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CHALLENGES TO NATIONAL DEFENCE IN CONTEMPORARY GEOPOLITICAL SITUATION CNDCCGS-2020

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GENERAL JONAS ŽEMAITIS MILITARY ACADEMY OF LITHUANIA
MINISTRY OF DEFENCE OF REPUBLIC OF LITHUANIA
NATO ENERGY SECURITY CENTRE OF EXCELLENCE LITHUANIA
KAUNAS UNIVERSITY OF TECHNOLOGY
NATIONAL DEFENCE FOUNDATION
LITHUANIAN RIFLEMEN'S UNION



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CNDCGS` 2020

ABSTRACTS OF THE 2nd INTERNATIONAL SCIENTIFIC CONFERENCE
EDITED BY S. BEKESIENE AND S. HOSKOVA-MAYEROVA

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PREFACE

The second international conference *Challenges to National Defence in a Contemporary Geopolitical Situation* (CNDCGS-2020) held on 31 March - 2 April 2020 in Vilnius, Lithuania is organized by General Jonas Žemaitis Military Academy of Lithuania, Ministry of National Defence of the Republic of Lithuania, Kaunas University of Technology in cooperation with the NATO Energy Security Centre of Excellence, National Defence Foundation and the Lithuanian Riflemen's Union.

The conference invites practitioners and researchers to discuss important issues related to current and future challenges to European defence capabilities and to collect great innovative ideas for future development. Also, an important contribution is made to defence innovation. The conference aims to attract the attention of the Lithuanian society and increase the attention of the international political community and the U.S. and European decision-makers to the security of the Baltic region.

The aims of CNDCGS-2020 were to share the latest topical information on the issues of national defence in a contemporary geopolitical situation. The papers in the Abstracts presented the following areas:

- ◆ Defence Technologies and Aviation
- ◆ Cyber Threats and Security Issues
- ◆ Democracy, Contemporary Threats and Warfare
- ◆ Modern Technologies and Social Sciences
- ◆ Multi-Criteria Decision-Making
- ◆ Sustainable Defence Solutions
- ◆ The Impact of New Defence Technologies on Humans
- ◆ Defence Technologies: Education and Training
- ◆ Environmental Issues and Modern Technologies
- ◆ Challenges to Face New Defence Technologies

The invitations to the CNDCGS-2020 include the instructions on the preparation of reports, abstracts and manuscripts as well as the deadlines for the reports.

The primary goal of the conference is to present the highest quality research results. The key element in attiring the goal is the evaluation and selection procedure developed by the Conference Scientific Committee. All the works presented in the conference and published in the Abstracts undergo the mentioned procedure. The instruction for submitting the proposals, including requirements and deadlines, are published in the Publication Opportunities on: <https://www.cndcgs2020.org/guidelines/>

All the conference participants prepare their research results in an extended abstract format of 500-1000 words, including references, according to the requirements that make our Abstracts book a valuable recourse of new information which allows evaluating the investigations of scientists from different countries.

Prof. Dr. Svajonė Bekešienė

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Overcoming of Areas Covered by Snow with the Perspective Materials

Klara Cibulova^{a1}, Martin Priesner^b

^{a, b}University of Defence in Brno, Kounicova 65, 662 10 Brno, Czech Republic

Introduction. The support of mobility is one of the main tasks of engineer units. The mobility consists of different parts – mobility of low-endurable terrain, watercourses, forests etc. In this paper the authors focused only to one area – trafficability of areas covered by snow. The snowy terrain covered most of areas, not only in the Czech Republic, during the winter season. But the mobility must be ensured even in such conditions. In some cases, the vehicles mire in the snow layer and they have to be rescued. In the others, the convoy of vehicles stop before the untrafficable place and they have to overcome it. It is not always possible to bypass the place and the units have to negotiate this area. But the removal of snow is very time and human consuming. So it was decided to undergo testing materials suitable for these purposes. The aim of this work is to evaluate the using of perspective materials for self-rescuing works in snow as well as for the negotiation of untrafficable terrain due to the layer of snow. And all this makes it possible to improve the ability of negotiation obstacles such as snowy terrain and thus better mobility of the troops even in such conditions. [1,2]

Method of investigation. The authors decided to verify the possibilities of using perspective materials by experimental testing *in situ*. It was chosen two types of perspective material, different areas covered by snow and three types of vehicles. Two types of perspective materials were tested. The first one was the plastic mat (Light Trackway type) reinforced by metal rods. The length is 10 m and the width is 3 m. The second were the Bogstripsset version 10 x 0.5 m. Both are able to be operated only by two (four – depended on the length) people, so there is no need of any special equipment. [5] Tested vehicles were represented vehicles of Czech army - one truck TATRA and two personnel vehicles UAZ and Mitsubishi. All with the winter types of tires. [6] Tests took place at three areas with different high of snow.

The approach of testing was following. The vehicles tried to overcome the given place. Firstly the personnel ones go and then the truck. In all cases they mired. After that, they tried to self-rescue with the bogies given under the wheels. Then they attempted to overcome this place with the mat or with the combination of mat and bogies.

Investigation Results. The aim of the experiment was to find out, if it is possible to use the perspective materials for the negotiation of the areas covered by snow and for the self-rescuing works. It was made seven experiments with different types of vehicles, materials and on three places. In two attempts the vehicles mired and they were able to self-rescued themselves by using the bogies. In the rest cases the vehicles mired, but after rescuing they

1 * Corresponding author. Tel.: +420 973 442 932
E-mail address: klara.cibulova@unob.cz

were able to overcome the area with the mat or combination of mat and stripes.

Conclusions. The areas covered by snow represent considerable obstacle for the troops. The vehicles can mire and the mobility of the troop can be stopped. That is why the authors decided to verify, if it is possible to minimize these obstacles and improve the mobility of the units. The following results of the investigation were obtained:

- ♦ The perspective materials can be used as self-rescuing means for vehicles mired in snow.

- ♦ The perspective materials can be used as the means for negotiation untrafficable areas covered by snow.

The result of this experiment is that using of perspective material, such as plastic mats, could be solution for negotiation areas covered by snow and for the self-rescuing of the vehicles. For this experiment there were chosen three vehicles, two types of plastic mats and three places. And the result of this experiment confirmed that the assumptions were right. The mobility of the troops would not be stopped and the means are very easy to use, in short time with few people. That is why the authors are planning to continue with these measurements and test more vehicles, more perspective materials and also different place with different slopes and conditions – like ice and others. [3,4,5]

Acknowledgements. Presented work has been prepared with the support of the Ministry of Defence of the Czech Republic, Partial Project for Institutional Development, K-201, Department of Weapons and Ammunition, University of Defence.

Keywords: *trafficability of terrain, snow areas, perspective materials, mats.*

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Full Face Masks Construction and Main Modernization Trends

Pavel Otrisal^{a,b1}, Stanislav Florus^a, Simona Bungau^c, Sarka Hosková-Mayerova^d

^a *University of Defence in Brno, Nuclear, Biological and Chemical Defence Institute, Sidliste Vita Nejedleho, 682 03 Vyskov, Czech Republic*

^b *Palacký University Olomouc, Faculty of the Physical Culture, třída Míru 117, 771 11 Olomouc, Czech Republic*

^c *University of Oradea, Faculty of Medicine and Pharmacy, Sq. 1 Decembrie, 10, 410073, Oradea, Romania*

^d *University of Defence in Brno, Department of Mathematics and Physics, Kounicova 65, 662 10 Brno, Czech Republic*

Introduction. Like many products also facial masks are subject to modernization trends aimed primarily at improving the protective properties of the mask as a whole. At present we can talk about the 5th generation of full face masks. It has to be objectively acknowledged that design trends are mainly determined by military masks, from which the individual components are progressively applied to civilian masks. In order to determine the basic modernization trends of the current time, it is necessary to recall the main design characteristics of the 4th generation masks. Names of individual parts in the text are used in accordance with standards [1, 2]

The faceblanks of the 4th generation masks have a shape that adapts to the maximally extent to the shape of the face, minimizing the dead space. Maximum attention is paid to the tightness of full face masks. Emphasis in this area is dedicated to tightness in the so-called facepiece seal, which is a strip of touching a mask with the user's face. Coupling facepiece seals are used which can be shaped in the problem areas of the face in order to the mask ensures good tightness. The obligatory part of each mask is an inner mask. It is a relatively demanding part to provide a variety of functions. The most important function is to ensure a good flow of inhaled air into the dead space of the mask and to direct the expulsion of exhaled air into the exhaled valve chamber. This is achieved by shaping the inner mask and the inside face of the faceblank. By adjusting the air in the dead space of the mask is achieved the effective visor demisting and reducing the carbon dioxide concentration on the required limit. The inner mask is equipped with check valves for effective airflow. However, increasingly there are also check openings, whose location on the inner mask is more variable than in the case of check valves. The mask is usually provided with one exhalation valve with preload and low value of leakage exhalation valve leakage coefficient. Masks provide users with a good view. This one is ensured by the appropriate shape of the lenses and their location regarding user's eyes and face. The employment of a visor thus one large visor has been gradually growing trend. In order to reduce the stiffness of the mask, the visor was glued to the faceblank, thus avoiding

1 * Corresponding author. Tel.: +420 973 452 335.
E-mail address: pavel.otrisal@unob.cz

the use of a visor sleeve which, on the contrary, increased the stiffness of the mask. Masks are usually equipped with two 40 x 1/7 inch standard threaded connections, which allow an alternate connection of the filter to the right or left side of the faceblank. The inhalation valve with preload allows the connection to be closed, allowing the filter to be replaced in a contaminated environment without the necessity to leave the contaminated area. Speech transmission is usually provided with a speech device that is located in front of the user's mouth or by an auxiliary speech device that replaces a plug of the connector unused to the filter connection. Some masks use both options of speech transmission [3,4].

Method of investigation. Protective masks used for fulfilment of operational tasks in all kinds of military operations are constructed with the aim to protect respiratory system and other important organs against the effects of toxic compounds such as chemical warfare agents and toxic industrial chemicals materials. During the last 2 decades we observed knowledge and collect the Czech Armed Forces Chemical Corps' specialists experiences from practical employments of the Czech protective masks which are in the armament of the Czech Armed Forces, particularly within the 31st CBRN Defence Regiment. The aim of study is to collect information and data concerning current protective masks. All achieved information and data was studied and compared with some specific types of protective masks used within the NATO forces.

