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Dear readers,

You are about to read the second copy of the journal Science & Military 2012. It is the 14th issue of the journal that has been continuously published since 2006. In the intervening years the Science & Military journal has undergone a number of positive improvements not only in terms of form but also in content. It has adapted to reflect the today's times, trends and to respond to current needs. On the proposal from the Chairman of the editorial board the new international editorial board was constituted. New contributors not only from Slovakia but also from abroad joined the authors' team. Editor's office accepts only those articles written in English language. Before being published, all articles must pass the anonymous review procedure. In 2009 the Science & Military journal was submitted to ProQuest database and in 2012 is was submitted to EBSCO database. Authors of articles thus need not worry that the article remains unrecognized, forgotten or inaccessible to the general professional community. However, a persistent effort to include the journal Science & Military in the Current Contents database remains the main long-term goal of editor's office. I believe the journal Science & Military will henceforward continue to provide stimulating and inspiring platform for communication at professional and civic society levels as well as for scientific and to all-society beneficial solutions to the problems concerning the current issues of military science in its wider interdisciplinary social contexts not only at national but also at the international levels. We are aware of the fact that a journal published in "small Slovakia" cannot compete with a big tens of thousands of studies but it may hold the attention of readers and meet the competition by its original image that must be presented in appealing way.

And what can you find in this issue? I would like to draw your attention to some articles. The article written by František Bartko and František Bartko, Jr.: „Identification and categorization of security risks "covers various approaches to categorization of risks. It presents approaches of the World Economic Forum, the World Bank, the Ministry of Interior of the Slovak Republic, OECD and NATO. The article by Peter Lipták, Igor Barényi and Ondrej Híreš titled „Degradation of mechanical properties after welding of high strength steel Armox 500" pays attention to yet the most commonly used armor ARMOX 500. The results presented in the article were obtained in experimental tests carried out by the authors and have significantly contributed to the field of welding armor. The authors Mariana Martišková and Ladislav Novák present an article titled „Findings on the Deployment of Civilian Experts from the Slovak Republic into Common Security and Defence Policy Mission" dealing with the relationship between the obligations of the Slovak Republic within the international crisis management and its population and comparing the results with other EU countries. The article by Jaromír Mareš, Nataša Pomazalová and Václav Zajíček: „Testing the influence of additives Envirox during operation of the combustion engine T 815" analyses the effects of additives on engine T 815 running. Klára Sipos Kecskeméthy in her article called „The Mediterranean", relevantly presents the geopolitical importance of the Mediterranean region, from which the NATO activities focused on this area stem. The article by Slavomír Bylen titled „Modelling of logistic in computer assisted exercises", describes the JTLS as a simulation tool suitable for logistics as well as logistics operations control methods in JTLS. The paper presents practical experience in using JTLS in the Polish army.

Dear readers, I believe that you will find this copy of the journal Science & Military both interesting and informative and on behalf of all members of the editorial board I would like to thank you for your interest and support.

Prof. Dipl. Eng. Pavel NEČAS, PhD.
Chairman of the editorial board

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COSTS AND EFFICIENCY EVALUATION MODEL OF TRAINING METHODS

Martin HUBÁČEK, Vladimír VRÁB

Abstract: This article results from the efforts of the authors to discover an objectified evaluation process of both necessary costs and costs incurred for training as a means of comparison and evaluation of the efficiency of the training conducted in the most conventional manner in the field training and of the training of military professionals employing the simulation and training technologies. The derived model is not finalized and cannot ever be. However, it may significantly influence the decision-making process about the proportionality of preferences of using individual training methods with regard to the available source framework. The model does not evaluate the efficiency of the training method itself because that is affected by available training resources, equipment, ammunition, fuel etc., and especially by the quality of training preparation, quality of the chief or the head of the training and many other factors.

Keywords: CAX, constructive simulation, training.

1 INTRODUCTION

The Center of Simulation and Training Technologies (CSTT) has played a significant role in the preparation of military professionals in the Czech army for more than eleven years using the simulation and training technologies. These technologies represented, mainly at the beginning of their deployment, a considerably expensive component in the category of investment costs. In general, the widespread opinion prevails that training using simulators is significantly cheaper than field training using real machinery and equipment. Literature and other available sources concerned with training and simulations do not provide enough evidence for this claim or instructions for comparing the costs of comparable field training and training using solely simulation technologies. One can readily agree with many conclusions about the benefits of training with simulation technologies [1] [2] [3] [4], which mainly apply to:

- possibility of repeating the same training session;
- training staff in safe conditions;
- saving costs for fuel and ammunition;
- causing no damage to the environment and countryside;
- reduction of the impact on the environment (no disturbance of everyday life of the population);
- identifying weaknesses in the decision-making process.

Even though these benefits are undeniable, and many of them would also offset any potential increased costs of training using simulation technologies because the possible losses of life and damage to the environment are hard to quantify; it is appropriate to prepare the methodology for the future which would serve as the basis for establishing the costs of comparison of these forms of training. As stated above, CSTT has provided training for several years and extended the range of operations from the primary capability to conduct primarily combat operations to training units for missions abroad, training in the deployment of army units in favor of the Integrated Rescue System (IRS) and the preparation of specific units such as military engineers, military police etc.

From a practical perspective, however, CSTT has no methodology by which it would be possible to make comparisons between the costs of the training using simulation technologies and the costs of similar exercises carried out in the field. The established methodologies, internal documents and other related papers address only the issues of the actual preparation, execution and evaluation of computer-aided exercise [4] [5] [6]. The model and the methodology of calculations described below may be the very first step for the introduction of exact calculations of the costs of training using simulation and training technologies as well as the costs of the "common" field exercises. It would be possible to clearly confirm the general assumption of the economic benefits of the training using simulators and training technologies.

2 EVALUATION MODEL OF THE TRAINING EFFICIENCY

The use of constructive simulation for members of staff and commanders training will expand only if its use is efficient (particularly financially profitable) when compared with other training methods that the Czech army employs for preparation of its members to fulfil their tasks.

There exists no exact methodology for calculating the costs of a live simulation exercise (actual exercise under real conditions) or the costs of constructive and virtual simulations. However, under certain circumstances, a simplified model may be created and employed for the comparative analysis.

The basis of the model for calculating the efficiency (or rather costs) of an exercise stems from the premise that in an analytic formula for calculating the costs, identical variables are accepted that characterize given phenomenon, process and

behavior as a process of constructive, virtual, and live simulations (training in a real environment). The relationship for calculating the costs associated with exercise N_{cv} can be expressed by the following equation:

$$N_{cv} = k \cdot \sum_i N_i \quad (1)$$

where
N_a refers to the costs of machinery employment during the exercise;
N_b refers to the rental costs of the area for the exercise;
N_t refers to the costs of technical equipment;
N_p refers to the costs of support of the exercise;
N_m refers to the costs of consumed ammunition;
N_s refers to the costs of boarding of the participants of the exercise;
N_h refers to the costs of accommodation of the participants of the exercise;
N_u refers to the costs related to maintenance of the equipment, depreciation;
N_n refers to the costs that have not been specified yet
k is a tolerance coefficient.

The variable N_a represents the cost of using all types of machinery during the exercise (passenger cars, transport vehicles, trucks, special vehicles, aircrafts, reconnaissance aircraft etc.). Its value can be expressed as:

$$N_a = \sum_{j=1}^{n} a_j \cdot l_j \cdot c_j \quad (2)$$

where
a_j refers to the number of pieces of j-th piece of machinery employed in the exercise,
l_j refers to the average kilometrage covered by j-th piece of machinery during the exercise in [km],
c_j refers to the costs of j-th piece of machinery spending on 1 km ride in [CZK/km].

In the case of the exact kilometrage covered by given type of machinery, equation 2 can be modified into such a form in which the product of the number of pieces of j-th piece of machinery and the average kilometrage covered by the type of machinery can be replaced by the actual kilometrage of the piece of machinery throughout the whole exercise.

This precise calculation can be used for exercises with real machinery in the field, or else in performing a similar exercise on virtual simulators and in constructive simulations with a small degree of aggregation, where this value can be easily obtained. With aggregated systems one can accurately determine the exact distance travelled only by the whole unit, not by individual pieces of machinery.

It is also important to point out that in the aggregate simulation during the conduct of combat operations, the known data is usually only the depth of the combat task and not the distance actually travelled. According to [2], based on the experience of the real conflicts it is possible to multiply the depth of the task in offensive operations by the factor K_m, which takes values of 1,4 - 3 depending on the readiness of defense. Thus the actual kilometrage may be obtained. CSTT uses the OTB system or its successor OneSAF for constructive simulation during the exercises. They both have a small degree of aggregation so that the actual kilometrage of individual pieces of machinery may be gained using the AAR tools.

Live simulation (real exercise in the field) can take place in areas whose use is a subject to payment for the rental. Quantifying its value is based on prices per m^2 of j-th area (c_j) multiplied by the overall use of the j-th area (Pj) or the total invoiced cost for rental may be put into equation 1.

Calculation of N_b can be performed as follows:

$$N_b = \sum_{j=1}^{n} P_j \cdot c_j \quad (3)$$

where
P_j refers to the area of j-th sector used during the exercise in [m^2];
c_j refers to the costs of 1 m^2 of j-th sector in [CZK/m^2].

In the case of training using virtual or constructive simulation, the costs for renting space equal zero. Exercise may in fact take place in any area. The spatial location of the exercise is possible in any territory which is mapped in a terrain database (TDB) or data can be provided from which the terrain database may be produced for the simulation. The cost of TDB is not insignificant, ranging in the hundreds of thousands of crowns, depending on the area and its details. The costs can be potentially increased by the cost of collecting digital geographic data required for the creation of TDB. Because of possible multiple repetitive use of given TDB, the potential increased costs are considerably reduced with each conducted exercise; unlike with the exercise in real terrain, where it is necessary that new resources are devoted to every other exercise again. Conducting exercises on simulators also allows training in areas that are not available for traditional training for various reasons (territory of another state, different climate area, considerable distance, region with ongoing combat operations, national park or otherwise valuable territory etc.). TDBs of these areas can be created from various data sources (national, allied, international) [6] [8] [9] or it is feasible to use contactless methods of data collection for creating geographic data [10] [11] which ought to be supplemented by information obtained through GEOINT, IMINT methods and geographic analysis [12] [13].

The costs of the use of technical equipment N_t represent the sum of money to be spent on their

employment during the exercise. The category of technical resources involves for example chain saws, power cutters, hydraulic shears, and also generators that supply them and other equipment with power (communication equipment, computers etc.). The following formula constitutes the equation for calculating the costs of the use of technical equipment:

$$N_t = \sum_{i=1}^{n} t_i \cdot c_i \quad (4)$$

where
t_i refers to the time period of using the i-th piece of technical equipment during the exercise in [h];
c_i refers to the costs of using i-th piece of technical equipment (operating expenses) per 1 hour [CZK/h].

The costs of support of the exercise N_p in equation 1 represent the expected or incurred expenses necessary to support the exercise. This category includes fees for hiring auxiliary staff such as figurants in the exercise, operators of the simulation systems etc., i.e. persons who are not trainees, but whose performance is essential for the conduct of the exercise.

$$N_p = \sum_{i=1}^{n} t_i \cdot c_i \quad (5)$$

where
t_i refers to the total time of engagement of i-th person in the support the exercise in [h],
c_i refers to an hourly wage of i-th person in [CZK/h].

The costs of the fees do not include salaries of permanent staff of the training facilities, operators of shooting ranges and simulation centers, or members of other units playing the role of the enemy forces in the exercises, participating in the high command and the referee service etc. Salaries of these employees are paid regardless of the running training.

The funds needed to ensure the effects and impacts of „firing destruction“ of used ammunition represent the costs of estimated (or actual) consumption of ammunition. These costs present consumption of all types of ammunition for all weapons deployed in the exercise. In the case of live training the live ammunition is replaced with blank and training ammunition. The costs of consumed ammunition can be expressed as follows:

$$N_m = \sum_{i=1}^{n} m_i \cdot c_i \quad (6)$$

where
m_i refers to the amount of consumed i-th ammunition during the given exercise in [pcs];
c_i refers to the price of i-th ammunition in [CZK/pcs].

The costs associated with boarding of participants of the exercise are included in the formula calculating the total costs of training, even though the participants are provided with free catering and defined extra pay during the training. The unit or facility that provides food service for participants of the exercise, nonetheless, always settles the costs.

The calculation of costs associated with catering of participants of the exercise can be performed as follows:

$$N_s = p_o \cdot (c_{dd} + \sum_{i=1}^{n} p_i) \cdot d \quad (7)$$

where
p_o refers to number of persons provided with boarding service during the given exercise [-];
c_{dd} refers to the price of daily diet for the given type of exercise (occupation) in [CZK];
p_i refers to the price of i-th extra pay defined for the given type of exercise (occupation) in [CZK],
d refers to number of days during the exercise when the free catering is provided to the participants [-].

Similarly, the costs related to accommodation of participants of the exercise are covered in the equation for calculating the total costs of the exercise; eventhough the participants are generally provided with free accommodation during the training (exercises in the field). The accommodation in the field or in the military facilities is provided for free; however, it may happen in practice that the army is not able to provide accommodation free of charge for the participants of the training. The resulting costs can be obtained from the following equation:

$$N_h = p_o \cdot c_h \cdot d \quad (8)$$

where
p_o refers to the number of persons provided with free accommodation [-];
c_h refers to the price of accommodation per person per night in [CZK];
d refers to the number of nights of accommodation.

The costs of maintenance of the machinery relate to the need to bring the vehicles and equipment into the default condition for their further use. These costs are generally involved in the item N_u in the equation 1. In the current state of knowledge, one cannot create an explicit formula for their calculation. Based on the real conducted exercises in the past, it is possible to put the real costs of the repair and maintenance of the equipment into the formula, or replace it in the future with the average expenses spent during the conducted exercises in a certain period of time.

The costs N_n represent unforeseen, unpredictable and additional costs that may occur during the exercise. This category of costs can include costs dealing with damage in materials, equipment, civilian property etc. in a direct or indirect connection with the exercise.

The total costs of the exercise N_{cv} can be increased by a factor k (k is the tolerance coefficient

ranging [$k \geq 1$]). The coefficient k is dimensionless and the value of 1 means that the exercise is not perceived negatively among the population that does not participate in the exercise. Population involved in the exercise is included in the variable N_p (the category of figurants, for instance). If the population is not tolerant to the exercise (due to limitations caused to the population etc.), the value of the coefficient is greater than 1. The upper limit of the coefficient is not precisely determined yet and, in general, its value will be competently estimated.

3 APPLICATION OF THE METHODOLOGY FOR CONSTRUCTIVE SIMULATION

When using the simulation and training technologies (especially constructive simulation), it is possible to use the data used for presenting entities (models) in the simulator. These data are stated in the Protocol Data Units (PDU). The total number of kilometres covered by combat and other vehicles, amount and the type of ammunition are parameters that can be quite easily obtained from the simulator. As all of the objects, effects, movements, and activities are simulated only, it does not have any influence on the costs of the exercise. The costs of the exercise with constructive simulation can be computed from the equation 1. During the training with constructive simulation only some of the expense issues arise:

- service for data processing (partial edits in data files);
- operators of the simulator;
- consumption of electricity by the simulator;
- boarding and diet of the participants of the training.

The list of the costs connected to the training with constructive simulation shows that items in the category "operation and employment of combat and other vehicles and equipment" and "consumed ammunition" are not included for the training with constructive simulation and thus the costs are reduced in comparison with training in the field. For the calculation of the expenses it is necessary to be familiar with the values of the variables to be inserted into the equations described above. The empirical data obtained in the course of conducting exercises using simulation and training technologies show that employment of the simulation technologies for training can reach up to 10-25% of the costs of the training in the field. It is necessary to state here that this number cannot be seen as decisive and it is obvious that it cannot be used as an argument because it is not based on the real data but only on experience and estimations of the participants who have taken part in both kinds of training.

4 COMPARISON OF THE COSTS OF THE TRAINING

In order to compare the costs of the two types of training – one with constructive simulation and the other conducted in the field, the exercise of the 73rd tank battalion under the command of the brigade headquarters taking place in CSTT in 2010 was selected. The subject and aim of this CPX was to launch an attack of a task force on the basis of tank battalion within the bounds of peacemaking operation. Although the exercise took place in the area of fictional states, geographically it was located in the Military training area of Libavá (MTA) and its surroundings. The whole operation was divided into several phases; the two following phases were simulated:

- movement from the assembly area to the FEBA;
- actual offensive operation divided into four stages.

Other phases of the operation (securing the passage for the follow-up echelon brigade and restoration of the fighting capacity) were not carried out during this exercise because of the time shortage. Therefore, when comparing the costs of similar training in the field, only two initial phases will be counted.

Currently, it is not possible to calculate and quantify all the items according to the methodology described above. For this reason, only the familiar costs and the costs of each item that can be computed from available information are stated.

Table 1 Numbers of persons and vehicles in the exercise according to the type of chassis

TYPE OF CHASSIS	TANK	BMP + APC	APC (wheels)	TRUCK (heavy)	LORRY (middle)	PASSENGER CAR (offroad)	persons
BATALLION	36	35	0	62	19	20	457
HICON	4	26	0	41	6	4	416
OPFOR	15	0	44	42	13	8	638

Table 1 contains numbers of all vehicles in the exercise summarized according to the type of chassis. There are of course more types of vehicles in the operations than those 6 stated in the table. For the sake of the calculation, more kinds of vehicles were included in the category of tanks, mainly battle and recovery tanks, bridge-laying tanks; and in case of the enemy forces, also the tracked self-propelled howitzers. Similarly, the category of heavy trucks assigned to the superordinate unit includes self-propelled howitzers DANA. All the categories of the chassis were created identically.

As one can see in the Table 2, the total number of kilometres covered by all vehicles during the first two phases of the operation is 15 612. When recalculated to the average consumption during the movement in terrain and on roads depending on the type of chassis, the new consumption for the covered distance represents 18 029 litres of fuel. If the price of fuel in the time of the exercise reached 33 CZK per litre, then the overall costs of 18 029 litres is almost 595 000 CZK. To the contrary, the cost of fuel consumed during the exercise using the simulator equals 5 650 CZK. This represents 856 kilometres (i.e. 171 litres of fuel) covered by two buses and two cars for the transfer to the simulation centre.

The costs of the flight support can be added to the costs for the fuel. Four attacks of the combat aviation took place during the operation. Four subsonic aircraft L-159 ALCA participated in all of them. Each of the attacks lasted about one hour including the time in the staging area. The information about the costs of a flight hour of this aircraft could not be obtained from the accessible sources. Therefore, on the basis of information obtained [14], the costs were substituted by the costs of commercial price for a flight hour of the aircraft L-39C which makes approximately 1 000 000 CZK. Similarly, the costs of support of the attack helicopters were set using [15]. For one planned and three required attacks on the trainees' side and one on the enemy side the cost for one flight hour is 600 000 CZK.

Table 2 Total number of covered kilometres sorted by the type of chassis in individual phases of operation

operation phase	task force		TANK	BMP +APC	TRUCK	LORRY	PASS. CAR
movement	battalion	roads	1006	938	1725	534	541
		terrain	24	31	41	18	14
attack		roads	648	308	547	146	74
		terrain	1409	382	93	37	13
movement	HICON	roads	98	743	940	154	94
		terrain	13	22	18	2	1
attack		roads	25	252	626	163	79
		terrain	132	948	65	14	8
movement	OPFOR	roads	16	53	184	16	21
		terrain	2	32	47	0	1
attack		roads	141	180	452	156	91
		terrain	58	1106	65	48	17

Other items that can be quantified and calculated on the basis of accessible data represent the costs of boarding and accommodation of the participants of the training. Despite the fact that the training in the field did not take place, it is possible to determine the number of participants based on the number of active members in the simulator. This number would be increased by evaluation team, directing staff and other participants. The total number of these people is not known and will be neglected in the final part of the calculation. In the overall number of participants, which is 1511 (see Tab 1), it would mean adding only several dozens of people. Correspondingly, another known element is the number of all participants in the simulator. Altogether with the directing staff and incident group, the number reached 55 persons. The full boarding service would have been available for the trainees in the field. Daily diet plus bonus for training in the field would have come to 105 CZK. For a five-day training the costs of boarding grows to 793 275 CZK; in comparison, the travel compensation with maximum daily food bonuses for the participants of CAX amounted to only 42 625 CZK. In similar fashion, one can calculate the costs of accommodation. In neither case is it a direct cost as the participants sleep in the field conditions during the field training and, thus, no more costs arise, except for the costs of potential heating, treatment of the tents and other supplies. During the CAX exercise, participants are accommodated in the barracks and the lodging is paid for from the central sources. In case of unavailability of the accommodation or if it is necessary to compensate for it, the price can be determined based on the price for commercial accommodation in the barracks [16], which amounts to 44 000 CZK.

As stated at the beginning of this chapter, the training took part partially in the area of military training area and partially outside this area. This can be conducted in the simulator without any restrictions. Field training could have not been conducted in this scale without costs for renting of the affected areas. Apart from the rent, it would probably be necessary to settle for the damages caused during the training on vegetation, roads, infrastructure and other property. Although it is not possible to calculate these costs explicitly, one may assume that they would range from hundreds of thousands to millions of CZK. On the other hand, it is possible to calculate the cost of creating the terrain database of Libavá (60 x 60 km). It is feasible to find the exact amount of money in the acquisition documents; with consideration to the price of individual TDBs, it is practical to substitute it with the amount of 750 000 CZK. Since this TDB was put into practice, 31 exercises have been conducted in this terrain so far. The calculated price for the database is about 25 000 CZK per training. This number will be lessened with growing number of exercises using this TDB.

Participants of the training do not pay for the rent of the training areas and the equipment either in the MTA or in CSTT. However, in the case of involvement of CSTT, it is possible to calculate the costs of running of the simulation and other technical equipment. Disregarding depreciation and potential damage on the equipment, it is the costs of energies. In this case it is especially electricity; other energies such as water, heating etc. will be neglected because the rooms need to be heated whether the exercise does take place or not. Number of consumed resources and amount of electricity used for machines during the whole exercise are stated in Table 3, assuming maximum running time. With the price being 4,80 CZK per kWh, the cost of electricity is 1570 CZK. The price of electricity was based on the pricelists of suppliers. The real price depends on the individual provider, tariff rate and other conditions. The consumption of individual resources was set based on [17] [18] and [19]. In the future it will be achievable to measure the exact consumption of individual pieces of the simulator and put these figures into the calculation. Part of technical resources, especially the system C3I and communications equipment would be situated on the command post even during the real operation. The power supplies would be provided from the network of fighting resources or generators.

When the same running time of tactical simulator is counted, altogether with the establishment of one full and two partial command posts for the exercising battalion, higher levels and enemy forces, the costs will reach 10 560 CZK. The costs of operating the generators are determined on the base of real consumption of generators used in the Czech army, their number in one location of the command post of battalion type, and the price of fuel that was used for calculation of the variable N_a.

Table 3 Consumption of electricity during CAX of tank battalion

	number of stations	average consumption [W]	number of hours	total consumption [kWh]
simulation station	42	170	32	228,5
system C3I	30	30	36	32,4
simulated radiostation	26	17	36	15,9
dataprojector	7	225	32	50,4

The N_p variable determines the cost of support of the training. In the case of field training, this includes figurants and other persons supporting and sustaining the training. During combat operations such as this, no involvement of figurants and others into potential events (incidents) are expected. In the case of the training in CSTT (especially with constructive simulation systems), the prerequisite is deployment of operators (attendants) of individual simulation stations. These operators can be employed permanently in the simulation center or hired only for the exercise. In the case of CSTT, the general practice is to combine both. The amount of money paid for this support in this exercise was about 320 000 CZK.

The last item that can be currently quantified is the cost of consumed ammunition. Prices of individual pieces of live ammunition used by ground troops are known thank to willingness of members of logistics of the Czech army. It is obvious that blank and training ammunition would be used during the training as opposed to real combat operations, as long as the live shooting is not tactically required as a part of the training. Despite all efforts, it was not possible to find out the price of training ammunition apart from small-arms ammunition and the cost of air guns ammunition. A comparison of the cost of training and live ammunition in small arms clearly shows that the price of one training round is approximately 70 % of the price of one live round. Given the fact that this is not currently confirmed for ammunition used in combat vehicles, and with respect to the significantly higher cost of this ammunition, this assumption cannot be used in the calculations for the costs of ammunition consumed during the training. Considering the above-mentioned fact, the authors took liberty of simplifying the calculation by the classification of ammunition into several categories, particularly with regard to the caliber or type of firing device. Numbers of rounds fired in each category were then summarized and the average price of rounds in each category was selected as the price of ammunition. This price was multiplied by the coefficient of 0,3 in the case of barrel guns, and by the coefficient of 0,1 in the case of missiles. The coefficient 0,1 also expresses the ratio between the prices of live and training ammunition. Due to this initial phase of addressing this problem and zero cost of ammunition in case of CAX training, it is possible to simplify the calculations. In the future, after obtaining the actual data, the processes of quantifying the exact costs of each type of ammunition and determining the coefficients for the conversion of prices between the training and live ammunition in the various categories will be very straightforward based on the earlier presented formulas and relations. Analytical tools of constructive simulation allow us to record every shot and, thus, it is not complicated to obtain the exact amount of consumed ammunition. The costs of the consumed ammunition by ground vehicles reach up to 7 830 000 CZK with regard to the above described simplification.

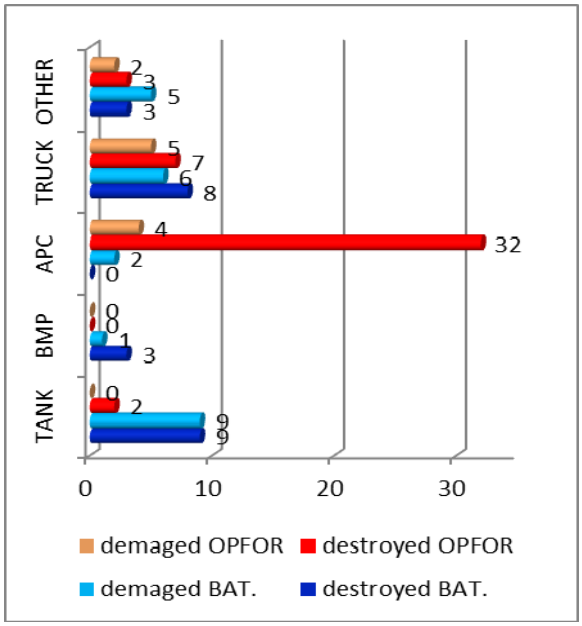

Fig. 1 Graph of losses after accomplishment of the second phase of the operation

The cost of maintenance and repair of machinery is not currently included in the calculations. Although Figure 1 depicts a graph of losses after accomplishment of the second phase of operations between the exercising battalion and the enemy units in the area of offence, there are no grounds for the statement that the machinery will be destroyed or damaged after the exercise. The objective of exercises using the simulator is to avoid potential losses of machinery and soldiers. One can readily claim that nowhere else than on the simulator is it possible to get the idea of incurred losses occurring immediately after the release of bad decisions, wrong plans, surprising moves on the enemy side, and wilful disobedience of command and other mistakes. Nevertheless, losses of machinery and damage on equipment do occur during the training. No machinery and equipment is trouble-free and one can assume that some damage may be caused due to the amount of engaged machinery as certain defects, improper operation, fatigue, and other circumstances may occur. Because the exercises in the field did not take place, this item cannot be quantified. A similar situation could arise during the exercises on simulators, when STT can be damaged for various reasons. During this exercise no damage was observed so in case of CAX, the value of N_u is zero. Authors' ten-year experience from CSTT shows that the costs incurred for repairs of damage and defects are usually in the order of tens of thousands per year and are negligible compared to general engine overhaul, for instance.

