategies is limited by the scenario space of the possible strategies, but the optimal output should be filtered and mixed, because of the multiple objectives and the use of FAR strategy. The use of orthogonal options in an analytic process should be based on a flexible selection mixed with dynamic adjustments, but in this complex task, the portfolio perspective, becomes more intuitive and effective. In portfolio-management the classic approach. investments are operated in different types to realize a balance among conflicting objectives. In defense planning, objectives are more complex and is difficult to asses the likelihood of subsystems/ elements but a portfolio might involve activities capable to support the general objectives, to maintain the military capability, and to avoid different types of risks. In this approach setting priorities and adjusting the weights of effort within the portfolio is important in the context of limited resources.

In the literature on defense planning (Davis, Gompert, Kugler, 1996; Davis, 2002; Hillestad, Davis, 1998; Dreyer, Davis, 2005) are also presented the key aspects of a portfolio-management framework, that responds to military FAR restrictions: the routine to use portfolio management tools; it responds to assessment of critical component capabilities, costs, and benefit cost ratios (near, mid, long term, anticipation of strategic adaptations); portfolio adjustment fill gaps, balance risks and opportunities, prioritize by packages, and conduct marginal or chunky marginal analysis; it offers more levels of zoom where needed in a clear assessment; it offers parametric capability models for comprehensive analysis; it permits the development of families of models, games, experiments.

This framework should support the commander's decision regarding the adjustment/tuning of the

portfolio so as to fill the gaps, balance risks/ opportunities, prioritize by groups rather than by discrete activities, and even to conduct investment analysis, such as marginal or chunky marginal analysis. Commanders are focused on the dynamics of the adjustment, the flexibility of levels of zoom or drill-down. The treatment and the representation of the risk within a portfolio-management DSS is based on the following risks: acquisition risks (feasibility, cost), at the time strategic risks (warning and decision time, allied permission to use bases), operational (effectiveness in achieving the principal effect sought, control of collateral damage, perceptions, behaviors), subsequent strategic-effect risks (the risk that a coalition will disintegrate, the fragility of domestic support). The set of risks includes risks involved in acquiring the capabilities in the first place, risks associated with their usability when needed in crisis or conflict, operational risks when actually employed, and risks associated with negative strategic effects even if the operation itself is successful and achieves the desired operationallevel effects. The representation of different types of risks in a portfolio-oriented DSS is difficult to be realized in a top-down architecture that needs to achieve comprehensibility. Some authors (Davis, Shaver, 2008) propose the following principles in the treatment of risks: the use of measures of effectiveness for both normal and extreme risk cases; the use of composite risk indicators. The interpretation of the analytical results from detailed technical calculations (the so called zooms) should be easy understandable by using intuitive charts and simple logic tables, and tuned by a combination of intuitively variables, charts allowing interactive response to questions, and simple logic tables.

Portfolio-management instruments are well adapted for the top-down perspective, but not for going into much depth. A candidate ingredient is the exploratory analysis, in which all of the key parameters are varied simultaneously so that one can understand results as a function of those parameters in the complex n-dimensional space. The cost benefit analysis (CBA) is a model for exploring the consequences of different perspectives about the relative importance of different missions and constraints, the relative probabilities of various risks, in a marginal analysis. Real option analysis (ROA) is another tool inspired from the financial options, capable to offer a better perspective.

4 HUMAN GAMING INTEGRATION IN MDMP

Although the development of foresight methods first occurred in nonmilitary applications, the central ideas are part of an ongoing interaction between military and nonmilitary thinking. Indeed, the use of human gaming ingredient in the form of foresight exercises could offer a good support for commander in creating and evaluating optimal CoAs. In military, the foresight approach is focused on building potential CoA in an attempt to obtain the desirable output.

In the absence of an efficient vision of the future potential of forces, commanders build different visions (scenarios) capable to offer a logical and consistent picture of the future, and then, elaborate the plan. In real world, the interest is to select scenarios that are intrinsically interesting or to decide which of the interesting scenarios could be used in planning. The challenge is to define a set of scenarios that, if used to challenge our planning in different ways, will provide adequate insight into the larger scenario space of interest. The creation of scenarios can be described as a set of tasks: expanding, structuring, focusing, assessing, and constructing.

After expanding the evidence base and assembling the elements/ L factors and the relationships/ R factors, the analyst filter the information collected. To maintain coherence and comprehension, the foresight exercise should have a focus, based on objectives. The assessment task, match the uncertainty of the scenarios with the aspects of the future taken as certain and identify the number and nature of the scenarios to be taken into account. Finally, the scenarios are build in a logical, meaningful, and thought-provoking manner, in anticipation of requests for more information.

5 THE USE OF THE CONCEPT OF FAMILY OF MODELS IN MDMP

Operation planning should be matched with the strategy of multiple goals, capable to improve the probability of success. This is not a pure strategy and it should includes heavy preparation of the battle space (air power, ground maneuver forces, information operations) and is design so as to avoid unnecessary collateral damage. An efficient use of alternative ways to achieve FAR strategies should be also consider portfolio-management techniques.

The key functional needs for analysis and supporting modeling and simulation include: routine and perceptive treatment of uncertainty, emphasis on FAR strategies, adaptive models and reinserting human capital in modeling and simulation and the use of the concept of family of models could offer a better functionality. The particularities of the concept of family of instruments to support analysis would include: a diversity of models with different levels of resolution, perspective, and character and different degrees of interactivity; human games and other exercises structured to increase the analytical aspects; experiments for integration and representing phenomenology, other empirical work and consultation with experts. Agent-based models in bottom-up architecture have modest ability to explore phenomenology and human action. Detailed models are important at low and intermediary levels, but are poorly suited to higher-level analysis or DSS, due to uncertainty. War-gaming offers agility and high speed to deal with previously unstudied issues. Multiple scenarios, can improve war-gaming offering a good focus on real factors, including human perceptions and behaviors. Field experiments offer an integrated picture that includes human issues

The human factor should be used more effectively in modeling and simulation, and DSS (human gaming, use of experts). Human games are idiosyncratic to players, focused on the playing through of a single scenario, undocumented, and relatively unstructured. In this case, games can be used for the following analytical purposes: discovery, sensitization, concept development, knowledge elicitation, identification of assumptions, and testing of hypotheses. In the literature is presented how to make human war-gaming more effective (Davis, 2004): the use of a design focused vignettes with relatively well-described on situations; the use of competing teams with different backgrounds to see/ test diverse tactics and assumptions, and to encourage teaming and team protection; to implement record planning factors and reasoning used during team play; a more effective use of Red teams, both to better appreciate different ways of assessing the situation and defining objectives.

The approach of Davis (2002) for gaming is based on a better understanding of possible adversary decisions and behaviors. The use of war-gaming to check on the adequacy of the factors and structure in difficult/ ambiguous situations is based on the generation of alternative adversary models and the integration of additional models for FAR. Another version (Santos, Zhao, 2006) address how adversary modeling can be accomplished focuses on inferring the intent and developing the consequences of that intent for subsequent actions in a dynamic environment.

Another strategy is based on experts: Delphi (Helmer-Hirschberg, 1967; Linstone, Turoff, 2002), Analytic Hierarchy Process - AHP (Saaty, 1999), Value-Focused Thinking-VFT (Parnell, 2004), Subjective Transfer Function Techniques-STFT (Veit, Callero, and Rose, 1984), Scenario-Based Planning-SBP (Schwartz, 1995), Day After Games-DAG (Mussington, 2003), Uncertainty-Sensitive Planning-USP (Davis, 2003), Assumption-Based Planning-ABP(Dewar, 2003). Difficulties are related to the real capability to find/ select the experts, group dynamics, effects of hierarchy and

social context, group-think and a possible tendency in the expert discussion/ group of experts, to move toward a best estimate or consensus, rather than exploit the opportunity to see distributions of possibilities.

In real world applications, we should mention the importance of the Integrated Marine Multi Agent Command and Control System (IMMAC2S), a multi-agent distributed system, designed in a dedicated 3D architecture (information, logic, presentation) and capable to offer the recognized tactical picture, with integrated decision support facilities.

6 CONCLUSIONS

The interest to build of a robust framework capable to offer decision support in military operations/ planning is based on FAR-M&S techniques. The adaptiveness may be achieved by having submodels that adjust simulated strategy and tactics depending on objectives, situation, and projections or submodels representing the behavior of individuals (adversary leaders), groups, or countries. The elements to improve adaptiveness include the use of agent-based models, control game-theoretic theory. methods. innovative model-related operations-research algorithms, in different styles, deterministic, stochastic, hybrids.

The principles for building a military DSS capable to serve high-level commanders are analyzed and it is also presented the possibilities to use and adapt the inspiration from classic portfolio-management methods mixed with human gaming. This strategy of mixing leads to an effective implementation of FAR strategies, based on a better exploitation of the human innovation in adaptive models.

Modern military DSS should be based on a better representation of the complex problem/ decision making situation in terms of objects/ relationships among objects, a better ability of decision support applications to process information in a collaborative way with the user. In addition, decision support software should be based on an integrated set of powerful tools.

The future design of DSSs should be focused toward the use not only on the classic modeling and simulation, but also on human-intensive methods such as war-gaming, foresight exercises, Red-teaming, assumption-based planning, and various methods for using efficiently the experts.

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HIGHER EDUCATION IN AIR FORCE: CHALLENGES AND PERSPECTIVES

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Abstract: Training of civil aviation and military personnel is based on higher education offen by, Air Force Academy, but also the courses Romanian Aviation Academy, and sport aviation. The Romanian aeronautics research set off while the great academies of the world believed that "the problem of flight with a device that weighs more than air can not be resolved and there is only a dream and he did successfully.In terms of aviation higher educational institutions, education is based more on teaching and learning and less or not at all on the research.

There weren't made any investments in research, not even in the present days and no support for young aviation enthusiasts is offered. Prospects are, as before, very good. We have, however, the same old dilemma: how to fund research and aviation industry? Does it follow another period of decline? Do we continue the series of missed opportunities? Or accept what the European papers say, that we should try a new road at the long-term sustainable development, the recovery of existing capacity and develop new science and technological progress, the elimination of the standard of living gap with the West, the which supports and accepts resignation of hundreds of years? Europe says that there where is the aviation industry, there is sustainable development.

Keywords: Air Force (AF), aviation industry, R&D research and development, global economic crisis.