Investigation Results. Let us remind, that there are a lot of protective masks used within the NATO. The spectrum of our interest has been focused on important parts of protective masks that are crucial for providing high quality protection of respiratory system. Our interest has been also focused on systems of water supply maintenance. This aspect is very important especially for currant time when the Czech Armed Chemical Corps' specialists have to complete their mission in the whole World.

We pay attention, that investigation has been performed in last two decades, in the presence and results could influence future decision making process within development of the brand new type of the protective masks.

Conclusions. The following results of our investigation were obtained:

- ◆ The employment of connectors for fast connection of the filter seem to be better in field conditions;
- ◆ The inhalation valves should be made of resistant materials;
- ◆ The inhalation valves should be constructed in order to enable to close tightly both clean and contaminated areas for a very long time during all military forces activities.

The above mentioned observations allow us to foresee that the new type of the protective mask which is currently under the process of investigation will be rid of lacks found up in the past and current time. Results allow researchers to think of operational demands and specification of particular requirements needed for the protective masks in current military operations.

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Keywords: *protective mask, inner mask, lens, filter canister, exhalation valve, exhalation valve chamber, inhalation valve, drinking system, speech diaphragm, faceblank, connector, head harness system.*

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Military Technical Developments in the Frame of the Czech Armed Forces Development

Zbyšek Korecki^{a1}, Miroslav Janošek^b, Blanka Adámková^c

^aUniversity of Defence in Brno University, Department of Air Forces, Kounicova 156/65, 662 10 Brno, Czech Republic

^bUniversity of Defence in Brno University, Department of Air Forces, Kounicova 156/65, 662 10 Brno, Czech Republic

^c Ministry of Defence, Tychonova 221/1, 160 00 Praha 6, Czech Republic

Introduction. The armed forces modernization associated with all the threats discussed at the London Summit, but the authors highlight the following text on hybrid threats and the 5G networks construction, the Baltic Air Protection, military mobility in Europe and technology and cyber defense [1].

The modern weapon systems acquisition, in particular aeronautical and support technology, requires the aircraft life cycle phase's analysis to define required system lifetime funding.

The acquisition process defines four phases of the material life cycle: the design and development phase, the production phase, the operation phase, and the recycling and disposal phase [2, 3, 4]. The current approach to plane life-cycle assessment does not stress the decommissioning phase of the aircraft, although a significant part of the fleet will be in the end of life phase in the next period. The following text describes the life cycle engineering (LCE) phases and the determination system boundaries [5, 6].

The Czech Armed Forces acquires new aviation material that is already in use or used by other armed forces of the Alliance. The design part ends with testing, and it is necessary to certify all areas ensuring the product working use before starting mass production. The production phase consists of the following steps: resource extraction, production, material logistic, final assembly, and completion.

Air traffic is a challenging phase that requires direct and indirect activities. Direct operations include activities and resources involved in aircraft operations and include flight operations, maintenance, and overhaul [7, 8]. Indirect operations include ticketing and administration. An air traffic important part is also the airport infrastructure development, which must create conditions for flight operation in all dimensions according to the type of operated aircraft [9, 10]. Reuse of resources is a fundamental principle of the last phase of life, mainly due to environmental requirements. Life cycle engineering (LCE) combines the cost of all phases of the material life cycle, taking into account environmental protection requirements by implementing technological constraints [11, 12]. The cost of all stages of the life cycle must be part of the preliminary design.

1 * Corresponding author. Tel.: +420 732 184 492.
E-mail address: zbysek.korecki@unob.cz

LCE processing is dependent on the data obtained from all aircraft subsystems. The collection and analysis of working data determined by the willingness of all participating parties to share information [13]. Providers of maintenance and other aircraft support services faced requirements to cut preventive repair time.

e-Maintenance implementation is important phase of new approaches in aircraft maintenance and include monitoring, collecting, recording, and distributing real-time aircraft technical data [14, 15].

The information and communication technologies development of enables the integration of embedded tests, external tests at various maintenance levels, technical information, diagnostics, forecasting, and other supporting information sources during maintenance and support processes. The authors analysed fundamental The Czech Armed Forces modernization steps into 2030. The process includes not only the new weapon systems acquisition but also the proper education and training of people for the national and coalition cooperation needs.

Method of investigation. The research carried out in two experiments. The first step is to select publications. The criterion for choice for the first experiment is the phrase “technological development” of publications indexed on WoS. The selection resulted in 684 publications. Authors filtered and used from these publications only publications with 40 or more citations.

The selection criteria for the second experiment were the e-maintenance and military capability keywords in all fields of publication data.

The selection resulted in 31 publications. Authors used only publications with more than 50 citations from these publications.

Investigation Results. The Czech Armed Forces will, in the near future, solve the problem of acquisitions or the lease of supersonic aircraft extension. Finding the answer to the question of what supersonic aircraft we will protect our airspace is a political matter.

Is it possible, to extend the rental of Saab JAS 39 Gripen fighters, or to choose more powerful F-16 or F-35 JSF? JAS-39 Gripen lease period will end in 2027 and cost of 40 billion.

Given the expected fighters length production (about three years), pilots training, ground staff preparation (about two years), and complex acquisition management, it is necessary to calculate within a 7 year period.

Purchasing such advanced and fundamentally military techniques, such as supersonic fighters, is also reflected in the strengthening of US diplomatic relations with the Allies.

According to one of the most influential managers of the Czech aviation industry, the choice of fighters determines the country’s political orientation for many years to come.

The estimated price of the F 35 is for partner countries and countries that have bought it through foreign military sales “, came just under \$ 80 million.

However, the Czech Air Force is currently struggling with a different problem – an extreme fighter pilot overload.

Currently, 21 pilots fly with 14 Gripen fighters and carry out the country air protection tasks, emergency, and foreign missions. Advanced training is another mandatory activity that requires time.

Conclusions. Maintaining the Czech Air Force's ability to protect the airspace of the Czech Republic should be resolved in the coming year 2020.

National responsibility for airspace protection should be ensured by the 24 supersonic aircraft ownership by the Czech Republic.

The main reasons are logistic independence from the supplier, increasing the ability of ground staff and continuous development of the necessary infrastructure.

Another necessary prerequisite is to make sure adequate education at the University of Defense in Brno, when the annual number of students - pilots should fill the number of 15 people.

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Keywords: *modernization, acquisition process, life cycle engineering, life cycle cost, supersonic, support processes*

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Research on the Properties of Friction Stir welded Armor Grade AA2519 Alloy

Robert Kosturek^{a1}, Lucjan Śnieżek^b, Janusz Torzewski^c, Marcin Wachowski^d

^{a,b,c,d}*Military University of Technology, Faculty of Mechanical Engineering,
2 gen. S. Kaliskiego str., 00-908 Warsaw, Poland*

Introduction. AA2519 is a high-strength aluminum alloy with good ballistic properties, which finds its applications in the construction of light military vehicles [1-3]. Due to a relatively high concentration of copper (above 5.3%), the solidification of AA2519 in traditional welding processes causes a problem of low melting phase Al₂Cu (548oC), which together with a welding shrinkage create a high risk of hot cracking [4]. The potential solution of this issue is the application of friction stir welding (FSW) - the solid-state welding process which allows to produce high-quality joints of aluminum, including its precipitate-hardened high strength alloys [5-7]. Although the low temperature of the FSW process (400-500oC) allows to avoid the problem of hot cracking it is still important to properly select welding parameters determining the quality of the obtained joint [8-9]. In this paper, the friction stir welded joint of AA2519 is taken under investigation with the main aim of evaluating its quality with microstructure observations, microhardness analysis and results of tensile test.

Method of investigation. The friction stir welding process was performed by using ESAB FSW Legio 4UT machine with an axial force equal to 17 kN and the tilt angle of MX Triflute tool set to 2o. The tool rotation speed and tool traverse speed were equal to 800rpm and 100mm/min respectively. The welded joint was sectioned perpendicular to the welding direction where metallurgical examinations and hardness measurements were carried out. In order to investigate the microstructure of the joint, sample was examined using a digital light microscope Olympus LEXT OLS 4100. The sample was etched by using Keller reagent (20 mL H₂O + 5 mL HNO₃ + 1mL HCl + one drop of HF) with etching time equal to 10 s. The Vickers microhardness of the weld was measured on the cross-section of polished sample by applying load of 0.98 N. Basic mechanical properties of the joint were examined by tensile testing according to ASTM standard E8/E8M-13a. Tensile tests were carried out on INSTRON 8802 MTL universal testing machine with WaveMatrix computer software. The strain extensometer with a gauge length of 50 mm was used to measure deformation. The joint efficiency was calculated as a percentage ratio of joint tensile strength to base material tensile strength.

Investigation Results. The microstructure analysis of the weld allowed to identify zones typical for FSW process: dynamically recrystallized stir zone (SZ), thermo-mechanically affected zone (TMAZ), heat-affected zone (HAZ) and base material (BM). At the same time, observations of the sample did not reveal any imperfections in the joint. The obtained

1 * Corresponding author. Tel.: +48-261-839-245
E-mail address: robert.kosturek@wat.edu.pl

distribution of microhardness on the cross-section of the weld indicates on a significant reduction of microhardness value in the joint zone, especially in the heat-affected zone (108 HV0.1) compared to the base material (145 HV0.1). The established joint efficiency in the tensile test is equal to 83% with the failure occurring at the thermo-mechanically affected zone / stir zone interface.

Conclusions. The following results of our investigation were obtained:

- ♦ The friction stir welding process allows to obtain the imperfection-free joint of AA2519 using tool rotation speed of 800rpm and tool traverse speed of 100mm/min.

- ♦ The tensile strength of the examined joint equals 87% of base material value.

The performed research allow to draw a conclusion that friction stir welding is the appropriate technology to produce a high-quality joint of armor grade AA2519 alloy.