Table 4 Prices of individual items according to the calculations of the costs

	CAX	terrain
N_{a1}	5 650	595 000
N_{a2}	0	1 600 000
N_b	25 000	0
N_t	1 570	10560
N_p	320 000	0
N_m	0	7 830 000
N_s	42 625	793 275
N_h	44 000	0
N_u	0	0
N_n	0	0
k	1	1
$\boldsymbol{N_{cv}}$	**438 845**	**10 828 835**

5 CONCLUSION

The calculation methodology, or rather its model, was created mainly for the purposes of calculating or competently estimating and comparing the efficiency of various types of exercises (constructive, virtual, live) with each other. The model represents generalized empiricism of possible assessment of costs of preparation (training) of military professionals. The authors of this model are well aware that the calculation can be used for calculating the costs of individual exercises, and thus can be used as a comparison of costs of individual training methods. The model does not evaluate the efficiency of training as such. The original reason for the creation of the model was the effort to find convincing arguments to justify why it is appropriate, in a given stage of development of the Czech army, to prefer that type of exercise in terms of available source framework, or search the borderline from which the given type of exercise (using a constructive and virtual simulation) is comparable in costs to "traditional" field preparation; i.e. when the use of simulation and training technologies does not bring the desired effect of savings funds. Under certain circumstances, this model can be also used for prediction (qualified estimate) of the amount of money necessary for training of military professionals in the Czech army.

The results of the first calculations confirm the general assumptions about the financial advantages of training with the use of simulation technology. The ratio between the field exercise and exercise using tactical simulator approximately rises to 25:1. The calculated values for individual variables, including total costs, are presented in Table 4. Based

on the calculation of one selected exercise, with simplification of some of the assumptions and with average values substituted in the formulas; the value cannot be taken as final. But already now it is possible to claim with great certainty that the costs of training on the simulator do not exceed 10% of the estimated costs of the same training in the field. On the other hand, one cannot neglect the number of participants of the exercise who gain valuable experience during the training. During the field training, the whole unit, including all levels of command and control undertake training; as well as coordination, all the principles and tactical drills are practiced and trained. In tactical exercises on the simulator, it is only staff and partially commanders of subordinate units who undergo the training. Therefore, the field training will be irreplaceable also in future and it will be the responsibility of the governing bodies of the army to find balance between training in the field and training using simulation technology.

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APPROACHES ON CURRENT RISKS AND THREATS TO THE INTERNATIONAL SECURITY ENVIRONMENT

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Abstract: Security has turned, more than ever, into a global problem. The world we live in is no longer bipolar, nor unipolar; it has become, more and more obvious, multipolar, and is going through a slow, but definite process towards re-establishing of power centres globally.
The international security environment is going through an ample process of transformation and remodelling, characterised by the manifestation of two antagonist tendencies: on the one hand, there are the expansion of the democratisation process, the growing weight of human rights and of market economy principles, at the same time with the enlargement of cooperation and integration in European and Euro-Atlantic structures; on the other hand, there is the process of disintegration and fragmentation of multinational state entities. In parallel, we can see that military and non-military risks are maintained – first of all of terrorism – and that international institutions' vulnerability towards these is increasing.
Throughout the article, we set ourselves to make a comparative study of the risks and threats towards the international security environment, analysing, in turn, the perspective of the USA, of NATO as a whole, of the EU and of Romania.

Keywords: Risks, threats, international security environment, multipolarism, balance of power, centres of power.

1 INTRODUCTORY CONSIDERATIONS

The international security environment is transforming continuously and in an accelerated manner, as a consequence of mutations on the world scale. Considering Barry Buzan's opinion in his book *People, states and fear*[1], we can analyse the security concept *through the lens of threats depending on sector*; in this respect, we can identify five sectors of security, reflecting in five major types of threats: military, political, social, economic and environmental.

To begin with, we can identify threats against both weak and powerful states:

- The negative consequences of economy *globalisation* resulted in impoverishment of millions of people.
- *Proliferation of CBRN weapons of mass destruction*, especially nuclear weapons, but also conventional. Non-state actors seem capable to procure such weapons.
- *Local, internal conflicts* between religions and ethnic groups, which combine with international terrorism and cause regional insecurity.
- *Poverty, epidemics, environment degradation*, stimulating local wars and at the same international terrorism.
- *Organised crime networks* (corruption, illicit drug trade, people trafficking etc.) threatening international security and the over-debt of poor countries. Organised crime can be managed by establishing or affiliating functional centres in different countries; establishing relations based on corruption with foreign leaders; creating trans-border strategic alliances; making illegal investments in certain countries.

According to military annalists, in order to counter global risks and threats, a concerted effort of the International Community is needed. Moreover, some risks and threats cannot be countered by stabilisation and peace-keeping military missions.

The rule of law in conducting international relations among states is the essential condition for peace and stability, while democratisation and good governance correlates with the respect of human rights and with security and international peace.

2 THE AMERICAN PERSPECTIVE

It can be stated that the U.S.A. maintained the dominant position in the international system and the distance from the so-called middle powers tends to grow.

Analysing the American point of view, we are going to make reference to a few fundamental documents: *Global Trends 2025: A Transformed World*, report elaborated in 2008 by US National Intelligence Council (NIC), *National Security Strategy* (2010) and the *Defence Strategic Guidance* (2012).

From NIC's report, *Global Trends 2025: A Transformed World*[2], result the following challenges and threats towards the American and international security environment: nuclear arms race in the Middle East, conflicts for access to resources and energy transportation, terrorism, the Iran issue. Let us have a closer look at each of these problems.

- The risk generated by the nuclear arms race in the Middle East is caused by the fact that Iran

[1] BUZAN, B.: *People, states and fear*. Romanian edition: *Popoarele, statele şi teama*. Chişinău: Editura Cartier, 2000.

[2] National Intelligence Council: Global Trends 2025: A Transformed World, November 2008. Available on the internet: Popoarele, statele şi teama. Chişinău: Editura Cartier, 2000. Available at: <http://www.dni.gov/nic/PDF_2025/2025_Global_Trends_Final_Report.pdf>

procured military nuclear capabilities, which can have destabilisating consequences in the *region* (which is already instable) as well as in the whole world. What is more, Iran is trying to maintain its local hegemony, its fragmentary political system and its nuclear program.

- Conflicts for access to resources and energy routes aim, from a geopolitical point of view: the display of energy reserves; regional instability threatening energy supply; terrorism and piracy directed towards areas with deposits and infrastructure for energy transportation; climate change which led to conflicts triggered by insufficient resources, especially water. It has to be noted that "Sub-Saharan Africa will remain the region most vulnerable to economic disruption, population stresses, civil conflict, and political instability3", civilian conflicts and inter-state conflicts like those in Central Africa.
- Terrorism is alarming, and the assessment envisages two possibilities. On the one hand, it is deemed that the fundamentalist Islamist terrorism will decrease because of the unrealistic objectives of Al Qaeda and its ruthless decisions, including killing Muslim civilians. On the other hand, radical Islamist terrorism will surpass Al Qaeda and it is possible to accede other capabilities in order to cause destruction, by making use inclusively of biological and chemical weapons.
- To the issue of Iran can be added three other states with serious security issues, respectively Afghanistan, Pakistan and Iraq. As the internal potential of conflict for each of these countries is deemed to remain substantial, it creates concern for the implications it has in the matter of frontier delimitation between Afghanistan and Pakistan. Iraq's future will be mainly determined by the politics between Shia and Sunni factions.
- National Security Strategy4 (2010) identifies the following risks and threats to the American and world security environment:
- Terrorism is one of many threats that are more consequential in a global age; the gravest danger to the American people and global security continues to come from weapons of mass destruction, particularly nuclear weapons.
- Asymmetric threats, such as those that target reliance on space and cyberspace. The space and cyberspace capabilities that power daily lives and military operations are vulnerable to disruption and attack.
- Dependence upon fossil fuels constrains options and pollutes the environment.
- Climate change, pandemics and infectious disease threaten the security of regions and the health and safety of the American people.
- Failing states breed conflict and endanger regional and global security.
- Global criminal networks foment insecurity abroad and bring people across U.S. borders.
- Dramatic inequality persisting within and among nations.
- Profound cultural and demographic tensions, rising demand for resources, and rapid urbanization could reshape countries and entire regions.
- Failed states, where the advance of democracy and human rights has stalled.

In addition, other key challenges are: violent extremism, promotion of global prosperity; peacekeeping and armed conflict, trans-national criminal threats and threats to governance.

Defence Strategic Guidance, 2012[5] makes a thorough analysis of the current security environment, reiterating the threat of terrorism and of CBRN weapons proliferation. The document establishes the following priorities for the American Armed Forces: countering terrorism and irregular warfare, deterring and defeating aggression, projecting power despite anti-access/area denial (A2/AD) challenges (in areas such as China and Iran), countering weapons of mass destruction, operating effectively in cyberspace and space, maintaining a safe, secure, and effective nuclear deterrent, defending the homeland and providing support to civil authorities, providing a stabilizing presence, conducting stability and counterinsurgency operations, conducting humanitarian, disaster relief, and other operations. The document stipulates that the aforementioned missions will largely determine the shape of the future American Armed Forces. Also, it reorients U.S. defence policy towards the Asia-Pacific area.

3 NATO'S PERSPECTIVE

In the Alliance' vision, the International Community is confronting new risks and threats, both for the public and the private sector[6]. The new

[3] Ibidem, p. vii.

[4] White House: *National Security Strategy*, 2010. Available at: <http://www.whitehouse.gov/sites/default/files/rss_ viewer/national_security_strategy.pdf>.

[5] U.S. Department of Defence: *Defence Strategic Guidance*, January 2012. Available on the Internet: http://www.defense.gov/news/Defense_Strategic _Guidance.pdf.

[6] RASMUSSEN, A.F.: *Speech*, 01 October 2009, London, Lloyd's HQ. Available at: <http://www.nato.int/cps/en/natolive/audiohtm?search=true&chunk=16 &sortbyfield=v_ releaseDateSearch&order =asc&query = *&date_from=&date_to=>

challenges will require NATO's intervention as future "casus belli" and comprise: climate change, global warming generating the rise of the sea level, the retreat of the Arctic ice (which led to the discovery of new resources that were covered by the ice layer); extreme meteorological phenomena – catastrophic storms and floods alternating with drought, causing lack of water; large scale population movement; a decrease of food production; CO2 emissions; the efficiency of carburant usage; reduction of dependency of external sources; support that needs to be granted to factories, energetic locations, energy transportation routes or harbours that can be endangered in case of storms or inundations; energy, where the diversity of supply is a security problem; piracy; security and cyber defence, natural and human disasters.

In order to meet these risks and threats, the current NATO reform is based on: improving political-military integration; developing modern capabilities; creating a new NATO-EU partnership; combating international terrorism; enhancing the Euro-Atlantic influence in the areas of Northern Africa, Closer and Middle East and Southern Asia; developing partnerships in Eastern Europe, Japan, Australia and New Zealand; supporting international security within UNO.

Within *NATO New Strategic Concept*[7], the security environment is influenced by the fact that more and more states are interested in and make efforts to acquire modern military capabilities with consequences hard to envisage. Here we include ballistic missiles, which represent a great danger for the Euro-Atlantic space. At the same time, weapons of mass destruction, together with means of transporting them, terrorism, regional instability outside the Alliance borders can be direct threats to Allies security. At the same time, the advance tendency of laser weapons, of electronic warfare and of space technologies have a major effect at global level, with a direct impact on military planning of NATO led operations.

3.1 Some implications of the 2012 NATO Summit in Chicago on the international security environment

The 2012 *Chicago NATO Summit* in May 20-21 was described as being the largest in the Alliance history but also one of austerity, the armed forces having to cooperate of an enhanced manner in order not to loose technological supremacy. The key points on the agenda were the Allied strategy on Afghanistan after the troops' retreat and the anti-missile shield in Europe.

Regarding the mission in Afghanistan, NATO's priority is to "gradually and responsibly" drawing down forces – 130,000 soldiers – "to complete the ISAF (International Security Assistance Force) mission by 31 December 2014", as agreed at Lisbon Summit[8].

NATO Member States' leaders declared operational the first phase of the anti-missile shield meant to protect Europe, despite Russia's opposition. NATO Secretary-general, Anders Fogh Rasmussen, showed that the anti-missile shield is an example of successful multi-national cooperation within the *smart defence* concept.

Rasmussen also explained the reason behind the smart defence initiative is that the military must do more with less in a time of budget cuts due to NATO members need to save money in the time of recession[9].

The NATO Summit in Chicago brought a good piece of news for Romania. By this we refer to the fact that the first phase of the anti-missile shield was accomplished. The South-East of Europe, as well as part of Romania are now protected by any ballistic missile attacks. However, the shield will become active only in 2015[10]. The shield is aimed to protect Europe against attacks from the Middle East, Iran being identified as a potential danger, as it already has ballistic missiles with a range of 2,000-2,500 km[11], capable of hitting targets in South-Eastern Europe.

4 EU'S PERSPECTIVE

The European point of view related to risks and threats of the security environment is expressed in the *European Security Strategy*[12] (ESS, elaborated in 2003) in which, on the background of global challenges, were identified threats that coincide mainly with those identified by the U.S. and NATO:

[7] NATO: *Strategic Concept*, Lisbon 2010. Available at: <http://www.nato.int/strategic-concept /index.html>.

[8] NATO: Chicago Summit Declaration, Chicago 2012. Available at: <http://www.nato.int/cps/en/natolive/official_texts_87593.htm?mode=pressrelease>

[9] Deutsche Welle: *NATO declares first stage of missile shield operational*, May 21, 2012. Available at: <http://www.dw.de/dw/article/ 0,,15964619,00 html>

[10] DUȚU, P., RAPAN, D.: *Implications of the Anti-ballistic Missile Shield in Europe on Russia-USA Relations*, in: *Strategic Impact*, no. 40 (3/2011). Bucharest: Centre for Defence and Security Strategic Studies, "Carol I" National Defence University.

[11] VICK, Ch. P.: The Samen, Sejjil, and Ashura Iranian New Ballistic Missile Developments. In *Global Security,* May, 2010. Available at: <http://www.globalsecurity.org/wmd/world/iran/sajjil.htm>

[12] EU: *European Security Strategy*, 2003. Available at: <http://www.consilium.europa.eu/uedocs/cmsUpload/78367.pdf>

terrorism, linked with religious extremism; proliferation of weapons of mass destruction, which is considered to be the biggest threat to the European security; regional conflicts, be them violent or frozen, affect regional stability, with effects that can lead to extremism, terrorism and state failure, states in collapse because an inefficient government, generalised corruption, impossibility of controlling their own sovereignty space; organised crime, including trafficking in drugs, human beings, illegal migration.

EU 2020 Strategy[13], although mainly focused on economic development, reiterates as challenges climate change, globalisation, natural resources, especially energy resources and the risk that, because of the interdependency phenomena between states, the financial-economic crisis could expand to other Member States as well.

After nine years since the adoption of the ESS, the EU has assumed responsibilities greater than ever, as threats have not disappeared, on the contrary, some of them have become more important and all became more complex. Thus, there were identified additional risks and threats: cyber security related to Internet based criminality, cyber attacks can be considered as a possible economic, political and military weapon; energy security, most envisaged by the gas crisis manifested in the past winters in Europe; climate changes can be a factor multiplying the threats by natural disasters, environment degradation and competition for resources, exacerbating the conflicts. Climate changes can also lead to disputes on commercial routes, maritime zones and resources that were inaccessible previously. That is why we consider that a revision of the European Security Strategy is needed[14], the more so that almost a decade has passed since the document was drafted and the EU was composed of 15 Member States compared to 27 current MS and, last but not least, the EU borders look very different.

The Member States are not able anymore to face by themselves all new security risks and threats without frontiers. A collective European effort will allow them to face risks and threats and to respond flexibly, efficiently and creatively to citizen's preoccupations. Still, in order to confront these challenges, Europe needs to constantly update; it has to acquire efficient and coherent instruments, adapted not only to a 27 MS Union and to the perspective of further enlargement, but to rapid transformations of the world we live in. The common policies of EU Member States, regulated by successive treaties, need to be renewed[15].

5 ROMANIA'S VIEW

The main documents related to defence are, *Romania's National Defence Strategy* (2008)[16] and *Romania's National Security Strategy* (SSNR, 2007)[17], elaborated by the presidency, in which the main tendencies related to security are presented. These are: the acceleration of globalisation and regional integration processes, concomitantly with the persistence of actions aiming the state's fragmentation; the reasonable convergence of efforts consecrated to structuring a new architecture of security, stable and predictable, accompanied by the accentuation of anarchic tendencies in some regions; the rebirth of states' efforts aiming to preserve their influence in the dynamic of international relations in parallel with the multiplication of the forms and the increase of the weight of non-state actors' intervention in the evolution of these relations.

Globalisation is the main phenomenon influencing the contemporary security environment regarding the appearance of new risks and threats and the emergence of various opportunities.

In the current and future security environment, risks and threats to national security are perceived primarily from the perspective of a NATO and the European Union Member State, as follows: international terrorism structured in cross-border networks; proliferation of weapons of mass destruction, regional conflicts, drug trafficking and drug consumption, maintaining a high level of instability and insecurity in the Black Sea Area, the maintaining of the uncertainty in the Western Balkans, the international financial system' fragility, trans-national organized crime, ineffective government, espionage and other hostile actions, proliferation of radical manifestations, irredentist or

[13] European Commission: *Europe 2020, A strategy for smart, sustainable and inclusive growth*, 2010. Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF>.

[14] AURESCU, B.: *The European Security Strategy revised. The Romanian perspective*, in: Strategic Impact, no. 43 (2/2012). Bucharest: Centre for Defence and Security Strategic Studies, "Carol I" National Defence University.

[15] DUȚU, P.; BOGZEANU, C.: *Reforma instituțională a UE din perspectiva Politicii de securitate şi apărare comune*, p. 6. Bucharest: Centre for Defence and Security Strategic Studies, "Carol I" National Defence University, 2011.

[16] HP nr. 30 din 4 noiembrie 2008 privind aprobarea *Strategiei naționale de apărare a țării*, Monitorul Oficial, nr. 799 din 28 noiembrie 2008 (Parliament Decision no. 30 of November 4, 2008 on the approval of *Romania's National Defence Strategy*, published in Official Gazette no. 799 in November 28, 2008).

[17] *Strategia de securitate națională a României* (*Romania's National Security Strategy*), Bucureşti, 2007, p. 12. Available at: <http://www.presidency.ro/static/ordine/SSNR/SSNR.pdf>.

extremist, the risk of pandemic, serious phenomena (floods, storms, severe drought or other extreme events caused by global warming; other sudden and radical changes in living conditions, landslides, earthquakes)[18].

According to our assessment, these risks and threats may be exacerbated by the existence of vulnerabilities and failures, which include: dependence on vital resources, negative demographic trends, illegal immigration, social insecurity and poverty due to poor and insufficiently protected infrastructure.

6 A COMPARATIVE ANALYSIS

Out of a comparative analysis of the security strategies presented throughout the article, a series of common aspects can be seen.

The main actors of the international relations system acknowledge that the situation at strategic level is completely different not only from the period before 1989, but from 9/11 as well, when the U.S.A. had an incontestable supremacy[19]. Since then, the "unipolarity" concept has been fading.

Threats and risks that define the new security environment combine aspects of military, political, social, economic, environment and human nature. The Euro-Atlantic community' institutions and their members, in terms of capabilities, organization and policies in the field, are not fully prepared to meet these challenges.

State actors involved in alliances and security partnerships agree, beyond their own interests and for various reasons, that security concerns can be better addressed together than individually, that is efficiently and expeditiously.

Accordingly, states acknowledge the need to massively improve national and institutional capabilities, that is military capabilities when using *hard power*, non-military capabilities for when using *soft power* and shared capabilities for when using both hard and soft power[20].

No state in NATO or EU can walk alone and impose its own security vision, because these countries have common values and form a community of converged interests. In a world of globalization, everyone can interfere *there*, anywhere, in order to get *here*, fact which leads the Euro-Atlantic countries to have a presence and implication at global and multidimensional level.

Traditional, classical threats of the form of a massive military invasion of a territory decreased in Europe, but there remain traditional state-centred or state-inspired threats, which aim to maintain a strong influence by using non-military means. This requires a collective response, mandated by Article 5 of the North Atlantic, extended nowadays beyond the geographical area agreed in 1949 when it was signed[21].

While 9/11 is acknowledged as a turning point rather for America than for Europe, it is more and more agreed that international terrorism "is a non-traditional threat whose global reach and potential access to weapons of mass destruction (WMD) makes it fundamentally different from the sort of local terrorism that Europe has known and endured in the past[22]".

Global terrorism intensifies other threats: proliferation and diversification of weapons of mass destruction, failed states, organized crime, access to resources, climate change, pandemics and so on. Most of the times these threats originate outside the Euro-Atlantic area, but the area can not escape them and it may well happen that the first victims be from this space.

Some of the current threats can be countered only by military means, but most of them involve the use of complex military and civilian capabilities, combining institutional instruments, both national and multilateral. Military capabilities are rarely sufficient, but often necessary, with a potential for rapid response, expeditionary and sustainable capacity with enough flexibility and versatility to cover a wide range of missions.

The new evidence of irreversible process of globalization, meaning the elimination of time and space, force the countries or regions to renounce isolation and indifference of the past. In a globalised world, economic growth, immigration and free trade play an important role in the management of security issues.

The studies of geopolitical analysts, highlight that the next crisis going to be a poverty crisis, followed on a medium-term by a water crisis, phenomena which in terms of global security, will lead to tightening relations between different state and non-state actors as a result of monopoly and restriction of free and fair access to regional resources and opportunities relevant to achieving national interests.

7 CONCLUSIONS

In conclusion, NATO's approach towards security in the XXI century is considered realistic, as it recognizes the importance of political, economic,

[18] Ibidem.

[19] SERFATY, Simon: The pressures for a new Euro-Atlantic security strategy, 2008, in: Europe's World, Security and Defence. Available at: <http://www.europesworld.org/NewEnglish/Home_old/Article/tabid/191/ArticleType/ArticleView/ArticleID/21138/ThepressuresforanewEuroAtlanticsecurity strategy. aspx>.

[20] Ibidem.

[21] Ibidem.

[22] Ibidem.

social and environmental factors, in addition to the indispensable defence dimension. The common goal is to achieve a collective European security architecture in which the Alliance tries to defend peace, to strengthen Euro-Atlantic security and stability in different ways: by enforcing the trans-atlantic connection; by maintaining effective military capability to ensure deterrence and defence, in order to meet the full range of its actions; by developing European security and defence identity within NATO, by keeping the overall capacity to manage crises successfully, by remaining open to new adhesions; by continuing the partnership, cooperation and dialogue with other countries sharing the Euro-Atlantic security approach, especially regarding arms control and disarmament.

The prospect of a direct military attack, along or across the Alliance' borders, is much diminished, at least for the near future. However, less conventional threats to the Alliance can occur far from its borders, but can determine a direct effect on its Member States' national security. These risks include, but are not limited to attacks with weapons of mass destruction, strikes from international terrorist groups, cyber attacks with various levels of gravity or illegal disruption of critical supply lines.

What is less predictable is how progress in scientific research technology will transform the battlefield. Such destructive potential can occur in dynamic areas such as information technology and communication, cognitive and biological sciences, robotics and nanotechnology.

We are witnesses of historical events as the Arab spring that could change the destiny of the region. What happened in North Africa and the Middle East can be considered a revolution that could eventually be a great turning point for tens of millions of people, made possible by the new generation, more educated and more dependent by digital technology.

Arab riots are a product of the XXI century, as the inevitable phenomenon of globalization. They were triggered by increasingly rapid circulation of information via the Internet, social networks and economic and social changes that Western governments and public opinion in general, either underestimated or ignored them. We appreciate that the Arab world is undergoing spectacular transformation, and expectations are rising because of the young generation's education and contact with the Western world.

The new international order will be less centralized and more complicated. Threats and dangers may arise from conventional attacks or from provocative statements designed to serve political blackmail.

The limited resources and environmental constraints will directly influence the security environment in areas of interest for NATO. In this respect, we believe that significant factors affecting the planning of stability and support operations of the Alliance are the risks to public health (pandemics), climate change, water shortages and continuing growth in energy needs.

The risks and threats analyzed in this paper are up to date, especially as they are considered at the highest level of the Alliance, in the new "Strategic Concept for the Defence and Security of the Members of the North Atlantic Treaty Organisation adopted by Heads of State and Government in Lisbon" in November 21, 2010. In this context, we consider that although the risks and threats above mentioned come, above all, from outside the Alliance, NATO strength can be eroded from within the organization.

Therefore, we believe that these new challenges can be better managed if cooperation at the level of the International Community is continued and intensified, especially in the fields of energy security, achieving a better coordination and concentration of efforts of all key state and non state actors.

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PAYLOAD OF UNMANNED AERIAL VEHICLES

Gábor KOVÁCS

Abstract: The observation of the enemy and the battlefield had a very important role in the past and today as well. The information gathering is vital because the movement and the strength of the enemy military vehicles and troops determine the tactic or the strategy. The early balloon detection has now been changed to aircraft observation. Pilots are sitting on these planes that have limited eyesight at night or are in bad weather condition. They are threatened by the environment and by the enemy anti-air defense. The loss of pilot is not allowable, his training course is expensive. Unmanned Aerial Vehichles (UAV) are the solution for this kind of problem.

Keywords: Application, devices, tracking, strike, future.

1 INTRODUCTION

Questions are raising during the programing of an UAV like: how will it navigate, if the robot is at the operational field about who or about what should give information, if the task requires, whom shall it strike, and with what kind of weapon. These questions are difficult to answer in such a short work, therefore I will just represent some important thoughts. I will write about devices that work with imaging, information gathering and transmission systems, some intelligent destructive weapons and search and rescue helper systems.

For our research on the department the "New Széchenyi Plan „TÁMOP-4.2.1.B-11/2/KMR-2011-0001 Critical Infrastructure Protection Research" gave the support.

2 UAV'S SERVICE CONDITIONS

The enemy moves his troops under camouflage, using the darkness of the night, or technical devices to get harder to discover their units. Tools are used that we, the UAVs can successfully counteraction their objects. The first task is the navigation and the information gathering.

Let's see the requirements against the navigation systems: it is important to choose the optimal flying profile for the aircraft. To automation this flying procedure it is needed a software that takes into consideration the variables. It is essential to think in six degrees of freedom. Be able to autonomously preform basic maneuvers, like the circle or the form eight. Define the load on the UAV because there are variable types of drones. A Globalhawk type plane bears different forces as a little Skylark drone. The flying profile must be optimized for weather and for surface. The flying route shold be taken into consideration of the payload, it should work as far as possible where the sensors work with 100 % efficiency (if a sensor has 10 km range, it shouldn't work at 2 km). Make a recommendation about the flying route with the calculation of the fuel consumption or with the available electric charge. How to behave if the drone goes out of the transmitter's range, how should fly back to the base, or maybe continue the task.

These expectations interweave with the Global Positioning System or GPS that the drones are using as benchmark. The military (!) drones can fully enjoy these advantages that the GPS gives; work in any weather conditions in daytime or at night.

We must note the disadvantages, too – the external influences can make confusions that can cause the loss of the drone. The switch-on of the system takes a long time, if this happens during the flight it can be harmful for the plane. It can be a good solution to double this system and it is not difficult due to its small size.

It can be used only in open area, for example deep in a valley it is impossible to use because the signal is shaded by the terrain. The sign can be reflected from the elevation and the buildings. It can cause difficulties in the measurements. The system is poerated by the US Army, therefore it can be shut down anytime required by the interest of the Army or make it work with reduced accuracy like during the Balkan operations.