1 INTRODUCTION

The aeronautical sector faces significant challenges especially in the twenty-first century. Romania has always had competence in the field of aviation and has a definite place both in history and especially, in this European aviation industry, while other eastern countries like Poland, Czech Republic and Hungary make efforts to find a place. The Romanian aeronautics research set off while the great academies of the world believed that "the problem of flight with a device that weighs more than air can not be resolved and there is only a dream and he did successfully".

Years after the fall of 1989 meant a further reduction of the Romanian aviation industry imposed by the disappearance of traditional markets and the difficulties of transition to the new economic system.

The Romanian science schools were formed in the late XIXth century. Also then have defined the main directions of modern development of our art. In the same century, was founded The Romanian Academy, University of Iasi and Bucharest, as the first institution of higher education named as "School of Pont and roads, mines and architecture". However, technical and scientific preoccupations are very old on and noteworthy achievements were recorded, representing a rich tradition in our country.

A domain in which the inventive spirit of man must necessarily be doubled with heroism was and remained the same of flight, from the legendary Daedal and Icar to the crews of today's cosmic modules. The Romanian ingenuity, spirit of sacrifice have come from so-called "prehistory" of the aircraft to its highest level of today's cosmonautic. There were very hard times for the inventors in this area. At the begining of the XXth century, the simply purchase of a jet engine was a difficult problem, both financial and technical as it required a special fabrication, because in those days the series assembly lines were inexistents.

Vuia had to go to Paris benefit the technical conditions of one of the most developed countries where technical, to be able to fly some a few tens of meters into the air,with a device conceived by himself, but his step up, first in the world (1906), conducted by its own means has a special significance.

Among the great pioneers of aviation inventors include some romanian, first Vuia, Vlaicu and Coanda. Between 1900 and 1910, Vuia's aviation achievements were the big break trough.. The first flight of an aircraft heavier than air, with onboard handeling system, and the first aircraft powered by jet engine are due to them romanian creations. It can be argued, rightly, that "Our Air Force was born along with the world's one."

Our people gave to aeronautics lots of talented inventors. Contribution, if not of all of them, at least of some, to whose originality, was for that era obvious, it is worth getting out of anonymity because they were busy perfecting fly machines and their projects have been unjustly forgotten . Even though most could not be accomplished due to harsh conditions in which worked their makers, some of them present even so a great interest, because are based on ideas wich technical evolution has confirmed them. The third figures that represent the crowning of romanian aeronautical creations are: Aurel Vlaicu, Traian Vuia and Henri Coanda. They have wrote glorious page in the history of romanian aeronautics, bringing a first grade contribution to the development of air navigation.

The scientists, the engineers, inventors are contributing to continuous improvement of flight technique. "The Romanian people," said academician E. Carafoli, "are among the first people
who participated in this wonderful manifestation of human genius that had to lead in only half of a century, to a stunning development of air navigation."

2 RESEARCH IN AVIATION: REALITY AND PROSPECTS

This beautiful story is the beginning of Romanian aviation, from which we like to get a mention from time to time. But there is another story, woven with the first one, and in conjunction with the question "Why is not investing in Romanian research aircraft?". The story of failures, missed project, the waste of opportunities and people. In 1901 Traian Vuia start to work in Lugoj, at the draft of his first flight. Due to financial shortcomings. after repeated failed attempts to obtain funds from both Bucharest and Paris, Traian Vuia fails to build the aircraft until 1906, three years after the first recorded history of human flight brothers Wilbur and Orville Wright. What would have happened if Vuia would find the necessary funding in 1901? We will never know. How do we know how it would be no written history of Romania if the Coanda air-built rocket for the Romanian Army in 1905 had been developed and realized its true potential. Or designed by hydroplane was John Paula developments in 1911, abandoned for lack of funds? And the sad story continues: in 1910, prototype Vlaicu I successfully participate in the general military maneuvers, Romania was, at that time, the second country in the world using this weapon. Aurel Vlaicu but fails to persuade the Romanian Government to begin construction of its own aircrafts series and Army aircraft will be equipped with French aircrafts.

The years after the Revolution from december 1989 meant a further reduction of the Romanian aviation industry imposed by the disappearance of traditional markets and the difficulties of transition to the new economic system. Factories in Bucharest, Brasov, Craiova, Bacau close or restrict their activity, and the opening of the romanian borders makes, many of Romanian aviation specialists to migrate.

Where are we today? Miraculous, perhaps Romanian aviation and refused to disappear this time too.It survived the transition IAR Brasov, Craiova aircraft, Aerostar Bacau, Bucharest Turbomecanica and Aerofina. They opened modernization programs and training school aircraft IAR 99 Hawk, the IAR 330 Puma "SOCAT", and MiG 21 Lancer (110 upgraded appliances).

Romanian aeronautical research (R&D) has an intresting growth potential because of the tradition in this industry, a very good preparation of students

and a good innovative potential from the young researchers in this field.

In aeronautical R&D, there are also reasons for optimism. In Bucharest, there are currently three research institutes of aviation, two governmental, the National Research - Development and turbo COMOTI and National Institute for Aerospace Research "Elie Carafoli" (Incas) and one private, Calculation and Testing Institute for Aero Structures - Astronautics STRAERO all three, came from the old INCREST, founded by Henri Coanda. The three research institutes active in analysis and testing aircraft structures and materials, flight control systems analysis and design and development of testing facilities (STRAERO) of general aerodynamics, flight dynamics and systems, space structures, strength of materials aviation and aerospace propulsion systems (INCAS), respectively aviation turbine engines, energy and energy efficiency and environmental protection and greening. Among the most important achievements of the Romanian research institutes of aviation in recent years can be mentioned the development of aircraft IAR 93, IAR 95, IAR 99, IAR 823, IAR 827 (STRAERO), AG 6, and - T and ECO 100 (INCAS) and modernization of IAR 330 and 300 and MiG 21 aircraft VYROBU.

One of the big problems of the Romanian research, often claimed by scientists as the main cause of poor results of R&D is inadequate funding from government, research and development infrastructure exceeded (by current standards facilities gap is 5 to 10 years); non-adaptation to competitive market conditions, the reduction and increasing average age of researchers. Another major problem is still the weak link between research and economy and relatively low capacity to exploit research results. Economic interest and involvement in research and development and innovation are low; in 2003 funds raised from businesses to co-finance such projects represent only 35 % of the total budget of the National Plan for Development and Research, Innovation (NPRDI).[1] With the launch of Framework Programme 7, the European Union has paid to European researchers millions of euro, virtually eliminating the deficiency for Romania to the budget created by lack of money. In practice, funding still remains a problem for many Romanian researchers, and that's because I have not yet proven ability to attract funds. Another branch of analysis is dedicated to the analysis of the competitiveness. The robustness of the national system of higher education could be viewed as a global indicator for the ability to sustain its position in a global knowledge economy. [3]

3 EDUCATION FOR RESEARCH IN MILITARY UNIVERSITIES

The three key pillars of the knowledge society: education-research-innovation are key factors for competitiveness and cooperation in global socio-economic development. [4]

Training human resources for the new society / knowledge economy requires an integrative vision for the entire life cycle of adapting means and methods specific steps in close correlation with the evolution of science and culture, knowledge in general. Orientation to the educational system and vocational skills and build capacity to accumulate knowledge to solve problems, develop innovation and creativity to stimulate curiosity and desire to explore is a necessity in a globalized education and research.

Education for research, scientific research and innovation are essential requirements for a competitive university in the context of globalization. The key role in training highly qualified human resources, by contributing to knowledge development through creative and innovative capacity promoted key pillars universities are in knowledge-based society. The scientific research in universities in close correlation with the formative process performance can, and should, contribute to knowledge production. The capitalization in the process of innovation and transfer in the socio-economic outcomes is essential.

A specific feature of universities is the use of multi and interdisciplinary research, via different partnerships. This is efficient also in the context of the explosion of knowledge and their recovery. Skills for inter-and transdisciplinary research, for research in multidisciplinary teams is another dimension to the work undertaken by universities.

In the context of integration into the European education and research, universities are called upon to assume responsibility for specific tasks to produce new knowledge, training highly qualified human resources competitive at European level by harnessing knowledge transfer and innovative products in the socio-economic environment. It must move to a qualitatively new stage in the process of education and scientific research that it matches the values system of international education and three universities research. The coordinate complementary activities - education, research and innovation and require a reconsideration of touch with society and adapt their performance according to selected universities and priorities and available resources and objectives.

The social dimension takes on new facets of education and democracy requires people able to learn, to seek and develop new complex subjects in the new knowledge-based society. Meanwhile, in addition to the objectives of increasing public funding, private question, mentioned in the policy research and development and innovation (RDI), an important goal in postaccession period is to increase the impact of research & development and innovation in the economy (orientation results). From this perspective, it is essential to develop / deepen partnership "business environment - universities - research institutes, both in terms of application of research / innovation and access to results.

The Bologna process is a far-reaching reform, involving currently 45 countries, which aims at the creation of a European Higher education Area by 2010. Major steps in that direction, currently underway, include the creation of a comparable structure of academic degrees, mutual recognition of diplomas and course units, the assessment of academic institutions and programs based on common quality standards, and direct incentives to geographical mobility of students and staff. [5]

The results of the study that the predominant issues or challenges encountered by the respondents can be divided in five categories with the following three most important frequent experiences: 1) problems regarding the students and their level of knowledge and experience, which was the most frequent issue raised by the professors; 2) curricula problems with regards to the adaptability to the new system requirements and 3) the lack of knowledge and enough information for both the students and the academic staff in what concerns the Bologna Process and its differences with the old system. The other two categories are close related to one another and refer to the people mentality and resistance to change as well as the bureaucracy and administrative problems existing in the Romanian faculties.

Faculty indicated that the predominant current challenges/issues centered on the shifts in paradigm, process planning issues, coordination of the Bologna Process whit accreditation issues and limited resources, lack of student information and the shortened cycles for each of the three degree levels. In the long term a noted superficiality and lack of leadership were of concern. With regard to benefits faculty currently perceived there to be career opportunity, mobility, wider choices and program improvement with both national and international benefits.

With regard to the use high tech tehnology in military and civilian aeronautics, for to remain competitive and to increase the level of participation for Romania the overall circuitul idea in this field is necessary to take into the following aspects: it is necessary to don't forghet the fundamentals (training in mathematics and physics); for susteneible growth of the eficientely of tehnological transfer is necessary to participate more actively at Europian partener ships; it is necessary a better gouvernmental support in the field of aeronautics by using different types of grands/ notional competitions of projects and a dedicated stimulation of innovative SMEs which activate in aeronautical industry.