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Keywords: *friction stir welding, AA2519, microstructure, mechanical properties, armor grade aluminum*

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UGV for Close Support Dismounted Operations – Current Possibility to Fulfil Military Demand

Marian J. Lopatka¹

Military University of Technology, Kaliskiego Str. 2, 00-908 Warsaw, Poland

Introduction. Unmanned Ground Vehicles (UGV) have been developed for over 20 years in different size, weight, payload and applications. The most popular classes are:

- ◆ throwable UGV – weight up to 2 kg, with very limited payload;
- ◆ backpackable UGV - weight up to 25 kg (can be carry by 1 man), with payload up to 5-10 kg;
- ◆ portable UGV - weight up to 75 kg (can be transported in any military vehicle and loaded/reloaded by 2 man), with payload up to 30 kg;
- ◆ light UGV - weight up to about 300 kg (can be transported in adapted military vehicle), with payload 150-200 kg;
- ◆ medium UGV - weight up to about 1000 kg (can be transported on the trailer or in adapted military vehicle), with payload 300-500 kg;
- ◆ heavy UGV - weight up to about 5000 kg (can be transported on the trailer or towed), with payload up to 2000 kg;
- ◆ very heavy UGV - weight above 5000 kg (can be transported on the trailer or towed) are typically robotized version of military maned vehicles.
- ◆ Their main field of applications covers:
 - ◆ UGV cooperation with maned vehicle teams in combat missions;
 - ◆ supporting dismounted missions;
 - ◆ conducting EOD (*Explosive Ordnance Disposal*) and IED (*Improvised Explosive Device*) missions.

Efficiency of UGV operation strongly depends on complexity of tasks, needed velocity of operation and demanded autonomous level of operation. The highest requirements are arise from co-action with manned combat vehicle – there are problems with communication and latency on long distances, navigation and path planning, and above all possibility of autonomous action and decision making. To solve the problems the progress in artificial intelligence is needed. On opposite side one may find EOD/IED missions. Relatively short distance of operation, lower time pressure, low pressure for autonomy and high level of threats for soldiers triggered introduction to army in short times a few types of UGV equipped with arms and other attachments. Now all modern army are using EOD/IED robots. UGV for supporting dismounted missions are not in service. The possibility of using them are strongly depend on planned tasks and level of demand and requirements.

¹ * Corresponding author. Tel.: +48 261-83-96-16.
E-mail address: marian.lopatka@wat.edu.pl

Requirements evolution. The first description of requirements for dismounted missions support system was contained in US Army Future Combat System program (2003 – 2009) [1,2]. Support tasks generally should cover:

- ♦ combat support - involving reconnaissance, surveillance, target acquisition and fire support;
- ♦ combat engineer support - involving mine detection, path clearance and engineer obstacle breaching;
- ♦ logistic support (MULE) - involving transport of munitions and team weapons, means of signal, spare battery and battery charging, water, food and medevac with payload up to 1090 kg.

The possibility to fulfil such wide spread of tasks should be achieved with the same base UGV by exchange modules of payload. Moreover the mobility of UGV should be extreme – better than conventional vehicle, a specially in obstacle negotiation. UGV needs have active suspension, quiet drive and high level of autonomy. After FCS program terminating, the new SMET (Squad Multipurpose Equipment Transport) program was started and requirements was amend. The payload was lowered to 454 kg and development was based on tests and evaluation of available UGVs and systems. Overall demands was similar to previous program – the UGV should autonomously navigate in terrain, to have “follow-me” function and high level of mobility. Over 17 UGVs participated in program. Some UGVs have had electric drive and time of operation up to 2-4 h, another hydrostatic power and time of operation up to 10 h, and some hybrid and time of operation up to 28 h. The width of part of tested UGV was limited to 0,91 m to improve their mobility in urban area and on narrow path but regular width was about 1,5 m. Different kinds of running gear was also tested – rubber tracks with semi-elastic suspension, metal track with elastic suspension, wheeled 4x4 with elastic suspension and 6x6 and 8x8 with rigid suspension. The trials include transport in complex terrain in the day and night, fire support and surveillance efficiency, possibility of mine-roller and flail operations, and finally different technic of remote control and tele-operation [3,4,5,6].

Conducted tests show that there are no one the best solution because requirements are partially in contrary to each other and therefore for selecting the best UGV the main purpose and concept of operation should be defined as well as clear requirements for it. Finally the demand was reduced: a UGV should can carry about 1,000 pounds worth of soldier equipment. This equates to lightening the load of nine soldiers across an infantry squad. The Army wanted the robots to be able to travel 60 miles off-road in 72 hours or less (over three days) and to provide a spare kilowatt hour of power while moving and at least 3 kilowatt hours while stationary, silent operation should be possible and cost about \$100,000 or less. There are no demand on advanced tele-operation with cameras, no “follow-me” function, no autonomously navigation, no extreme obstacle negotiation possibility. After one year trials on 4 previously selected UGVs, the best solution was funded and contract for delivery of 624 UGVs was awarded [7].

Conclusions. The present level of technology allows introducing in service UGVs able to efficiency support of dismounted operations. But it demands to work-out clear concept of operation and requirements which should corresponds to actual level of technology and possible UGV autonomy. Important role in this action should take analysis of terrain and planed activity.

Keywords: *unmanned ground vehicle; dismounted operation support; mule function; requirements; trials.*

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The Influence of Friction Stir Welded Process Parameters of AA2519- T62

Alexander Kravcov^{a1}, Janusz Kluczyński^b, Robert Kosturek^b, Ondřej Franek^a,
Nikolaj Morozov^a, Lucjan Śnieżek^b, Pavel Svoboda^a, Petr Kubeček^a

^a*Czech Technical University in Prague, Faculty of Civil Engineering,
Thákurova 7/2077, Prague 6 - Dejvice, 166 29, Czech Republic,*

^b*Military University of Technology, Faculty of Mechanical Engineering, Institute of Robots & Machine Design, gen. S. Kaliskiego Street 2, Warsaw, 00-908, Poland*

Introduction. FSW (Eng. Friction Stir Welding) is a very promising method in terms of joining aluminum alloys, which are difficult to weld using conventional methods [1-4]. This method is a solid-state welding process, where the joint is formed by plasticizing and mixing two work pieces during the action of a specially design tool on the material to be welded [1, 5-6]. An example of aluminum alloy difficult to weld by conventional means is AA2519 – armor grade alloy used for light military constructions [8, 9]. Due to the relatively high concentration of copper (above 5.3%), solidification of this alloy in traditional welding causes a problem of low melting phase Al₂Cu (548oC) and as a result, a high risk of hot cracking [10]. Although the low temperature of the FSW process (400-500oC) allows this problem to be avoided, it is still important to properly select welding parameters determining the quality of the obtained joint [11].

It is very important to determine the joint quality not only using destructive but also non-destructive methods to analyze joints right after the process. In connection with the growth in usability of FSW technology it is very important to determine the proper joint quality check method to ensure the required welded material properties. Ultrasound testing methods are useful in determining the internal quality of the material including internal and surface inclusions and defects [11]. This method is also useful for analyzing material properties by measuring the shear wave velocities [12]. The ability to use a laser to amplify the signal ensures the possibility of analyzing elements whose thickness is greater than 10 millimeters [12].

Conclusion. As a result of the work, it was possible to diagnose the technology of friction stir welding with the help of laser-ultrasonic structures copy and the subject of the presence of continuity defects. A method for determining Young's modulus and shear modulus is presented. The study showed that the decrease in the value of the elastic moduli of the recrystallization region and thermo-mechanically affected zone was on average 15%. During the analysis of the microstructure, it was determined that high values of tool traverse speed lead to the appearance of defects in the joint. Most of the specific defects are localized on the advancing side of the joint.

1 * Corresponding author.

E-mail address: kravtale@fsv.cvut.cz

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Keywords: *Friction Stir Welding, aluminum alloys, microstructure analysis, laser ultrasonic structures' copy, non-destructive testing*

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Trafficability in the Czech Army

Klara Cibulova^{a1}

^aUniversity of Defence in Brno, Kounicova 65, 662 10 Brno, Czech Republic

Introduction. The main area of interest of the author is the trafficability. Trafficability is the basic assumption of mobility, which is one of the main tasks of engineer units. The trafficability consists of different parts – trafficability of low-endurable terrain, watercourses, forests, snowy area, etc. This means that the trafficability is a very wide and general problem. And why is trafficability so important? There is a lot of critical situations in which the army has to overcome the landscape not only on roads and existent ways. They could be damaged by the enemy or by natural disasters. In these situations, the communications, appointed for this kind of movement, are not supposable to use. The use of detours is not always advantageous and facultative. Then it is necessary to judge, whether the vehicles are able to go through the terrain or not. One of the most important thing, how to solve these situations, is to know the trafficability of terrain. The trafficability is the capacity of soils to support vehicles. The question is, if the terrain is suitable for passing for the given type of vehicles or not. Different types of instruments are used for judging the trafficability of terrain.

The instruments used for evaluation. There are more ways how to evaluate the trafficability of terrains. For example, in the Czech Republic it is described in the Field Manual Žen 2-16 “Military Roads and Ways”. But due the fact, the Czech Army is in the NATO, there is also Field Manual 5-430-00-1 “Planning and Design of Roads, Airfields and Heliports in the Theater of Operations – Road Design”, used by some NATO countries.

The first approach contains two instruments the engineer crowbar and telescopic penetrometer. These instruments are based on finding out the resistance of soil against leaking of the thorn. The engineer crowbar is used only for casual judgement of the trafficability of terrain, but the telescopic penetrometer is used very often. The second approach is the measuring with the cone penetrometer. In that field manual we determine the trafficability of the soils by two indexes – rating cone index (RCI) and vehicle cone index (VCI). As soon as we know the values of this two indexes and compare them, we are able to judge if the soil is trafficable for the given number of vehicles. The aim of the authors work is to compare these two systems and decide which one is suitable for the Czech units or try to find out a new one system of evaluation trafficability.