3 ONBOARD MEASUREMENT DATA COLLECTION SYSTEM

The variables are transmitted from the sensors as analog electric signals. The transformation of the signals is done with an analog-digital converter for further use. The signals are collected and transmitted in digital form.

Onboard can be placed sensors or devices operating on various principle like compass which work in 3D – if the GPS is out of order it helps the navigation, the acoustic altimeter – which work more precisely as the barometric or GPS altimeters (under 8m!). The sizes of these devices are manageable for smaller planes (based on the Fig. 1).

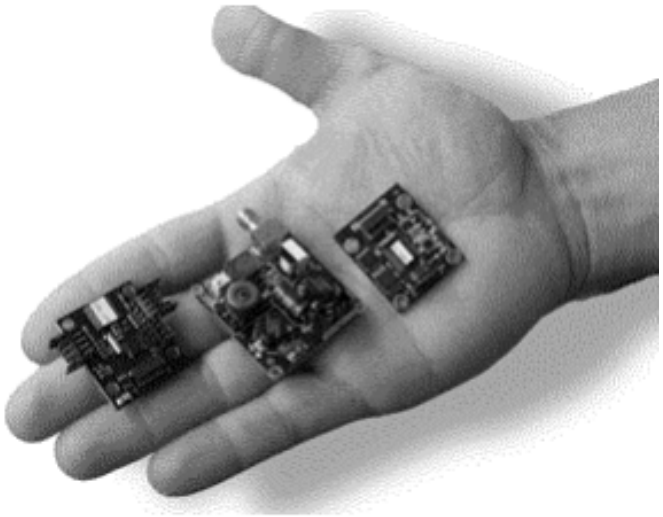

Fig. 1 (from left to right) A/D converter, altimeter, compass. Note the size of the devices!

4 ELECTRO-OPTICAL AND INFRARED DEVICES

The cameras that provide conventional images work in visible light range. With the development of the technology the size of the devices are reduced, so we can install them to smaller planes. If we need pictures beside the video stream, we have to store this data. The former tape recorded storage replaced by hard disk or even solid state drive (SSD). The sizes are very small, around 2,5" extent.

Thermal camera, also known as infrared (IR) camera, is a device that can imaging up to 14 micrometers on the electromagnetic range. Images from this range are converted to visible light (450-750 nanometers).

The story of the IR camera has begun with Kálmán Tihanyi [1] in 1928 when he announced his invention. With the improvement he developed the first IR camera that worked in IR range. This device was developed for the British anti-air defense system. Tihanyi worked for the UK about two years. With his invention the RCA and the Telefunken based their TV industry. The public get it after 1956, called „Evaporograph", non-military grade IR camera.

The IR energy is the part of the electromagnetic spectrum that includes the gamma, x-ray and ultraviolet ray. The visible range is only a very small part, like as the IR and microwaves. The difference is only the wavelength. Every body emit heat from itself. Generally we can say, the higher body temperature provides higher wavelength. The IR camera is capable to detect and to display this radiation. It works also in pitch black. Hence it is ideal for rescue from burning house in low visibility, or for reconnaissance and for fire control in the case of UAVs.

The visualisation is achieved with fake-colored images where different wavelengths have different colors. So we get the well-known picture where the white color is the warmest and the black is the coolest. There are not only black and white images. Polychromatic imaging exists, too where the technology works with all colors. Because of the difficulty of the imaging they are working often in lower resolution, frequently in 160x120 or 320x240 pixels. The most advanced IR cameras are often prohibited for civilian use and banned from export. They are used in the military.

Their scope of application – in addition to military porpuses – is very wide: the fire service uses it to see through smoke in a case of a burning house as well to search the source of fire. The public utilities use it for searching failure in the electricity network. In the building industry it is helpful to control heat insulation and it is useful in the astronomy because the sensors work with widened spectrum. In the case of military use it is good for reconnaissance, to follow marked objects and to guide missiles to their target. It provides some degree of „night vision" to the soldier or to the UAV.

The parameters of the IR cameras, like resolution, define the details of the image. It limits the service range of the UAV. With low resolution it is difficult to identificate objects, so the plane must fly closer, exposed itself to enemy aerial defense.

Fig. 2 Possible aircraft built dome cameras

5 HYPERSPECTRAL IMAGING AND THE C.O.B.R.A.

During hyperspectral imaging the range of electromagnetic spectrum is widened to 300-1000 nanometers. This technology provides more detailed pictures as the multispectral imaging. It is possible to separate different terrain types. With the help of this technology there are opportunities to speed up the current terrain examinations and the costs are even cheaper. Such an area is the mineral resource scanning above the ground level from the air. It is a humdrum work for humans, so an UAV is the best choice.

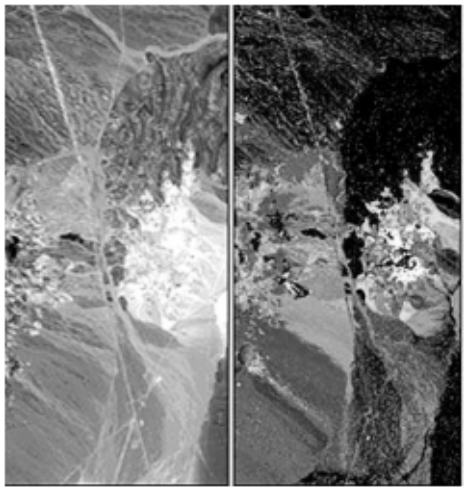

Fig. 3 Real picture on the left, hyperspectral scan from the same area on the right

Detecting landmines before the start of a conventional conflict is vital. US Marine Corps developed the Coastal Battlefield Reconnaissance and Analysis system or COBRA which helps to detect landmines before the landing of friendly troops. This system is mountable to an UAV and it gives detection and analysis capabilities. With the hyperspectral electro- optical sensors the UAV can detect the soil rootings of the landmines in daytime or at night. The example system above was tested in 1996. Today due the developments there are much more processing capabilities. Despite this the system is not 100% reliability, if the landmines are in the soil long ago the information is hided by the nature and the vegetation.

6 MOVING TARGET TRACKING

The tracking of moving targets involves increasing attention in the UAV warfare. It is used partly to indentify friend-or-foe. So far seemingly impossible missions have become feasible.

The basic of the tracking is the change of the information from the selected object. It is a simple math operation, from two pictures the static pixels are withdrawn from each other, so the remainder pixels define the moving object. It is used in the radar technology where the change of the Doppler frequency indicates the movement. Airplane-built radiolocators are able to track airborne or ground moving targets. They are filtered out from the static information of the surroundings.

The other, nowadays proven technology is based on pixel movement. The system chooses the moving pixels from the sequence of images and indicates the direction and the speed of the dots. On figure 4. we can see the monochrome indicator where the moving objects are surrounded with green square. The system should give alert, if it detects displacement. It is a hard work to see the object even with trained eye.

Fig. 4 Moving target indicating and tracing

7 GPS GUIDED BOMBS

The UAV can be a platform for bombs or missiles. The majority of us think about the Hellfire as an air-to-ground missile, however intelligent bombs exist already which are an alternative of the Hellfire. It can have the same precision and destructive force. For static (or with low mobility) targets it is a good solution because the cost of this weapon is one-third cheaper as the Hellfire.

Fig. 5 MQ-9 Reaper with mixed armament

One of the main progress is the „fire and forget" principle. The bomb is guided by the signal of the GPS satellites. The UAV has the possibility to search new targets or turn back to the safezone after the release, while the bomb is falling down. In case of laser guided bombs there is a problem. It is not possible to release laser guided bombs if any cloud, smoke or dust is over the target because the reflected guiding signal from the target needs to reach the head of the missile. GPS guided bombs are independent from weather.

Initially the installation of the new devices started on the 2000 lbs bombs. The weapon becomes „smart". The guiding system located in the streamlined tail section. The electronic parts are mounted on a discoid mainboard including three accelerometers which detect the release of the weapon. The accelerometers were accurated enough to provide almost a direct hit on the target if the GPS signals went off suddenly. Accelerometer controlled bombs have 30 meter accurate.

Less developed military aircrafts also can carry smart weapons because high-tech avionics are not needed. In this case the coordinate of the target is entered in the bomb and it navigates only by this information. The weapon is freefall-type with minimal maneuver possibility, so the approach of the battlezone is the key. With alternate wings the range of the weapon is longer, providing the safe of the carrier plane.

After the millenium the size of the control panel was reduced thus allowed the mount on 250 and 500 lbs weapons. These bombs are enough small to carry by UAV as payload.

No one needs to prove the legitimacy of precision weapons. On the first Iraqi war in 1991 there were used only 6% smart weapons of the total amount of 250 thousand, but it destroyed the 75 % of the targets.

8 RELAY STATION / REPEATER AND JAMMING CAPABILITY

Deep in enemy territory in some case the nature of the terrain does not allow the communication between the units. For example in Afghanistan, the high mountains reduced the range of the communication devices. But the handhold tools also have low range. Or in the endless Iraqi deserts, the shape of the Earth can block the broadcast. The communication is vital for a unit that must fight in a valley.

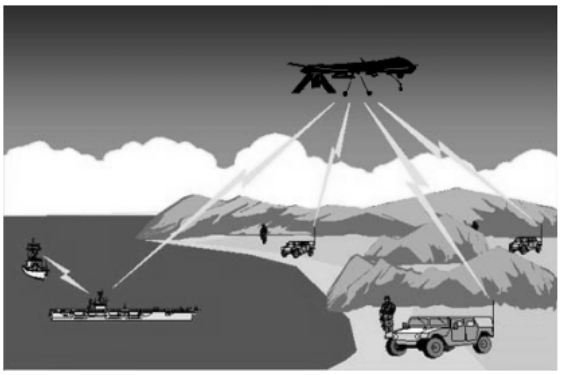

Fig. 6 UAV as relay station

A mobile relay station can solve the problem which works as repeater and keep up the connection between headquarter and the units. The relay is installed on the UAV. More relays can do a communication chain so theoretically the range is infinite. With the altitude of the flying plane the shade of the terrain is surmountable.

There is more way to launch an UAV, from hand or with catapult. For a single unit the ideal planes have small size and the relay may works on shorter range so it limits the use of the device. Large units use catapults which are mounted on vehicles. These planes are larger and it can carry more payload or larger relay so it can be created a connection with greater range.

UAVs can be used as jammer device that interfere the communication of the enemy [2]. Approaching the object the UAV covers the area with jammer signals while the friendly troops operate in the sector. Or it is possible to gather information from the broadcast. It is organized in a data-bank and it is processed during the flight or in the base.

9 SURVIVOR RADIO REPEATER SYSTEM (SRRS)

To improve the search and rescue operations (SAR) of downed aviators, it is needed to develop and integrate a Survivor Radio Repeater System (SRRS) into current and future UAV systems. The existing system is limited to Line of Sight (LOS) operation and transmits a low power signal to overhead manned aircraft. The short range of these signals creates an added risk to another manned asset in the early moments of the SAR mission. The development of a low cost, lightweight repeater system for UAVs would improve the operation of survival radio systems and increase operational range by eliminating the need for LOS operations. The SRRS solution must meet technical requirements; have minimum impact on UAV performance; work in existing SAR infrastructures; and adapt to a spectrum of UAVs. The flight test program on EXDRONE UAV commenced in September 1998. However, due to technical difficulties, the flight test program was temporarily suspended, later the program restarted in March 1999.

10 CHEMICAL AGENT DETECTORS

By the spread of nuclear and chemical weapons it is essential such a device that can provide information about the contamination without risk to human life. Its use extends also to the private sector like powerplant accidents, chemical disasters and accidents of vehicles transporting hazardous materials.

At the beginning the sensors were attached to the hardpoint of the airplanes. Thank to the miniaturization the UAVs are capable to carry these devices, so it is not needed to risk the life of the crew over the polluted area. Robots can be used to clearance tasks. It is important the reuse of the robot and the resist against to chemical agents. With the help of GPS it is possible to localize the polluted area. It is appropriate to process the gained information on board then transmit to the HQ. Thank to the fast datastream it is almost followed the movement and the direction of the contaminated air volume in real time.

11 THE SOLUTION OF THE MICROPILOT FOR THE MANAGEMENT OF THE PAYLOAD

The Canadian MicroPilot [3] operating since 1994 is one of the best known UAV manufacturer company in the world. From a few hundred grams of airplane model to the jet engine decoy are used in 65 countries by 750 operators. There are popular in schools, universities, research institues, in different areas of the economy but the defense sector also uses MicroPilot devices on their UAVs.

MicroPilot offers different camera platforms like MP DAYVIEW PTZ for daytime and MP NIGHTVIEW PTZ for night records. [4] Based on the camera images the aircraft can be flown or it can be selected the flightpatch over a detected object.

The camera uses RS232/PWM signs for the communication with the HQ. The transmitted signals can have PAL or NTSC format. The operation of the camera platform like rotation and zooming is based on the commands of the HQ. The image is displayed in separate window or monitor. The most important flight datas like current position, heading and altitude are also readable from the transmitted image.

Fig. 7 The MicroPilot HORIZON display at the HQ with flight datas

12 CONCLUSION

Where do we go robotic flying? The size of devices are reduced with the technical development,

the process capacity is growing with the digitisation. Nowadays we do not have to calculate that the enemy air defense activites will damage it. The soldiers of modern age can attack from cyberspace, too. For example the lost of an American drone over Iranian airspace at the beginning of 2012.

Fig. 8 The potential use in the future

In the future the vulnerability will be reduced also the dependence on weather in anytime of payloads. Certainly, new payloads are also applied. It is important to be integrated in the existing reconnaissance systems or cooperated with it. Data process systems are generally in disadvantage against to data gain devices so their close-up is probable. The precursor of stealth technology is now present.

Flying safety research are under way on NKE HHK KÜLI Military Aviation and Air Defense Faculty for several years. We publish the experiences obtained during the install and the trial of different payloads on scientific forums in the laboratory of Unmanned Aerial Vehicles.

Acknowledegement

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IDENTIFICATION AND CATEGORIZATION OF SECURITY RISKS

František BARTKO, František BARTKO Jr.

Abstract: The experience in recent years clearly shows the shortcomings and problems related to crisis management in public administration, particularly the problems concerning the 2010 floods. The major factors which are directly related to these shortcomings include especially occurrence of new risks not typical for a particular region, ignoring major climatic and geological changes, insufficient analysis of security risks, absence of experience in managing new crisis situations as well as absence or lack of forces and means necessary for disaster relief. Other countries are facing similar problems as well. Taking an increasing number of these new risks into consideration, it can be said that their timely identification and analysis as well as measures taken in a particular crisis situation will be of vital importance when saving human lives and minimizing damage resulting from these risks.

Keywords: Crisis management, public administration, security risk, security environment, identification of security risks, categorization of security risks, categories of security risks.

1 INTRODUCTION

Recently we have been witnessing an increase in security risks which often turn into crisis situations affecting the wide variety of human activities.

Consequences and outcomes of revolutionary changes in Egypt, Tunisia and Libya and movements in other Arab countries are hardly predictable even these days when nobody doubts their impact on policy, economy and security environment of all the European countries (increase in migration, radical Islam, etc.).

Similarities between the events which took place in Europe in the first half of 2012 and the protests resulting in the Arab Spring consist in their character – "the young generation rebellion". In today's economic and political situation, the young generation is becoming the generation of outcasts who are excluded from making decisions concerning the future of the society. What is more, the youth jobless rate is continually rising. As a result, young people are convinced that the politicians are not able to deal with the economic crisis in EU, and that is the reason of political scandals and corruption which can cause anarchy and chaos in Europe.

The severe earthquake that took place on March 11, 2011, and struck the east coast of Japan triggered tsunami which disabled the Fukushima nuclear reactor's cooling system. This resulted in overheating and radiation leak. This catastrophic nuclear accident is considered the worst since the Chernobyl disaster in 1986. It resulted in the death of almost 16,000 people. Besides this, more than 3 thousand people are still missing and over 340,000 Japanese lost their homes.

In December 2011, we witnessed the Slovak health care system crisis which broke out after doctors had been seeking a pay rise for several months. Despite proclaiming readiness for the worst-case possible scenario, the state was not able to compel the doctors' civil obedience even after declaring the state of emergency in some hospitals. Moreover, the doctors could avoid duties and responsibilities specified by law without any punishment. This was possible due to legislative shortcomings.

These cases undoubtedly prove an increasing significance of crisis management concerning not only the military but also non-military threats and subsequent non-military crises. It is important to realize that all known but also new security risks present an inevitable burden people have to cope with throughout their life. Their timely identification, understanding of their causes as well as analysis of possible impacts are only the first step towards making effective decisions and taking measures focused on prevention or elimination of potential security crises.

To identify security risks and factors affecting them, it is necessary to do a thorough and complex analysis of the global and internal security environment with emphasis on the changes this environment is undergoing recently as well as the causes of these changes.

The security environment analysis is a key element in risk management. It is the basis for planning of a functional security system of the country, which is vital for security risks management. Furthermore, this system plays a decisive role in management of crises (elimination of crises and their impacts) which may evolve from risks (as a part of the country's crisis management). The analysis is aimed at gaining reliable, up-to-date and relevant information which is necessary for identification of security risks and is focused on the security environment. The analysis contains systematic, purposeful, cyclical and continual process of obtaining, collecting and processing the information concerning particularities of the environment which may cause occurrence and escalation of security risks and threats in connection to the country, region or a particular protected property.

Security of each country is closely connected with global, international (regional) and internal

(national) security environment in which a particular country exists. This security environment can be perceived from different perspectives (political, economic, cultural, religious, environmental, etc.).

Changes in any perspective of the environment have a direct impact (either positive or negative) on the country's security. That is why monitoring of these changes and early identification of new risks present one of the basic prerequisites for taking adequate measures and making good decisions. The level of security environment is determined by external and internal threats which are often interconnected and cannot be separated. They are largely specified by global changes and trends [1].

Analysis of the security environment of the Slovak Republic is included in the Security Strategy of the Slovak Republic, which was passed by the Slovak National Council on September 27, 2005. The analysis contains also identification of external and internal threats which may pose security risks to the country, its infrastructure and people.

According to the Security Strategy of the Slovak Republic [2], our security environment is characterized particularly by the following factors which have a direct impact on occurrence and development of security threats. These threats may become serious security risks for the Slovak Republic and its inhabitants. The factors are as follows:

- Slovakia is a part of the Euro-Atlantic region due to its geography as well as historical, cultural, political, economic and other relations.
- Having joined NATO and EU, the Slovak Republic became part of the joint defense and security system and its security is guaranteed by alliance commitments.
- EU membership guarantees political and economic stability as well as possibility to take active role in the European security and defense policy.
- Geopolitical position of the Slovak Republic in central Europe affects its defense policy.
- Slovakia's membership in the key international organizations has greatly changed its security environment.
- Increasing globalization directly affects also national security environment.
- Uncontrolled spread of information and military technologies.
- Uneven development of the world regions.
- Unbalanced demographic development and migration waves around the world.
- General increase in intolerance (particularly religious one) and nationalism.
- Growing dependence upon vital resources and their limitedness.
- Environmental deterioration.

The above mentioned factors may pose security risks the Slovak Republic must be aware of and prepared for. According to the security strategy, the following are the threats which may become risks for the security of the country and its citizens:

- uncontrolled spread of weapons of mass destruction and their carriers,
- terrorism,
- failing economies which contribute to regional instability,
- ongoing regional conflicts,
- organized crime,
- vulnerability of information and communication systems,
- illegal uncontrolled migration,
- activities of foreign intelligence services focused against the interests of the Slovak Republic,
- unreadiness of the country to respond to globalization,
- increasing influence of non-state factors on security and stability in the world,
- growing economic disparity in the world,
- increasing dependence upon vital resources, including food and water,
- growing national radicalism and intolerance,
- natural disasters, accidents and catastrophes,
- ecological changes,
- uneven demographic development,
- increasing risk of the spread of infectious diseases due to globalization.

Considering the extent and origin of potential sources of the above-mentioned security risks, it can be said that their identification must be focused on different sources of these risks in a particular security environment. Early and successful identification of risks is dependent particularly on continual monitoring and assessment of the security environment and factors that may considerably affect development of existing risks or even cause occurrence of new risks we have not experienced yet. When identifying risks, two basic groups of methods may be used, depending on an approach to sources of needed information (data):

- **Direct identification methods** focus on direct acquisition of necessary data in a particular environment. These methods include different measurements (especially environmental ones), sociological research, continual recording of data (the course of events), factor analysis, etc.
- **Indirect identification methods** use data which are already processed, particularly data provided by international sources (NATO, WEF,...) as well as scientific research outputs in individual academic disciplines.

Effective use of endeavor made by all involved parties as well as knowledge obtained from different sources requires a complex and systematic approach

managed from one centre at different levels of national crisis management. Such an approach can ensure an early identification of new security risks for a particular region, their thorough analysis as well as consequent measures taken in order to eliminate these risks or develop crisis plans in case the risks turn into a real crisis.

2 CATEGORIZATION OF RISKS

Categorization of security risks is important especially when it comes to their analysis and complex assessment. When choosing particular categories, which have common features, it is necessary to proceed from general criteria to specific ones. It means that an initial categorization of risks will depend on basic definitions of a risk, which will be further specified by particular features common for a given group of identified risks. We can always categorize identified risks from several aspects (e.g. in terms of possible impacts, places of their occurrence, their course, etc.).

When classifying security risks in terms of extent of their impacts on the security environment, we can divide them into the following groups:

1. *Global risks,* which have an overall geographical impact (at least 3 world regions, 2 continents) affecting several sectors (at least 3 sectors). Their development into a crisis and its consequences (security, economic, social …) are characterized by insecurity for the period of at least 10 years. Moreover, management of these risks requires cooperation of a number of involved parties.

World Economic Forum - WEF identifies the following 37 global risks which may have a direct or indirect impact on the Slovak Republic in the document called „Global Risks 2011" [3]. These risks are divided into 5 categories:

Economic risks	Environmental risks	Societal risks	Geopolitical risks	Technological risks
Asset price collapse	Air pollution	Chronic diseases	Corruption	Critical information infrastructure breakdown
Extreme commodity price volatility	Biodiversity loss	Demographic challenges	Fragile states	Online data and information security
Extreme consumer price volatility	Biodiversity loss	Economic disparity	Geopolitical conflict	Online data and information security
Extreme energy price volatility	Earthquakes and volcanic eruptions	Food security	Global governance failures	
Fiscal crises	Flooding	Infectious diseases	Illicit trade	
Global imbalances and currency volatility	Ocean governance	Migration	Organized crime	
Infrastructure fragility	Storms and cyclones	Water security	Space security	
Liquidity/credit crunch			Terrorism	
Regulatory failures			Weapons of mass destruction	
Retrenchment from globalization				
Slowing Chinese economy				

The World Bank - WB - divides the identified global risks into five categories related to its mission [4]:

Political Stability and Absence of Violence	**Government Effectiveness**	**Regulatory Quality**	**Rule of Law**	**Control of Corruption**
Military coup risk	Government instability	Export regulation	Losses and costs from crime	Losses and costs of corruption
Major insurgency/rebellion risk	Government ineffectiveness	Import regulation	Kidnapping of foreigners	
Political terrorism risk	Institutional failure	Other business regulation	Enforceability of government contracts	
Political assassination risk		Non-resident business ownership restrictions	Enforceability of private contracts	
Civil war risk		Non-resident equity ownership restrictions		
Major urban riot risk				

2. *International (regional) risks*, which may geographically affect several countries in one world region (they could, however, have an indirect impact on other regions as well) and their development into a crisis and its subsequences (economic, social) may last a much shorter time than the development of global risks. International risks are more increasingly managed and eliminated by the world and international crisis management organizations (UNO, NATO, OECD, EU,...).

The Organization for Economic Co-operation and Development ***(OECD)*** *specifies the following categories of risks as part of the project called „Future Global Shocks", the aim of which is to identify the biggest challenges and risks for the OECD member countries in the 21st century [5]:*

1. Systemic Financial Risks.
2. Pandemics.
3. Cyber risks.
4. Geomagnetic Storms.
5. Social Unrest.
6. Anticipating Extreme Events.

Global and international risks can be referred to as **external risks** having their origin outside the monitored system (country) as they develop with no direct influence of the country (especially the global risks).

Their consequences may have a direct impact particularly on the state's security. However, they can also disrupt internal functionality of the security system with all their negative effects. These risks are extremely dangerous due to the fact that the country has a limited or no influence on them. This means that elimination of their consequences will mostly include their monitoring and timely measures taken in order to reduce their potential impacts. Since all the categories of risks are closely interconnected, their impacts will be present in all the areas of human existence and activities. As a result, they must be assessed using a systematic approach.

3. *National risks (internal)* occur within the monitored system (country). They result from mistakes and shortcomings of the internal system and can have different features and extent (national, regional, local). All the same, the country has its means to eliminate them before they turn into a real crisis.

Slovakia is an active member of the international community and its security environment is tightly related to regional and global security environments. It is therefore obvious that identification and categorization of national security risks will proceed from the global to the specific (national particularities and internal risks).

The Department of Crisis Management and Civil Protection of the Slovak Ministry of Interior issued a directive (January 1, 2009) stating that all district

offices are supposed to make ***„Analyses of the region in terms of potential states of emergency“*** *[6]. This directive is updated annually as of December 31 or right after reporting the changes in a particular analyzed region, which could affect the level of security risks. The analyses include also identification of security risks which could cause state of emergency. The identified risks are divided into the following categories:*

1. Natural disasters.
2. Industrial disasters.
3. Catastrophes.
4. Terrorism.

There are two categories of security risks in terms of impacts these risks have within the international crisis management**:**

1. **Military security risks** which may develop into open armed conflicts of various extent as well as non-military risks. These risks result particularly from political and economic interests (national, coalition, etc.) and the way these interests are furthered. What is more, they will have considerable influence on development and implementation of the national security strategy as well as the country's security policy.
2. **Non-military security risks** which occur on the basis of the factors people cannot eliminate and can hardly affect (natural disasters, climatic changes, exhaustion of natural resources, etc.).

This categorization of security risks is used particularly in international and national crisis management. It is characterized by the fact that the security risks would have a direct impact on the security of citizens as well as functioning of the country and its infrastructure.

Assessment of the security environment within the strategic defense and security concept of the ***North Atlantic Treaty Organization*** *member countries, which was ratified by the heads of countries and governments in Lisbon, focuses on the analysis of the following risks. The first three risks belong to the category of military risks whereas the others are included in the category of non-military risks. However, consequences of all the identified risks may develop into a major armed conflict [7]:*

1. Development of a major conventional conflict in the NATO member countries: Nowadays, there is peace in the Euro-Atlantic region and only a little threat of a major conventional attack against the NATO region.
2. Development and implementation of conventional long-range weapons in problematic countries.
3. The threat of conventional weapons cannot be ignored. Many regions of the world acquire great modern military capabilities with hardly unpredictable consequences for the international stability and Euro-Atlantic security. These include also the spread of ballistic missiles, which poses an increasing threat to the Euro-Atlantic region.
4. Uncontrolled spread of nuclear weapons and other weapons of mass destruction. The threat with unpredictable impacts on the global stability and prosperity. In the following decade, this phenomenon may become the most serious one in the most unstable countries.
5. Terrorism. Terrorism is a direct threat against the security of the NATO member countries' citizens. In broad terms, terrorism poses a threat to international stability and prosperity. The extremist groups keep on infiltrating the NATO strategic areas. What is more, modern technologies increase the risk and potential effects of terrorist attacks, particularly if terrorists had nuclear, chemical, biological and radiological capabilities.
6. Instability or conflict beyond the NATO borders. Such a conflict can directly endanger the NATO security by promoting extremism, terrorism, cross-border illegal activities as well as weapons, drugs and human trafficking.
7. Cyber attacks. These attacks are more frequent, better organized and more costly when it comes to damage caused to government authorities, enterprises, economies as well as transport and supply systems and the vital infrastructure. They can even threaten national and Euro-Atlantic prosperity, security and stability. Cyber attacks may be done by foreign armed forces and intelligence services, organized crime groups as well as terrorist and/or extremist groups.
8. Security of important communication, transport and transit links affecting the global trade as well as energetic security and prosperity. This security requires more international attempt to protect these links against attacks or damage. Considering their future energetic demands, some NATO member countries will depend more on foreign energy suppliers and in some cases also on foreign energy supply and distribution networks.
9. New trends in the development of new technologies. For example, laser weapons, electronic warfare technologies which hinder entry into the space. Their consequences may affect NATO military planning and operations.
10. Environmental risks. Key limitations concerning environment and resources, climatic changes, health risks, shortage of water and increasing energy needs will shape future security environment in the NATO's areas if

interest. Furthermore, they may greatly affect NATO planning and operations.