4 CONCLUSIONS

In terms of aviation higher educational institutions education is based more on teaching and learning and less or not at all the research. Achilles heel is lack of assessment of Romanian research, many scientists argue that the vital Romanian research funding but not how to do the assessment results. "Hundreds of thousands of dollars paid in the budgets of collective facilities resulting either broken or the same quality work with the '90s, when research funding was almost non-existent. In this sense, especially for true revival of the research system in Romania is desirable efficiency audit of spending". [6]

An objective and fair assessment of the situation of higher education in accordance with the reality of Romania in the European context, one can only be a collective complex of several fields, where a decisive role it should have experts from Ministry of Education and academics with experience. University funding is a major integrated into a building complex which includes, inter alia, national education policies, sectoral policies developed and implemented by the Ministry of Education, its relationship with social partners represented by unions, civil society and specific policies proposed by the Advisory Councils.

The results of research and technological development is scientifically innovative solutions will be subject to patents in accordance with national legislation on intellectual property protection and respect of copyright.

Invested, there was never invested, and not even now invests in research and neither offers support for young aviation enthusiasts. Prospects are, as before, very good. We are, however, the same old dilemma: how to fund research and aviation industry? Follows another period of decline? Continued the missed opportunities? Or accept what they say European papers, we try a new road at the long-term sustainable development, the recovery of existing capacity and develop new science and technological progress, the elimination of the standard of living gap with the West, the they support and accept the resignation of hundreds of years? Europe says that where there is the aviation industry, is sustainable.

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VISUALIZATION SERVICES FOR JOINT TRAINING FACILITY

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Abstract: 3D visualization services of Common Operational Picture can play a key role in achieving better understating of battlefield situation by providing spatial unit positions in 3D terrain data. This fact is valid in M&S world as well as in command and control systems. Appropriate mixing of two dimensions (2D) and three dimensions (3D) battlefield visualization can significantly increase the shared awareness not only at the tactical level but also at the operational level. For the operational level using aggregation filters to decrease amount of visualized information is essential.

This paper deals with an original solution that integrates the possibility of hybrid training system for air defense units together with constructive simulation and a new presentation layer of command and control system of Czech Ground Forces in three dimensions. It creates complete joint training environment with connection to real time ground forces situation. It can be used as an offline training tool or if deployed as support tool (train as you fight).

First, the joint training architecture solution is mentioned. It is based on 2D desktop solution based on constructive simulation and 2D/3D visualization services implemented in Czech command and control system. The Service Oriented Architecture is used in design and implementation of interface layers.

Second, issue of merging the air and ground forces visualization is analyzed. The information fusion and mainly aggregation functions must be implemented to join these two totally different areas (air force tactical time is much faster than ground forces tactical time).

Finally paper reports on the current state and benefits of this joint training facility.

Keywords: Visualization, common operational picture, battlefield, command and control, three dimensions.

1 INTRODUCTION

Technology has made a big progress in the sense of visualization techniques prepared for a commander by Command and Control (C2) systems. Size of visualized scene goes hand in hand with ability to display C2 critical information with higher level of fidelity. This higher resolution environment creates new requirements for software architecture and visualization of tactical symbols. Commander should accept these new approaches to be able to interpret tactical information in an effective way.

The CODS (Common Operational Decision System) visualization system can be taken as an example. It is composed of 4 x 4 horizontally arranged flat screens with more than 40Mpixel resolution [1]. The importance of terrain and tactical data 3D visualization illustrates the CG2 COMPANY and its software product C3D. It uses FBCB2 VMF message parsing, a Quantum3D GeoScapeSE (TM) COTS McKenna MOUT terrain database, high-resolution digital map imagery and Mil-Std-2525B symbols. It opens a new possibility of real-time view of the battlefield environment by including 3D terrain [2].

Joint training that is loosely coupled with real C2 systems has still lots of shortages. These are mainly:

- Bandwidth is not limited only in distributed simulation environment but also in the interconnection between the C2 and Simulators environment.
- Rapid real time 3D terrain generation for C2 system.
- No mature common operational picture in 3D merged into one display.

- Different level of tactical data is needed for tactical, operational, and strategic levels. Smooth transitions between these levels are extremely important.
- No geographic data visualization in 3D with perspective of no disturbing effect to total battlefield understanding.
- No precisely defined area that is positionally covered by particular unit.

In this context the Czech Army defined a defense research project that should provide a new interface to the current C2 system. It was a pilot project for the integration of 3D battlefield visualization into Ground Forces Tactical Command and Control System (GFTCCS). One of the main output of this project solved from 2007 to 2008 was a new presentation layer of GFTCCS that is capable of visualize battlefield situation in 3D based on the available real-time tactical and terrain data. Figure 1 shows 2D outputs from GFTCCS. The operational picture of two friendly ground units is depicted and tactical overlay as well.

To deal with the issues related to battlefield visualization in 3D the C2 ontology was used in a new presentation layer of GFTCCS [3]. Main tactical information like shape and area of size of a unit and its position must be also solved in 3D respect. The shape of unit is based on perpendicular cuboid with the particular APP6a symbol placed on the surface. The size of base corresponds with delivered position data of particular unit and its inferior units. Level of tactical information is selected with respect of current operator (commander) needs. The system of aggregation



Figure 1 2D GFTCCS output

filters is used in the new presentation layer. The brigade commander can select level of aggregation, e.g. squad, platoon, company and battalion. Selected level of unit is only visualized and position data from inferior units is aggregated to get more precise position of appropriate unit. Position data from units above the filter is omitted. C2 ontology discovered the main supportive tactical data of unit that must be visualized as well in 3D. It is mainly: unit efficiency, velocity of the unit movement and actual fuel and weapon capacity. This data are visualized as bar graphs and express the current state of the measured values in percentages. 100 % of value corresponds with the lower border of a tactical symbol billboard.

Figure 2 shows visualized mechanized squad with the 80 % of efficiency, 33 % of maximal velocity and 50 % of weapon and fuel capacity. This type of visualization is totally new and brings the commander native way to get the main tactical data from the battlefield. Commander can command and control the current situation in more naturally way in 3D by immersion. Such type of unit and tactical data visualization has never been used before.



Figure 2 3D GFTCCS output

2 JOINT TRAINING FACILITY ARCHITECTURE

The new presentation layer with 3D visualization abilities have been already used in the Networking Challenge exercise in 2009 in the Czech Republic and is under the massive testing in Afghanistan from spring 2010. From that perspective the training process had to be changed. New presentation layer had to become the essential part of training process in joint training facilities. The Figure 3 shows the architecture of joint training facility. Architecture integrates the possibility of hybrid training system for air defense units together with constructive simulation and a new presentation layer of command and control system of Czech Ground Forces in three dimensions.



Figure 3 Joint Training facility architecture

The distributed environment is currently based on Distributed Interactive Simulation (DIS) protocol. DIS is still applicable for our type of exercise where real –time simulation and low number of simulation entities is used. Air Force simulation is based on one Wing Operation Centre (WOC) that is composed of three Squadron Operation Center (SQOC). Each SQOC uses different virtual or full mission simulators. These are mainly:

- Virtual and full mission simulators of subsonic fighter Alca 159.
- Full mission simulator of supper sonic fighter JAS 39 GRIPEN.
- Virtual simulators of Mil Mi 24 helicopter.

All these simulators create the main input for Air Defense Forces simulation.

Constructive simulation creates the synthetic environment with entities that reflect activities of Air Force simulators. VR Exchange is used to create message broker that convert DIS protocol PDUs into LINK 11B messages. These messages are then sent to Czech Air Defense Command and Control System (RACCOS) via Static Fire Distribution Centre (SFDC). SFDC creates Recognized Air Picture (RAP) and offers this information to Command and Control System (GFTCCS). New presentation layer of GFTCCS enables brigade commander and its staff to make decision based on common operational picture in 2D and 3D as well.

3 AIR AND GROUND FORCE PICTURE MERGED

Utilization of the 3D visualization opens new approaches for the ground forces and air forces visualization synergy. The speed of movements (changing positions) for the ground forces is relatively slow but there are many entities on the battlefield so intelligent aggregation functions that are part of 3D presentation layer of C2 system are used.

The number of air force units in the COP is lower than the number of ground forces units but their speed of movement is usually very high. Especially for the fast jet planes the information flow can be insufficient for the fluent movement visualization thus special techniques such as movement extrapolation had to be implemented.

The most recent position of the unit is placed on the ground as a rectangular symbol. From this position a 3D line is drawn to the altitude of the unit. At the unit altitude there is a 3D cube that has the unit symbol projected on its sides. Beside this 3D unit symbol there is a text area with the information about the unit altitude and type. Due to different update time of air and ground forces this visualization would not be sufficient enough, so from previous position a track of the unit is displayed as a 3D line arrow array. This track is extended to show a future extrapolated position (or movement vector). A relative time information (T plus or T minus) is displayed beside the arrows to inform the user about the speed of the unit. An example of the merged situation is shown on the Figure 4.

The user can fly with the virtual camera over the terrain using the mouse and keyboard or can lock the camera to any unit so the movement of the camera is relative to the selected unit.

The output can be a standard monitor, LCD panel or projector (up to 6 channels to provide wide angle visualization) or there is a provision to support 3D monitors or 3d active projection. The 3D stereoscopic projection was tested at "Network

Challenge 2009" exercise and it was positively accepted by commanding staff. We use an active 3D DLP projector that works at SXGA+ resolution with 120Hz refresh rate. Users wear active glasses that are synchronized using IR sensor and transmitter. The main advantage is that this technique does not require special projection screen material and uses only one projector so it is very easy to transport and setup. The visualization system allows adjusting the level of stereoscopic projection effect and various parameters connected with it. The level of immersion is significantly better; the stereoscopic projection screen looks as a big window to the landscape.

4 JOINT TRAINING FACILITY BENEFITS

This solution creates complete joint training environment with connection to real time ground forces situation. It can be used as an offline training tool or if deployed as support tool (train as you fight). Joint training facility enables variety of scenarios. An example follows.

The tactical Air Force simulators generate the friendly and opponent air units and via DIS are these entities included into Recognized Air Picture (RAP). RAP is then used for Air Defense Forces training. Thus, there is no need to get the real radar data and the whole air command and control process can be executed with the real system. Joint capabilities are then trained in the main brigade command post. Brigade commander can easily see the common operational picture in 3D and can control the movement and activity of ground forces in respect of air and air defense forces. Brigade commander must have at least information about friendly air unit position and their expected time of approach and flight direction.