The possibilities of negotiation untrafficable areas. The evaluation of the terrain is only the first part of solving the problem. The author is more far interested in the question, how to negotiate the untrafficable terrain. Are there any means how to overcome it? The Czech Army used for ages the wooden ways. There are different types of them - fascine causeway, corduroy roads, metal roads, etc. But this approach is very time, human and material consuming. That

1 * Corresponding author. Tel.: +420 973 442 932
E-mail address: klara.cibulova@unob.cz

is why the author has been tested perspective materials, such as plastic mats. These materials becoming more and more popular these days. There are different types light or heavy ones. They are made in different widths and lengths. These materials have not been very known and used in the Czech Army yet. That is why there are tested now different types in different conditions and with various types of vehicles. It is possible solution not only for the ACR, but for all during the crisis situations. And relating to this the author also perform experimental measurements with the perspective materials in critical situations such as overcoming of watercourses, negotiation of snowy areas, etc.

Conclusions. In conclusion it is good to emphasize the importance of knowledge the trafficability of terrain. There are two spheres of utilization – military and civil. In the military sphere the very quick negotiation of the terrain during military actions is necessary. If it is not possible to use the original route the troops tent to choose the shortest way through the terrain. In the civil sector we use this method for judging trafficability of terrain when the normal roads or bridges are damaged due to some natural influences. Then there is need to get to these weatherworn areas to ensure food, material, reconnaissance of harms. And we must not forget one of the most important things, such as the transport of ambulances and other help. If we are able to judge the trafficability of terrain quickly and reliably, we can help in all these cases mentioned above.

There are a lot of possibilities how to determine the trafficability. Here are mentioned two possible systems of methods how to determine it. The first one corresponds with the field manual “Military Roads and Ways”. Here we measure with the telescopic penetrometer. On the other hand, there is a method described in the field manual “Planning and Design of Roads, Airfields, and Heliports in the Theater of Operations – Road Design”, where it is known the number of vehicles and it is wanted to learn if they can go through the area or not. So in this system we take with account two factors - “soil factor” and “vehicle factor”. More over the author also examine the means how to negotiate the untrafficable areas, not only low endurable terrain, but the watercourses, snowy areas, etc.

The goal of the author’s research is to compare these two approaches, find out their advantages and disadvantages during the use and during the evaluation and eventually to determine new system of evaluation of low endurable terrain. Then the next goal is to prepare the conditions for the acceptance of the new one approach in case that it will be taken over. This acceptance means the determination of the vehicle indexes for the mostly used vehicles in Czech army and the assessment of the soil indexes with respect to the Czech system of classification. Also within the scope of the research is to find out new possibilities of using perspective materials.

Keywords: *trafficability of terrain, penetrometer, vehicle cone index, rating cone index, perspective materials.*

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Medium Altitude Long Endurance Unmanned Aerial Vehicles for Land Forces

Leonas Ruzgas^{a1}, Svajone Bekesiene^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania, Silo str. 5A, LT-10322 Vilnius*

Introduction. The unmanned aerial vehicle industry, which emerged in the mid-20th century, is still one of the most important direction of modern aviation. In the future, UAVs are expected to be able to replace many of the tasks performed by manned aircraft [1]. Unmanned aerial vehicles have been developed for military purposes and are therefore particularly advanced and advanced in military aviation. Under these circumstances, unmanned aircraft and drones are nowadays used not only in military but also in civilian industry.

The development of new technologies and their effective use in the military will provide advantage in future military conflicts [2]. The military has always been improving, and new technologies are needed to strengthen the army. Intelligence has always been highly valued and important in military conflicts, and has been collected in every possible way. The most commonly used method of reconnaissance is pedestrian reconnaissance. However, 21st Century technologies allow for much more efficient reconnaissance capabilities, like unmanned aerial vehicles with various types of sensors, which enable them to perform their intelligence tasks much faster and more efficiently.

Unmanned aircraft come in many types and sizes, are unmanned for their intended purpose, and are usually programmed to perform a specific task. Unmanned Aircraft is a prospect of future wars, as most missions will no longer have to endanger soldiers' lives. During the operation, the unmanned are capable of scanning the area with special equipment, providing real-time information, detecting enemy forces, marking them and, if necessary, destroying them. Unmanned troops can scan surrounding areas as enemy forces approach, protecting their own forces and carrying combat equipment. 57,000 pilots were killed in World War II, but today, most pilots' tasks can be performed by unmanned aerial vehicles [3]. The main advantage of unmanned aircraft is that they can perform tasks that are dangerous to the lives of soldiers and therefore can be used in extremely dangerous missions. Nowadays, reconnaissance and weaponry technologies of unmanned aerial vehicle are highly advanced, which is why they are used by the armies of most countries around the world. The medium altitude long endurance unmanned aerial vehicles with enhanced functionality can be used for the reconnaissance tasks, when patrol and unit guarding endanger the lives of soldiers.

Method of Investigation. Based on the chosen research objective and problems the questionnaire survey method was selected. There was collected primary data which was processed by software using a computer-based statistical analysis program.

Next analysis, which solve in part about goals and objectives was the experts' evaluation

1 * Corresponding author.

E-mail address: Leonas.Ruzgas@lka.lt

methods based on experts' surveyed sample analysis. The Kendall's coefficient of concordance (W) was selected for experts' data analysis. The statistical software package SPSS version 26 was used for the collected experts' data analysis and for the hierarchical clustering analysis as well [10].

Investigation Results. The aim of these investigations was to evaluate the application and use of medium-altitude long endurance unmanned aerial vehicles in the land forces. According to main goal, there was carried out the analysis of the functions and tasks of the Lithuanian Armed Forces, largest brigade. Additionally there was conducted an analysis of the need for, and capabilities for, unmanned aerial vehicle enhanced brigade operations. Further there was developed selection and possibility of using unmanned aerial vehicles for deployment at the „Iron Wolf” brigade.

The survey let us to assume that: all respondents claim that their UAV's do not have the necessary functions. Also this survey showed that available capabilities do not meet the needs and there is a need to deploy advanced unmanned aerial vehicles with special reconnaissance, cargo and combat capabilities. Finally as this survey result there was made a table of criteria for the selection of unmanned aircraft has been drawn up.

Conclusions. A review of the unmanned aerial vehicles at Defense and Security Equipment International (DSEI) and comparing them with the criteria, concludes that:

- ♦ Only the MALE FOX unmanned aircraft meets all the criteria;
- ♦ the deployment of MALE FOX unmanned aircraft to the Lithuanian Armed Forces would increase combat and reconnaissance capabilities as well as reduce the risk to the lives of soldiers.

For these reasons, it was suggested to integrate the MALE FOX unmanned aircraft in the structure of the Lithuanian Armed Forces.

Keywords: *unmanned aircraft, unmanned aerial vehicle, Lithuanian Armed Forces, Land Forces.*

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Investigation of Dependence of Microstructural Changes of Aluminum Alloy 2024-T3 Taking Into Account the Type of Preliminary Load

Volodymyr Hutsaylyuk¹

Military University of Technology, Gen. Sylwestra Kaliskiego 2 str., 00-908 Warsaw, Poland

Introduction. Despite the widespread use of composite materials, Aluminum alloy 2024-T3, remains the main alloy for the use in construction for both civilian and military aircrafts. In real life exploitation, the structural elements made out of this alloy are subject to various loads. A specific and little-studied type of loading is the combined effect of monotonic stretching and instantaneous additional pulses of loading of different magnitude. Tests of aluminum alloy under combined load conditions (monotonic tensile + additional load impulse) revealed a change in mechanical properties at room temperature. As a result, of the implementation of the combined load in the material, dynamic non-equilibrium processes initiated and the plasticity of the tested material is increased. To explain the physical content of the phenomena responsible for initiating structural changes in the emergence of new states (dissipative structure), it is necessary to analyze the process realize of the deformation in the material not only at the macro level (the whole specimen), but also at the micro level (the grain of the material). In the experimental research, it was predicted, that the course of deformation and its mechanism of realization at the grain level to some extent reflect changes in the structure and appearance of a new state (dissipative structure) in the researched material. The results of the original experimental research of the deformation process and the mechanism of its realization at the micro level by the thin foil method presented in this study.

Method of investigation. The combined load was realized on a ZD-100Pu hydraulic machine equipped with an experimental equipment set-up unit for instantaneous pulse loading realization. Flat samples of 2024-T3 aluminum alloy with a cross section of 3x10 mm were investigated. After realization of the combined load on the elastic section of the deformation, the samples were removed from the experimental set-up and immediately specimens for the microscopic examination. Cylindrical rollers with a diameter of 3 mm for the manufacture of thin foils, were cut from the working part of the sample on an electric spark cutter. Thin foils, were manufactured by electrolytic polishing and researched on a Hitachi STEM HD2700 transmission microscope.

Investigation Results. Electron microscopic studies of foils revealed in the aluminum matrix the inclusion of particles of the minor phase, which form a noticeable contrast of the image - dark inclusions on the background of the light matrix. The minor phase particles are evenly distributed in the volume of the grains. The preferential arrangement of the particles

¹ *Corresponding author.

E-mail address: volodymyr.hutsaylyuk@wat.edu.pl

at the grain or sub-grain boundaries has not been detected. The minor phase particles can be interpreted as dispersed particles of Al_2Cu and Al_2 (Cu, Mg, Si, Fe, Mn) intermetallides. In deformed specimens, after the test, the scalar density of dislocations with the calculation method [1] is approximately $\rho=2,0 \times 10^{14} \text{ m}^{-2}$; whereas the scalar density of dislocations in the sample is approximately $\rho=2,5 \times 10^{14} \text{ m}^{-2}$. The increase in the density of dislocations after stretching explained by the deformation hardening, when at the plastic deformation - increases the density of dislocations [2].

The change in the density of dislocations after combined loading is the most interesting moment, since the scalar density of dislocations in the material in this case is less than after the test by stretching, despite the same residual plastic deformation of the samples. The presence of excess density of dislocations ρ_+ in an aluminum alloy 2024 T3, ie dislocations of identical potential, was determined by the study of concentrated ring pattern [3].

In the material of the initial state, the extinction contours are almost uniform within the subgrain, indicating the equilibrium state of the dislocation structure, small internal stresses within the subgrain and, accordingly, no accumulation of dislocations of identical potential.