3 CONCLUSION

The above-mentioned facts just prove the significance of security risks' identification and categorization.

The timely identification of potential security risks, their thorough analysis and consequent taking of adequate measures are the most effective prevention of crises which may endanger global security as well security of the human society, countries and its inhabitants.

Categorization of security risks enables the systematic approach to their analysis and management. As it was already mentioned, we can make categories according to several criteria. This means that the first step in risks categorization is the specification of the criteria we will follow in our categorization. These criteria will consist of a general part (e.g. extent of risks' consequences on security environment, their influence on the security environment, etc.) as well as a specific part, which results from the objectives and tasks of an assessing unit.

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DEGRADATION OF MECHANICAL PROPERTIES AFTER WELDING OF HIGH STRENGTH STEEL ARMOX 500

Peter LIPTÁK, Igor BARÉNYI, Ondrej HÍREŠ

Abstract: The Armox steels by SSAB Oxelosund are the most known and most widely used armored plates in European area. Secondary processing of these steels is generally problematic. The paper deal with research of ARMOX 500 steel and its behaviour during welding and consequential change of microstructure and then mechanical properties as is strength. The main topics are to determine the level of degradation and its reason.

Keywords: High strength armoured steels, ARMOX, welding, hardness, thougness, tensile strength, termo – mechanical processing.

1 INTRODUCTION

ARMOX 500 is the steel form group of high strength armoured steel by Swedish company SSAB Oxelosund. These steels have high strength, hardness and good toughness acquired by application of thermo-mechanical treatment (TMT).

Armox 500 steel has good weldability according to the chemical composition because of its carbon equivalent is relative low (0.65).

$$CEV = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}[\%] \quad (1)$$

However, there is a problematic factor also at welding of Armox 500 and other steels of this type. The heat generated during welding process minimalizes the TMT effect and the decrease of mechanical properties level occurs.

The producer recommends to not exceeding the temperature circa 200°C during their secondary processing as is welding. The high temperatures occurring during welding process lead to uncontrolled temperation and then to the degradation of mechanical properties level. Submitted paper study the level of the degradation of mechanical properties during welding process of Armox 500 steel.

2 MATERIAL AND METHODS

Armox 500 steel was used for all experiments. Its basic characteristics including chemical composition and mechanical properties are shown in the Table 1.

Table 1 Chemical composition and mechanical properties of ARMOX 500 [1]

Chemical composition [wt. %]	C	Si	Mn	P	S	Cr	Ni	Mo	B
	0.32	0.1-0.4	1.2	0.015	0.010	1.0	1.8	0.7	0.005
Mechanical properties	Tensile strengh R_m [MPa]	Yield strength $R_{p0.2}$ [MPa]	Impact energy KU[J]	Hardness HBW	Elongation A_5 [%]				
	1450 - 1750	min. 1250	25	480 - 540	8				

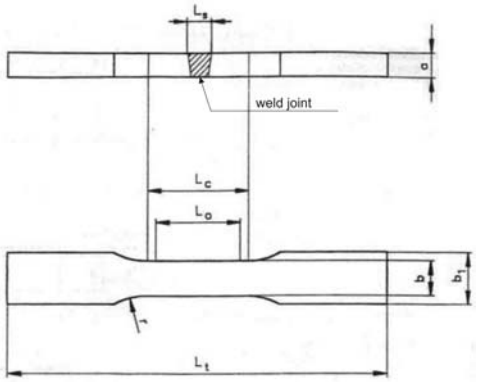

Fig. 1 Experimental sample (a=4 mm, b=10 mm, L_0=40 mm)

The experimental samples were produced from the steel by using of unconventional cutting methods like laser, plasma and water jet cutting. Selection of cutting technology was secondary experimental topic. The influence of cutting method selection on the basic ARMOX material is described in [2].

Two groups of experimental samples were made. There were samples without weld joint in the first one (basic material only). The second one consisted of samples with weld joint. Welded joint is situated in the middle of the weldment in compliance with STN EN 895 (Fig. 1). The shape of experimental samples with and without weld joint is designed according to STN EN ISO 6892 – 1 standard.

Experimental specimens of second group were welded by using Metal active gas method (MAG). Thermanit X were used as a welding consumable (18 Cr/8 Ni). Protect atmosphere consisted of 80 % Ar and 20 % CO2.

3 EXPERIMENTAL RESULTS

All experimental samples were examined by tensile strength test (STN EN ISO 6892-1). Testing device Instron 5500R with automatic evaluation of mechanical characteristics (Tensile and Yield strength) was used. Results of tensile strength test are presented in Table 2. The results from every presented alternative are average of ten measurements.

Table 2 Experimental results

Group	Type of Armox steel	Cutting method	Yield strength $R_{p0,2}$ [MPa]	Tensile strength R_m [MPa]
1 without WJ	500 T	Plazma	1359,60	1539,90
	500 T	Laser	1392,68	1579,15
	500 T	Water jet	1422,09	1614,32
2 With WJ	500 T weldment	Plazma	593,82	614,65
	500 T weldment	Laser	818	837,35
	500 T weldment	Water jet	750,56	772,60

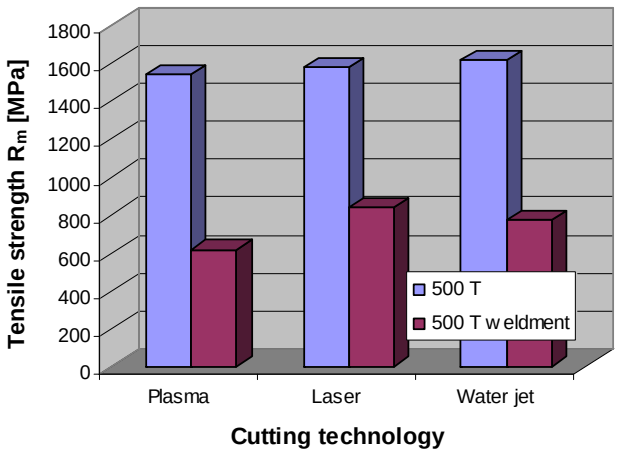

Fig. 2 ARMOX 500 - Yield strength of basic and welded material

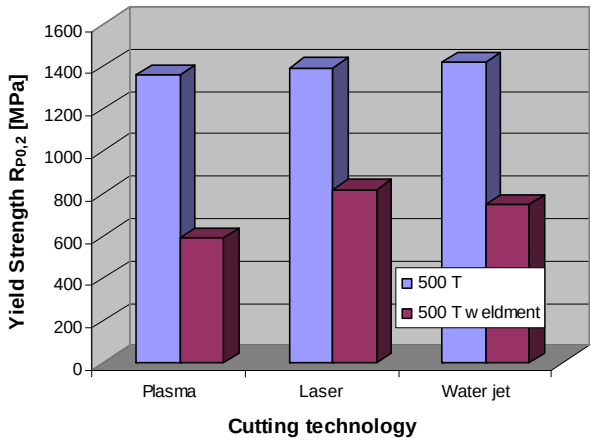

Fig. 3 ARMOX 500 - Yield strength of basic and welded material

Comparisons of all variants between weld and basic materials bring those results:Yield strength ($R_{p0,2}$) decreases about 44 % in the case of plasma cutting, about 42 % in the case of laser cutting and about 45 % in the case of water jet cutting. Decreases are almost equal; therefore cutting method has no influence on the yield strength level.

The highest decrease of tensile strength (R_m) indicates the alternative with plasma cutting, where the decrease is about 60 %. The decrease is about 47 % in the case of laser cutting and about 52 % in the case of water jet cutting. Significant decrease of R_m at variant with plasma cutting means that affection by heat is so high to appear even after welding application (in contrast to other two cutting technologies).

4 INFLUENCE ON MICROSTRUCTURE

The main reason of degradation of mechanical properties during ARMOX 500 steel welding are changes in microstructure. The original (un-affected) microstructure is shown on Fig. 4 and it consists of very fine-grained heterogeneous martenzitic structure obtained as a result of thermo – mechanical treatment. This structure provides all good features of Armox steel as are high strength, hardness and good toughness.

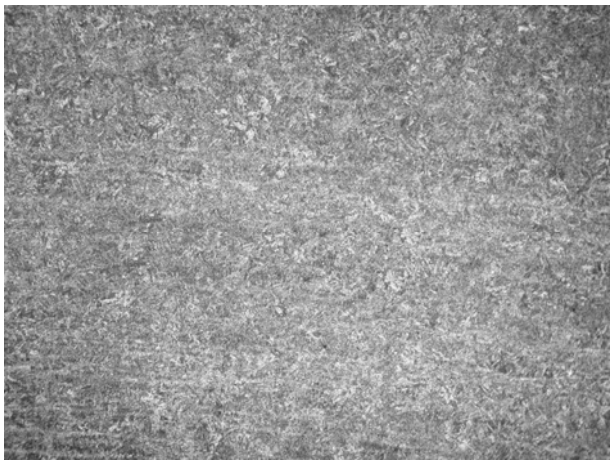

Fig. 4 Mictrostructure of base material (ARMOX 500), 500x

Fig. 5 Microstructure of HAZ (area close to weld metal), 500x

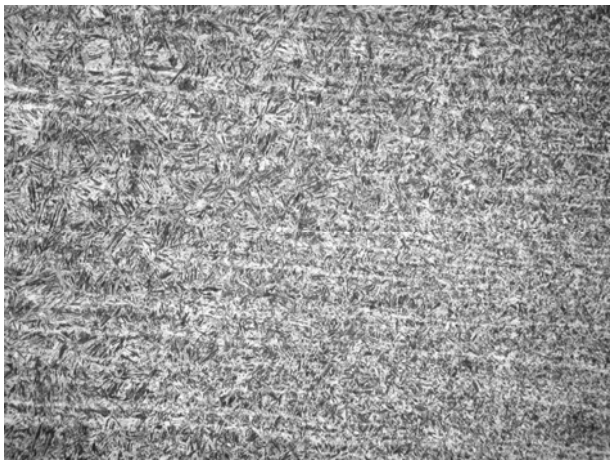

Fig. 6 Microstructure of HAZ (area close to base material), 500x

The microstructure of heat-affected zone (HAZ) is absolutely different in comparison to microstructure of basic material. There is shown the microstructure of HAZ area close to welding metal. It consists of very coarse martensitic needles (Fig. 5).

The needles became finest sequentially in areas farther from weld metal, but structure still remains relative coarse (Fig. 6). Too much martensitic elements and especially big coarse martensitic needle leaves HAZ area of steel brittle. The degradation effect is bigger because of un-wanted change of microstructure specifically obtained by thermo-mechanical processing in this case.

5 CONCLUSIONS

Decrease of both mechanical properties (Rm and Rp0,2) is obvious at welding joints. The weld metal is the weakest place of welding joint where all of experimental specimens is broken. The level of decrease is in relation to the used welding consumable properties.

The study of microstructure of heat-affected zone brings detailed information about affection of ARMOX steels by welding process. Heat affection changes very fine-grained martensitic microstructure obtained by thermo-mechanical treatment to worse one, mostly consisted of coarse martensitic structure.

The subject of experiments was Armox 500 steel, but we can await similar behaviour during welding at all steels from Armox and Hardox groups. Therefore is very important to mind that behaviour in all cases of secondary processing of described steels based on heat transfer as are welding, cutting atc. Ignoring of the over tempering effect may lead to critical components failure and threat of safety. Armox steels are applied as mobile army containers for mobile hospitals or maintenance centers.

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FINDINGS ON THE DEPLOYMENT OF CIVILIAN EXPERTS FROM THE SLOVAK REPUBLIC INTO COMMON SECURITY AND DEFENSE POLICY MISSIONS

Mariana MARTIŠKOVÁ, Ladislav NOVÁK

Abstract: Deployment of civilian and military personnel into Common Security and Defense Policy (CSDP) missions is an indispensable part of a unique integrated crisis management approach used by the European Union and its member states. The aim of the following article is to demonstrate select problems concerning deployment of Slovak civilian experts into Common Security and Defense Policy Missions based on the results obtained from observation and statistical survey.

Keywords: Civilian expert. Slovak Republic. Common Security and Defense Policy. European Union.

1 INTRODUCTION

Term „civilian expert“ represents according to the Act no. 503/2011 Collection of the Laws of SR an expert in any of the fields of: crisis management and civil protection, justice, prosecution, human rights protection, public finance, customs, taxes, police, defense and security, rural development and civil society, health care, education as well as in economic development being a citizen of Slovakia. Frequently used equivalent of the term civilian expert within European Union (EU) is the term „civilian personnel“ deployed into 6 priority areas of: police, rule of law, civil administration, civil protection, mission monitoring and support. [1] It's important to note however, that the EU and Slovak usage of the terms: „civilian expert“ and „civilian personnel“ involve also the police members (contrary to the UN terminology, failing to involve humanitarian actors and the police within the term: civilian – non-uniformed personnel). This is why using the equivalent of non-uniformed personnel instead of the civilian personnel is terminologically improper.

2 PROCESS OF DEPLOYING CIVILIAN EXPERTS INTO CSDP MISSIONS IN SLOVAKIA

Slovak Republic has after its entrance into European Union (EU) committed itself to contribute its own civilian experts into then ESDP (current CSDP) missions. This commitment and specific measures as attached to the civilian experts deployment have evolved mainly from the following documents:

- Specifying Slovak Commitment into EU Civilian Crisis Management at EU Civilian Capabilities Conference (adopted as the Governmental Declaration no. 1070/2004 of the Col. of Laws);
- Strategy of SR Membership in the EU Civilian Crisis Management (adopted as the Governmental Declaration no. 527/2005 of the Col. of Laws);
- Ministry of Interior's Regulation on International Police Peace Missions and Civilian Crisis Management Operations according to the Minister of Interior's Regulation No. 12/2009;
- Suggestion to Streamline Civilian Experts Participation in the Crisis Management Activities Conducted outside the Territory of Slovakia (adopted as the Governmental Declaration no. 48 from 19.1.2010);
- Act on the Deployment of Civilian Experts into Crisis Management Activities outside of the Slovak Republic Territory No. 503/2011 of the Col. of Laws.

3 IDENTIFYING PROBLEMS OF DEPLOYING CIVILIAN EXPERTS APPLYING RESULTS OF STATISTICAL SURVEY AND OBSERVATION

With an aim to find out more about the select problems linked to deployment of civilian personnel into Common Security and Defense Policy (CSDP) missions there has been conducted a statistical survey in March – April 2012. The survey was conducted both online as well as in the form of a direct distribution among the participants of select public administration organizations in the Slovak republic with a total number of 107 filled out copies. In this case statistical findings were real, direct, simple and inexhaustive. Second exhaustive data file for the observation purpose involved all EU member states. Simple statistical findings for questions related to this file are derived from the secondary sources available at: <http://www.csdpmap.eu/>.

Main purpose of statistical exploration and observation methods was to predominantly examine mutual relationships between the problems as attached to deployment of civilian personnel into CSDP missions, namely between:

- making commitment to deploy civilian experts into CSDP missions as opposed to actual deployment;

- number of deployed civilian experts and a total population number of a deploying EU member state;
- deployment of civilian personnel and its dependance on the CSDP mission type;
- preference towards specific CSDP missions from the EU viewpoint as opposed to preference towards specific CSDP missions considering viewpoints of the survey participants.

Table 1 Commitments of Slovak Civilian Experts and Their Real-life Numbers in the CSDP Missions in 2012

SR Commitment (Gov.Decl.1070/2004)	Number of experts	Civilian CSDP misions: total number of deployed experts in 2012	Number of deployed Slovak experts in Civilian CSDP missions in 2012
Police (Min. of Interior SR)	33	EUPM Bosnia and Herzegovina (360)	4 police experts
Civil Protection (Min. of Interior SR)	76	EUBAM Moldavia a Ukraine (200)	1 customs expert 3 police experts
Monitoring (Min. of Int. SR, Min of For.Af.)	4 (Min. of Int.) 5 (Min. of For.Af.)	EUMM Georgia (340)	1 police expert 1 military expert 1 civilian expert
EUSR Support Functions (Min. of Int. SR)	3	EULEX Kosovo (1950)	6 police experts
Rule of Law (Min of Int. SR, Prosecution General SR)	–	EUPOL Afghanistan (300)	2 police experts
Civil Administration (Min. if Int. SR, Min. of For. Af. SR)	–	–	–

Source: Ministry of Foreign Affairs of Slovak Republic [2]

4 SOLUTION OF SELECT PROBLEMS OF DEPLOYING CIVILIAN PERSONNEL

- *Problem of alleged disaccord between the commitment and real-life deployment of civilian personnel:*

Results demonstrate that the number of commitments is directly dependent on the total population number of EU member states and for the more populated countries we may expect higher number of commitments. Number of Slovak Republic Commitments expressed as a total of 145 is in correlation (88,59 % accordance) with remaining EU member states, even though at the same time in disaccord with the real-life deployments. Unless there have been implemented changes on the side of remaining EU member states, it's improper to modify Slovak commitments, too. Current number of deployed civilian capacities from EU member states into CSDP missions from 1st of February, 2012 stands for a total of 1,587 deployed civilian capacities. This means fulfillment of Civilian Headline Goal 2008 Commitment of 11,203 civilian capacities at the level of 14,1 %. [3]

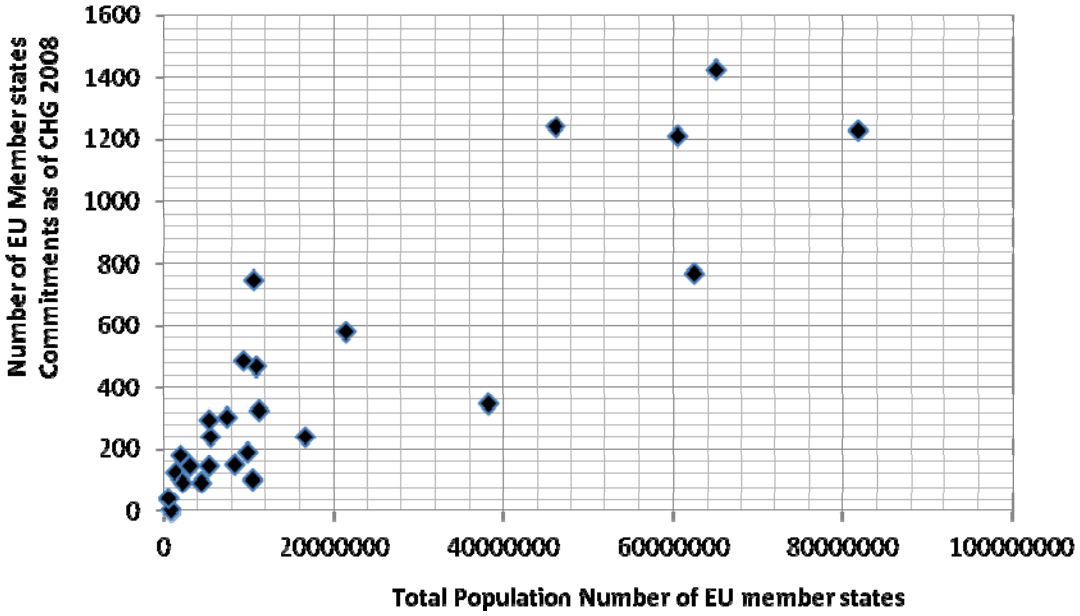

Fig. 1 EU member Ssates according to the total population Number and number of commitments as set by Civilian Headline Goal (CHG) 2008

Problem of alleged discrepancy between the total number of member-state's population and the number of actually deployed civilian personnel:

Solution building on correlation analysis with the correlation coefficient set as **r = 0,708098** defines a strong dependency between the number of deployed civilian crisis management personnel into CSDP missions and the total number of the country's population. Results demonstrate that the number of deployed civilian experts from individual EU member states is directly dependent on individual total population number and therefore less populated countries would deploy less civilian personnel. The only significan exception is that of Spain, whose number of deployed personnel is comparable with numbers deployed by less populated countries. Number of currently deployed civilian experts from Slovak Republic as of 1st of February 2012: 14 civilian experts is in correlation (70,8 % accordance) with remaining EU member states.

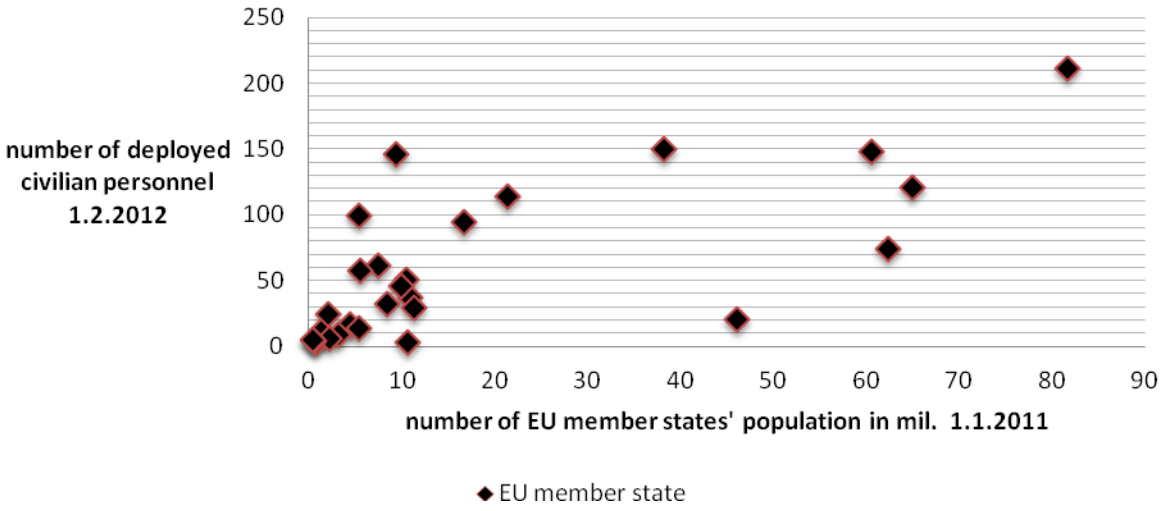

Fig. 2 EU member states according to the total population number and number of deployed civilian personnel from 1.2.2012

Problem of alleged discrepancy between the deployment of civilian personnel as based on a specific CSDP mission type:

Observation results show that deployment of civilian experts into crisis management missions is slightly dependent on the type of the CSDP missions. The graph also shows the dominance of deployed experts into integrated Security Sector Reform Missions aimed mainly at reforming the police and building up the rule-of-law. These are followed by the CSDP missions focused on police reform, monitoring and justice reform missions. Three out of four mentioned types of missions: integrated missions, police reform, justice reform are an inevitable part of Security Sector Reform missions. Therefore it's been proper to mention that the deployment of civilian personnel from the EU member states into CSDP missions aims predominantly at Security Sector Reform. Deployment of Slovak personnel is in accordance with this tendency.

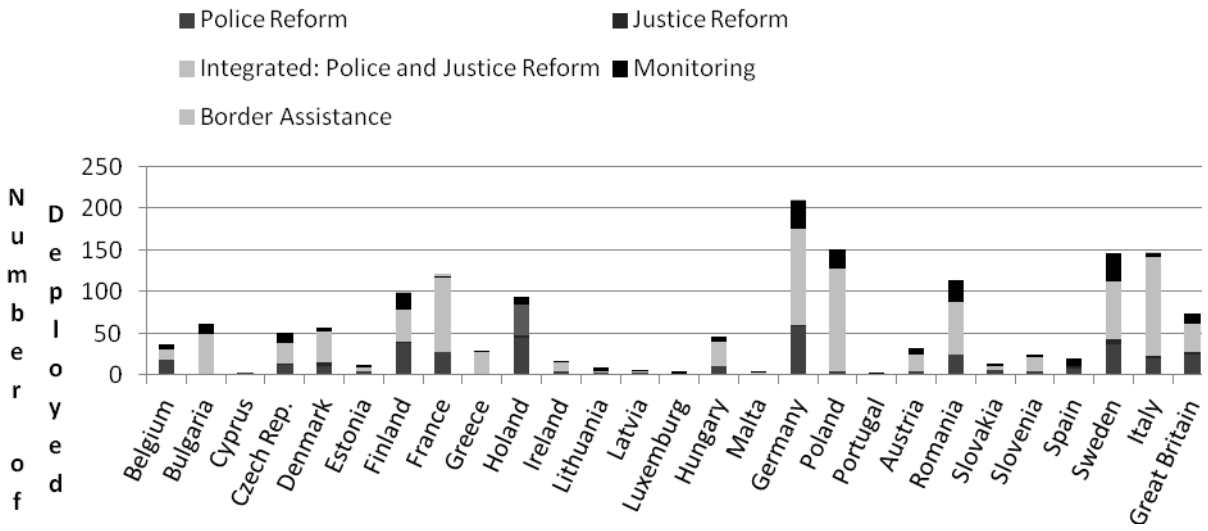

Fig. 3 Number of deployed civilian experts from EU member states into CSDP missions according to the type of the mission

Problem of alleged preference of Civil Protection Missions by survey participants as opposed to EU's preference for missions aimed at Security Sector Reform:

Statistical survey included a question aimed at participants in order to specify crisis management missions by ticking any, or more types of missions set in accordance with the priority areas of CSDP missions as: building up the rule-of-law, civil administration, civil protection, police or other. Survey participants were divided into categories according to their specific job appointments as set by the law. Obtained results show that definition of the term „crisis management" is slightly dependent on the category of participants and for the higher number of participants in the given category we may expect more responses prefering civil protection, police, followed by the rule of law and civil administration. The fact that majority of participants in all but one categories has been mostly identified with the definition of crisis management as civil protection is in the sharp contrast with the abovementioned finding that the EU CSDP missions show the tendency to aim at integrated missions of Security Sector Reform: composed of Police and Justice (Rule of Law) Reform.