The 3D visualization of common operational picture improves spatial orientation in the area of interest. This is achieved by placing tactical symbols in correlation with 3D terrain so the additional dimension (compared to standard 2D tactical map) provides the information that in the 2D visualization system would need to be created in the commander's mind. The integration of ground force and air force unit visualization brings new challenges to symbol representation. It was necessary to find a way of representing ground and air unit symbols in 3D space that would benefit from the additional dimension to represent information such as unit altitude or unit size. Our representation was found to be easy to understand by air and ground forces commanders. This was even more emphasized using the stereoscopic projection system that provided easier understanding of the visualized situation and it was positively accepted by users.



Figure 4 Air and ground forces visualization in 3D

4 CONCLUSION

In the integration process only the COTS products were used but it doesn't affect the overall quality of joint training facility. Usage of products (VR Link, VR Exchange, MAK RTI, VR Forces) from same company enabled and simplified the process of joint training architecture implementation. Overall architecture of the new presentation layer is based on Service Oriented Architecture approach.

Project was focused on critical elements of situational awareness in the visualization scope:

- Technical resolution of visualization mean.
- Number of visualized entities in the scene.
- Critical set of information delivered to the commander.
- Visualization of area that is covered by particular unit.

We used the output devices with resolution up to the 2560×1600 pixels. Due the aggregation filter we are able to reduce the number of visualized units. Units at the selected level are only depicted and other information is aggregated or omitted. C2 ontology helped us to select the set of critical information that must be depicted as well. Other information is not visible and doesn't overload commander. The size of visualized rectangular symbol refers the area that is covered by particular unit. The unit is not connected to exact position but corresponds with the area of its activity.

These features supports the ability to make quicker decision and support the cognitive

performance of commander based on the better spatial orientation. Training facility is expected to be fully operational in 2011.

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RESEARCH SCALAR FILTERING ALGORITHM WITH SELFORGANIZATION METHOD FOR MODELLING CONTROL SYSTEM

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Abstract: The scalar filtering method with selforganization method is discussed in this paper. This complex method is one of the key points in building compact algorithm of control systems for dynamic objects. The selforganization algorithm can synthesize target, produce decision-making and bring out control action to realize target under effects of series of uncertainties.

Keywords: Scalar filtering, selforganization method.

1 INTRODUCTION

The methodology of evaluation uses complete mathematical models of researched processes. Therefore, it is very difficult to use classical algorithms to evaluate processes under limited condition of computation.

A scalar method enables us to strongly reduce the memory volume that needed for organization of evaluations, and also the time consuming for calculation.

Scalar algorithms are actually formulas which contain changeable coefficients and these allow to evaluate state vectors at any instants.

In order to synthetic a scalar algorithm for evaluations, it is needed to build up scalar equations of system's model for all the necessary state vectors and carried out our measurements.

2 SCALAR EQUATIONS OF SYSTEM'S MODEL

First of all, we consider a scalar algorithm to evaluate all constant components of state vectors:

Equation of our processes or systems have form:

$$x_{k+1} = \phi x_k + w_k \tag{1}$$

We rewrite this equation for instants: m=2,3,....n where: n is dimension of vector x_k and vector

$$x_{2}, x_{3}, \dots x_{n} \text{ by } x_{1}:$$

$$x_{2} = \phi x_{1} + w_{1}$$

$$x_{3} = \phi^{2} x_{1} + \phi w_{1} + w_{2}$$

$$\dots$$

$$x_{n} = \phi^{n-1} x_{1} + \phi^{n-2} w_{1} + \phi^{n-3} w_{2} +$$

$$\dots + w_{n-1}.$$
(2)

Similarly, we can empresses all states by the initial value x_0 .

Now, we write the measuring equations at instants: 1,2....n:

$$z_{1} = Hx_{1} + v_{1}$$

$$z_{2} = Hx_{2} + v_{2}$$
...
$$z_{n} = Hx_{n} + v_{n}.$$
(3)

Substitute 2 into 3, we derived:

$$z_{1} = Hx_{1} + v_{1}$$

$$z_{2} = H\phi x_{1} + Hw_{1} + v_{2}$$

$$z_{3} = H\phi^{2}x_{1} + H\phi w_{1} + w_{2} + v_{3}$$
...
$$z_{n} = H\phi^{n-1}x_{1} + H\phi^{n-2}w_{2} +$$
(4)

$$+H\phi^{n-3}w_3+...+Hw_{n-1}+v_n.$$

These can be rewritten in block matrix as follows: $Z^0 = Sx_1 + V_1^0,$

where:

$$Z^{0} = \begin{bmatrix} z_{1} \\ z_{2} \\ \dots \\ z_{n} \end{bmatrix}; V_{1}^{0} = \begin{bmatrix} V_{1} \\ HW_{1} + V_{2} \\ H\phi W_{1} + HW_{2} + V_{3} \\ \dots \\ H\phi^{n-2}W_{1} + H\phi^{n-3}W_{2} + \\ \dots + HW_{n-1} + V_{n} \end{bmatrix};$$

$$S = \begin{bmatrix} H \\ H\phi \\ H\phi^2 \\ \dots \\ H\phi^{n-1} \end{bmatrix}.$$

X in equation 5 is now described as: $x_1 = S^{-1}Z_1^0 - S^{-1}V_1^0$.

(5)

When matrix S^{-1} existed, S will be observable matrix. Thus, in order to have S^{-1} matrix existed, all state vectors must be completely observable.

We denoted:

$$Z_1^* = S^{-1} Z_1^0; V_1^* = S^{-1} V_1^0$$

Then equation 6 will be:

$$Z_1^* = x_1 + V_1^* \,. \tag{7}$$

So, the new state vector is measured via new easement vector Z_1^* . However, state vector could only be evaluated after measurement n times.

We have equation for i component of the state vector:

$$Z_1^{i^*} = x_1^i + V_1^{i^*} \tag{8}$$

or

$$Z_1^{i^*} = a_1 z_1 + a_2 z_2 + \dots + a_n z_n, \qquad (9)$$

where

- $V_1^{i^*}$ is the ith- modified component of measured disturbances,

$$\begin{bmatrix} a_1 & a_2 & \dots & a_n \end{bmatrix}$$
: ith line of matrix S⁻¹.

In general cases, ith- modified component of state vector will in form:

$$Z_{k}^{i^{*}} = a_{1} z_{nk-n+1} + a_{2} z_{nk-n+2} + \dots + a_{n} z_{nk}$$
(10)

An optimal Kalman filter can be applied to filter disturbances. When evaluating constant components of state vector x_k^i , all scalar components of Kalman filter will in form:

$$\hat{x}_{k}^{\prime i} = \hat{x}_{k-1}^{\prime i} + K_{k} \cdot v_{k}$$
(11)

$$v_k = z_k^{*i} - \dot{x}_{k-1}^{\wedge^i}$$
(12)

$$K_{k} = \frac{P_{0}^{i}}{P_{0}^{i} + r^{i}}$$
(13)

where:
$$P_0^i = M[(x_i)^2]; r^i = M[(v^{i^*})^2]$$
.

The above given algorithm enables us to reduce modified disturbances V^* equal to optimal form. This is true when disturbances are white and discontinued V_k^* . In case the modified disturbances are color, algorithms must be in an auxiliary optimal form.

Equations of dynamic system and measurement have same forms as discussed before.

Equation of dynamic system at the n+1 sampling interval could be described via the initial interval:

$$x_{n+1} = \phi^n x_1 + \phi^{n-1} w_1 + \dots + w_n \quad (14)$$

And the ith component of state vector will have form:

$$x_{n+1}^{i} = b_{ii}x_{1}^{i} + b_{i1}x_{1}^{1} + b_{i2}x_{1}^{2} + (15)$$
$$\dots + b_{in}x_{1}^{n} + w_{1}^{io}$$

where:

+
$$W_1^{i0}$$
 is a component of vector
 $w_1^0 = \sum_{j=1}^n \phi^{j-1} w_{n+1-j}$
+ $[b_{i1}...b_{in}]$ - ith line of matrix ϕ^n .

Since equation 6, we derived dynamic equation of ith component of the state vector as:

$$x_{n+1}^{i} = \sum_{\substack{j=1\\j\neq i}}^{n} b_{ij} z_{1}^{j*} + b_{ii} . x_{1}^{i} + \sum_{j=1}^{n} b_{ij} v_{1}^{j*} + w_{1}^{j0},$$
(16)

where

$$z_1^* = \begin{bmatrix} z_1^{1^*} & z_1^{2^*} & \dots & z_1^{n^*} \end{bmatrix}^T$$

Thus, the input and measurement disturbances have a discontinuous, white noise Gaussian output signal. The linear combination of these are also discontinuous- white noise Gaussian signal. In those cases, an optimal evaluation could be carried out with a Kalman filter. In formula (10) element of model may be identificated with algorithm selforganization [2].

3 ALGORITHM SELFORGANIZATION

The selforganization method is one of the key points in synthesis model of control objects. The selforganization algorithm can synthesize target, produce decision-making and bring out control action to realize target under effects of series of uncertainties. The process bases on prediction of the future state of object. Simulation research on application of selforganization algorithm in prediction of error of navigation systems shows the effectiveness of building of prediction model in control system.

Structure of selforganization algorithm has form



Figure 1 Structure of selforganization algorithm

 $X_1, X_2, X_3, \dots, X_n$ – basis model; AKC – ensemble criteria selection;

| || ||| _____ generator model;

 $Y^{m1}, Y^{m2}, \dots Y^{mm}$ – building model.

The application ability of above evaluation algorithm could be tested by method of simulation.

All result of simulation is described for test systems [1].

The selforganization filtering (modification algorithm) process will start its satisfaction in evaluating parameters test model since the 5th steps, classic scalar algorithm since the 30th steps.

This modification algorithm could be functioning well without enough information of the objects model.

4 CONCLUSION

These designed algorithms require small amount of memories, easy to implement with computers, ensure high accuracies with lack of information of parameters object.