Conclusions. The following results, were obtained from our investigation:

- ♦ a smaller scalar density of dislocations when stretching after an impulse, compared to normal stretching, due to the effect of the impulse, which obviously has a certain influence on the dislocation structure, changing the dislocation structure, possibly increasing the number of dislocations of identical potential or the number of dislocations in sub-boundaries, also possibly releases dislocations that particle affixed, which provides further plastic deformation with fewer dislocations;
- ♦ in the material of the initial state, the concentrated ring pattern are practically uniform within the sub-grains, which indicates the equilibrium state of the dislocation structure, small internal stresses within the sub-grains and, accordingly, no accumulation of identical potential dislocations;
- ♦ in deformed specimens after combined loading and stretching, a significant number of concentrated ring pattern were detected within the sub-grains, which indications to a local foil bend caused by the accumulation of identical potential dislocations and high internal stresses in the microstructure of the material. Also, individual extinction outlines are found in the vicinity of dispersed inclusions, which means an accumulation of internal stresses near dispersed inclusions due to the accumulation of dislocation charge inclusions.

Keywords: *2024-T3 aluminum alloy, combined load, thin foil method, scalar dislocation density.*

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Modification of the Short-range Rocket Target RT-400 for Middle-range Air Defence Systems

Hari Prasanna Manimaran^{a1}, Algimantas Fedaravicius^b

^a*Kaunas University of the technology, Department of mechanical engineering, K.Donelaicio St.73, LT-44249, Lithuania,*

^b*Kaunas University of the technology, Department of mechanical engineering, K.Donelaicio St.73, LT-44249, Lithuania*

Introduction. As defence technology is rapidly growing, it requires effective training to operate the defence hardware. Live firing exercise are mostly conducted to test the specific military equipment such as weapon systems. During the practice, personnel requires a target that imitates real incoming enemy military hardware is required. It demonstrates the realistic scenario for the trainee to acquaint with the battle situation. More precise practise making the personnel a skilful operator. For this purpose, targets that resemble enemy aircraft or rocket are used. Initially, the practice is limited to virtual and dummy targets. Targets are of different types based on the requirements. The main objective of targets is to be used as a bullseye target for practice. Most of the targets are designed to be destroyed during the exercise. Targets may be used in land, sea and air defence.

Most of the developed countries have designed their own targets for their personnel. Targets are three types as stationary, UAV, rocket target. Some targets are turbojet engine powered drones and missile targets. These are mostly made from the missile parts without warheads. Other designs are particularly designed to meet the demand. As the drone targets are used to resemble as low-speed vehicles like spy planes, unmanned aerial vehicle and subsonic missiles. These drones cannot simulate the situation for fast-moving missile and fighter aircraft. To fulfil this requirement rocket target are used. These target use rocket motor, mostly solid propellant.

Rocket target usually slower than the real missile or aerial vehicle which is used to shoot the target. This is because, the trainee personnel require training to acquire, lock and terminate target. In the early stage of the training, identifying the fast-moving object is difficult. To match the trainee reaction time, the speed of the target is decided. Rocket target is used once and mostly destroyed during the exercise unlike drones can be reused. In drones, the rocket is kept as secondary target and ejected to resemble the missile. Some drone use rocket for the first stage as rocket-assisted take-off (RATO). Drone targets are difficult to maintain and cannot be operated in all-weather condition. But solid-propellant rocket target can be fuelled and stored for a longer period. And require less maintenance. In considering all the benefit of using rocket target for a military exercise, it is necessary to design and test the hardware.

In rocket target design internal and external ballistics are mainly analysed. Internal ballistics deals with the propulsion system characteristics whereas the external ballistics study about

1 * Corresponding author. Tel.: 370-6-54-33-957.

E-mail address: hariprasanna.manimaran@gmail.com

the flight of the projectile. The external ballistics of the target gives the basic parameters such as thrust, velocity, acceleration, altitude flight angles and range. With the help of this parameter, the target can be optimised for requirements. Design can be altered to meet the required specification. In this research rocket target to be used for the air defence system is analysed. RT-400 is designed and developed by Institute of defence technology, the Kaunas University of Technology with a range of 5km. The range can be increased by the optimising the propulsion system. By making the alteration in any system, it is required to analyse for the performance. External ballistics is the performance of the rocket target.

Based on RT-400 with single motor data, multiple motor grid can be studied. As per the requirement, the range of the missile varies. To increase the range from short to the medium additional motor is added. In this research, the middle range rocket target with four motors will be used to achieve 15-20 km range.

Method of investigation.

1. Engineering conception of an aerial target for middle-range air defence system;
 2. create a methodology of investigation;
 3. analysing rocket motor with a constant thrust and different time impulses;
 4. research of external ballistics of each model;
- comparative analysis of external ballistics characteristics.

Investigation Results. Use of one motor to carry a mass of 185 kg and launched at 45 to 50-degree launch can provide a thrust to reach the rocket target the distance of 2552 m with 738 m of altitude. The highest altitude in this configuration can be reached by launching at 80-degree.

In case-2 the ignition of four motors together will pull the rocket to 12,360 m of distance and height of 6065 m at 45-50-degree launch angle. Highest possible altitude is 6265 m.

In the third case of burning two plus two motors make the rocket to reach the distance of 19,916 m close to 20 km range with an altitude of 7103 m at 48-degree launch. At 80-degree launch, the rocket can reach 9360 m.

Conclusions.

- ◆ Engineering conception for modernisation of RT-400 as middle-range rocket target in middle range air defence systems was created;
- ◆ Computational model using solid works® and numerical modelling in MATLAB® was carried out;
- ◆ External ballistic parameters such as thrust, velocity, acceleration, altitude (height), range (distance), drag force, g-loads, flight angles are detailed;
- ◆ From the research of different model following results are obtained:
 5. Rocket burning one motor can travel up to a range of 2552 m with an altitude of 1196 m;
 6. Four motors burning together reach a range of 12360 m and altitude of 6257 m;
 7. Igniting two motors in the first stage and burning two more motors after burnout of first two motors can make the rocket to travel 19916 m with an altitude of 9360 m.
- ◆ Even though the magnitude of thrust output from the two-plus two-motor configuration is lower compared to the model ignites all motors in a four-motor grid of 48 kn, the advantage of continuous supply of thrust in two plus two motor model boost the second stage to maximum distance;
- ◆ From the comparative analysis, it is concluded that the rocket target with four motor grid using sequential ignition, the first stage of two motors for 3.2 seconds produce 24 kn and

igniting another two motor for 3.2 seconds with 24 kn after the burnout of the first stage is preferred;

- ◆ Four motors are arranged in a parallel configuration: alternate motors are ignited to produce symmetrical thrust which gives stable rocket flight;
- ◆ The reduction in second stage mass and initial velocity of 350 m/s from the first stage coupled to produce a higher range for the rocket target;
- ◆ The flight velocity reaches supersonic during the flight of both four and two plus two motor configurations;
- ◆ Research and comparative analysis of rocket external ballistic characteristics by constant thrust and different time impulses are completed to use the data in the modernisation of rocket target for middle-range air defence systems.

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Keywords: *Solid propellant rocket motor, external ballistics, flight range, velocity, acceleration, thrust impulse, rocket target.*

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Hi-Integrity Micro-optical Elements Using Stitch Free Fabrication Applying Femtosecond Laser-based 3D Nanolithography

Tomas Gadišauskas^{ab1}, Dovilė Mackevičiūtė^{ac}, Tomas Baravykas^{ac},
Darius Gailevičius^{ac}, Linas Jonušauskas^{ac}

^a *Femtika Ltd., Saulėtekis ave. 15, LT-10224, Vilnius, Lithuania*

^b *The General Jonas Žemaitis Military Academy of Lithuania, Silo g. 5A, LT-10322 Vilnius*

^c *Vilnius University, Laser Research Center, Saulėtekis ave. 10, LT-10223 Vilnius, Lithuania*

Introduction. Defense sector has broad needs to deploy better biochemical sensors for applications in medical diagnostics, environmental monitoring, rapid identification of threats, hazardous materials control, basic scientific research, and more. For example, point-of-care chips occur a detection of biomarkers with optical-based sensing using photonic integrated circuits (PICs) [1], hybrid fiber-optic sensors find applications in basic vital signs monitoring [2] and others hi-complexity, real world micro-optic applications. It is important to understand that the development of these novel technologies are directly tied to the advances in manufacturing techniques.

Hi-integrity micro-optics elements is a fast developing field showing large potential in industry and military enabling small and highly functional tools for light control down to a micro-scale. One of the most promising technologies to produce such elements is 3D laser lithography (3DLL) as it enables fabrication of free-form 3D objects with resolution and surface roughness control down to nm level [3]. So far it was employed to create integrated functioning monolithic 3D micro-optical elements on functional substrates for in such applications as spatial light control or imaging [4,5]. In this paper, we demonstrate a capability to fabricate functional, stitch free micro-optical components, such as refractive and Fresnel lens, also equilateral prism witch was fabricated.

Design and fabrication. Micro-optical element printing still have some limitations concerning current progress. In this work we present several advances needed to push femtosecond laser based 3D nanolithography from the laboratory level use to the industrial production lines. First, linear stage and galvo-scanners synchronization is employed to produce stitch-free mm-sized structures. Furthermore, it is shown that by varying objective numerical apertures (NA) from 1.4 NA to 0.45 NA, voxel size can be tuned in the range from sub μm to tens of mm, resulting in structuring rates between $1809 \mu\text{m}^3/\text{s}$ and $313312 \mu\text{m}^3/\text{s}$ at 1 cm/s translation velocity achieved *via* simultaneous movement of linear stages and scanners. Discovered voxel/throughput scaling peculiarities show good agreement to ones acquired with numerical modelling. Furthermore, support-free 3D printing of complex structures is demonstrated. It is achieved by choosing pre-polymer that is in hard gel form during laser

1 * Corresponding author.

E-mail address: tomas.gadisauskas@lka.lt

writing and acts as a dissolvable support during manufacturing. All of this is combined to fabricate micro-optic structures. First, 2 mm diameter refractive lens, then 0.5 mm diameter Fresnel micro-lens and equilateral micro-prism with scale $450\ \mu\text{m} \times 350\ \mu\text{m}$ were fabricated. Quality and functionality of these elements are investigated in qualitative and quantitative fashions. Focusing properties of lenses and beam shape and dispersion spectrum of prisms was tested.