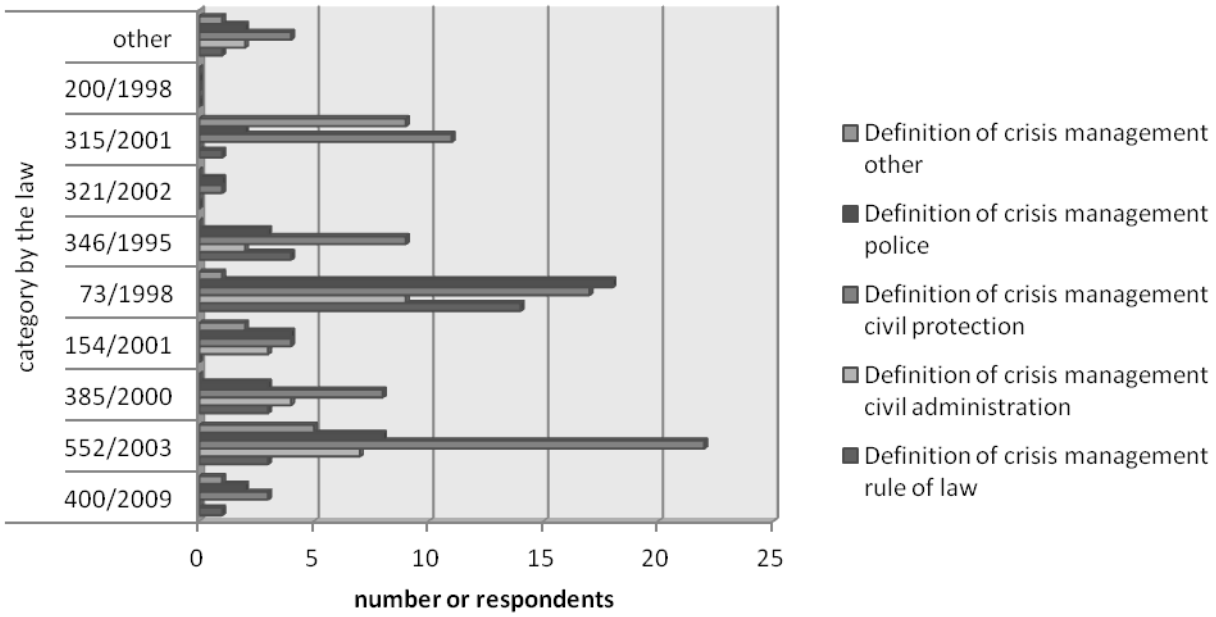

Fig. 4 Defining crisis management according to the category of survey participants set by the law

5 CONCLUSION

One of the EU's key crisis management tools is definitely that of CSDP missions. Up to date there have been deployed altogether: 14 civilian missions, 3 mixed civilian-military missions and 7 military operations. Since the adoption of the Lisbon Treaty (2009) and subsequent establishment of the European External Action Service (EEAS) in 2011 aimed at further enhancement of EU's crisis management tools, there hasn't been a new CSDP mission launched yet. [4] This is partially attributable to the individual EU member states' problems, present in the Slovak Republic as well, which are as follows:

- alleged disaccord between the commitment and real-life deployment of civilian personnel;
- alleged discrepancy between the total number of member-state's population and the number of actually deployed civilian personnel;
- alleged discrepancy between the deployment of civilian personnel as based on a specific CSDP mission type;
- alleged preference of Civil Protection missions by civilian experts as opposed to EU's preference for missions aimed at Security Sector Reform.

Observation results altogether with the results of the statistical survey show that the problem of an alleged disaccord between the member state's commitment and its real-life deployment of civilian personnel exists, however without being exclusively attached to the Republic of Slovakia, but rather in correlation with the remaining EU member states.

On the other hand observation results have failed to prove the existence of the alleged discrepancy between the member state's total number of population and its number of actually deployed personnel (excluding Spain). On the contrary it's been proven that the countries with a smaller population number tend to deploy smaller numbers of civilian personnel into CSDP missions. Observation results also show that the deployment of civilian personnel is slightly dependent on the individual mission types with the dominance of the Security Sector Reform missions involving Police Missions as well as the Missions on the Rule of Law. Contrary to the aforementioned findings preferred types of crisis management mission as defined by the participants of the conducted statistical survey face a decreasing tendency in the areas of: Civil Protection, Police, Rule of Law and last but not least Civil Administration. It would be highly appropriate to consider the released findings not only while making further commitments of Slovak Republic into Civilian Headline Goals, but also while deploying Slovak civilian personnel into current as well as future CSDP missions.

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HYBRID - ELECTRIC POWER SOURCES ENERGY MANAGEMENT DURING DYNAMIC LOADS IN MILITARY VEHICLE

Viktor FERENCEY, Martin BUGÁR, Vladimír STAŇÁK, Juraj MADARÁS, Ján DANKO

Abstract: This paper describes a management energy source supplied by a polymer-electrolyte-membrane fuel cell (PEMFC) as a main power source and secondary power source with reversible storage energy devices: battery and supercapacitor system, for modern distributed generation energy system, and particularly for future fuel cell military applications. The energy system in hybrid system is balanced by optimization and regulation algorithm in dependence of the driving conditions - drive cycle. A supercapacitor system (module) is a high dynamic and high power density device and supercapacitor system. Function of supercapacitor system is supplying energy traction system in extremely short power demand requirements. A battery module, as a high energy density device, operates for supplying energy traction system for long time. The aim is the real-time control management of the power distribution between the fuel cell and its associated energy storage to optimize the global hydrogen consumption and energy consumption of each energy storage system in military vehicle – Unmanned Ground Vehicle during dynamic loads in the drive cycle.

Keywords: Energy management systems. Military application. Fuel cells. Batteries. Supercapacitors.

1 INTRODUCTION

The development of new control systems and modules of power and energy system provide possibility to combine power energy sources and create advantage their energy management system. It could be one of the goals of the army science and army development. The amount of research works deal with hybrid power sources for the military application such as ground vehicles and for individual soldier. The objectives of development new hybrid power sources, which contain fuel cell as a primary power source, are to lighten the military vehicle and other military applications (Fig.1). Fuel cells provide critical pulse-power components and reduce logistics and disposal costs by developing battery system and supercapacitor systems and theirs management system.

The battlefield and military advanced technologies such as digitization are implemented to the complex systems and the power needs are increased and new energy solutions required are. There is a need for longer life, higher reliability power sources which will extend mission time and reduce weight of the military vehicle during dynamic loads.

The utilization of vehicle powertrain systems, communications equipment, portable computing devices and remote monitoring and sensing equipment have increased over the past decade. Due to the abbreviated operating time observed when conventional battery system are utilized the need for high energy density power sources has been established. Power requirement for military systems and military vehicles has limited special the selection of battery and supercapcacitor power sources for these applications. New management technologies that could benefit from hybrid power sources. Hybrid energy system can be applied for: traction and powertrain systems for vehicles, unmanned ground vehicles, robots, portable power sources, personal communication systems, GPS, remote sensors, automatic target systems, silent watch systems, power regeneration system, and backup power systems. Some of the potential advantages are mainly focused in the better power management, lighter components and higher power density to extend operation time, driving range, etc.

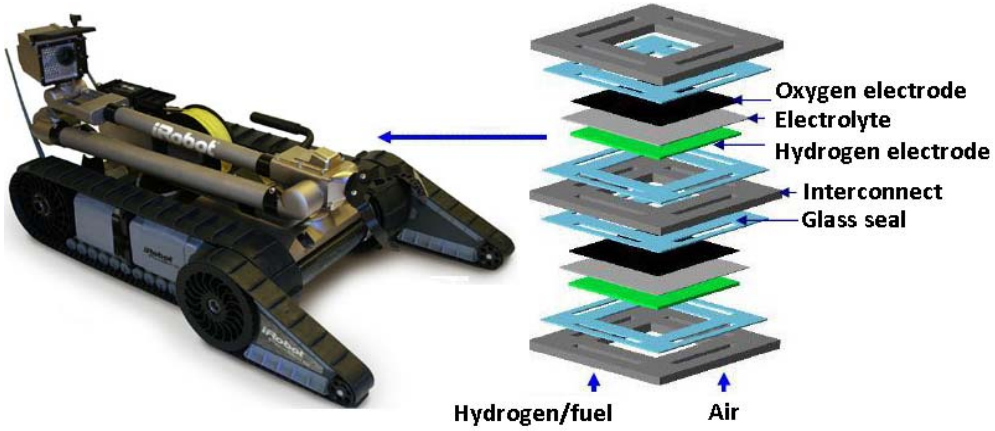

Fig. 1 Application of Solid Oxide Fuel Cell (on the right side of the figure) for military robot (on the left side of the figure) [11]

2 HYBRIDIZATION IN MILITARY APPLIACTIONS

2.1 Potential electric power sources for military application

Fuel cells are electrochemical devices, which convert chemical energy into electrical energy directly by oxidizing hydrogen without intermediate thermal or mechanical processes. Proton exchange membrane fuel cells (PEM-FC) also known as polymer electrolyte fuel cells (PEFC) are preferred in automotive applications because they are efficient, compact and of low weight [4]. Since PEFC operate at almost ambient temperatures, the warm-up process is kept short and their ability to follow the dynamic changes in the applied load [1].

The power output of a single cell with an active area of 200 cm2 is less than 100 W. Individual component cells are connected in series form a multi-kW stack, and a system contains stacks generates a power output of several tens or hundreds of kW [4].

Supercapacitors are electrical storage devices with a high power and a high energy density. Their energy density is up to 100 times higher than that of conventional capacitors, and their power density is up to 10 times higher than that of batteries. With their wide operating temperature range and their long lifetime, supercapacitors are the short-term storage elements of choice [3].

Battery is next component in electric drive. In the classic electrical vehicle the battery is the only energy store, and the component with the highest cost, weight and volume. Battery must continually accept and give out electrical energy, is also a key component of the highest importance [3].

2.2 Advantages of hybridization

The potential advantages of hybridization are [5]:

- As the additional energy source can fulfill the transient power demand fluctuations, the fuel cell can be downsized to fit the average power demand.
- The ability of the reversible energy source to recover kinetic energy during regenerative braking causes significant energy savings.
- The hybridization creates additional degrees of freedom in the power flows and offers opportunities for the optimization of the vehicle efficiency.

The coordination among the various power sources requires a high level of management control energy system in the vehicle, typically referred as a supervisory control. This work focuses on the management of these power flows at any instance in a unmanned ground vehicle equipped with PEM fuel cell system with battery system or PEM fuel cell system with supercapacitor system.

2.3 Theoretical analysis of energy management systems

The optimization of energy management systems are based on knowledge of the future driving conditions, as provided by scheduled driving cycles [6]. Therefore, they are not suitable for real-time control, but they still have an acknowledged importance as a basis of comparison for the evaluation of the quality of real-time control strategies. In this approach, often referred as “local optimization”, two main constraints must be accounted for:

- very limited knowledge of the future driving conditions is available during the actual operation of the military vehicle such as UGV,
- the charge of the reversible energy source must be sustained without external sources, but based only upon fuel conversion or regenerative braking during the UGV operation.

The core of each “local optimization” strategy is the definition of a cost function (Fig. 6), that is to be minimized, which depends only upon the system variables at that instant time [6].

3 HYBRID – ELECTRIC POWER SOURCE ENERGY MANAGEMENT AND TRACTION SYSTEM MODEL

Model of the military vehicle powertrain was created based on SimPowerSystems and SimDriveline. The powertrain system is propelled by two electric motors powered by a fuel cell and reversible energy storage system (Fig. 2).

3.1 Reversible energy system

Reversible (rechargeable) energy system is based on the nonlinear model calculation using the knowledge of the battery model and supercapacitor model.

All parameters, including the charging and discharging the battery and supercapacitor resistance, an open perimeter of battery and supercapacitor voltage, charge level and temperature were given either theoretically or acquired pursuant to the battery and supercapacitor manufacturer's data.

3.2 PEM fuel cell energy system

The PEM fuel cell system produces electricity through an electrochemical reaction of fuel (pure hydrogen) and oxidant (oxygen from the air). This

reaction produces the water as the output product. The fuel cell produces no harmful emission and is relatively quiet during operation. Electric-powered UGV is generally very quiet. Fuel cell with the proton exchange membrane (PEM) operates at a low level of the temperature around 100 °C and working at full power shortly after starting to work.

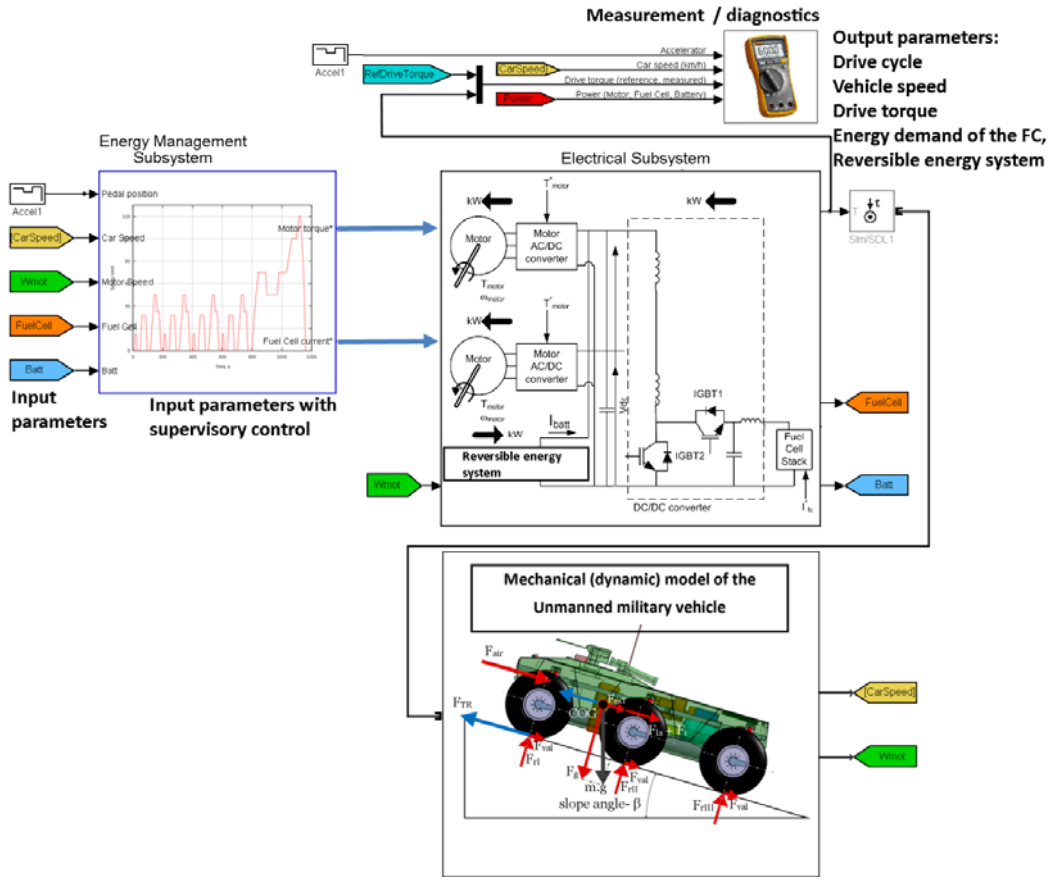

Fig. 2 Military vehicle model (UGV) with energy management system, which is applied on electric energy source combination of: first - fuel cell and battery system and second – fuel cell and supercapacitor system in the program environment MATLAB/SIMULINK®

Where: F_{val} is the rolling resistance force, F_{air} is the aerodynamic drag, F_{gxT} is the hill climbing force, F_{la} is the force required to give a linear acceleration, F_i is the force required to give angular acceleration to the rotating pats of the vehicle, F_{RI} is the vertical reaction force on wheels of the front axle , F_{RII} is the vertical reaction force on wheels of the center axle, F_{RII} is the vertical reaction force on wheels of the rear axle, m.g is gravity force of the vehicle mass, F_{TR} is traction force, COG is center of gravity, MATLAB variables: Accel1 is value of acceleration or deceleration depending on the drive cycle, CarSpeed is real vehicle speed during simulation, Wmot is value of the RPM of the electric motor/generators, Fuel cell is the value of the electric power of the fuel cell system, Batt is the value of the electric power of the reversible energy system (battery/supercapacitor), RefDriveTorque is the demanded drive torque of electric motor during the acceleration and motion, Ifc is the value of the electric current of the fuel cell system, Ibatt is the value of the electric current of the reversible energy system (battery/supercapacitor).

3.3 Mechanical system design of the UGV

From the vehicle mass Simulink block, the vehicle speed is obtained for subsystems. For every wheel block is modeled a mechanical brake subsystem with mechanical friction clutch block, which is controlled by generated brake signal from the automatic vehicle driver subsystem.

Transmission subsystem presents a physical model of the transmission of the simulated vehicle. This subsystem consists from mechanical rotational elements (Fig. 2)

3.4 Electric systems design of the UGV

The electrical subsystem is composed of four parts. The electric motor with DC/AC converter, the energy storage system (battery / supercapacitor), the fuel cell and the energy management subsystem - supervisory control (Fig. 2).

Performance of one electric motor/generator is 67 kW in the continuous term / 120 kW for a peak term. By the effectiveness 95 % be its input power about 126,3 kW. Regulation of revolutions and power calculation of electromotors is solved over DC/AC converter - invertor. A flux weakening vector control is used to achieve a maximum motor speed of 10 000 rpm.

Reversible energy system - model is based on Lithium-Ion battery. Battery pack is to size on voltage - 619 volts and their capacity is 193Ah. Battery will put performance about 119 kW in the continuous terms.

The model of fuel cell for simulation is a 1200 cells, 600 Volts - direct current, with maximal peak power - 170 kW Proton Exchange Membrane (PEM) fuel cell stack. Weight of PEM fuel cell energy system with reversible energy system is 1 500 kg and depends on hydrogen storage in hydrogen tank.

The vehicle dynamic and mechanical subsystem model contains all the mechanical parts of the vehicle [2]:

- The single reduction gear reduces the motor's speed to increase the torque.
- The tires dynamics represent the force applied to the ground.
- The vehicle dynamics represent the motion influence on the overall hybrid traction and energy system.

Model of supercapacitor is based on Maxwell Technologies' 125V Heavy Transportation series of supercapacitor modules, which five supercapacitor modules are serial connected with another five. Supercapacitor module pack - system is designed on voltage - 625 Volts. Weight of the supercapacitor system is 200 kg.

Total weight of UGV with hybrid power and energy system and electric traction system is less than 7 tons (Fig.3).

mass analysis

component	quantity	weight of the component [kg]	total weight [kg]
axle	3	800	2400
wheel with tire	6	100	600
supporting frame	1	100	100
subframe for the other elements of the	3	100	300
central carrier tube	1	400	400
transfer box	1	115	115
armored protection			
hood and fenders	1	400	400
PEM FC (fuel cell stack + cooling system)	1	210	210
power electric cables	1	50	50
DC/DC converter	1	60	60
Traction inverter	2	65	130
CPU for electric traction system	1	10	10
AUX system box	1	30	30
traction electricmotor/generator	2	90	180
connecting transmission	1	70	70
six speed automatic transmission	1	80	80
drive shaft	1	40	40
cooling system of the electric traction			
coolers, blowers, filling, tubes,	1	100	100
airflow rectifiers	1	20	20
fuel reservoir, fuel	1	170	170
reversible energy system	1	1120	1120
brake system			
brake cylinders, actuators, control system	1	150	150
suspension system			
air reservoir (for suspension and brakes)	1	50	50
(actuator, compressor)	1	60	60
electronic weapon system elements			
electric motors, sensors, wiring	1	70	70
electronic components of the control			
sensoric system, transmitter / receiver, antenna, cables	1	40	40
central electronic control unit	1	10	10
Σ			6965

Fig. 3 Mass analysis of the Unmanned Ground Vehicle

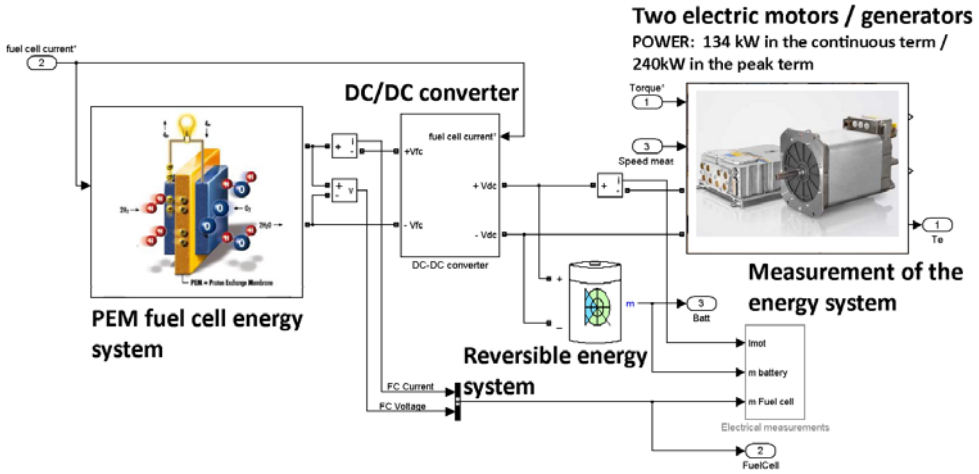

Fig.4 Energy storage system (PEM fuel cell system – battery system /PEM fuel cell system – supercapacitor system) with traction electromotor/generators and control signal output

Management of the fuel cell is actually design model can be divided into two management subsystems. Both subsystems are interconnected to form to a unified complex management system. These subgroups can be directed to:

- Calculate the required power of the PEM fuel cell system;
- Management of support equipment of the PEM fuel cell system.

The simulations consider the overall efficiency of PEM fuel cell. Support fuel cell systems will be simulated because of the speed of calculation and the small impact assessment and energy balance electric.

4 DESIGN OF AN ENERGY MANAGEMENT SYSTEM ALGORITHM

Based on the requirements of the electric motors/generators is calculated the current value that is obtained from the energy sources. Electric current can be directly calculated, because the electric voltage in this system is maintained in a certain interval. Electric current requirement is divided by the size of the fuel cell and reversible energy system. A fuel cell can be used as the primary power source or secondary energy power source. It can supply the main part of traction performance requirements.

Power and energy requirement s can be expressed by the equation:

$$E_{net} = \int_{t=0}^{t=N} (P_{fc\ traction\ system} + P_{discharging\ rev})dt + \int_{t=0}^{t=N} (P_{charging\ rev\ recuper} + P_{charging\ rev\ fc})dt \quad (1)$$

Where: E_{net} is energy required/generated electric traction system, $P_{fc\ traction\ system}$ is power generated by the fuel cell system for traction, $P_{discharging\ rev}$ is power comes from a reversible system for traction power system, batteries $P_{charging\ rev\ recuper}$ is reversible power of the traction system supplied to the energy system for recovery $P_{charging\ rev\ fc}$ is power supplied to the reversible energy system from the fuel cell, t is time, N is time of the drive cycle.

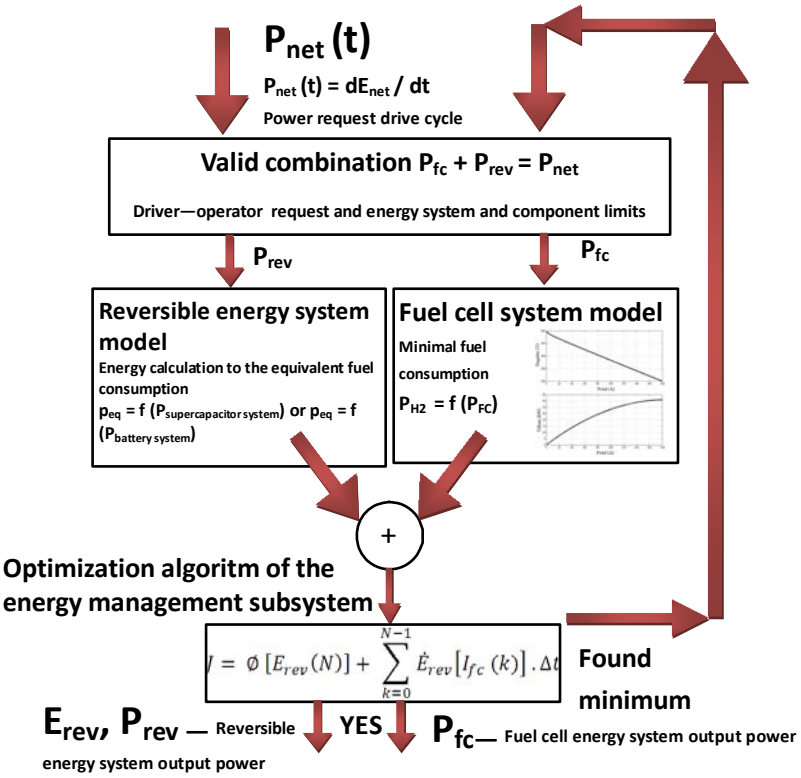

Fig. 5 Power and energy control algorithm implemented into the energy management subsystem model

Where: P_{net} is traction system power demand, E_{net} is electric energy demand, P_{fc} is output power of PEM fuel cell system, P_{rev} is output/input power of the reversible energy system, P_{H2} is equivalent fuel(PEM fuel cell) consumption, $P_{supercapacitor\ system}$ is output power of supercapacitor system, $P_{battery\ system}$ is output power of battery system, E_{rev} is energy of reversible energy system, $\dot{E}_{rev}$ is power of reversible energy system, J is optimization function of energy management algorithm.

Optimizing operational strategy and algorithm (Fig. 5) is performed during drive cycle – simulation can be characterized as a problem of optimal control strategy, indicating the distribution of energy flows and performance of energy in discrete time point.

The time between these discrete points is dependent on the amount of energy given by optimizing energy sources and is identified the required energy of the traction system.

5 SIMULATION RESULTS OF PEM FUEL CELL SYSTEM WITH BATTERY SYSTEM

The simulation procedure is described as calculation and evaluation of the fuel equivalent power demand of the electrical energy systems. Power demand is given from hybrid electric energy system during drive cycle. The procedure requires running the model for various constant values of the control variable of state of charge of the battery system and voltage level of supercapacitor system. For this reason the storage capacity of the supercapacitor system was increased (high start value electric current) in order to extend the driving range.

The simulation of dynamics loads with primary energy source – battery system shows Fig. 8. The PEM fuel cell is used to assist batteries in some critical parts of dynamic loads in drive cycle (Fig. 6).

The value of acceleration and deceleration is calculated by equation:

$$a_{\frac{accel}{decel}} = \frac{dv_{cycle}}{dt} \qquad (2)$$

Where: $a_{accel/decal}$ is value of acceleration and deceleration in each simulation time step, v_{cycle} is value of UGV's speed, t is the simulation time step.

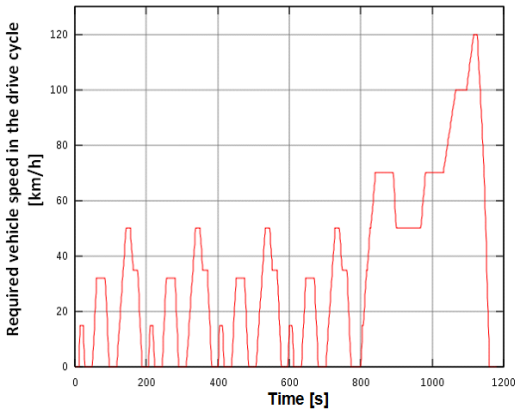

Fig. 6 NEDC drive cycle implemented into the simulation model

For loading an electric traction system and PEM fuel cell system with reversible energy system NEDC driving cycle without climbing resistance selected was (Fig.8).

At the end of each run, the values of the fuel energy use and of the reversible energy use over the cycle are collected.

These values represent the final values of the cumulative results.

The fuel cell and its power can be design for charging battery pack, when battery power is on low level. Fig. 9 shows on the right side of the graph (time between 1100 and 1200 seconds), that fuel cell with kinetic energy recuperation system starts charging battery system.

Power requirement depends on the driving cycle, the state of charge battery system, and the current requirements of all electrical systems in support UGV including supporting devices.

PEM FC system is connected to provide power for traction system during the high current load battery system. If UGV accelerated to higher values of the speed higher in the driving cycle, is PEM fuel cell system is connected to the battery system (Fig.7).

This is important function, due to that, UGV has in the terrain high values of the drive resistance and the requirement of electric current (electric power).

At the beginning of the each simulation battery system state of charge was set to 95 percent of the maximum capacity.