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ENVIRONMENTAL CAPACITY OF AN AIRPORT AS AN ELEMENT OF BALANCED APPROACH TO AIRCRAFT NOISE CONTROL

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Abstract: The paper presents analysis of Environmental Capacity of an Airport as an Element of Balanced Approach to Aircraft Noise Control. The main aim of the article is to use the concept of airport environmental capacity as according to ICAO Balanced Approach to aircraft noise control and emissions control. The interrelations of environmental, economic and operational capacities are discussed.

Keywords: Airport capacity, airport environmental performances, noise and emissions control.

1 INTRODUCTION

Aircraft noise disturbance is probably the most important factor (first of all, because it is the most geographically extensive form of impact) affecting the operation and development of airports around the world. Most of the world major airports have operational constraints or capacity limits based upon noise. But the future potential growths of air traffic imply that emission sources in the future will increase in importance.

The study of integrated airport impact shows that it is necessary to introduce the concept of airport (operational) traffic capacity according to environmental safety conditions. Evaluation of an airport impact on surrounding environment in terms of noise and air pollution could be realized by defining environmental capacity of an airport. Environmental capacity [1, 2, 3] means such environmental performances of airport (both operations and future development) that ensure fulfillments of normative conditions of noise at the control points around airport.

The main objective of this research is to use a concept of environmental capacity as it applies particularly to airports according to ICAO Balanced Approach to aircraft noise control and emissions control.

2 THE CONCEPT OF ENVIRONMENTAL CAPACITY

The concept of environmental capacity: as applied to an airport, the notion of "environmental capacity" C_{en} means reduction of an airport's (and by definition the air transport system's) capacity so as to ensure that airport environmental performances comply with the environmental rules [4]. According to this, airport's capacity *C* will be:

$$C = \min(C_{op}; C_{ec}; C_{en})$$

where, C_{op} - the operational capacity of an airport,

 C_{ec} - the economic capacity of an airport, C_{en} - environmental capacity of an airport.

The operational capacity C_{op} of an airport can be measured as the number of runway-taxiways slots, the terminal capacity or capacity of the apron areas. The operational capacity is limited only by means of flight safety.

The economic capacity C_{ec} can be measured as the maximum number of passengers or aircraft, which can be accommodated on a particular day with a given amount of infrastructure under given economic conditions. In a short-term, the airport services load during peak and of-peak period determine these conditions. In the long-term, the availability of investments for airport expansion principally determines the economic conditions (Figure 1).

The impact of the airports' operation upon the local environment is a major issue, which will affect both the capacity and the potential for future growth. This concept of "environmental capacity" as it applies to airports can be approached in at least two ways:

The first is that an airport's operational capacity is less the total sum of the individual environmental mitigation measures already in place at that airport.

The second is or could ever lead to an environmentally optimal solution:

It is necessary to identify and separate short-run concerns which mainly affect quality of life (e.g., aircraft noise) from long-term issues which mainly affect the assimilative capacity of the environment to cope with what we are throwing at it (e.g., pollution and global warming);

It is necessary to evaluate the viability of the environmental mitigation measures that are in the airport territory and in the vicinity. For example, many major airports have long-established night flight restrictions whose aim has been to protect local communities from excessive exposure from aircraft noise. From an environmental capacity perspective, such restrictions may be seen as a short - run, quality of life issue - and a successful mitigation measure – but with potentially more serious long-term environmental consequences.

3 THE METHODOLOGY OF DEFINING AN AIRPORT ENVIRONMENTAL PERFORMANCES

Evaluation of an airport capacity according to noise and emissions is defined by three groups of conditions: technical, political and social.

Technical conditions:

- Monitoring and creation and survey noise and air pollution data bases.
- Integration these data bases with monitoring system for track keeping survey (for each landing-take-off cycle it is necessary to provide the following information flight track used, time, aircraft type).
- Monitoring and survey for aircraft maintenance on ground (timetable of engine run-up operations for noise and emissions, aircraft anty-icing handling and painting for emissions).
- Modeling noise contours for various variants of operational conditions (intensity of aircraft operations). It is necessary to evaluate present day intensity of aircraft operations, to predict it for short-term and long-term period. But if the accuracy of such prediction is not sufficient, it is proposed to make noise contours assessment for intensity of aircraft operations equal to operational capacity of an airport.
- Defining sanitary-hygienic zone around an airport according to air pollutants emissions for all activities which generates emissions.
- Correlation noise contours and sanitaryhygienic zone to habitable areas around an airport.
- Analysis of probability that this airport has or can have in future constraints for its capacity or expansion according to its environmental performances.
- Analysis of probability that this airport can be influenced by any capacity constraints in associated airports.
- Land-Use Planning and Management: Planning (zoning, easement, etc.), mitigation (building codes, insulation, etc.) financial (tax incentives, charges, etc.); key to protecting noise reduction and abatement benefits; may involve "opportunity costs" for airports/local government.
- Social conditions:
- Availability of information about ensuring noise and emissions standards for population living in an airport vicinity.

• Establishing special service for processing with complaints.

Political conditions:

- Establishing operational constraints according to noise and air pollutants
- emissions for short-term and long-term perspective.
- Ascertainment of conformity between, on the one hand, profits from airport operation and job placement for local community and, on the other hand, expenses for realization of environmental programs.
- Opportunity to make amendments to norms by means of implementation national, European or international recommendations.

Limitations to noise during observation time T_{observ} are established in the fixed control points (zones) of noise control in the form of noise levels L_{AGoal} which, usually, serve as equivalent or day/night (which are also equivalent in fact, but include noise impact features during day and night time) levels. In Ukraine the equivalent noise level is established by national regulations as such criteria, for daytime $L_{AGoal} = 65 \ dBA$ and for nighttimes L_{AGoal} =55 dBA. Limitations to air pollution are established in the fixed control points (zones) of air pollutants emissions control in the form of instantaneous and continuous (effective) concentrations. On the basis of aforesaid the algorithm of evaluation of an airport environmental performances by means of environmental capacity are developed (Figure 2).

4 MAXIMIZING THE ENVIRONMENTAL CAPACITY OF AN AIRPORT

There are three variants of airport development according to the problem being discussed [5]:

- 1. Capacity changes at existing sites, without physical development.
- 2. Physical development of airport including new sites or extensions to exiting ones.
- 3. Implication of redistributed air traffic to other airports.

The key to maximising the environmental capacity of an airport is the integration of environmental management into the corporate business planning process.

It is a characteristic of environmental issues that they can require significant short-term investment in order to ensure long term return. Airport operators need to begin to plan now for the long term in order to meet anticipated infrastructure demand and environmental constraints. It is necessary to invest sufficient resources in environmental management and mitigation to ensure future capacity.

And as applied to the air transport industry it means that not only airport operators are responsible

for taking into account environmental factor, but also their service partners (airlines and other

transport services). Of course, airport operator is the central figure who has to solve the problem of



Figure 1 Interdependency of airport capacity types



Figure 2 Algorithm of evaluation of airport environmental performances by means of environmental capacity

aircraft noise in the working area and in the vicinity (on the local level).

All organisations involved need to work jointly and where necessary airport operator has to enforce controls to ensure corporate environmental targets are met and that the environmental impact of the airports total operation is kept to a minimum.

Airlines wishing to develop hub operations at a particular airport may actually take a proactive approach to encouraging the development of environmental best practice in order to secure their own future

In the long term it is to the advantage of all involved in the air transport industry that it continually strives to improve its environmental performance. Only through such action, coupled with planning for the long term that it will maximise its capacity within a climate of increasing environmental pressures.

An important issue for airports is that the noise contamination can be minimised by:

- minimising noise disturbance using all technological, operational, and planning devices within its power;
- considering mitigation and compensation for affected communities;
- working within standards limits.

5 CONCLUSIONS

A general definition is "Airport Environmental Performances are the individual for each airport characteristics which allow evaluating the interrelation of its operational, economic and environmental capacity".

On the basis of this analysis it is possible to make the following conclusions:

- 1. Evaluation the environmental capacity starting from individual characteristics of the airport;
- 2. On the local level (environmental capacity defining from the environmental requirements on the airport territory and in the vicinity) theenvironment ability to assimilate this negative pressure varies widely and is dependent on different factors;
- 3. The airport is considered as the focus of environmental capacity definition; this can be explained so that there are many negative factors concentrated directly in the airport boundaries. Thereafter the levels of the influence of this factors and hence the number of people being subjected to it are individual for an airport;
- 4. Effective environmental management and long term planning are the key to ensuring that the environmental capacity and hence the operating capacity of an airport can be maximised.

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INTERPOLATING SOLID ORIENTATIONS WITH QUATERNION CURVES BASED ON ATOMIC FUNCTIONS AND CARDINAL SERIES

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Abstract: New classes of unit quaternion curves to smooth interpolation of a given sequence of solid orientations are proposed. The first technique uses the compactly supported atomic functions for forming the so-called cumulative bases in the way similar to the procedure for constructing the B-spline quaternion curves. The resulting quaternion curves are infinitely differentiable and their curvature can be regulated by an appropriate choice of atomic function's parameters. Another approach is based on the cardinal interpolation series (the Whittaker–Kotelnikov–Shannon series) and its generalized version which uses the Fourier transforms of some atomic functions. It is shown that cardinal cumulative bases result undesirable oscillatory behavior of quaternion curves while their atomic generalization allows one to eliminate these unnatural oscillations.

Keywords: Quaternion, rotations, interpolation, atomic function.

1 INTRODUCTION

The problem of rotational movement approximation arises when we deal with spatial orientation of a solid body at discrete time moments.

Rotations of three-dimensional Euclidean space constitute the three-dimensional non-Abelian orthogonal group SO(3). The following two main ways for rotation approximation are respectively based on Euler angles and rotation matrices and on Euler's theorem and quaternions.

Due to the first approach, an arbitrary rotation is decomposed by a sequence of three rotations around axes of the Cartesian coordinate system. Each of these elementary rotations is described by a corresponding orthogonal rotation matrix while the resulting rotation is represented by a product of these matrices.

The second approach makes use of Euler's theorem: if *O* and *O'* are two directed axes (orientations) in \mathbb{R}^3 , then passing from *O* to *O'* can be realized by the only rotation by the angle $\gamma \in]-\pi,\pi]$ around a definite axis $l \in \mathbb{R}^3$. This rotation is described by the quaternion apparatus [1]. Let the axis, around which the vector quaternion q is rotated, be defined by a unit quaternion $p = \cos \gamma + r \sin \gamma$, where *r* is a unit vector. Then the quaternion $r = pqp^{-1}$ is obtained by rotation of *q* by the angle 2γ around *r*.