Results. It is shown where multiphoton polymerization can outpace standard stereolithography in terms of throughput while still maintaining superior resolution and higher degree of freedom in terms of printable geometries. All these elements are produced in a single printing step showing the potency of 3DLL as a straight-forward and relatively simple technology to produce micro-optics at these sizes. Lens focusing close to diffraction limited spot ($w_0 \sim 2.5\ \mu\text{m}$) and well visible prism dispersion are observed.

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Keywords: *3DLL nanolithography; direct laser writing; femto-second lasers; material processing; micro-optics.*

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Helicopter Turboshaft Engine Emission Estimation Based On Standard Flight Profile

József Tóth^{a1}, László Kavas^b, Benjamin Rózsa^c

^aNational University of Public Service, H- 5008 Szolnok, Hungary

^bNational University of Public Service, H- 5008 Szolnok, Hungary

^cNational University of Public Service, H- 5008 Szolnok, Hungary

Introduction. Over the past decades, environmental protection, including regulation of air pollution, has become an important economic and political issue. Reducing emissions of greenhouse gases (GHG) from the transport sector is an important challenge in the fight against climate change. Although aviation accounts for only 2% of atmospheric pollution, regulation at national, international and global level is still very important. The International Civil Aviation Organization (ICAO), the committees of the European Union, have developed various strategies based on long-term forecasts. As a result, the CORSIA system was created and currently approved until 2035. This system includes measures on aircraft technology, engine development, air traffic management, and sustainable alternative fuels. However, this system only contains requirements for commercial aviation to, so for the public aviation, and especially the defense sector have limited application [1].

The high level aim of our current research is to determine the emissions of aircraft engines in the defense sector and to explore ways to reduce them by using alternative fuels, focusing military aviation in the military aviation. For turbofan-powered aircraft, ICAO standards are available to estimate emissions for the operational flight profile. Although helicopters are a smaller source of air traffic emissions, but its play a very important role in non commercial aviation.

However, the helicopter emissions is extremely difficult to assess because of the emission data of turboshaft engines are generally not open to the public, and the operation flights is much more complex, so there is currently no generally accepted methodology to calculate absolute emissions of helicopters [2].

Method of investigation. The most important methodological elements of the research task are the preparation and adaptation of the mathematical model of the engines, the application of simulation to the processes of the combustion chamber and the pursuance of experiments with the test engine [3,4].

In order to assess emission of tuboshaft engine, it is advisable to define a standard flight profile LTO cycle (LTO = Landing and Take-off cycle) that can be used to estimate individual helicopter emissions for each type of alternative fuel.

The standard flight profile is modelled on that used by ICAO. However, it should be taken

1 * Corresponding author. Tel.: +36-70 674 7665
E-mail address: toth.jozsef@uni-nke.hu

into account that helicopters use several different procedures, so the operating mode of the engines must be determined accordingly. It should also be taken into account during the remainder of the cycle that helicopters perform their special flight duties over a wide altitude and speed range. With this in mind, we developed the LTO cycle for further calculations. Based on the engine mode for the flight profile, engine emissions were determined using the method developed by FOCA [5]. Calculations were performed on the TV2-117 engine on the Mi-8 helicopter. The required engine data were determined from the aircraft operating documentation [6].

Investigation Results. Using the procedure mentioned here, the following results were obtained:

- ◆ Emission values for CO₂, NO_x, unburned hydrocarbons, non-volatile ultra-fine particles (smooth) for the helicopter type
- ◆ Emission values for different take-off and landing modes
- ◆ Effect of horizontal flight altitude and speed on emission values.

Conclusions. This can be an important point of reference for future decision-making on the use of different alternative fuels. At the same time, the economic dimension of the problem, which takes into account the entire life cycle of fuels, needs to be analysed and is a key issue for environmental safety research.

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Keywords: *turboshaft engine, emission, alternative jet fuel, air pollution*

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Simulation of Vibration Propagated by Rolling Element Bearings in Mechanical Gearbox

Cao Vu Tran^{a1}, Jan Furch^b, Xuan Phong Cu^c

^a*University of Defence in Brno, Faculty of Military technology,
Kounicova 65, Brno 66210, Czech Republic*

^b*University of Defence in Brno, Faculty of Military technology,
Kounicova 65, Brno 66210, Czech Republic*

^c*Le Quy Don Technical University, Faculty of Vehicle and Energy Engineering,
236 Hoang Quoc Viet, 100000, Hanoi, Vietnam*

Abstract. Rolling element bearings are major component parts to be used in rotational mechanical system. During the operation, vibration signals are generated and these signals are related to the technical condition of rotating machinery. The aim of this paper is simulated the vibration signal that propagated by rolling element bearings in mechanical gearbox. The gearbox dynamic model that combined gearbox components, such as, shafts, involute gears, rolling element bearings is developed. Consequently, this model is simulated using multibody dynamic solution. Eventually, results are compared with experiment data in order to verify the precision of the dynamic model.

Introduction. The gearbox is important part of transmission system that plays a role to transfer the torque from the engine to wheels at different ratios. The gearbox consists of complexed components, such as, gears, shafts, bearings and gearbox cases. When mechanisms operate within the gearbox, contact forces generate gear noise and vibration signal in the environment. The vibration signal is corresponded with the technical condition and it can be used to identify gearbox failures. The study about the behavior of gearbox using vibration signal is called vibration diagnostics. The objective of vibrodiagnostics is to recognize an “unhealthy” condition in sufficient time to take into the condition - based maintenance before significant defects arise. Vibration monitoring is used at many researches to predict needs for condition-based maintenance. Over the past few years, experiments have been used widely for investigating and diagnostics gearbox failures, such as, the gear tooth damages (pitting, wear, plastic flow, breakage), bearing defects (macro pitting, denting, fretting corrosion, scuffing), and mechanical looseness (misalignment, unbalance). The experiment could be used effectively to assess the gearbox behavior. However, it requires the knowledge of experts, the long-term testing procedure, and high investment cost.

To overcome those disadvantages, besides the development of computer technology, the simulation method has been used widely to analyse the mechanical system. The multi-body dynamic solution is the most effective method for vibration analysis. The aim of this paper is to develop the mathematical model of dynamic analysis of gearbox. The fault of gearbox is

1 * Corresponding author. Tel.: 420-773-880-246.
E-mail address: caovu.tran@unob.cz

created in rolling element bearings to demonstrate an increase of vibration signal when the failure occurs. After that, the model is simulated using multibody dynamic software MSC. ADAMS. Results are compared with the experiment data to verify the precision of model.

Modelling of mechanical gearbox. The mechanical gearbox is a complex system that composed of different components. It is difficult to model exactly completely parts of gearbox. An accurate model can be presented not only the actual physical system, but also the essential dynamic characteristics of system. The vibration mechanical model is assumed as the lumped – parameter model (discrete model), in which, all objects are rigid bodies that considered as mass (m) – damper (k) – spring (c) system. The entire model that consists of the dynamics of gears, shafts, and bearings is developed to simulate the behavior of mechanical gearbox. In the model, the dynamic model of gear mesh couple is considered as 6 DOF and dynamic model of bearing is manifested as 5 DOF.

Simulation of gearbox modelling. The gearbox modelling is considered as the multi-body dynamics system, in which, loads and contact forces are distributed throughout the mechanical system. The basic simulation process consists of five main steps. First, the physical model that has accurately geometries (e.g. length, width, depth, dimension, distance) is created. Generally, the model is created by professional 3D-CAD designed software. Next, the physical characteristics, such as inertia properties, mass, and dynamic friction coefficient are set. Then, the kinematic definitions, e.g. translational and rotational are fulfilled. After that, the model is simulated with initial conditions. Finally, the results are analyzed and evaluated. The gearbox fault is created on the rolling element bearing. This multi-dynamic model of bearing is simulated as the flexible body. The bearing is used for investigating is SKF 6028 and its parameters are showed in the SKF bearing dynamic handbook.

Investigation results. Results show the translational acceleration signals of rolling element bearings. Bearing defect frequencies, such as, BPFI, BPFO, BSE, FTF are used to assess the behavior of bearing when the failure occurs. Investigation results are recorded in the time domain, after that, these results are transformed to frequency domain using FFT function. Simulation results are compared with experiment data to verify the presence of model.

Conclusion. The following results of investigating were obtained:

- ♦ The mathematical model of dynamic analysis of gearbox that developed can be used to calculate in the presence of dynamic parameters of gearbox.
- ♦ The multi-body dynamic of gearbox can be simulated the localized fault that occur in rolling element bearing.
- ♦ The simulated result is compared with experiment data demonstrate the presence of model.

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Keywords: *gearbox dynamics modelling, vibration analysis, multi-body dynamics simulation*

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Applicability of Selected Mathematical-statistic Methods During Decision Activities within Joint CBRN Defence COE

Břetislav Štěpánek^a, Pavel Otrísal^{a,b1}, Šárka Hošková-Mayerová^c

^a*Palacký University, Faculty of Physical Culture,
třída Míru 117, Olomouc, 771 11, Czech Republic*

^b*University of Defence in Brno, Nuclear, Biological and Chemical Defence Institute,
Sídlistě Víta Nejedlého, 682 03 Vyškov, Czech Republic*

^c*University of Defence in Brno, Department of Mathematics and Physics,
Kounicova 65, 662 10 Brno, Czech Republic*

Introduction. Mathematical-statistic methods provide proved instruments, suitable for analyzing problems by means of relevant information acquisition to determinate possible consequences of variant decisions [1]. However, it is impossible to affirm that application of these methods in decision activities makes possible to find always solving of all problems with them we meet in environment of NATO. But these methods can provide some important information [2]. Gained information have to be correctly interpreted, appreciated their reliability and determined possibility of their maximal utilization. However, this way gained information represents only one part of decision activities [3].