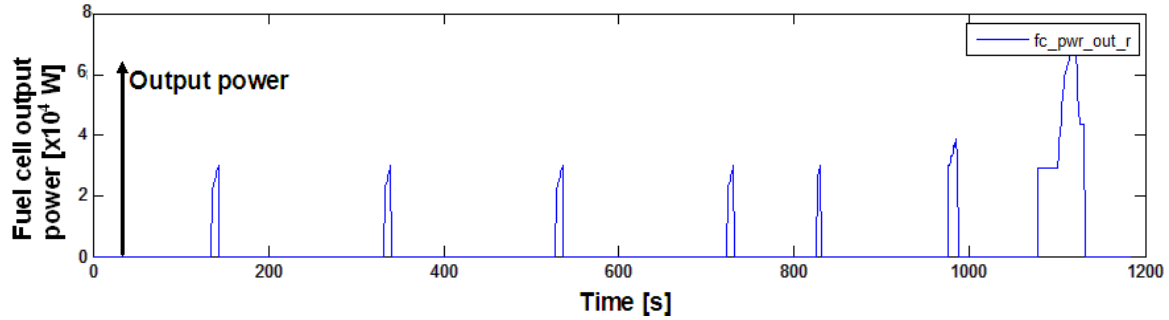

Fig. 7 Fuel cell energy system characteristics during dynamics load in drive cycle

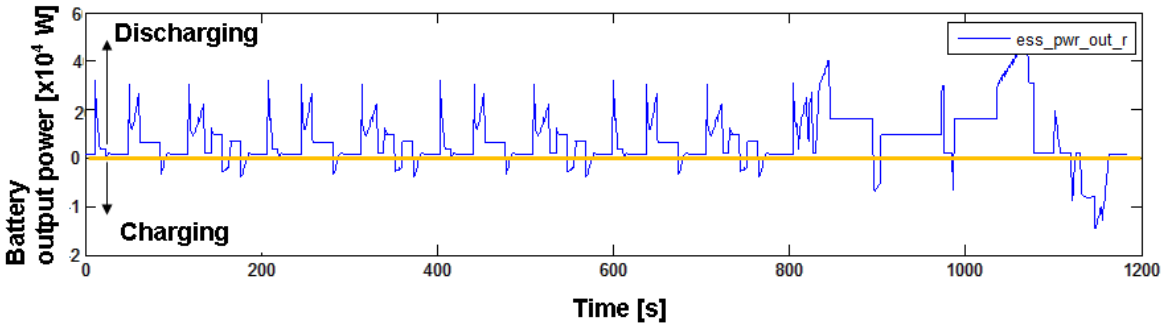

Fig. 8 Battery system energy characteristics during dynamics load in drive cycle

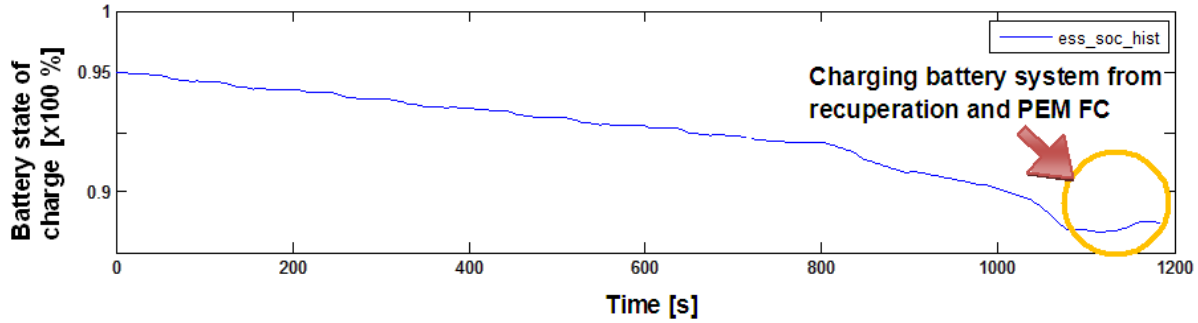

Fig. 9 State of charge (SOC) of the battery system

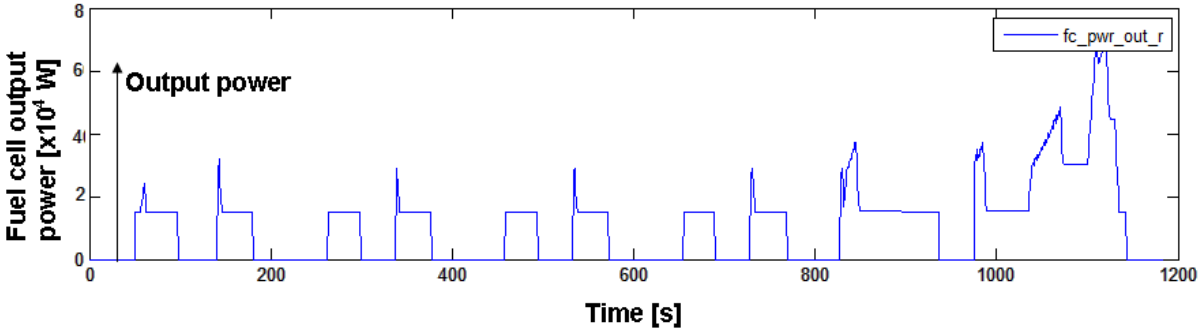

Fig. 10 Fuel cell energy system characteristics during dynamics load in drive cycle

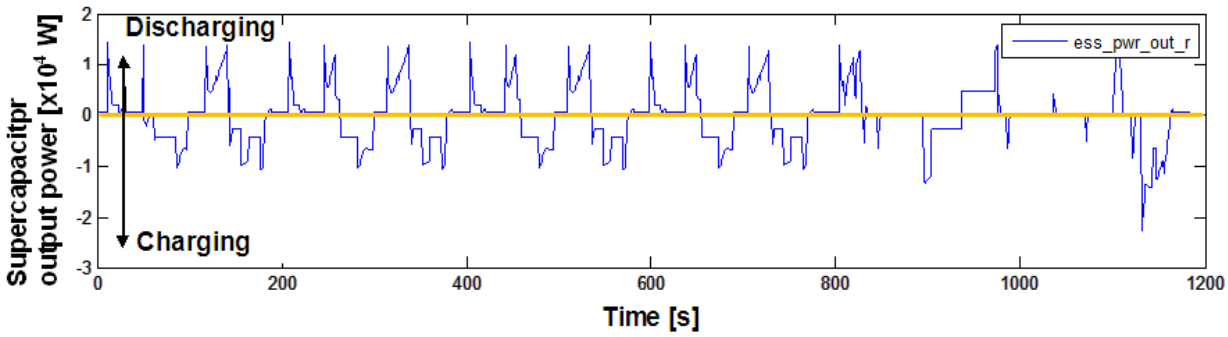

Fig.11 Supercapacitor system energy characteristic during dynamics load in drive cycle

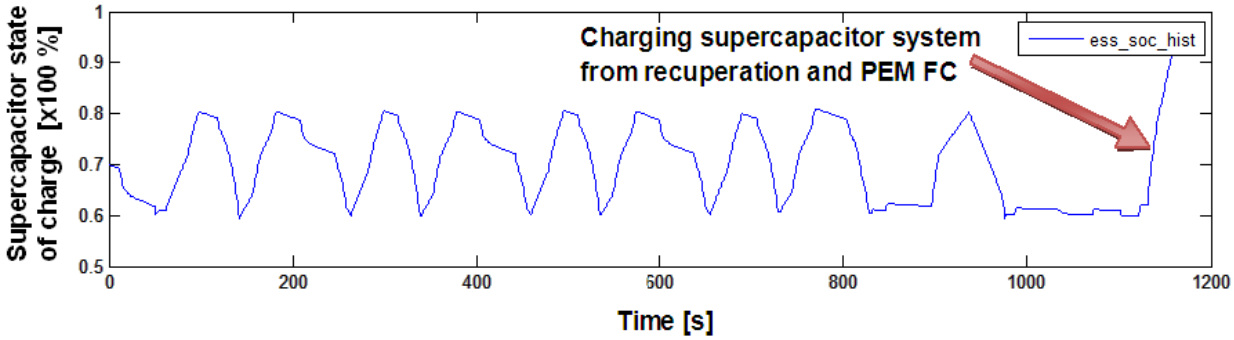

Fig. 12 State of charge (SOC) of the supercapacitor system

6 SIMULATION RESULTS OF PEM FUEL CELL SYSTEM WITH SUPERCAPACITOR SYSTEM

The model of UGV with supercapacitor system and with PEM fuel cell acts as the primary power source (Fig. 9).

The supercapacitor system is sized for peak power leveling to assist the PEM fuel cell system during high value of acceleration (Fig. 10). The supercapacitor systems are used to store energy from regenerative braking and they offer an opportunity to optimize the military vehicle efficiency (Fig. 11).

At the beginning of the each simulation supercapacitor system state of charge was set to 70 percent of the maximum capacity.

7 CONCLUSION

If fuel cell military vehicles go into production in the near future, their degree of hybridization and design of energy management strategy will significantly impact on the military vehicle operational time, combat deployment time, vehicle equipment costs of fuel cell system, battery system and supercapacitor system and vehicle weight.

Fuel cell stack can operate only if provided with pressurized air and hydrogen and flushed with coolant. Practical fuel cell systems require additional equipment to regulate the gas and fluid streams, provide lubrication, operate auxiliary equipment, manage the electrical output and control the process. Some systems include reformers for fuel processing. All of this equipment introduces losses and reduces the total efficiency of the system from its theoretical ideal.

In this work PEM fuel cell energy system is operating on pure hydrogen, an overall system efficiency breakdown at the output of the system is roughly 30 to 40 %. Batteries have electrochemical efficiencies comparable to fuel cells. Supercapacitor system has the highest value of efficiency and the maximum level acceptance of the electric energy from regenerative braking (Fig 12).

More difficult to quantify is the effect of overall system weight. Fuel cell systems including fuel storage are heavier than small internal combustion engine systems. Battery system as a means of power storage is heavier than fuel cells although this is offset somewhat by the elimination of other components.

Work presents energy management system algorithm of fuel cell vehicle model with battery storage system and supercapacitor system, which can predict the effect of sizing parameters on the system efficiency characteristics, overall efficiency of PEM fuel cell system.

Model and parameters of simulation is based on existing traction system of Unmanned Ground Vehicle.

Work mainly focused on basic principle of hybrid power source management modeling during

dynamic loads. The main part of the model is characterized by the creating the PEM fuel cell energy system as a primary and secondary energy source for vehicle traction system and reversible energy system. Energy system with optimization control management system was created and implemented into the UGV model in the software environment MATLAB/Simulink®.

In the end of the work are presented the results of simulations which can be summarized into these points:

- Model can be applied to loads the electric vehicles, mobile military applications and stationary military applications;
- In the model is implemented recuperation management system which can extend the operational range and operational time.

The combined optimization (maximal energy saving and maximum efficiency of energy use) results show that the optimality lies in:

- Increasing degree of hybridization with implementation of the regenerative braking;
- Design corresponding control strategy of hybrid energy system for special military applications;
- In the correct power rating of the energy system according to the weight and the use of the operational requirements.

Future of this work will create complete model of military vehicle with full hybrid electric energy system, which contains PEM fuel cell system, battery system and supercapacitor pack together.

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TESTING THE INFLUENCE OF ADDITIVE ENVIROX DURING OPERATION OF THE COMBUSTION ENGINE T 815

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Abstract: In diesel engines burning process produces a significant amount of undesirable substances, which together with the mist of lubricating oil produce carbon, which is deposited in the combustion chamber and exhaust tract. Usage of additive with CeO_2 nanoparticles added to the fuel allow better fuel combustion comprising hydrocarbons and consequently reduce fuel consumption and with support release of burnt deposits occur in the final effect gradually to eliminate them. The primary endpoint of 25 tests was the specific consumption of fuel with and without additive. Tests of engine Tatra were performed at speed 1400 min^{-1}, 1800 min^{-1} and 2200 min^{-1} with 40 %, 60 %, 80 % and 100 % loads of torque. Additive Envirox did not effect consumption of fuel. Measurement error determined by statistic analysis of fuel consumption as a percentage of the standard deviation ranged from 0.15 to 1.77 and exceeded only 1% at 1800 min^{-1} and 40% of the load and speed of 1400 min^{-1} (1.3 %), also at 40% load of torque. Measurement accuracy, defined as the combined standard uncertainty of the standard deviation and error of measuring instruments, less than 2 % was very good.

Keywords: Envirox, fuel, additives.

1 INTRODUCTION

Different types of additives are characterized by different characters. Complex additives are characterized by multifunctional properties. Additives are antioxidants, antistatic, bactericidal and bacteriostatic, deemulsifiers, depressant, detergents, lubricating, viscosity modifiers, anti-corrosion additives, anti-foam agents, additives increasing the cetane number and improving the fuel ignition properties. [1, 2]

We also use additives that affect smell of diesel, or additives for regeneration filters of particulates [3]. For most products intended for diesel engines are fuel savings expressed numerically only for EU products Envirox.

ENERGENICS Company from United Kingdom supplies Envirox, based on CeO_2 nanoparticles, which is used as an additive to diesel engines. Its research and development was carried out in laboratories in Oxford and was tested from 2002 to present. The test results are guarantee reduction of fuel consumption by 5-12 %, improving the combustion, less smoke in current processes, reducing unburned hydrocarbons, and better economy. It extends and improves the combustion mixture, carbonization reduces, engine exhaust gas temperature decreases [4].

In diesel engines burning produces a significant amount of undesirable substances, which together with the mist of lubricating oil produces carbon, which is deposited in the combustion chamber and exhaust tract. These deposits result in increased friction and cause undesirable changes in heat losses on the inner space of engine. The temperature of the piston head and combustion chamber walls is between 200 °C to 500 °C. But this is just the activation temperature range of carbon under the influence of CeO_2 nanoparticles. This leads to gradual oxidation and removal of deposits from the engine exhaust gases. CeO_2 nanoparticles added to the fuel thus allow better fuel combustion comprising hydrocarbons (which would consequently reduce fuel consumption) and the support of burnt deposits to eliminate them.

Envirox is a chemical preparation based on cerium oxide, which when added to fuel acts as a catalyst. Does combustion processes so that substantially reduces imperfect combustion, unburned fuel and particulate matters in exhaust gases. Dioxide CeO_2 allows almost complete combustion of hydrocarbons and soot. The decisive factor is the very low temperature at which catalytic reactions occur. In the first stage of combustion, ignition, allows low temperature catalytic combustion of fuel much better [5]. It turned out that the catalytic activity of CeO_2 is strongly dependent on particle size and specific surface area. The so-called oxygen vacancies are formed more easily on the surface of CeO_2, which explains that the material with higher specific surface area has a higher catalytic activity. This is a key factor that enables the combustion catalysis using nano cerium-based rival catalytic systems based on metals. High thermal stability of CeO_2 has resulted in the ability of nanoparticles Ce_2O_3 reoxidation, so these are active after ignition fuel, seen from eq. (1) – (4) [6].

$$(4x+2y)\ CeO_2 + C_xH_y = (2x+y)\ Ce_2O_3 + x\ CO_2 + y\ H_2O \quad (1)$$

$$4\ CeO_2 + C = 2\ Ce_2O_3 + CO_2 \quad (2)$$

$$CeO_2 + CO = Ce_2O_3 + CO_2 \quad (3)$$

CeO_2 catalyst regeneration runs according to the formula (4).

$$4\ Ce_2O_3 + O_2 = 2\ CeO_2 \quad (4)$$

2 METHODOLOGY

The research, which results are presented in the article, included the impact of diesel fuel (NM-54) and diesel fuel with additive (EnviNM54) under different engine speed and engine load. The aim of the tests was to verify the expected reduction in fuel

consumption when using diesel fuel with an additive Envirox.

2.1 Material

The subject of the test fuel, diesel oil NM-54 with additive Envirox product in a ratio of 1 part by volume Envirox to 4000 parts by volume of diesel.

Tests were carried out on the engine Tatra T3-930-31 production year with the 1990th. The engine is direct-injection four-stroke, air-cooled. Stroke volume of 19,000 cubic centimetres, bore/stroke 120/140 mm, OHV, compression ratio of 1:16. The engine has 12 cylinders in two separate rows at an angle of 90°. Rated power 235 kW at is 10% by speed 2200 min^{-1} ISO, maximum torque of 1130 Nm at 1400 min^{-1} ±200 min^{-1}. Vehicle with this engine after overhaul travelled 33,493 kilometres. Tatra test was performed on a test bench hydraulic brakes HORIBA DT900-1.

2.2 Method

The test consisted of a sub-tests on the selected engine and in specialized centres.

Monitored factors [7]

- The main engine parameters (power, torque, specific fuel consumption, etc.).
- Properties and Envirox additive by additive in its fuel use.
- Engine emissions (gaseous pollutants and particulate matter).
- Status of oil filling.
- Storage of fuel and additives EnviNM54.

Tests contained engine test bench and special tests. Tests consisted from three parts of the different types of fuel in the sequence NM-54, EnviNM54, NM-54 and comprised four-hour stress cycles (Test 4Mh). Special tests include the analysis of oil samples collected from the engine during testing, analysis and assessment of samples Envirox additive, fuel additive fuel NM54 and NM54, estimation of emissions in the exhaust gases and fuel storability evaluation EnviNM54 purchased and additives.

Test Tatra engine included [8]

- Tests on the engine located on the bench, laboratory analysis of oil samples collected from the engine to brake during the test.
- Measurement of emissions in the exhaust gases to the engine and brake at the specified modes.

The influence of additives was assessed by comparing the Envirox values of the parameters characterizing the engine to operate, especially values, the state of its parts (carbon on the walls of the combustion chamber and exhaust) and carbon emissions in the exhaust gases before and after the application of additives Envirox. Test had long-term in nature and represented a total of 25 tests. Engine when it worked approximately 100 hours (5 tests, 20 Mh, 17 tests, 68 Mh, 3 exams, 12 Mh). Engine operating modes were selected in order suited to the operation of vehicle engines, which is characterized by activity in a wide range of speeds and loads. To assess the influence of additive Envirox used on the engine is implemented reduced specific fuel consumption referred mpred. This parameter describes the comprehensive quality of the engine. Reduced specific fuel consumption is defined in equation (5).

$$m_{pred} = \frac{G_h}{P_{red}} \cdot 1000 \quad [g.kW^{-1}.h^{-1}] \qquad (5)$$

G_h [$kg.h^{-1}$] hourly fuel consumption.

P_{red} power reduction at standard atmospheric conditions.

Tests were divided into three parts. First group No. 1 to 5 test fuel NM-54, (5 trials, 20 Mh); Second test group No. 6 to 22 fuel Envi NM-54, (17 tests, 68 Mh); Third group tests No. 23 to 25 NM-54 fuel (3 tests, 12 Mh). Oil samples taken at the end of the test 4Mh. Emissions measured only in the designated green tests 4Mh. In each test, samples were taken from engine oil, which were analyzed by tribological method in military research laboratory. [9, 10]

3 TEST RESULTS

Research methodology is described more broadly in order to familiarize the reader with the whole range of defence research project. For this purpose there is a bibliography of subjects examined at the end of the article. The aim of the tests was to verify the expected reduction in fuel consumption when using diesel fuel with an additive Envirox. [15]

3.1 The measurement of reduced specific fuel consumption

When measuring on the brake 23 variables were registered. Measurements were performed at engine speed 1400, 1600, 1800, 2000, 2200 min^{-1} and expressed it with loads of torque to 100, 80, 60 and 40 %. Load of 100 % corresponds to the maximum torque at every speed. Basic information about the parameter reduced specific fuel consumption (m_{pred}) during the tests are shown in graphical form in Figures 1a, 1b and 1c, i.e. at engine speeds 1400, 1800 and 2200 min^{-1}. The figures show that the specific fuel consumption, regardless of whether it

is with additive, is constant and its amount depends on the engine load at the given engine speed. Suitable tool for the assessment of the engine at partial loads is the load characteristics. It is a graphical presentation of the monitored parameter dependence, in the battery of tests, specific fuel consumption, on engine load. In absolute values, it can be express either performance ratio (the maximum output performance) or as the ratio of mean effective pressure on the pistons or the ratio of torque. In tests is used expression ratio torque when torque value is directly measured on the brake. The load is expressed as the ratio of torque at an engine speed with the designation Zat_M, where the subscript M indicates that it is the expression of the torques ratio. [11, 15]

Tatra engine load characteristics during the transition from NM-54 fuel to fuel Envi NM-54 was carried out in the 6th test after 20 Mh engine performance. There was little change of reduced specific fuel consumption due to changing the fuel in the tests. Transition to fuel Envi NM-54 is also shown in Figure 2. The shape of the curves of load characteristics are quite typical. Differences between the curves for fuel NM-54 and fuel NM Envi-54, however, are negligible. During the transition to fuel NM-54, after 68 Mh engine with fuel Envi NM-54, it is the test of 23rd and following, virtually no significant changes in values happened.

Through the load characteristics are compared values before and after the change of fuel that are shown in Figure 3. In comparison with the previous figures in fuel consumption after switching to diesel at all loads at speed 1400 min^{-1}. The largest increase (2.1%) is at 40 % load.

In the Table 1 is presented statistic analyzes of reduced specific fuel consumption. Designation is used as following: For example number 60/14 means the load torque 60 % and 14 hundreds of engine speed in min^{-1}, arithmetic mean [$g.kW^{-1}.h^{-1}$] of the range of tests, e.g. tests 1 to 5. The standard deviation [$g.kW^{-1}.h^{-1}$] from mean (function in software Excel) and the relative standard deviation [%] from the mean. In this table are shown for clarity only selected values of speeds and loads, characterizing the most common modes of operation of vehicle engines. Accuracy of measurements was assessed by statistical analysis. Its value exceeds 1 % only in two cases. At 1800 min^{-1} (1.77 %) with 40 % load, and speed of 1400 min^{-1} (1.3 %), also with 40 % load. It is therefore concluded that the accuracy was quite good. [12, 13]

3.2 The measurement uncertainty

Uncertainty of measurement consists mainly of statistical uncertainty of type A, which equals the standard deviation described above in %. These values were obtained by standard statistical method for normal distribution. They are also marked u_A. Besides the uncertainty of type A uncertainty also includes the uncertainty of type B, which takes into account the non-statistical uncertainty. In this case, the uncertainty of type B uncertainties is determined as the sum of three measuring devices used for determining the value of specific fuel consumption, i.e. speedometer an error ± 0.025%, torque an error ± 0.2% and the fuel flow meter an error ± 0.01%. Calculated uncertainty of type B, ie. u_B = 0.20180436% was rounded to two decimal places for value u_B = ± 0.20%. In our case, the largest uncertainty of type A is equal to ± 1.77 % see Table 1 at a load of 40% at 1800 min^{-1}. The uncertainty of type B is defined above ± 0.20%. The largest combined standard uncertainty is then given to this mode, the geometric sum at equation (6).

$$u_C = \sqrt{u_A^2 + u_B^2} = \sqrt{1.77^2 + 0.2^2} = 1.78\ \% \quad (6)$$

The uncertainty of measurements for the Tatra had shown that only in two cases the combined measurement of uncertainty is unfavourable. In the vast majority of cases (modes of the engine) is smaller than ± 1%. Even if we consider the expanded standard uncertainty would be in most cases less than ± 2%. It is quite common, acceptable value. [14]

4 CONCLUSION

Reduced specific fuel consumption during Tatra operations was not different from the standard engine diesel NM-54 consumptiom in comparison with the engine when it was running with fuel NM-54 improved additive Envirox. The tested largest uncertainty of the measurements on the engine Tatra reached no more than 1.78 %. It is therefore concluded that the uncertainty of the measurements was acceptable because standard uncertainty was ± 2 %. Based on engine analyzes can be stated that the product Envirox fuel consumption, technical condition of the engine and its serviceability did not affect in any direction.