The main benefit of describing rotations with the help of quaternions is in simplicity of arithmetic operations, especially if we deal with a series of sequential rotations. Also, it is difficult to obtain expressions for angles of elementary rotations from the resulting rotation matrix while the quaternion representation has the intuitive physical sense and a great number of practical problems is based on immediate use of Euler's theorem.

Among other shortages of the approach based on Euler angles and rotation matrices one should

mention essential influence of an order of elementary rotations on the final result, that may cause the «gimbal lock» effect and losing one of the freedom degrees. Quaternion representation of rotations does not depend on the choice of a coordinate system, and only two rotation quaternions correspond to the same rotation. Besides, the apparatus of quaternions gives the possibility to realize an essentially greater number of methods for approximation and interpolation of discrete rotations.

Spherical linear interpolation (*Slerp* – Spherical Linear intERPolation) probably was the first effective method of such approximation [2]. After that, a great number of other approaches and algorithms were proposed [3], including one of the most simple and effective method of cumulative bases [4, 5].

In this work, the new classes of cumulative bases are considered, which are based on the family of the atomic functions (AFs) [6] and generalized Whittaker–Kotelnikov–Shannon series [7].

2 CUMULATIVE BASES TECHNIQUE

As is known, in the *Slerp*, the interpolation curve coincides with a geodesic line on a unit sphere, passing through neighbor quaternions q, p. Thus *Slerp* provides optimum interpolation of two quaternions. If it is necessary to interpolate a sequence of two or more quaternions, the usage of *Slerp* yields a nondifferentiable curve whose angular velocity tends to infinity at nodal points.

Among different methods for constructing smooth interpolation curves on the sphere, one should note approaches with using Catmull–Rom and Kochanek–Bartels splines, circular interpolation, algorithms *Squad*, *Spring*, et al. [3]. These techniques do not ensure infinite differentiability of the resulting curve. Moreover, some of them are relatively complicated due to using cumbersome expressions and algorithms, especially when interpolation nodes are not equally-spaced.

One of the simplest and universal techniques for constructing quaternion curves on unit sphere is the method of cumulative bases [4, 5] which main idea is in the following.

There exists a number of ways for approximation of a function f(t) in \mathbf{R}^3 by a discrete set of coordinate functions $\{\varphi_i\}$:

$$\mathcal{F}(t) = \sum_{i=0}^{N} p_i \varphi_i(t) , \qquad (1)$$

where $\{p_i\}$ are determined by values $f_i \equiv f(t_i)$ on nodal set $\{t_i\}$.

Polynomials, splines, and other functions are usually chosen in the capacity of functions $\{\varphi_i\}$.

Represent (1) in the form

$$f(t) = p_0 \varphi_0(t) + \sum_{i=1}^N \Delta p_i \varphi_i(t) , \qquad (2)$$

where $\Delta p_i = p_i - p_{i-1}$, $\phi_i(t) = \sum_{j=1}^{N} \phi_j(t)$.

Then replace in the latter expression respectively $\oint (t)$ for q(t), p_0 for q_0 , Δp_i for $\omega_i = \log(q_{i-1}^{-1}q_i)$, and the sum of vectors for the quaternion product. As a result we obtain

$$q(t) = \exp\left(\overline{\varphi}_{0}(t)\log q_{0}\right)\prod_{i=1}^{N}\exp\left[\overline{\varphi}_{i}(t)\log\left(q_{i-1}^{-1}q_{i}\right)\right] = q_{0}^{\overline{\varphi}_{0}(t)}\prod_{i=1}^{N}\left(q_{i-1}^{-1}q_{i}\right)^{\overline{\varphi}_{i}(t)}.$$
(3)

The new basis $\{\phi_i\}$ is called *cumulative* [4]. It allows constructing in *SO*(3) various quaternion curves whose properties are defined by the choice of initial coordinate functions $\{\phi_i\}$. Usually, the following types of cumulative bases are used: Bezier basis on the base of the Bernstein polynomials, Hermite basis; Schoenberg *B*-spline bases of *n*-th order.

One of advantages of a cumulative basis is the simple formula for the derivative of q(t):

$$\frac{d}{dt}q(t) = q(t)\sum_{i=0}^{N}\omega_{i}\frac{d}{dt}\overline{\varphi}_{i}(t), \qquad (4)$$

where $\omega_0 = \log q_0$. Analogously, the higher order derivatives can be found.

Cumulative bases are interpolants, i.e.,

$$q(t_i) = q_i \,, \tag{5}$$

if and only if

$$\phi_{i}(t_{j}) = \begin{cases}
1, & t_{j} \ge t_{i}, \\
0, & t_{j} \le t_{i-1}.
\end{cases}$$
(6)

Thus, for cubic B-splines instead of Eq. (8), we have

$$\phi_{i}(t_{j}) = \begin{cases}
1, & t_{j} \ge t_{i+1}, \\
0, & t_{j} \le t_{i-2},
\end{cases}$$
(7)

and the cumulative basis does not interpolate but realizes smoothing. To obtain interpolation curve, one should take undetermined coefficients $\{r_i\}$ instead of $\{q_i\}$ in Eq. (3). Interpolation condition (5) yields the system of nonlinear equations

$$r_{j-1} \left(r_{j-1}^{-1} r_j \right)^{5/6} \left(r_j^{-1} r_{j+1} \right)^{1/6} = q_j, \quad i = \overline{1, N-1} , \qquad (8)$$

which can be solved numerically by iteration procedures.

The cumulative bases technique have essential benefits in comparison with other algorithms, especially when nodes are located on the sphere not so far from each other and function of the initial basis $\{\varphi_i\}$ are compactly supported and have relatively small supports.

3 ATOMIC CUMULATIVE CURVES

3.1 Atomic functions up(x) and $fup_n(x)$

The simplest and most important AF up(x) satisfies the following functional-differential equation:

$$up'(x) = 2up(2x+1) - 2up(2x-1).$$
(9)

Atomic function up(x) is a compactly supported infinitely differentiable function:

$$\operatorname{supp} \operatorname{up}(x) = (-1, 1); \ \operatorname{up}(x) \in C^{\infty}(-\infty; \infty).$$

It is even and monotonically increases on the interval [-1, 0], decreases on [0, 1], and up(1-x) = 1 - up(x) for $x \in (0, 1]$.

The AF up(x) is not analytical, so it cannot be expanded in the Taylor series. Many techniques for evaluation of up(x) were proposed. Some of them use the fact that values of up(x) at binary rational points $k/2^n$ are easily computed rational numbers.

Recurrent functional-differential relations for AF $\sup_{n}(x)$ are similar to those for Schoenberg B_n -splines:

$$y'_{n}(x) = K \left\{ y_{n-1}\left(x - \frac{1}{2}\right) - y_{n-1}\left(x + \frac{1}{2}\right) \right\},\$$

 $y_{0}(x) \equiv up(x),$

where K is a normalizing factor.

The latter expressions imply that

$$\operatorname{supp} \operatorname{fup}_n(x) = \left(-\frac{n+2}{2}; \frac{n+2}{2}\right).$$

On this interval the function $fup_n(x)$ can be expressed via up(x) in the following manner:

$$\begin{split} & \operatorname{fup}_{n}(x) = \sum_{i=0}^{m+1} \alpha_{i}^{(m)} \operatorname{up} \Bigg[2^{-m} \Bigg(x - 2^{m} + \frac{m}{2} + 1 - i \Bigg) \Bigg], \\ & \alpha_{0}^{(m)} = 1, \quad \alpha_{i}^{(m)} = (-1)^{i} C_{m+1}^{i} - \sum_{j=0}^{i-1} \alpha_{j}^{(m)} \delta_{i-j+1}, \\ & \delta_{1} = 1, \, \delta_{2k} = -\delta_{k}, \, \delta_{2k-1} = \delta_{k}. \end{split}$$

3.2 Interpolation curve on the base of AF up(t)

Let interpolation nodes $\{t_i\}$ be equally spaced with step $h = t_{i+1} - t_i$. Suppose in (3)

$$\overline{\varphi}_{i}(t) = \sum_{j=i}^{N} \sup\left(\frac{t}{h} - j\right).$$
(10)

Here, condition (6) is satisfied, therefore this basis is interpolating. Moreover, due to features of the AF up(t), the expansion (3) is infinitely differentiable and the condition for quaternion curve derivative (4) takes the form

$$\frac{d}{dt}q(t) = \frac{2}{h}q(t)\sum_{i=0}^{N}\omega_i \operatorname{up}\left(\frac{2t}{h} - i + 1\right).$$
(11)

3.3 Smoothing curve on the base of AF $fup_2(t)$

Rewrite (3) in the form

$$q(t) = q_{-1}^{\overline{\varphi}_{-1}(t)} \prod_{i=0}^{N+1} \left(q_{i-1}^{-1} q_i \right)^{\overline{\varphi}_i(t)}, \qquad (12)$$

where the cumulative basis

$$\overline{\varphi}_i(t) = \sum_{j=i}^{N+1} \operatorname{fup}_2\left(\frac{t}{h} - j\right), \quad i = \overline{-1, N+1}.$$
(13)

Derivative of the expression (13) is also easily determined with using (4) and functional-differential equation for the AF $fup_2(t)$. Since $supp fup_2(t) = (-2, 2)$, the condition (7) is satisfied and the basis (13) is smoothing. To obtain an interpolation curve, instead of (12) one should take the expression

$$q(t) = r_{-1}^{\overline{\varphi}_{-1}(t)} \prod_{i=0}^{N+1} \left(r_{i-1}^{-1} r_i \right)^{\overline{\varphi}_i(t)}, \qquad (14)$$

where coefficients are found from the system of equations

$$r_{j-1} \left(r_{j-1}^{-1} r_j \right)^{13/18} \left(r_j^{-1} r_{j+1} \right)^{5/36} = q_j, \quad i = \overline{1, N-1}$$
(15)

solved analogously to Eq. (8).

4 CUMULATIVE CURVES BASED ON CARDINAL SERIES

4.1 Cardinal Series and the Whittaker-Kotelnikov-Shannon theorem

As is known, a signal f(t) with compactly supported spectrum $(f(p) = 0 \text{ if } |p| > \Omega)$ can be restored by using the discrete set of its samplings [8]:

$$f(t) = \sum_{k=-\infty}^{\infty} f(k\Delta) \operatorname{sinc}\left[\frac{\pi}{\Delta}(t-k\Delta)\right],$$
(16)

where $0 < \Delta \le \pi / \Omega$ and sinc $t \equiv \sin t / t$.