Every manager problem is to be examined in terms of quantity and quality. Quantitative criteria use direct appreciation and comparison of variants on the basis of predefined values [4]. We use them at the time, if we can required measured quantities determine reliably. If some qualitative criteria should be used, these are to be transformed on measurable values. For example the qualitative feature „reliability” can be expressed in intervallic scale. Next step is sorting and variant selection, where we use various methods and techniques. Needed information must be acquired at the same time and considered in light of certain problem [5]. The aim is on the basis of these two informative sources to accept optimal solving variant.

Method of investigation. Methods of useful cost analyze has been studied by decision activities within NATO international military organization Joint CBRN Defence COE. For international environment of NATO, there are suitable support methods - useful cost analysis (cost-output methods), namely from following reasons:

- they make possible to measure inputs (costs on the actions under consideration of public policy) in relation to expected outputs (results of public policy),
- application of these methods is relatively easy and provides at the same time relatively enough needful information for final decision,
- mentioned methods are based on criteria application of economy, efficiency and useful-

1 * Corresponding author. Tel.: +420-973-452-335
E-mail address: pavel.otrisal@unob.cz

ness, so on criteria, that every manager of public sector is obliged to trace, who uses public funds.

Investigation Results. Methods of cost utility analyze are suitable instruments for the best variant selection. Each of mentioned methods highlights a specific criterion. We should consider the choice of appropriate method with regard to appraising criterion.

For cost output methods is characteristic that all mentioned methods measure inputs (costs) in monetary units. Than it means, if we want to use some of mentioned method for variant appreciation, we have to know cost quantification for the actions given by policy. It's a real prerequisite, because we can find needed data in costing to given action, in budget, or in accounting.

Conclusions. Possibilities of cost analyze methods application during decision activities in international environment within Joint CBRN Defence COE are during evaluation and selection of „complex system projects of defence”, i.e. projects, when we consider technical, personnel, military-special, economic, political and others targets. To utility determination is then important to consider priorities of individual targets, or importance of individual utility properties.

Above all can be recommend using of Costs and benefits analyze method, namely for arguing assistance during political discussions about contribution of extensive military projects in NATO (e.g. purchase of new armored vehicles, airplanes etc.), because this method gives possibility to regard on query in light of general structure of military costs and social benefits.

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Keywords: *mathematics, statistics, cost, benefits, analyze, decision, activities, methods, application, projects.*

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Observation of Drench of Porous Barrier Materials with Employment of the Conductivity Sensor

Pavel Otrisal^{a,b1}, Vladimír Obselc, Simona Bungau^d, Sarka Hosková-Mayerova^e

^a *University of Defence in Brno, Nuclear, Biological and Chemical Defence Institute, Sidliste Vita Nejedleho, 682 03 Vyskov, Czech Republic*

^b *Palacký University Olomouc, Faculty of the Physical Culture, třída Míru 117, 771 11 Olomouc, Czech Republic*

^d *University of Oradea, Faculty of Medicine and Pharmacy, Sq. 1 Decembrie, 10, 410073, Oradea, Romania*

^e *University of Defence in Brno, Department of Mathematics and Physics, Kounicova 65, 662 10 Brno, Czech Republic*

Introduction. Nowadays, filtration barrier materials are more often used for providing with long-term protection of the Czech Armed Forces professionals and Fire Rescue Brigades specialists against the effects of toxic compounds. A comprehensive study provided authors with evaluation of their protective properties qualitative changes in connection with knowledge development of possibilities of sensor technologies at this time. A solution usable for an electronic detection of the moment of water permeation or a liquid phase of other test chemicals (penetration) through construction materials of a filtration type or permeable barrier materials which are or perspective can be used for protection against the effects of toxic compounds has been recently proposed by the University of Defence's researchers. The aim of the solution is to replace a current used subjective way of the visual observation of water or other test chemicals penetration through textile materials used in anti-gas protection with the objective observation of the moment of test chemicals permeation (time of drench) with the help of a conductivity sensor with a possibility of an automatic record of penetration with the employment of the KONDUKTOTEST device [1-2].

Protection of military professionals and civilian firefighters against effects of toxic compounds is possible to understand as comprehensive problems coming within the ambit of a row of under interest areas of military, security and science. Protection against effects of weapons of mass destruction and toxic industrial materials is a traditional and long-term crucial part of force protection in the area of military. Specific tasks pointed to formation of conditions for deployed forces in the environment with chemical, radioactive and biological contamination quite unambiguously are a part of professional gesture of the Czech Armed Forces Chemicals Corps. One of conditions of forces survival in areas contaminated with chemical, radioactive and biological agents is their provision with high quality individual protective equipment (IPE) that will be made of the first-rate barrier materials and, moreover, will meet a number of specific demands. One of them is the resistance of IPE's barrier materials against permeation (penetration or drench), which should be relevantly

1 * Corresponding author. Tel.: +420 973 452 335.
E-mail address: pavel.otrisal@unob.cz

investigated and evaluated. Requirements that are specified for the fulfillment of tasks in military operations are similarly applicable to the conditions of dealing with toxic leakage interventions for which the specialists of the chemical service of the Fire Rescue Service are primarily responsible [3].

Method of investigation. We tested abilities of filtration materials to resist various form of chemicals and even water against the permeation and penetration through filtration materials. These materials designated for the Czech Armed Forces specialists' body surface protection have to fulfil a lot of specific requirements. The most important is to provide a long-term protection not only against the effects of chemical warfare agents and toxic industrial chemicals gases and vapors in all kinds of military operations but also against the water. The KONDUKTOTEST device which enables to observe changes in conductivity after the permeation of toxic compounds and water through the tested barrier material has been used. This measurement system and used method is very sensitive and is able to verify the functionality of the conductive sensor. Conductivity of the clear material equals zero. After the water permeation or even penetration the conductivity is changed that declares destruction of protection properties of filtration materials. All changes are recorded by the special software GRYF HB Magic XBC 8.

Investigation Results. Let us remind, that all barrier materials should be produced in the way they should protect user against water gases and vapors. However, the level of hydrophobic or oleophobic treatment can be changed after the time of the practical employment, some activities concerning decontamination, cleaning, washing and so on. It is very important to have a system which enables to measure these changes and provide researches with quick data for immediate decision related to the real time of protection either after performed modification of the barrier materials surface or after some activities common in the military life. Authors found that the tested system works very well and obtained data is repeatable.

Conclusions. The following results of our investigation were obtained:

- ◆ The measurement system KONDUKTOTEST is usable for quick measurements of drench;
- ◆ The conductive sensor on the circuit board seems to be very good for further application;
- ◆ The obtain data can be evaluated in accordance with norms concerning permeation measurements.

The above mentioned observations allow us to foresee that the new type of the measurement system can be used for observing changes barrier protective materials after the maintenance activities performed in normal military live. It also enables researches to contribute to the verification and occasionally development of new approaches in order to enhance the capability to protect against drench.

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Keywords: *KONDUKTOTEST, conductivity sensor, barrier material, chemical warfare agent, drench, penetration.*

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Modern Cybercrime Threats for Modern Organizations

Simonas Panavas^{a1}, Jolanta Sabaityte^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania,
Silo g. 5A, LT-10322 Vilnius*

Introduction. It is important for a modern organization to understand the potential harm of cybercrime and to be able to use preventive measures focused on improving the cyber literacy of staff and protecting their computer equipment. The growing tendency of cybercrime forms is a reason of cybersecurity existency in every modern organization [1-4].

Taking into account the topicality and the problem raised that modern organizations cyberspace is not secure, this work aims to provide the conceptual framework of cybersecurity threats prevention for modern organizations. To analyze that problem deeper, a theoretical study of cybercrime has been carried out, including an analysis of cybercrime conception, typology, and characteristics of individual types such as cyberattacks, viruses, and social engineering by analyzing [5-12].

According to the National Cyber Security Center of Lithuania (NKSC) research [13], social engineering has been identified as a major threat to modern organizations due to its tendency to grow. Also, based on [14], the weakest part of the information system was found to be human. Therefore, security measures for the information system have been established based on experts of cybersecurity [15]. In order to gain a deeper understanding of the cyber security situation of the modern organizations, a multi-stage empirical research methodology was developed, consisting of two social engineering experiments. The analysis of the research results revealed that the lack of cyber literacy knowledge and attentiveness of the organization staff in research determines that the internal network of the organization is not adequately protected against modern cyber threats.

Method of Investigation. The typology of cybercrime was identified by analyzing scientific literature. The tendencies of cybercrime were analyzed by analyzing statistical data of the National Cyber Security Centre. The social engineering “*phishing*” type attack experiment, imitation of cyber attack, was done by programming a fake site and sharing it. Also, Gmail used for creating fake email box from which letters were sent to the organization personnel’s email.

Investigation Results. The objective of the empirical study was to verify the cyber-security of the modern organization network. The analysis of the results of complex research revealed that the cyber literacy knowledge of the users is insufficient to protect the organization’s network. Lack of cyber literacy knowledge is proved by a series of experiments and the

1 * Corresponding author. Tel.: 370-6-47-17-538.
E-mail address: simonas.panavas@lka.lt

comparison of the results. Thus, conducting the experiment, it was found that:

- ♦ Hypothesis H was raised that the modern organization's network is not secure, was confirmed due to the lack of cyber literacy knowledge of the organization's email users. After experimenting to test the social engineering resistance of an organization's email account users, it is found that 36 % of all users opened a website with the address provided in the fake email. This shows that as many as 36% of all users are vulnerable to this type of cybercrime, although one person would be enough to open an infected link and infect the entire network.
- ♦ A comparative result of the study of a similar experimental method from May 17, 2018, until May 19, 2018, with the analysis of the research results showed that cyber literacy knowledge is improving, even that in this paper the research letter was more visually realistic, but the number of those involved in the experimental activities was 20% less.