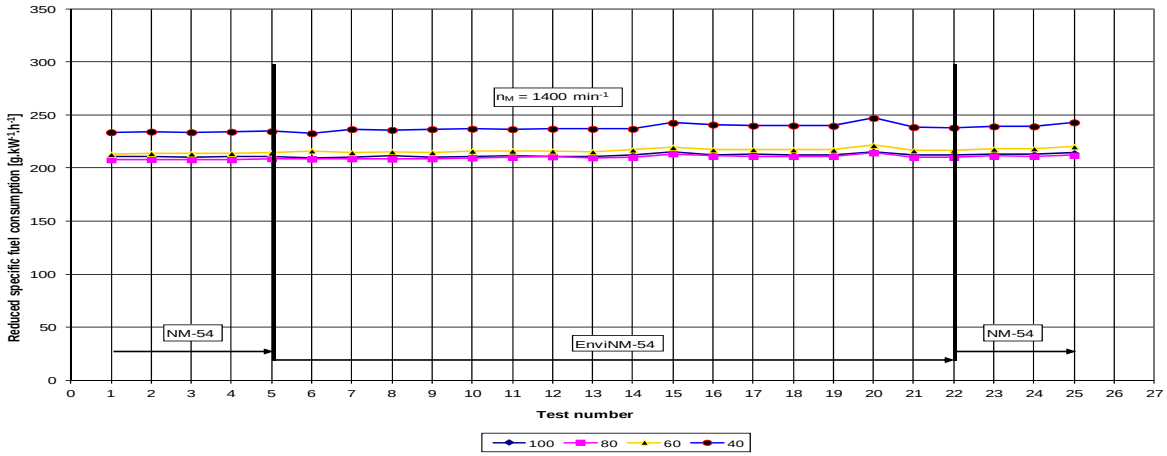

Fig. 1a Reduced specific fuel consumption (m_{pred}) at engine speed 1400 min^{-1} in tests by load in %

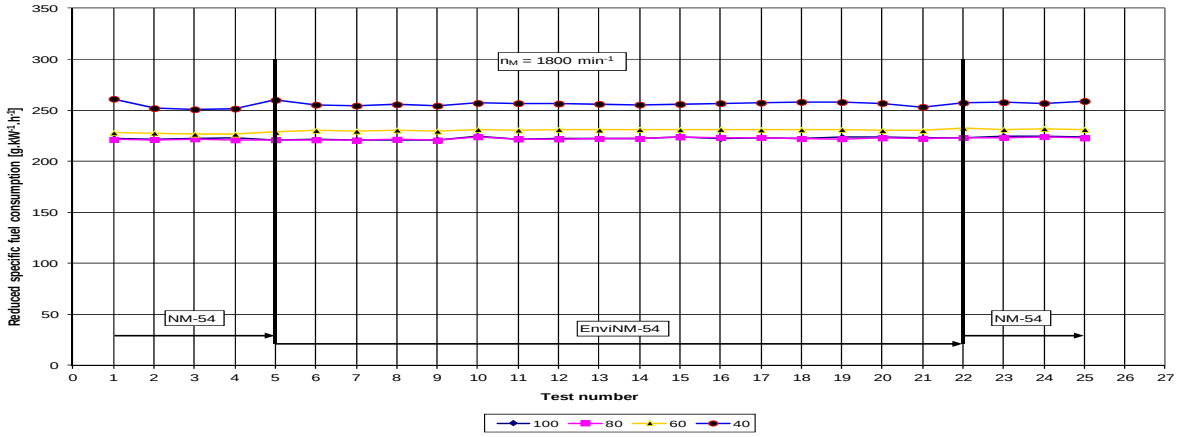

Fig. 1b Reduced specific fuel consumption (m_{pred}) at engine speed 1800 min^{-1} in tests by load in %

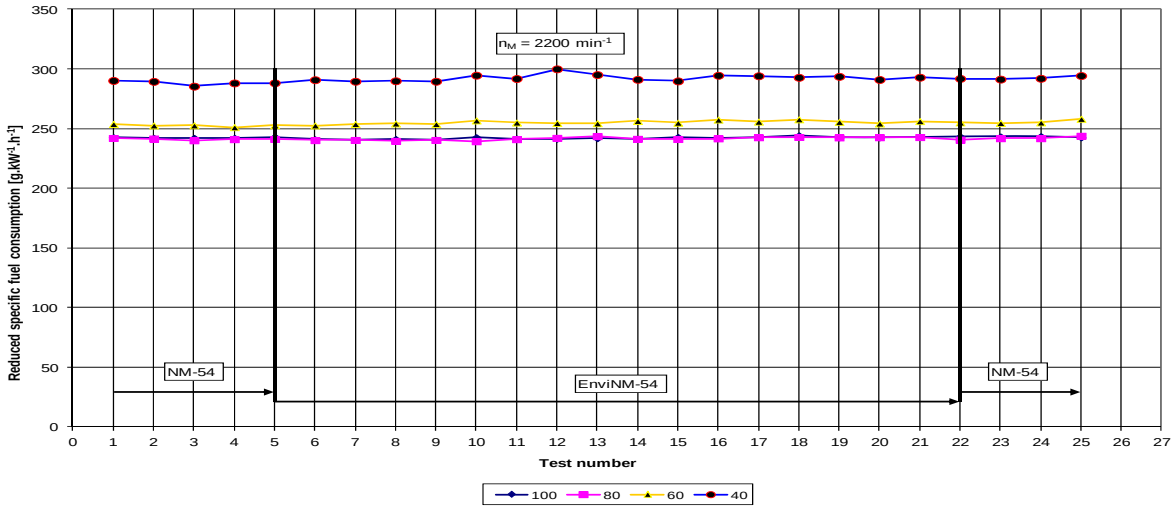

Fig. 1c Reduced specific fuel consumption (m_{pred}) at engine speed 2200 min^{-1} in tests by load in %

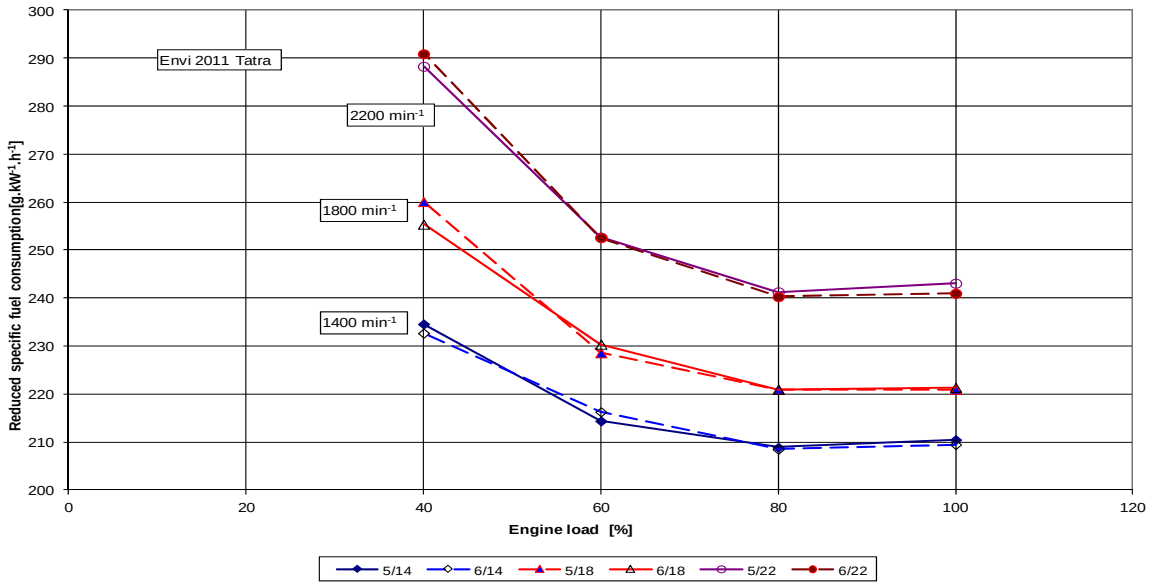

Fig. 2 Engine load characteristics during the transition of diesel – test No. 5 - to fuel with additive - test No. 6

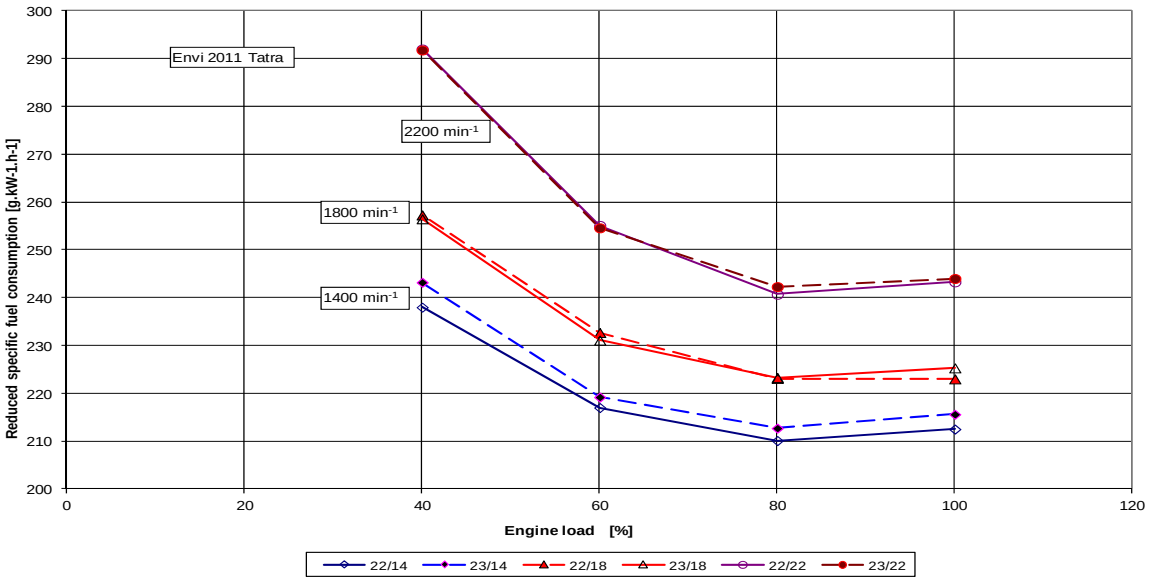

Fig. 3 Engine load characteristics during the transition of fuel with additive - test No. 22 to diesel - test No. 23

Table 1 Statistic analyzes of reduced specific fuel consumption m_{pred} during tests [$g.kW^{-1}.h^{-1}$]

Test No.	Load/speed	60/1400	40/1400	60/1800	40/1800	60/2200	40/2200
1-5	mean	213.74	234.10	227.52	255.16	252.58	288.36
	SD	0.47	0.35	0.80	4.51	0.86	1.63
	SD %	0.22	0.15	0.35	1.77	0.34	0.56
6-22	mean	216.83	238.41	230.84	256.27	255.21	292.62
	SD	1.63	3.10	0.72	1.28	1.35	2.59
	SD %	0.75	1.30	0.31	0.50	0.53	0.88
23-25	mean	218.80	240.47	231.50	257.93	256.00	292.63
	SD	1.00	1.79	0.36	0.82	1.56	1.28
	SD %	0.46	0.74	0.15	0.32	0.61	0.44

SD - Standard deviation

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THE MEDITERRANEAN

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Abstract: The author of the article deals with the Mediterranean region, which is one of the important geopolitical and geostrategic pivots in the world. The article gives a detailed description of the borders and characteristics of the Mediterranean region. In the second part of the article the renewed geopolitical and geostrategic importance of the area is depicted. The third part evaluates NATO's Mediterranean region related initiatives.
A more efficient and flexible partnership policy was adopted in April 2011. The Individual Partnership and Cooperation Programme will replace the Individual Cooperation Programme (ICP) extended to Mediterranean Dialogue and Istanbul Cooperation Initiative partners.
Stability in the Euro-Atlantic region is closely linked to the security of the Mediterranean area, therefore knowing and understanding the region is of extreme importance.

Keywords: Mediterranean Dialogue, Istanbul Cooperation Initiative, Strategic Concept, Berlin Partnership Package, Individual Partnership and Cooperation Programme.

1 INTRODUCTION

The unbelievably varied and coloured Mediterranean region encompasses thousands of divergences. It has always been a crossroad of peoples and civilizations (the Egyptian, the Greek, the Roman and the Arabic) and can be considered the cradle of religions (Christianity, Islam, Judaism) which is also indicated by its ancient name: Mare Nostrum. Situated at the intersection of three continents it provides economic, cultural and political connection to the European, Western-Asiatic and North African people.

In the light of the above the Mediterranean doesn't lend itself to an all-coherent, all-encompassing definition. The French historian Fernand Braudel described it as follows: *"A thousand things together. It is not one landscape but numerous landscapes, it is not one sea but a complex of seas, it is not one civilization but a number of civilizations piled one above the other"*.

In geostrategic respect it is a very important region, which is extraordinarily wealthy in natural resources (crude oil, natural gas, phosphate), but characterized by terrible lack of drinking water.

2 BORDERS AND CHARACTERISTICS OF THE MEDITERRANEAN REGION

In scientific literature the Mediterranean region is referred to by several different names for example East and West-Mediterranean; European Mediterranean; the Latin, the Greek, the Arabic Mediterranean, the Maghreb and Mashrek, the Middle East, Moyen Orient etc. This variety of terms can be explained by palpable intertwining, sometimes overlapping national interests, security perceptions, and intersecting field categories.

The Mediterranean Sea is bordered by Europe in the north, by Asia Minor in the east, and by Africa in the south. It is connected by he Straits of Gibraltar to the Atlantic Ocean by the Dardanelles to the Black-Sea, by the Bosporus to the Marble-Sea and by the Suez Canal to the Red-Sea. On the Northern and Southern littorals - "sea between the continents" - 21 countries can be found[1].

The general characteristics of the region can be spotted at the neighboring territories of the Mediterranean like the territories of the United Kingdom Cypriot Akrotiri and Dhekelia, as well as Gibraltar; two autonomous cities Ceuta and Melilla under the Spanish authority; and the Palestinian territories. Taking into account the climate, the flora and fauna, as well as the common cultural grass-roots, Jordan, Andorra, Portugal, San Marino, Vatican, Serbia and Bulgaria are seen – in spite of the fact that those countries have no border with it – as part of the wider Mediterranean region.

Several researchers identify the Mediterranean region by its climate, its characteristic vegetation citrus, vine, and the symbolic significance of the olive-tree (Olea Europaea) is seen as an identifying factor.

Pap Norbert in his book *Political Geography of South Europe*, outlines in detail political configuration of the Mediterranean countries. According to their genesis he grouped the countries of this region into four categories: the middle-age mini or relict states (Andorra, San Marino, Vatican); the former British colonies (Malta, Cyprus); the recuperating nation states (Greece, Italy); and the former great colonial powers (Spain, Portugal)[2].

[1] The Worldatlas.com also acknowledges bordering countries as part of the Mediterranean. The difference is that it does not reel Malta off, because following this logic all islands of the Mediterranean could also be mentioned.

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The Mashriq (or Mashrek) is the region of Arabic-speaking countries to the east of Egypt and north of the Arabian Peninsula. It is derived from the Arabic word meaning "east" or "place of sunrise". It refers to a large area in the Middle East situated between the Mediterranean Sea and Iran.

The Maghreb also rendered Maghrib meaning “place of sunset” or western in Arabic, embraces the North African countries: Morocco, Algeria, Tunisia, Libya, Mauritania and Western-Sahara.

Some historians also included Spain, Portugal, Sicily and Malta in the definition, especially during the periods of Arab and Muslim domination. Partially isolated from the rest of the continent by the Atlas Mountains and the Sahara, the Maghreb has long been closely tied in terms of climate, landforms, population, economy, and history to the Mediterranean basin. The region was united as a single political entity only during the first years of Arab rule (early 8th century), and again for several decades under the Almohad dynasty (1159–1229). In 1989 to promote cooperation and economic integration the Arab states of North Africa established the Arab Maghreb Union. Egypt occupies an ambiguous position. While it has cultural, ethnic and linguistic ties to both the Mashriq and the Maghreb, it is unique and different from both. Thus, it is usually seen as being part of neither.

The many century-old human activity (pasturage, deforestation, urbanization) caused unbelievable shrinking of the vegetation[3], but the environmental risk of the region increased substantially in the last few years due to oil extraction, oil supplier routes, the large-scale increase of population, and mass tourism.

Recognition of the looming environmental crisis has produced an increased political will to tackle environmental problems and to ensure economic and social stability and sustainability. The main goal of the Convention for the Protection of the Mediterranean Sea Against Pollution signed in 1976 in Barcelona is to take all appropriate measures to prevent, abate, and combat pollution and emergency situations; to establish - in close co-operation with the international bodies programs at the bilateral or multilateral levels - pollution monitoring of the Mediterranean Sea; and to undertake cooperation in the fields of science and technology[4].

The traditional Mediterranean landscape became chaotic as a result of human intervention and the outcome of urbanization. 380 million people live on the Northern and Southern Mediterranean coastal area. According to the estimates the population will increase to 420 million by 2025, and to 470 million by 2050. The most important characteristics of the countries of the Northern and Southern rim of the region can be seen in Table 1.

What is geopolitics? There has been a great variety of definitions and concepts developed; two of them allow a better understanding of the geopolitical importance of the Mediterranean region. 1. Geopolitics is the theory of political processes. It traditionally indicates the links between political power and geographic space. In the field of international relations geopolitics is the knowledge of balances and tensions; strategic questions of the political, military, economic and diplomatic problems, bearing in mind the new system, which encompasses security political paradigm, in relationship with the emerging factors that cause instability or asymmetric threats and methods.

Before the geographical discoveries the Mediterranean Sea was an important geopolitical and geostrategic pivot, but then its importance decreased, and the focus was gradually transferred to the Atlantic Ocean.

After the geographical discoveries Zbigniew Brzezinski in his Grand Chessboard differentiates geopolitical actors and geopolitical pivots[5], which is decisive in the evaluation of the Mediterranean region. The geopolitical actors are the states active in the international arena, aiming to expand their power and influence, to control the resources, while the pivots are the geopolitically important key areas.

The geopolitical pivots, regions or states whose location is important and their control provides a geopolitical player quick and easy access to vital strategic resources while it denies competitors the access to these strategic resources.

It was only about 500 years ago, that the center of world trade shifted from the Mediterranean Sea to the Atlantic Ocean. Most of the great powers of the ancient times (Egypt, Persia, Macedonia, Greek world, Rome, Cartage, the Byzantine Empire) and the Middle Ages (the Italian republics of Venice and

[3] BORSY, Z.: *Általános természetföldrajz.* Nemzeti Tankönyvkiadó, Budapest, 1993. p. 764-767.

[6] The United Nations Environment Programme has estimated that 650 million tons of sewage, 129,000 tons of mineral oil, 60,000 tons of mercury, 3,800 tons of lead and 36,000 tons of phosphates are dumped into the Mediterranean each year. 70 per cent of the wastewater dumped into the Mediterranean is untreated. See Pollution in the Mediterranean Sea. In http://www.explorecrete.com/nature/mediterranean.html, (viewed September 8, 2012).

[4] Barcelona Convention. Convention for the Protection of the Mediterranean Sea Against Pollution, 1976. Available at: <http://www.unep.ch/regionalseas/regions med/t_barcel.htm> (viewed September 8, 2012)

[5] BRZEZINSZKI, Z.: *A nagy sakktábla.* Európa Könyvkiadó, Budapest, 1999, p. 314.; Brzezinski Zbigniew: The Grand Chessboard: American Primacy and Its Geostrategic Imperatives, Basic Books. 1998. p. xiii. ISBN 0-465-02726-1.

Genoa, the Ottoman Empire) were concentrated on the shores of this geopolitical pivot.

The formation of sea power and maritime domination in the region is also important. The maritime power is the state itself/alliance that achieve a state of domination. According to Admiral Gorskhov the essence of the sea power of the state is the possibility of the most efficient use of World Ocean or in other words the hydrosphere.[6] The elements of the sea power are the naval strategy and the navy.

The maritime domination over the seas and oceans means power status. According to Edward Wegener the maintenance of sea transport and the prevention of hostile maritime activities constitutes the exercise of "sea control".[7]

The Atlas of the geopolitical types of Max Georg Schmidt and Hermann Hack distinguishes different geopolitical forms and tools of the sea power: access to the sea, artificial occlusion from the sea, efforts to reach the opposite shore, encapsulation of the sea basin (Roman Empire, Ottoman Empire), the straits (Bosporus, Gibraltar, Bab-el Mandeb), maritime geopolitical power lines intersection (Mediterranean Sea), occlusion of the straits.[8]

Florin Diaconu in his work highlights the renewed geopolitical and geostrategic role of the Mediterranean sea,[9] and emphasizes that the structure of international relations was shaped by major naval wars, or by wars, in which naval operations played an important role. Throughout history major wars and major changes, in which political power was shared, were closely dependent. Major military conflicts in the Mediterranean region, on the shores or on the waters of the Mediterranean Sea made great powers involved in the conflicts and status even stronger or helped some medium-sized powers reach great power status. As in any other region, sea or ocean of the world the main goal was to eliminate all competitors, threats and risks, and to attain entire control of the sea trade and the extension of political influence.

From 495 B.C. (Lade battle) until the end of the 16th century when the British fleet defeated the mighty Spanish Armada major sea battles that influenced the history of mankind took place in the Mediterranean Sea.[10]

The political and military distribution of the power in the Mediterranean region had great influence on other regions of the world as well. Athenian Navy by means of diplomacy, direct political and military pressure made the city-states located on the shore of the Black Sea obedient taxpayers. Later on the Roman imperial expansion (Britannia, Pannonia, Asia Minor, Asia Maior etc.), the trans-regional hegemonic status of Rome became possible only after the complete defeat of Carthage.[11]

The failure of the Crusades, the unsuccessful attempts to open the trade route between Europe and Far East played important role in this - at least in the initial period. Therefore the Europeans decided to search and open new alternative routes. Over the next centuries, amazing geographical discoveries were made; the Americas and almost the entire Africa were annexed by the European great powers. The main geopolitical pivot gradually shifted to the Atlantic Ocean connecting Europe and the New World.

3 RENEWED GEOPOLITICAL AND GEOSTRATEGIC IMPORTANCE OF THE MEDITERRANEAN AREA

At the beginning of the Cold War the geostrategic importance of the Mediterranean grew again. For the first fifty years of its existence, NATO concentrated its attention mostly on the East, because the main threat was perceived as coming from the East. North Africa and the Mediterranean have always been of secondary concern to NATO, and never considered as a likely front of conflict. With the end of the Cold War NATO started paying more attention to its southern periphery.

Political and military efforts of the United States and its allies in the region were directed to prevent the Soviet Union from gaining ground in the Mediterranean and the Middle East, and to secure straits, transport routes and the lines of communications.

Both superpowers' purpose was acquisition of raw materials, military bases, control of sea and land transport routes. This made the Mediterranean Sea basin strategically important for both superpowers; they mutually sought to reduce the other's sphere of influence.[12]

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[6] GORSKOV, S. G.: *Az állam tengeri hatalma, Zrínyi Katonai Kiad.,* 1983. p. 16.; Sergei Georgyevich Gorshkov: The Sea Power of the State, 1979. Annapolis, Naval Institute Press, 284 pp.

[7] WEGENER, E.: Die Elemente von Seemacht und maritimer Macht In *Mahncke.* Dieter – Schwarz, Hans-Peter (szerk.); Seemacht und Aussenpolitik (Alfred Metzner Verlag - GmbH, Frankfurt am Main, 1974.), p. 27.

[8] Max Georg Schmidt-Hermann HACK: Geopolitischer Typen-Atlas, zur einführung in die grundbegriffe der geopolitik, Justus Perthes in Gotha, 1929.

[9] DIACONU, F.: A renewed geopolitical and geostrategic role for the Mediterranean sea. In *Strategic Impact,* No. 3/2008. pp. 43-46.

[10] Ibid p. 44.

[11] Ibid p. 44.

[12] KECSKEMÉTHY, S. K.: *A mediterrán térség jelentősége a NATO számára*. Hadtudományi Szemle című on-line tudományos folyóirat 2008. 1. évfolyam 2. szám, p. 101-106.

Thus, conflicting aspirations, maritime geopolitical power lines crossed in the Mediterranean.

The strategic importance of the region is clearly indicated by the fact that only one year after NATO's foundation, the Southern Command was established, the 6th U.S. Fleet area of operation was in the Mediterranean Sea.[13]

In 1946, President Truman dispatched the battleship Missouri to the Eastern Mediterranean, to demonstrate U.S. power in view of Soviet threats to Turkey and Iran, and to prevent Soviet base construction plans in Turkey. The main task of the fleet was to monitor the Soviet Fleet's development, keep track of their movement on the world's oceans.

Three northern Mediterranean states were founding members of the Alliance (France, Italy and Portugal). The enlargement of the organization continued in the early fifties, in 1952 Greece and Turkey joined the Alliance. Clear objective was to secure the straits and to prevent the Soviet Union getting to the Mediterranean Sea. In 1982, Spain became a NATO member, and with this accession the northern Mediterranean coastal participation was completed. Slovenia joined the Alliance in 2004, Croatia and Albania in 2009 (a Mediterranean countries in a wider sense).

The US policy in 1947 provided financial, economic and military aid and strategic protection to Greece and Turkey because they were threatened by the Soviet Union. It was the start of the containment policy to stop Soviet expansion; it was a major step in beginning the Cold War.

According to the Truman doctrine the United States will not tolerate World War II status quo's violent change, by economic and military assistance will intervene in those countries where the threat of communism is spreading. On 12th March, 1947, Harry S. Truman, in his speech to Congress announced in details the principle of containment. He pledged American support for "free peoples who are resisting attempted subjugation by armed minorities or by outside pressures". President Truman requested that Congress provide $400,000,000 worth of aid to both the Greek and Turkish Governments. He also explained that he intended to send American military and economic advisers to countries whose political stability was threatened by communism.

Later in the beginning of 1960 the Mediterranean region became the scene of strategic superpower rivalry and open confrontation. The Soviet Union provided economic and military assistance to Syria and Egypt, the U.S.to Israel. The region was vital to both superpowers for major strategic offensive operation and strategic direction. In the post-Cold War era the transformation of the Middle East took place. The disintegration of the Soviet Union meant the loss of a great power ally for the socialist Arab countries.[14]

In these fifty years numerous international organizations launched initiatives related to the Mediterranean region. NATO's Mediterranean Dialogue, Istanbul Cooperation Initiative, the European Union's Euro-Mediterranean Partnership, 5+5 Dialogue, Barcelona Process, Mediterranean Forum, and the Union for the Mediterranean are excellent examples of these.[15]

The events in the spring of 2011 – the Arab spring – surprised the international community (government, security experts etc.).[16] The international organizations (European Union, OSCE, NATO) could not really come up with an applicable and acceptable alternative or solution.

4 THE MEDITERRANEAN AND THE NATO

At the end of 1994, NATO launched an initiative aimed at its southern neighbors and the term Mediterranean Dialogue (hereinafter MD) was coined. Six countries joined the Dialogue initially: Egypt, Israel, Mauritania, Morocco and Tunisia in February 1995, and Jordan, in November 1995. Algeria became a member in February 2000. The Mediterranean Dialogue's overall aim is to contribute to and promote regional security and stability by enhancing better mutual understanding between NATO and the Dialogue countries, as well as promoting regional security and stability.[17]

The Dialogue reflects NATO's view that security in Europe is tied to the security and stability in the Mediterranean. The guiding principles are as follows: gradual approach, mutual benefit, taking into account Mediterranean partners' expectations and interests.

The Mediterranean Dialogue was launched at the same time as the Partnership for Peace, but the two initiatives and their success cannot be compared. MD over the past fifteen years has not achieved

[13] GAZDIK, G.: *Az EU és a NATO szerepvállalása a Mediterráneumban.* Nemzet és biztonság, II. évfolyam, 7. szám 2010. augusztus p. 15-28.

[14] ERZSÉBET, N. R.: *Új világrend a Közel-Keleten?* Nemzet és biztonság, 2011. 2. szám. p. 2.

[15] KECSKEMÉTHY, S. K.: *A mediterrán térség és az Európai Unió.* Európai Tükör, 2010. május XV. évfolyam 5. szám p. 87-94. Siposné Kecskeméthy Klára: Mediterrán Párbeszéd a biztonság és az együttműködés erősítésében, Hadtudomány, 2004. 2. szám, p. 90-97.

[16] GAUB, F., GUPTILL, S., KAMP, K. H., RAZOUX, P., SCHWARZ, R.: *The Arab Explosion: Questions and Options for NATO.,* Research Report, NATO Defence College, Rome, 23 February 2011, p. 3.

[17] KECSKEMÉTHY, S. K.: Security and cooperation through education and research in the Mediterranean Area. In *AARMS,* Academic and Applied Research in Military Science, 2004. Issue 2, Volume 3. p. 295-304.

groundbreaking success in the regional stability and development. The real dialogue was missing, financial resources were insufficient, and the security perceptions were different. The Alliance is judged negatively in the region; the significant social and cultural differences, the Arab-Israeli conflict and the Middle East regional security issues, seriously strain relationships. NATO countries are not in agreement on the content, the main objectives and methods of the initiative.

Over the years MD has become more structured and new possibilities for practical co-operation, particularly in the military field, have been endorsed. Much of this cooperation is focused on defense and military issues, where NATO has particular experience and expertise. Priorities include military education and training, defense policy and strategy, and enhancing the ability of our forces to work together. But the practical cooperation also covers areas such as fight against terrorism, border security, air traffic management, and civil emergency planning.

Operation Active Endeavour (hereinafter OAE), was one of the measures taken by NATO to support the United States in the wake of the terrorist attacks of 11 September 2001, following the invocation of Article 5, NATO's collective defence clause, for the first time in the Alliance's history. Since October 2001 NATO ships have been patrolling the Mediterranean monitoring shipping and boarding any suspect ships.[18]

Initially the boats patrolled the Eastern Mediterranean. In March 2003, OAE was expanded to include providing escorts through the Straits of Gibraltar to non-military ships. After 4th March 2004, NATO extended its remit to the whole Mediterranean. In June 2004 at the Istanbul Summit meeting, Allied leaders decided to enhance Operation Active Endeavour, and made participation possible for Partnership for Peace, as well as for Mediterranean Dialogue partners in the operation. The mandate was extended to combat terrorism and the proliferation and smuggling of weapons of mass destruction.[19] This was the start of a new partnership policy: MD was elevated to a genuine partnership, based on mutual interest, benefit, joint ownership, transparency, self-differentiation and progressiveness.

The Istanbul Cooperation Initiative (hereinafter ICI) was launched in 2004 for the purpose of contributing to security and stability (democratization of societies and institutional systems, helping economic development) in the broader Middle East region from Mauritania to Afghanistan. There are four participating countries (Bahrain, Kuwait, Qatar, and United Arab Emirates). Specific areas of co-operation include tailored advice on defense reform, budgeting, planning and civil-military relations; military-to-military cooperation; fight against terrorism, the proliferation of WMD and their means of delivery, and co-operation in border security and civil emergency planning. Practical implementation draws on activities and mechanisms developed in the PfP framework and builds on experiences gained in MD.

The location of the Istanbul Summit made clear that NATO's security concerns, the centre of gravity had shifted towards the southeastern part of the European continent.