Expression (16) is often called the *Whittaker–Kotelnikov–Shannon (WKS) theorem* and the series with respect to translations of dilations of functions sinc t is called the *cardinal series*. Some generalizations of Eq. (16) are known [8]. The new

method for reconstruction of bandlimited signals with the use of the AFs $h_a(t)$ was proposed in [7].

4.2 Atomic functions $h_a(t)$ and Zelkin-Kravchenko-Basarab interpolation basis

Atomic functions $h_a(t)$ (a > 1) are infinite differentiable compactly supported solutions to linear functional-differential equations

$$\frac{2}{a^2}y'(x) = y(ax+1) - y(ax-1).$$
(17)

Function $h_2(t)$ is usually denoted by up(t) and it was considered in section 2.1. Some important properties of $h_a(t)$ are

- $h_a(t) = 0$ if $|t| \ge 1/(a-1)$;
- $h_a(t) = a/2$ if $|t| \le (a-2)/a(a-1)$ and $a \ge 2$;
- the Fourier transform of $h_a(t)$ is

$$\hat{\mathbf{h}}_{a}(p) = \prod_{k=1}^{\infty} \operatorname{sinc} \frac{p}{a^{k}}.$$
(18)

Theorem [7]. Let a continuous function f(t) be bandlimited (supp $f(p) = [-\Omega; \Omega]$). If $a \ge 2$ and $\Delta \le \pi(a-2)/\Omega(a-1)$ then the following expansion is valid

$$f(t) = \sum_{k=-\infty}^{\infty} f(k\Delta) \hat{\mathbf{h}}_{a} \left[\frac{a\pi}{\Delta} (t - k\Delta) \right].$$
(19)

The series in the right-hand part of Eq. (19) is called the *Zelkin–Kravchenko–Basarab* (*ZKB*) series.

Formula (19) is correct even if we take a finite number of terms in the product (18), i.e.,

$$\hat{\mathbf{h}}_a(p) = \prod_{k=1}^M \operatorname{sinc} \frac{p}{a^k}$$

with the following restrictions:

$$a(1+a^{-M}) > 2, \ \Delta \le \frac{\pi}{\Omega} \cdot \frac{a(1+a^{-M})-2}{a-1}$$

The truncated series

$$\tilde{f}_N(t) = \sum_{k=-N}^N f(k\Delta) \hat{\mathbf{h}}_a \left[\frac{a\pi}{\Delta} (t - k\Delta) \right],$$

will give us better results than truncated expansion (16) because the sidelobe levels of functions $\hat{\mathbf{h}}_{a}(p)$ are significantly lower than that of sinc *p*.

4.3 Whittaker–Kotelnikov–Shannon cumulative basis

Let us take translations of dilations of functions sinc t as an initial basis $\{\varphi_i\}$ in (1). Since here the condition (6) is satisfied, approximation on the base of this basis provides interpolation of a quaternion sequence. Expansion (3) will take the form

$$q(t) = q_0^{\overline{\varphi}_0(t)} \prod_{i=1}^N \left(q_{i-1}^{-1} q_i \right)^{\overline{\varphi}_i(t)} , \qquad (20)$$

where

$$\varphi_i(t) = \sum_{j=i}^{N} \operatorname{sinc}\left[\frac{\pi}{h}(t-jh)\right], \quad i = \overline{0, N} .$$
(21)

The shortage of this basis is in the fact that the function sinc has relatively high level of sidelobes (about -13 dB) that may cause sufficient oscillations, especially near ends of an approximation interval.

Additional error may be caused by the fact that the WKS cardinal series is an ideal tool for interpolation of bandlimited functions while in other cases the error between interpolation nodes may be sufficiently large.

4.4 Zelkin–Kravchenko–Basarab cumulative basis

Functions $h_a(t)$ in ZKB series have essentially lower sidelobe levels (from -23 dB at a = 2 to -13 dB at $a \rightarrow \infty$) than the basic functions sinc(t) of the conventional WKS series. Cumulative basis functions have the form

$$\overline{\varphi}_i(t) = \sum_{j=i}^N \prod_{k=1}^\infty \operatorname{sinc}\left[\frac{\pi}{a^{k-1}h}(t-jh)\right], \quad i = \overline{0, N} .$$
(22)

In Eq. (22) it is enough to take a relatively small number of product terms to ensure appropriate accuracy. This basis is convenient due to the fact that it allows one to control the quaternion curve behavior by adjusting the atomic function's parameter a. At differentiating the quaternion curve one should take into account the expression

$$\frac{d}{dt}h_a(t) = h_a(t)\sum_{n=1}^{\infty} \left(\frac{\operatorname{ctg}(ta^{-k})}{a^k} - \frac{1}{t}\right).$$
(23)

5 CURVATURE OF CUMULATIVE CURVES

Among the criteria for estimating quaternion curves quality, we can select the angular velocity behavior and minimum curvature. The first criterion is obvious: all the novel cumulative bases proposed ensure infinite smoothness of a quaternion curve. An expression for angular velocity is obtained from the relation $q'(t) = q(t)\omega(t)$.

Taking into account Eq. (4), we get the following expression for the modulus of angular velocity

$$\left\|\omega(t)\right\| = \left\|\sum_{i=0}^{N} \omega_i \frac{d}{dt} \overline{\varphi}_i(t)\right\|.$$
(24)

According to [3], the local curvature of a quaternion curve q(t) in SO(3) is defined as

$$\kappa(q,t) = \left\| q''(t) - \left[q''(t) \cdot q(t) \right] q(t) \right\|.$$
(25)

where (\cdot) is the scalar product of quaternions.

The total curvature on an approximation interval

(a,b) has the form

$$K(q) = \int_{a}^{b} \left\| \kappa(q, t) \right\|^{2} dt .$$
⁽²⁶⁾

6 KEYFRAME INTERPOLATION EXAMPLE

Consider interpolation of a sequence of six unit quaternions $\{q^{<i>}\}$, $i = \overline{0,5}$, with the help of the proposed novel cumulative bases. The whole

interval is split with a mesh of 120 nodes. Figure 1 illustrates projections of quaternion curves on a unity sphere in \mathbf{R}^3 . Parametric equations of the curves have the form [3]

$$x_i(t) = \frac{q_i(t)}{\sqrt{q_1^2(t) + q_2^2(t) + q_3^2(t)}}, \quad i = 1, 2, 3$$

Analysis of obtained data allows making a conclusion about efficiency of using the novel cumulative bases constructed with the help of AFs. In particular, one can determine experimentally the optimum value of the function h_a ($a \approx 3$), minimizing the interpolant curvature.

Curves on the sphere (Fig. 1,a and Fig. 1,b) seem to be identical, however, they do not reflect the contribution of the rotational component of the quaternion q_0 . As for the smoothing curve on the of the AF fup₂ (Fig. 1,f), we may say that it practically coincides with one obtained by using cubic *B*-splines or Bezier-splines, but unlike the latter ones, it is infinitely differentiable.

Example of keyframe interpolation by the ZKB cardinal basis is presented in Fig. 2. Here points denote the keyframes. The plot of the angular velocity is shown in Fig. 3.



Figure 1 Projections of cumulative curves based on B_1 -splines (a), functions up (b), sinc (c), $\overline{h_2}$ (d) $\overline{h_3}$ (e), fup₂ (f)



Figure 2 Example of quaternion interpolation with the help of ZKB cardinal interpolation basis (h_2^{\downarrow})



Figure 3 Cumulative quaternion curve angular velocity plot

7 CONCLUSION

It was shown that atomic functions have some essential benefits in comparison with B-splines or other interpolation tools. The family of atomic functions is very large and further investigations probably will give us new interesting and valuable examples of applications of AFs in quaternion approximation of solid orientations. The results of this work can be applied not only for keyframe animation but also for solving problems of telemetric information processing, astroorientation, spacecraft control, scanning antenna synthesis, et al.

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DEVELOPMENT OF MOTORIC ABILITIES AND PHYSICAL FITNESS OF MILITARY PROFESSIONAL DURING THEIR STUDIES AT THE ACADEMY OF THE ARMED FORCES IN LIPTOVSKÝ MIKULÁŠ

Dušan LITVA

Abstract: We deal with the level of motor abilities and skills of male and female students of the first up to the fourth year of the Armed Forces Academy in Liptovsky Mikuláš in respective semesters of study. Two generation of four year study students were involved in the research. There are observable changes in almost all motor abilities in comparison with the beginning of study. The interesting differences are in swimming skills perfomance. The highest increase was recorded in endurance tests (Cooper test , 4 km, 5km run). Gradual increase of perfomance from the first up to the fourth year was recorded in female sample. On the contrary, male reached the top level of conditioning abilities in the second year and they did not improve noticeably further. The most noticeable changes in the level of conditioning abilities appeared in the tests during the last semester of study.

Keywords: Motoric abilities of military professionals, fitness performance tests.

1 INTRODUCTION

The following authors achieved the partial knowledge related to development of soldiers' motoric abilities: Žára (1969) measured the performance of young men preparing for "Spartakiada" mass exercise in the former Czechoslovakia; Přívětivý (1992) analyses special redeployment training of soldiers performing combat duties, Rezek (1998) analysed the training of pilots, Švrlo (1997) focused on the training of the Russian special forces called Spetznaz and in his study he emphasises the high level of general fitness and universality of these soldiers (trained for land, sea and air combat missions); Papay (1996) dealt with optimization of physical fitness of professional soldiers. However, I could not find the more detailed and more complex study of the physical fitness development concerning the students in both military and civilian universities. This article is one of the results of the research done as a part of the project AGMO-09 called "Optimization of Physical Fitness and Motoric Abilities of Professional Soldiers in the Slovak Armed Forces."

2 INITIAL TRAINING OF CADETS FOR THEIR FUTURE PROFESSION

Preparation of cadets for their future profession in the Slovak Armed Forces requires the wellthought methodology concerning development of fitness abilities. Considering the performance of tough combat duties in Slovakia as well as in foreign missions, the emphasis is placed on high readiness as well as physical and fitness capabilities. A professional soldier must be able to cope with fatigue while performing various combat duties in all military specializations. However, cadets begin their studies with very low physical fitness and motoric abilities and that is why their adaptation to their future profession is quite difficult. This fact is the result of entrance tests and it considerably hinders the work of PT instructors who want the cadets to develop their motoric abilities. This means that from the very beginning the PT instructors must follow the programme for development of all motoric abilities (the programme lasts from 1 to 3 months) so that the cadets can build up an appropriate physical fitness from the very beginning and continue in development of their fitness in further years of study.

Development of fitness capabilities may be understood thanks to experience and knowledge of a military professional. During studies the stress is laid on development of endurance and stamina in different forms since these are essential for enhancement of physical performance, general readiness as well as future performance of a military professional. Endurance and stamina depend largely on functional capabilities of cardiovascular and respiratory systems, on aerobic and anaerobic capacity of the body, perfect coordination of locomotive organs as well as on mental capabilities and overall health condition of a military professional.

The purpose of this article is to determine and compare fitness level of cadets in two consecutive years of study who are preparing for their profession in the Slovak Armed Forces and following the study programme of the Department of Physical Education and Sport at the Academy of the Armed Forces.

3 ASSESSMENT OF MOTORIC ABILITIES

We diagnosed the level of motoric abilities of men and women by the set of motoric tests / Cooper test – 12-minute running, endurance shuttle 20-metre running with the "beep", four and five-kilometre run while wearing fighting order or sports clothes, pullups on a bar, 30 seconds of push-ups, one minute of

sit-ups, obstacle course, special track consisting of a buck, bench, mat, shuttle run (10x10 m), swimming 100 m course in the first year of study followed by an increase by 100 m in every consecutive year and every semester/.

The students who were tested were divided into Team A (male and female cadets studying from 2004 to 2008) and Team B (cadets studying at the Academy of the Armed Forces from 2005 to 2009). The number of these students gradually decreased as some of the them did not manage to pass all the exams.

The empirical material was processed by means of mathematical-statistic and analytical methods. Comparison of individual measurements was done individually for men and women categories.

The test results were acquired from the records in the archives of the Department of Physical Education and Sport at the Academy of the Armed Forces in Liptovsky Mikulas. The tests were carried out by the department staff who used the methodology which has been used at the department as well as in the Slovak Armed Forces for a long time. Having completed the entrance PT lessons focused on the enhancement of motoric abilities, the cadets had 90-minute PT lessons twice a week in 15week semesters. What is more, they also took part in summer and winter training which lasted five days as well as in military training which was organized after each semester and which lasted from 2 to 6 weeks.

4 ASSESSMENT OF MOTORIC ABILITIES DEVELOPMENT

This article presents preparation of a special group - soldiers. Considering their future profession, this preparation has special objectives and contents and it is performed in the specific surroundings. Moreover, it uses specific means applied in different sports in order to enhance fitness of cadets. The examples include running in a difficult terrain with different load (e. g. up to 25 kg) when soldiers are able to perform specified combat duties, overcoming artificial and natural obstacles, for example, on skis. The training and performance of cadets are influenced by different factors, such as the altitude, angles of slopes, snow, water, sand, the sun, the air, special equipment (different uniforms, e. g. the battle dress uniform, etc.), application of sports such as karate, judo, close combat, sumo, fighting with combat knives and shovels, swimming, diving military-practical swimming - with special equipment and uniform, explosives handling under water, etc. The fitness and motoric abilities achieved in this way are incomparable with common population because physical training of university students in civilian colleges is often done in the first semester, when students pick a particular sport. What is more, physical training is not included as an obligatory subject necessary for the overall graduate profile. Civilian students are preparing for professions which are not dependent on their fitness level; physical training just helps them adopt a healthy lifestyle. That is why it is not possible to compare cadets and students and civilian universities.

The graphs show that the performance of male cadets considerably increased in winter semesters within the four years of study. The biggest changes were made with pull-ups (Table 1), push-ups and situps (Graph 4), that is in the activities focused on testing the muscle strength of upper limbs and chest. The Team B is much better at enhancing their performance.

Motoric abilities which were tested in summer semesters (Table 1) improved gradually within the four years of study. The (Graph 5) shows that at the end of the first year cadets were able to run 2,800 m in 12 minutes and that in the second year of study this distance remained steady and did not increase with both tested teams. This tendency proved true with the 5-kilometre run under eased conditions (running in sports clothes). The results of these tests are comparable with the research done by Bence (2003), who studied motoric abilities of the state administration staff (soldiers, policemen, pilots and firemen) and Litva (2001), who studied training and enhancement of the special forces performance within the Slovak Armed Forces.

The test results show that the female cadets enhanced their performance uniformly throughout the whole study. However, the results of sit-up tests proved that their strength of abdominal muscles considerably increased, (Graph 2). What is more, there was some improvement with the 20-metre endurance shuttle run - 59.07 repetitions. The female cadets from Team B had better results.

The (Table 2) presents motoric abilities of female cadets in summer semesters. The test results proved increasing performance in endurance disciplines, mainly in the 12-minute run (Graph 3), where we can see the gradual upward tendency. Graph 4 and Graph 6 show that there are slight differences between male cadets of the two teams (Team B is slightly better) regarding strength disciplines (pull-ups, push-ups, sit-us) and coordination and endurance disciplines (obstacle course and common exercise). There were more striking differences with swimming and endurance 12-minute run and 5-kilometre run, Graph 5. The higher performance was observed in the summer semester of the fourth year of study, table 1, 2, when cadets do the selective disciplines which are necessary for the final evaluation in their

personal profiles. The female cadets had equal performance in strength disciplines (Graph 1 and 2 - climbing, sit-ups) whereas there were

similar differences in swimming as with the male cadets.



Graph 2 Women sit - up



Graph 3 Women 12 minutes run











Graph 6 Men lift - up

Table 1

		Discipline																			
		SAC		lie dsit d.		run10x10 m		PDSKC		run 5 km		run 5 km ZP				run60 m		swim300 m		run 12 min	
														pull-aps							
		Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	В	Α	в	Α	В	Α	В
	n	64	67			64	67					64	66							64	66
1.y	x	19	19,1			25,3	25,2					25:34,4	25:37,4							2812,9	2800,6
	s	1,16	1,518			0,744	0,729					01:33,2	01:40,3							175,05	149,3
	n	57	61			57	60			57	60									57	61
2.y	x	19,1	19,2			25,1	25,1			23:28,8	23:17,0									2771,4	2754,1
	s	1,61	1,66			0,88	1,66			01:33,2	01:29,3									147,5	140,16
	n					54	57	54	57			54	57							54	57
3.y	x					25,1	25,4	01:26,3	01:27,5			26:37,4	25:26,6							2768,9	2818,4
	s					0,798	0,764	00:08,6	0,09,6			01:20,6	01:51,4							140,2	172,08
	n			21	31	31	28							33	29	28	47	22	16	31	42
4.y	x			54,8	63,8	25	25,9							15	18,5	8,0	8,0	06:24,0	06:27,3	2777,9	2798,1
	s			7,24	9,71	0,76	0,81							4,8	4,96	0,49	0,37	00:43,3	00:46,6	177,5	206,1

Table of developing motor skills first - 4 year summer semester - Men

Legend: n - scale, x - arithmetic mean, s - standard deviation A - set of students studying in the years 2004 - 2008, B- 2005-2009

Table 2

												Discipline	2								
		run 100 m		lie dsit d		r un10x10 m		DzM		run 4 km		run 5 km ZP				run 60 m		swim.300 m		run 12 min	
														run 1000 m							
		Α	В	Α	в	Α	В	Α	В	Α	В	Α	В	Α	в	Α	в	Α	в	Α	В
1.y	n							30	30					30	30	30	30				
	x							188,9	189,4					04:22,7	04:20,8	9,9	9,7				
	s							17,479	10,988					00:19,1	00:15,4	0,576	0,413				
2.y	n	27	28									27	27							27	28
	x	15,9	16,1									27:03,1	26:30,2							2383,7	2368,2
		1,01	0,76									01:12,9	01:16,4							156,356	178,16
	S	9				27	27			27	27									27	27
	n					21	27			27	21									27	27
3.y	х					27,7	27,8			25:25,2	23:50,1									2557	2434,1
	s					0,765	0,655			02:12,4	02:06,8									178,042	188,297
4.y	n			22	26	25	21	5	2							8	10	11	8	19	20
	х			58,5	64,6	27,9	28,3	204,6	193							9,5	9,2	06:43,3	07:02,8	2300,5	2485
	s			7,03	7,04	1,402	0,729	7,893	18,385							0,538	0,346	00:27,4	00:43,5	184,16	201,91

Table of developing motor skills first - 4 year summer semester - Women

Legend: n - scale, x - arithmetic mean, s - standard deviation

A - set of students studying in the years 2004 - 2008, B - 2005 - 2009.

Climb - climbing to 4 m rod-woman lie down – sit down- per-minute, swim -100 - 400 m v. way from first to 4class, VCB 20 m - 20 m endurance Shuttleless running an audio signal, running at 60 m-60 m, 100 m - run 100m, 10x10m - You may run the 10 meters to repeatedly DzM-jump from a position, 1000 m - run 1000 m after atlet.track, 12 min - Cooper running for 12 minutes, 5 km - 5 km run on the sports Gear, 4 and 5 km MD - run 4 km to 5 km women and men in Military Gear, SKC PD - Joint Control Exercise for special military obstacle track in the military tract, SAC - acrobatic jumping exercises (special track is composed of gym gear - leather 120 cm, bench, mat, horse 120 cm), cranks - exercise in the supine case forward for 30 seconds, pull-aps – repeated attracting in trapeze

5 CONCLUSION

The performance and motoric abilities of the male and female cadets studying at the Academy of the Armed Forces in Liptovský Mikuláš in two consecutive years of study mostly increased in all parameters gradually throughout the studies. There were no statistically striking differences in the strength tests – sit-ups, pole climbing (women). However, there were considerable differences in

swimming, jumping and acrobatic exercises as well as the common exercise on an obstacle course. What is more, there were also striking differences in the 4kilometre and 5-kilometre endurance run in a fighting order. The female cadets recorded gradual performance increase in the 12-minute endurance run whereas the male cadets reached the top performance in the first year of study and maintained this throughout the studies. All the cadets enhanced their performance considerably in the summer semester of the fourth year of study, when their results are included in the personal evaluation important for their posting in the Slovak Armed Forces.

Analysis of the results has proved wellfoundness of the PT educational system applied at the Academy of the Armed Forces in Liptovský Mikuláš and its effectiveness in term of development of performance and overall motoric abilities among the military professionals necessary for performance of their duties sin the Slovak Armed Forces.

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