At the Riga Summit in 2006[20] the Alliance launched the NATO Training Cooperation Initiative to share its training expertise with MD and ICI partners from the broader region of the Middle East, to increase participation of representatives of the Mediterranean region in existing NATO training and education and subject specified modular courses and programs at different strategic and operational level schools (NATO Regional Cooperation Course at the NDC is an excellent example). NATO created a network system of expanding training capabilities; the Mediterranean Faculty was established in the NATO Defense College.[21]

At the Bucharest Summit the Alliance welcomed the progress made in the implementation activities of the NATO Training Cooperation Initiative, the conclusion of Individual Cooperation Programmes (ICP) with Egypt and Israel. The summit encouraged other Mediterranean Dialogue partners to develop their own ICP, and welcomed the implementation of the first ever Mediterranean Dialogue Trust Fund project to assist Jordan with the disposal of unexploded ordnance and ammunitions.[22]

[18] Since its initiation in October 2001, OAE forces have hailed over 100,000 ships, boarded more than 155 suspected ships and escorted nearly 500 merchant ships across the Strait of Gibraltar (See NATO's official website)

[19] Greece, Italy, Spain and Turkey, contribute directly to the operation with naval assets. Escort operations in the Straits of Gibraltar used to involve the use of fast patrol boats from Northern European Allies Denmark, Germany and Norway. Spain also provides additional assets in the Straits. Operation Active Endeavour relies heavily on the logistic support of Mediterranean NATO Allies. From 2004, Partner and non-NATO countries started offering their support. Exchanges of Letters have been signed between NATO and Israel, Morocco, Russia and Ukraine. For 2011Russia, Ukraine, Morocco and Israel have offered physical assets.

[20] Riga Summit Declaration Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Riga on 29 November 2006

[21] RADEMACHER, F.: The NATO Training Cooperation Initiative, In *NATO Review*, 2007. Issue 1. Partnerships: Old and New, p. 32-35.

[22] Bucharest Summit Declaration Issued by the Heads of State and Government participating in the meeting of

The new Strategic Concept (Active Engagement, Modern Defence) was adopted at the Lisbon Summit in 2010.[23] NATO's Strategic Concept identified the three essential core tasks and principles of the Alliance: collective defense, crisis management and collective security.

The „Partnerships" chapter of the document analyzes in detail a world-wide network of partner relationships with countries and organizations around the globe[24], where partnership makes a valued contribution to the success of NATO's fundamental tasks.

In the „Partnerships" chapter, fairly limited attention is devoted to the Mediterranean region and to two important initiatives - the Mediterranean Dialogue and the Istanbul Cooperation Initiative of this region.[25]

It was obvious that in the light of the new geopolitical power lines and the developments in the region the Alliance would review the regional strategy. NATO has to clearly formulate and revalue the interests and priorities related to the Mediterranean. The Mediterranean Dialogue and Istanbul Cooperation Initiative should be amended along these preferences and priorities, because these initiatives have to strengthen security and stability in the region.

In April 2011, NATO Foreign Ministers adopted a new partnership policy (Berlin Partnership Package) designed to facilitate more efficient and flexible partnership arrangements, which provides new tools for existing and potential partners, allow them to shape their relationship with NATO.[26]

The areas of dialogue and cooperation are as follows: defense reform, capability and capacity building, education and training, fight against terrorism, countering proliferation of weapons of mass destruction and their means of delivery, cyber-defence, energy and maritime security, including counter-piracy.

The existing partnership frameworks – PfP/EAPC, the Mediterranean Dialogue, and the Istanbul Cooperation Initiative – are further developed, while their specificity is preserved. The Individual Partnership and Cooperation Program will replace cooperation programs that had been unique to individual partnership frameworks, including the Individual Partnership Program (IPP), established for PfP/EAPC members; the Individual Cooperation Programme (ICP) extended to MD and ICI partners; and the Tailored Cooperation Packages (TCP's) made available to NATO's global partners. [27]

The Individual Partnership Action Plan (IPAP) and Planning and Review Process (PARP) will also be opened to partners beyond the PfP/EAPC, on a case by case basis and on decision of the North Atlantic Council.

Stability in Europe is fundamentally linked to the security of the Mediterranean area. States in the greater Mediterranean basin have significant effect on the energy security of Western Europe. The Straits of Gibraltar, the Dardanelles/ Bosporus Straits, and the Suez Canal are all critical transit points of strategic importance, both in terms of the energy security, and the general stability of maritime trade routes.

There is no system of regional security, economic integration or cooperation between the countries of the Southern and Eastern Mediterranean littorals. Nations of the region maintain only limited political dialogue with each other, mostly through international and regional fora. The region is characterized by a climate of political distrust and suspicion. Countries of the region perceive NATO as a military instrument of the West.[28] One of the most important goals is the elimination of misunderstandings, differences, century-old and new-fangled historical grievances between the Mediterranean countries. The main objective is to enhance regional security and stability.

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the North Atlantic Council in Bucharest on 3 April 2008

[23] Active Engagement, Modern Defence, Strategic Concept for the Defence and Security of the Members of the North Atlantic Treaty Organization, Adopted by Heads of State and Government, at the NATO Summit in Lisbon, 19-20 November 2010 p. 40.

[24] NATO has partnership relations on different levels, holds dialogue and cooperation with more than 40 countries and international organizations. It also looks for cooperation with other international and non-governmental organizations, global partners in order to promote security and stability of the region.

[25] See page 31. in Strategic Concept for the Defence and Security of the Members of the North Atlantic Treaty Organization Adopted by Heads of State and Government at the NATO Summit in Lisbon 19-20 November 2010, p. 40. In the Lisbon Summit Declaration only two paragraphs outline the above mentioned two initiatives of the Mediterranean region. See Lisbon Summit Declaration, Issued by the Heads of State and Government participating in the meeting of the North Atlantic Council in Lisbon, November 20. 2010. p. 13.

[26] Active engagement in cooperative security: a more efficient and flexible partnership policy, Berlin, April 15, 2011.http://www.nato.int/nato_static/ assets/ pdf/ pdf_2011_04/20110415_110415-Partnership-Policy. pdf (viewed October 23, 2012)

[27] R. MOORE, R. R.: Lisbon and the Evolution of NATO's New Partnership Policy. In Perceptions, Spring 2012. Volume XVII, Number 1, pp. 55-74. Available at: http://sam.gov.tr/wp-content/uploads/ 2012/02/ RebeccaMoore2.pdf (viewed June 19, 2012)

[28] FABER, P.: *The future role of NATO in the Mediterranean Basin.* NATO Defence College, 2003. p. 5

Table 1 Demographic data and estimates for the Mediterranean region (2012 World Population Data Sheet)

	Population mid-2012 (millions)	**Projected population mid-2025 (millions)**	**Projected population mid-2050 (millions)**
Southern Rim			
Algeria	37,4	42,0	46,5
Egypt	82,3	102,0	135,6
Libya	6,5	7,5	8,8
Morocco	32,6	36,9	41,4
Tunisia	10,8	12,1	13,7
Western Sahara	0,6	0,8	0,9
Southern Rim Total	170,2	201,3	246,9
Northern Rim			
Albania	2,8	2,9	2,6
Andorra	0,1	0,1	0,1
Bosnia-Herzegovina	3,8	3,7	3,0
Croatia	4,3	4,1	3,8
France	63,6	67,4	72,4
Greece	10,8	11,1	10,9
Italy	60,9	63,1	63,6
Kosovo	2,3	2,7	3,2
Macedonia	2,1	2,1	2,0
Malta	0,4	0,4	0,4
Monaco	0,04	0,04	0,04
Montenegro	0,6	0,7	0,7
Portugal	10,6	10,7	10,6
San Marino	0,03	0,04	0,04
Slovenia	2,1	2,2	2,1
Spain	46,2	47,3	47,9
Northern Rim Total	210,67	218,58	223,38
Total	**380,87**	**419,88**	**470,28**

Source: Available at: <http://www.prb.org/pdf12/2012-population-data-sheet_eng.pdf>

Numerous international organizations are operating together in the Mediterranean region: so overlaps in the different initiatives are inevitable. Keeping in mind the strategic, political and economic importance of the Mediterranean region, it is necessary to guarantee financial resource to the programs, and also to avoid its dissipation.

What is the key to the success in the Mediterranean? The expected security benefits of NATO initiatives should be indivisible; they should apply to the Mediterranean basin and the Euro-Atlantic area. International organizations (NATO[29] European Union) in the region must operate in close cooperation in order to achieve greater coherence and effectiveness. Any cooperation, program or proposal should reflect as closely as possible the expectations and pretensions of the Mediterranean partners.

One can only hope that initiatives promoting regional security, stability and cooperation in the Mediterranean will contribute to sustainable development as well as fruitful economic and cultural relations.

[29] The NATO created a network system of expanding training capabilities, the Mediterranean Faculty was established in the NATO Defence College (hereinafter NDC); the NATO Training Cooperation Initiative was launched at the Riga Summit; in order to increase participation of representatives of the Mediterranean region in existing NATO training and education and subject specified modular courses and programs at different strategic and operational level schools (NATO Regional Cooperation Course at the NDC is an excellent example). See Fritz Rademacher: The NATO Training Cooperation Initiative, In: NATO Review, 2007. Issue 1. Partnerships: Old and New, p. 32-35.

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MODELING OF LOGISTICS IN COMPUTER ASSISTED EXERCISES

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Abstract: A command post exercise, supported by computer simulation, is one of the primary training tools available to the Polish Armed Forces for training their commands and staffs on their joint mission essential tasks. The published article contains detailed information about modeling of logistics in computer assisted exercises. The Polish National Defence University (NDU) is the most important military university in Poland. The War Games and Simulation Centre (WG&SC) is an integral part of University which is one of the most modern in Europe. WG&SC is equipped with the Joint Theater Level Simulation (JTLS). JTLS is an interactive, computer-based, multi-sided war gaming system that includes land, sea, air, intelligence and logistics functions.
The article emphasizes that practical training is the most effective form for commands, staffs and troops to develop operation's scenarios or solve problems regarding the process of preparation for operations in time of war, crisis or peace.

Keywords: Computer assisted exercises, simulation system, modeling of logistics.

1 INTRODUCTION

Attainment of high level military commands and staff is possible thanks to training conducted in conditions and situations approximate to those which prevail on the battlefield. Exercises are the most suitable form of training ensuring "realism of battlefield"[1]. They allow verification of correctness and usefulness of doctrinal (operational-tactical) assumptions regarding rules and means of military operations in various conditions of battlefield. Exercises constitute one of the best way to evaluate efficiency of organizational structures of individual ranks of command, efficiency of leadership system, armament and protection of operations. They allow to assess the degree of achieved combat readiness and also to verify possibilities of the armies to execute in specific time and place planned operational tasks.

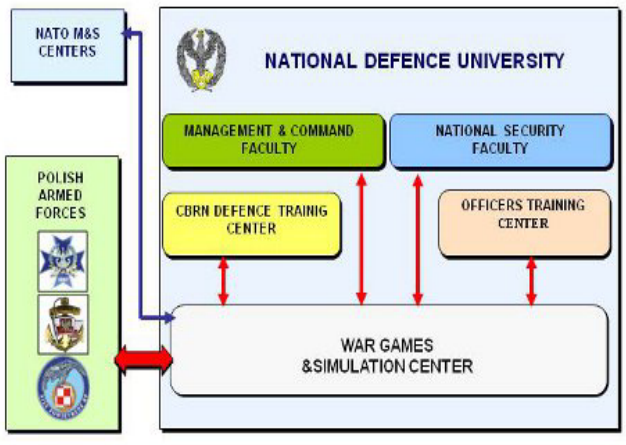

Fig. 1 Position of War Games and Simulation Centre in the system of Polish armed forces training[2]

The Polish War Games and Simulation Centre is the organizational unit of National Defence University. The WG&SC located in Warsaw, provides facilities and equipment needed to conduct computer assisted exercises (CAX). The overall goal of the Centre is to train the military leader and his staff on the level of brigade, division, and corps. Figure 1. shows position of WG&SC in the structure of National Defence University.

2 MODELING CAPABILITIES OF LOGISTICS IN JTLS SIMULATION SYSTEM

The Joint Theater Level Simulation is an interactive, multi-sided simulation that can model air, ground and naval combat, with Special Operation Forces (SOF), intelligence support and logistical[3].

JTLS system has implemented all basic logistics support tasks but some of them are modeled differently than in the Polish Army. In particular the non-compatibility some of logistical processes appears during tactical level CAX. We can observe differences between logistics support in JTLS and logistics support in the Polish Army. Differences exist especially between supply and field services. JTLS defines division on the ten classes of supply and the 272 miscellaneous category of supply.

[1] Available at: <http://csikgw.aon.edu.pl/>, [15.06.2012].
[2] Available at: <http://csikgw.aon.edu.pl/>, [15.06.2012].
[3] Joint Theater Level Simulation, *Analyst's Guide*, (JTLS Document 01, version 3.3.0.0), March 2008, page 2-1.

Conceptually National Logistics defines five classes of supply and various kind and group of supply.

The following logistics capabilities exist in JTLS[4]:

- movement of supplies by truck, barge, or rail;
- transportation of units by rail, barge, or truck convoy;
- use of trucks from one unit to pick up supplies from one or more other units, and deliver them to the other units or locations;
- mandatory transfer of supplies from one unit to another;
- automatic or player-directed resupply of units;
- creation of logistics loads for use in future orders;
- creation of supply caches for future use;
- operation of pipelines, including drawing supplies from the pipeline and replenishing supplies;
- capture of enemy supplies and recovery of own supplies;
- modification of stockage objectives and/or reorder thresholds of one or more supply categories for either a single unit, a group of units, or all units;
- change of the depot from which a unit orders its supplies or from which a pipeline is replenished;
- Airlift and Airdrop Operations (through the air module);
- Sealift Operations (through the naval module);
- evacuation of casualties (WIA) and evacuation of remains (KIA).

JTLS partially based on the Field Manual FM 4-0[5]. Combat Service Support (CSS) tasks are to personnel, arm, fuel, fix and move the force. These tasks are generally categorized into: logistics support, personnel service support and health services support. In JTLS all of the above tasks were placed into logistics operations which includes: supply, maintenance, medical support and personnel support.

3 LOGISTICS OPERATIONS IN JTLS

Supply

In the Polish Armed Forces supply and services consist of wide-ranging functions that extend from determining requirements at the strategic level to delivering items and services to the user at the tactical level. Supply involves acquiring, managing, receiving, storing, and issuing all classes of supply except class VIII (medical support). Field services involve feeding, clothing, and providing personnel services to soldiers. It consists of clothing exchange, laundry and shower support, textile repair, mortuary affairs, preparation for aerial delivery, food services, billeting, and sanitation.

Consumption supplies

In JTLS units do not consume supplies until they arrive in the game. Consumption may occur during routine activity, with additional usage while in combat or involved in combat-related activities such as moving or flying. Supplies such as ammunition or bombs are consumed only when used. In JTLS, all supply consumption falls within three categories:

- *As Used*: consumption occurs only if the asset is used, as with air weapons and ammunition.
- *Per Day*: routine unit consumption, affected only by length of time.
- *Per Person*: depends on the number of personnel in the unit over a length of time.

Supply Categories

JTLS can have an essentially unlimited number of supply categories, however, some of them are mandatory for certain game functions. The logistic directives are designed to permit modifications to the automatic requisitioning and delivery process. To fulfill the requirements of a Logistics Player, you must be familiar with the concept of the operation, including the logistics concept, as well as the parts of the database that affect or are affected by logistics considerations.

Transportation Support

Army transportation plays a key role in ensuring that Army execute global force projection and sustain forces in operations. Supporting the Army transportation is essential to effective and efficient force generation and sustainment. Army transportation operates as a partner to deploy, sustain, and redeploy forces in all military operations. Transportation provides vital support to the Army across the strategic, operational and tactical levels of war.

In JTLS the resources used to move supplies around the battlefield are modeled as entities called *Transportation Classes* (TC). *Transportation Classes* are described in terms of:

- the type of asset: truck, rail or barge;
- their capability to carry supplies;
- their vulnerability to air attack and ground detection and attack;

[4] Joint Theater Level Simulation, *Executive Overview*, (JTLS Document 08, version 3.4.5.0), September 2010, page 3-11.

[5] Field Manual No. 4-0, *Combat Service Support*, US Headquarters Department of the Army, Washington, DC, 29 August 2003.

- whether they may use, must use, or are prohibited from using Materiel Handling Equipment (MHE) in the process of loading and unloading;
- the amount of time it takes to load and to unload one asset if MHE is not used.

In JTLS transportation support is a part of logistics operations has implemented:

- implicit resupply;
- explicit resupply.

Because JTLS is designed to train higher-level staff, the lower logistics functions can be automated. Implicit resupply is based on an explicit convoy distance. If the distance from the support unit to the requesting unit is less than the *Explicit Convoy Distance*, supplies are shipped to the receiving unit implicitly — i.e. without explicitly modeling a convoy moving the supplies. However, the support unit must have the supplies on hand. Convoy load/unload times and travel time are considered but the supplies cannot be interdicted.

If the distance between the requisitioner and the supplier is greater than the *Explicit Convoy Distance*, then explicit convoy resupply occurs up to a maximum defined distance. The support unit automatically fills the order provided that:

- transportation assets (rail, barges, or trucks) are available;
- requested supply stocks are available.

Convoys are formed and sent to the requesting unit, observing load/unload times and travel times. Convoys are attritable—i.e. they can be interdicted though convoys do not venture into hexes that are occupied solely by enemy units. *Explicit Resupply* does not apply to airlifting supplies, which requires an order to be executed.

Maintenance

Maintenance is central to any mission operational success. Aviable maintenance system is agile and synchronized to the combat scheme of fire and maneuver. It anticipates force requirements. A commander who has 65 percent of his tanks operational may wisely delay an attack if he can realistically expect the repair process to have 90 percent ready within 24 hours. Alternatively, he can weight the battle by allocating replacement systems. Maintenance is a combat multiplier. When opposing forces have relative parity in numbers and quality of equipment, the force that combines skilful use of equipment with an effective maintenance system has a decided advantage.

JTLS system has implemented:

- modeling loss of combat systems (arms, military equipment);
- modeling of repair and maintenance in home units (reconstitution of combat systems);
- supply of arms, military equipment and repair parts.

The logistics module includes[6] a maintenance function that simulates the initial fail on issue rate, repair of systems damaged in combat, and their eventual return to operational status. Each combat system has several attributes in the database; one of these specifies a percentage of casualties that can be recovered from combat, and another specifies a percentage of those that will eventually return to their combat unit. This method is used to represent recovery and repair times of various combat systems.

Health service support

In the Polish Army health service support is a single, integrated system. It consists of all services performed, provided, or arranged to promote, improve, conserve, or restore the mental and physical well-being of personnel in the Army. This system encompasses the ten functional areas of medical treatment: area support, medical evacuation, medical regulating, hospitalization, preventive medicine, health service logistics, dental, veterinary, combat operational stress control services, and medical laboratory support.

JTLS system has implemented:

- modeling loss of personnel;
- modeling of medical treatment in own units;
- modeling medical evacuation KIA and WIA[7];
- medical materiel and equipment supply.

Personnel combat systems may have a number of systems that are in undergoing medical treatment[8]. The concept of evacuating personnel with long recovery times is represented in JTLS. Each faction has an WIA max. unit treatment attribute. Units that belong to the faction try to evacuate any casualties that will not be returned to duty before this time has elapsed. Personnel who are to be evacuated are transferred to the casualty. In addition to representing casualties to be evacuated, JTLS can represent personnel remains, i.e. KIAs. In JTLS, if both casualties and remains are to be evacuated, casualties have priority for transport.

[6] Joint Theater Level Simulation, *Executive Overview*, (JTLS Document 08, version 3.4.5.0), September 2010, page 3-12.

[7] KIA – Killed in Action, WIA – Wounded In Action.

[8] Joint Theater Level Simulation, *Analyst's Guide*, (JTLS Document 01, version 3.3.0.0), March 2008, page 6-74.

4 THE METHODS OF CONTROLLING LOGISTICS PROCESSES IN JTLS

Players interact with the simulation by sending orders to units over which they have command authority[9]. JTLS provides the commander of each Force Side with the ability to manage the allocation of command authority. The Player must interact with the model by monitoring the Information Management Tool, requesting reports, interpreting advisory messages, scheduling resupply airlifts, sending resupply to units in trouble or ones that do not have supporting units, changing stockage objectives and reorder levels, assigning new support units, or directing mandatory transfers of supplies.

JTLS models logistics play to suit the players ability to manage the many logistics functions. Logistics may be played more or less hands-off, or "unconstrained," for those factions which do not have sufficient log players or the inclination to manage the logistics flow. On the other hand, logistics in JTLS may be played in an entirely explicit or "constrained" mode, with all the attendant complexities of resupplying all units within the exercise scenario. Directed resupply requires that an order be input by a player.

In WG&SC, using JTLS during conducting CAX exercises, we apply both of the methods controlling logistics processes. Knowledge of the logistic concept is vital because tactical level logistics are not automatic. Logistics Players may enter orders to assess and change the way logistic support is accomplished. Menu Logistics Orders consist of four primary group: ***Supply Transfers***, ***Requisition Parameters***, ***Logistics Operations*** and ***Logistics Assets***. Figure 2 shows the *Logistics Orders*.

The orders are *Mandatory Transfer, Directed Resupply, Push, Change Support Unit, Alter Requisition Level, Cache Supplies, Alter Pipeline Operations, Assign Pipeline Support, Establish Port Priority, and Direct To New Port.*

The Mandatory Transfer order directs one unit of any type to give a list of supplies to another unit. A Player, normally the Logistics Player in an exercise, may send this order to direct any unit to give supplies to another unit and specify the list of supplies. For the order to be executed, the units must be within an input-specified distance (below 24 km). The giving unit fulfills the order to the fullest extent possible reducing itself to a destroyed status if necessary. Figure 3. shows the *Mandatory Transfer* order.

The Directed Resupply order is used to direct a support unit (airbase or FARP[10]) to ship a single load of supplies to one other unit or to direct a support unit to dispatch a truck convoy with or without supplies on a *Supply Run*. Figure 4. shows the *Directed Resupply* order.

Fig. 2 Menu Logistics Orders in the JTLS system

[9] Primary or shared authority.

[10] Forward Arming and Refueling Point.

Fig. 3 Menu Mandatory Transfer order in the JTLS system

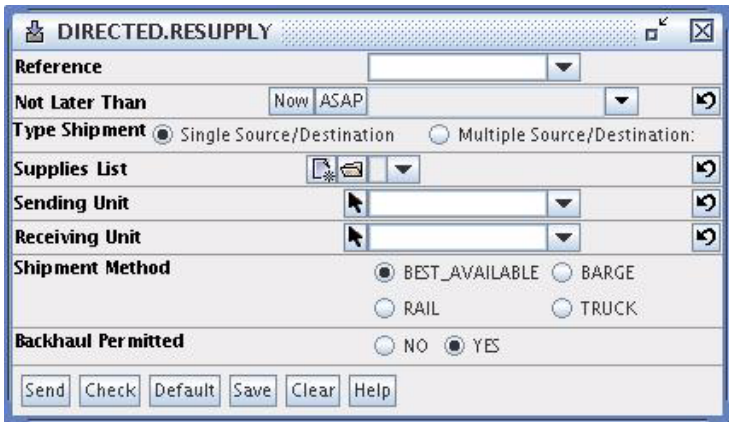

Fig. 4 Menu Directed Resupply order in the JTLS system

A Player can direct that a support unit (airbase or FARP) sends a periodic shipment of supplies to another unit. This creates an automatic *Push* requirement at the shipping unit. An automatic push requirement is the second highest priority requirement. The shipping unit will either ship the supplies or backorder them. The period may be any length of time. Figure 5 shows the *Push* order.

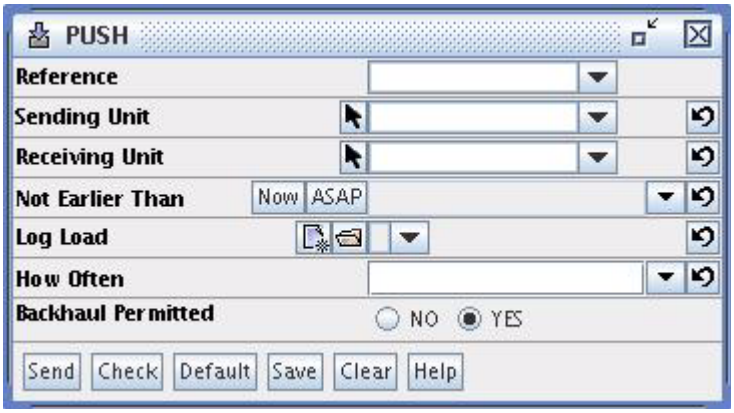

Fig. 5 Menu Push order in the JTLS system

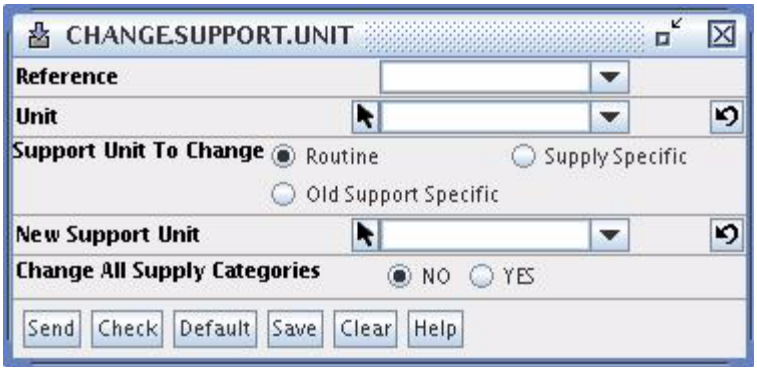

Fig. 6 Menu Change Support Unit order in the JTLS system

A Player can change a unit's routine support unit or any of its supply specific support units using the *CHANGE SUPPORT UNIT* directive. A unit will order all its resupply, except for those supplies specified explicitly by category, from the default support unit. The unit's routine (default) support unit or supply specific support unit might be changed for the following reasons[11] :

- To provide better support. For example, the new unit may have more of the supplies needed by the unit.
- To provide more responsive support. For example, the new support unit is closer to the unit than the unit's current support unit.
- To provide a support unit. For example, the unit may not have a current support unit defined.
- To remove a support unit. For example, the unit may have moved to a location that cannot be supported by the available theater support assets.

Figure 6 shows the Changes Support Unit order

The Controller can also greatly influence/the sustainment process by changing strategic resupply, adding trucks, changing unit data parameters concerning supplies on hand, changing convoy speeds, sizes, load/unload times, and specifying implicit/explicit convoy distances.

As noted elsewhere, a Player may have the ability to order units to perform actions. These units are called "orderable units". Generally, a Player must have authority over a unit to direct it to take any action. For example, to direct a unit to ship supplies to another unit, the Player must have authority over the shipping unit. The Player does not need authority over the receiving unit. Additionally, each *Force Side* has a "relationship" with each other *Force Side*. All relationships are initialized based on data input or a default.

[11] Joint Theater Level Simulation, *Player's Guide*, (JTLS Document 12, version 3.3.0.0), March 2008,page 5-2.

5 CONCLUSIONS

Practical training is the most effective form for commands and staffs to develop operation's scenarios or solve problems regarding the process of preparation for operations in time of war, crisis or peace. The Polish War Games and Simulation Centre provides facilities and equipment needed to conduct *Computer Assisted Exercises*.

All JTLS processes are doctrine-neutral for maximum flexibility. Model JTLS features detailed logistic modeling. The logistic directives are designed to permit modifications to the automatic requisitioning/delivery process.

References

[1] Field Manual No. 4-0, *Combat Service Support*, US Headquarters Department of the Army, Washington, DC, 29 August 2003.

[2] The *JTLS Analyst's Guide* (JTLS Document 01, Version 3.3.0.0), March 2008.

[3] The *JTLS Executive Overview* (JTLS Document 08, version 3.4.5.0), September 2010.

[4] *The JTLS Player's Guide*, (JTLS Document 12, version 3.3.0.0), March 2008.

[5] Available at: <http://csikgw.aon.edu.pl/>.

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