Conclusions. The following results of the research were obtained:

- ♦ The cybercrime is defined as a crime related to computer-related crimes. Types of cybercrime identified include cyber-attacks, viruses, and social engineering. The analysis identified the types of cyber-attacks, social engineering, and viruses and their characteristics, which describe the signs of crime and potential harm.
- ♦ Analysis of the statistical data revealed that the cybercrimetends to grow, especially social engineering, because of the weakest part of the human being in the information security system. Measures are in place to prevent cybercrime, such as firewalls, antivirus software, public key infrastructure system, surveillance equipment, hacking tests, and staff training.
- ♦ The research of modern organization personnel resistance to modern cybercrime threat is carried out. The methodology of the experiment website HTML and PHP programming codes and operation algorithm is presented according to the created experimental scenario. Using the experimental method study, simulation of social engineering phishing type attack, it was found that 36% (266 persons) of organization personnel are not resistant to social engineering attacks, thus confirming the hypothesis (H) raised t – a network of the modern organization is not safe. If this were a real case of this type of attack, the chosen organization's network would be infected with malicious software.

Keywords: *cybersecurity, information security equipment, cybercrime, social engineering, cybersecurity plan.*

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Challenges of State Security through the Lens of ATO / JFO Literature

Anhelika Dilai^{a1}

*^aMilitary Institute of Taras Shevchenko National University of Kyiv,
Lomonosova str. 81, 03022 Kyiv, Ukraine*

Introduction. The almost unconcealed attack by the Putin regime on Ukrainian democracy has caused shock in the West, from which it has not yet fully recovered. One of the evidences of this situation is the statement by the chairman of the most important non-governmental forum on security - Munich Security Conference - V. Ischinger before the opening of this meeting: “2017 will be the year of the highest level of uncertainty for the world” [1].

The traditional Munich Security Report 2017, which is being produced over the year by over twenty of the world’s leading security institutes, has been dubbed “Post-Truth,” “Post-Event,” “Post-Order?” This agenda is uniquely inspired by the Kremlin’s global influence technologies, one of which is the post-truth issue [2].

Information in today’s world plays a key role in all aspects of life, especially security. The media have become a platform for discussion and for terrorism, which today is the publicity. The ultra-fast dynamics of the information space led to the news that it lives the maximum of the day. And naturally, the question is, is there anything that can have a lasting effect and what can we use in the security field?

Such an instrument has been the literature that has raised to the surface the “blind” zones of security institutions, problems and trends of the modern post-information world. Literature as a medium of communication is the most talked-about source for security research, particularly in Ukraine.

The sources of our study were prose for the period 2014-2018, describing the armed aggression of Russia against Ukraine, written by direct participants in hostilities, volunteers, internally displaced persons (real refugees), public figures, journalists, writers.

Method of investigation. The main methods are content analysis and critical discourse analysis, which is to enter the identified problems into the dynamic military-political sphere of Ukraine, where public negative becomes a challenge to strategic communications in the security and defense sector. First, we have identified and analyzed such key concepts as “post-truth” and “hybrid war” as the realities of the new era and “misinformation” and “fake” as tools for achieving the goals of “post-truth” and “hybrid war”.

Investigation Results. The study revealed a number of problems: lack of diverse information directly in the ATO area, insufficient number of state-owned media, poor external and internal

1 * Corresponding author.
E-mail address: lika_dilay@ukr.net

communication, lack of sufficient cultural enrichment of fighters as a way of psychological unloading.

Conclusions. The analyzed source confirmed that fake and post-truth are artificially created and manipulative-imitation technologies that Putinists use for hybrid warfare. By imposing the post-truth era on the international community, the Kremlin regime creates a reality where emotions are dominated by facts. Thus, Russia's information strategy is based solely on the needs of the lower order.

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Keywords: *security, media, literature, hybrid aggression*

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Content Senses Influence on Military Communities through the Mass Communications System

Grygorii Lubovets^{a1}, Yurii Dubinchenko^b, Dmytro Ivashchynshyn^c

^a*Military Institute of Taras Shevchenko National University of Kyiv,
Lomonosova str. 81, 03022 Kyiv, Ukraine,*

^b*Military Institute of Taras Shevchenko National University of Kyiv,
Lomonosova str. 81, 03022 Kyiv, Ukraine,*

^c*Military Institute of Taras Shevchenko National University of Kyiv,
Lomonosova Str. 81, 03022 Kyiv, Ukraine*

Introduction. Fastening and diversification channels/formats of service-man's communications in everyday life and service force us to behave properly with sociolinguistic "luggage". Meanwhile, appears an issue of personal sociolinguistic hygiene of military and his/her capability of sociolinguistic discursive methods, and their application in AFU frameworks and defense and security area for efficient activity.

Investigation results. Full-fledged complex development of marker categories for the methodological principles of the sociolinguistic mapping of the military security environment should be based on a comprehensive multi-stage humanitarian-cultural, sociolinguistic communication-content research as a separate research case.

In our investigation (it is a scientific-research "Research of public-content negatives in the modern dynamics of various-format practices of hybrid aggression" accomplished by Military Institute of Kyiv National University named after Taras Shevchenko) we outline the identified approaches to such categories, content meanings of the aggressor of consciousness and group mentality of the Ukrainian society, in particular servicemen through the mass communication system - mass media and communications assets.

Science-research group concluded that popular memes, for example – "vatnyky", "separiy", "maidanuti", "maidanivtsi", "ukry", "ukropy", "junta", "nashi", "opolchentsi", "kadyrivtsi", "na movi", "humconvoy", "narod Donbasa", etc. appeared to be simulated comprehension markers of processes due to communication employment on the line of engagement in separate areas of Donetsk and Luhansk regions (and eventually, across whole territory of Ukraine and Russian Federation as well). They have become axiomatic statements to divide people on friends or foes. If such expressions are used on opposite sides of line of engagement, they form up imaginary demarcation line based on principle friend/foe. If such expressions are used in AFU units, they can - in some cases - create or stress the psychological atmosphere in the collective.

We draw attention to the fact that quite often the uncritical attitude towards the memes

1 * Corresponding author. Tel.: +380674041572
E-mail address: bmv0662@i.ua

imposed by the aggressor is used to demonstrate to the international community that in some areas of Donetsk and Luhansk regions (TOT) there is a civil confrontation with employment of the Armed Forces of Ukraine to suppress so-called Donbass people etc.

Conclusions. These and other marker categories indicate the status of sociolinguistic infection / impression, lexical-semantic influences, and mental-mythological memes of the aggressor (direction requires separate study). The last are often implemented in human space through varieties of lies (fakes), narrative compositions, ideologues or simply dogmas of the past, which are historically based on the principles of the Soviet era and the mental patterns of the “red man”. All these mental-semantic features are used by the aggressor to hold attention and seek to dominate in public space in the occupied territory of Donetsk and Luhansk regions, the line of engagement, and generally in the territory of Ukraine.

Identification of specific marker categories of sociolinguistic reflection of the military and security environment in the process of sociolinguistic diagnosis of personnel will help us to fix cultural-humanitarian, geopolitical, historical-mental, society and social attitudes and civic values in the military (defence and security) collectives and set up dependencies between use and pre-existing understanding, goals and application, appropriateness of use in business, private, family places, etc.

Keywords: *hybrid aggression, public-content, sociolinguistic diagnosis, psychological atmosphere*

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Global Climate Change as a Challenge to the National Security of Ukraine

Olena Shevchenko^{a1}, Kira Horiacheva^b

^a*Institute of International Relations of Taras Shevchenko National University of Kyiv, Lomonosova str. 81, 03022 Kyiv, Ukraine,*

^b*Military Institute of Taras Shevchenko National University of Kyiv, Lomonosova str. 81, 03022 Kyiv, Ukraine*

Introduction. Climate change is a new threat to international security. The manifestations of global climate change are warming the atmosphere and the ocean, melting of glaciers, rising sea levels, ozone layer depletion, polluting the forests, desertifying, depleting soils, the problem of mass scarcity of food and drinking water, reducing biodiversity.

Global climate change is a challenge for Ukraine. 2018 was the warmest year in Ukraine for last 140 years. The manifestation of climate change in Ukraine are the shift of climate zones from the south to the north, increasing the area of the steppe zone. Polesia, which was previously considered as an area of excess moisture, suffers from drought, and precipitation becomes more local and is accompanied by heavy showers, thunderstorms and floods. Uncharacteristic pests have appeared, fresh water has been reduced, which is a threat to food production.

The response to the global climate challenges has been the approval of the National Security Strategy of Ukraine in 2015, where the challenges discussed above are classified as topical threats to the national environmental security. Threats to environmental safety include, in particular, excessive anthropogenic impact and a high level of technogenic load on the territory of Ukraine; significant amount of waste of production and consumption, inadequate level of their recycling and utilization, etc. [1].

Method of Investigation. The complexity and multidimensionality of the problem have determined the methodological basis of the study, which consisted of the principles of objectivity, multifactoriality and systematicity. In the context of this paper, an interdisciplinary method of discourse analysis is considered to be the most productive for studying the impact of global climate change on Ukraine's national security, as it allows us to answer the following questions: "How is global climate change in Ukraine today? What are the possible scenarios and consequences of climate change in Ukraine and in the world? What are threatened by climate change; and what adaptation and mitigation strategies will be best for the area?"

To determine the impact of global climate change on Ukraine's national security, a systematic approach and its component as a political analysis were used, which provided a holistic view of climate challenges for Ukraine. The comparative method made it possible to collate scenarios of the climate change effects on Ukraine, other European countries and the most

1 * Corresponding author.
E-mail address: ovsh@ukr.net

climate-vulnerable countries in the world. The most significant threat to Ukraine's national security as a result of global climate change was identified using the forecasting method. The empirical basis of the work was data from the World Meteorological Organization (WMO), the Intergovernmental Panel on Climate Change (IPCC), the Adelphi Research Center, Germanwatch, Zoi environment network, the Ukrainian Climate Network and the Ecodia Initiative Center [2-7].

Investigation Results. The analysis showed that the most likely scenarios of global climate change for Ukraine would be the effects of rising oceans, lack of drinking water, soil erosion and new diseases.

So, due to the rising sea level by the end of this century, coastal cities in the south of Ukraine will completely go under water, and Odessa, Nikolaev, Kherson, Mariupol, Berdyansk will be partially covered with water. Shortage of drinking water will be especially serious in large cities. Due to the prolonged drought, rivers will grind, and cities like Kiev will either have to look for new sources of water, or save water [6]. The degradation of land and steppes in the south of Ukraine is already happening and will continue. From new infectious diseases and pests, Ukrainian forests will gradually disappear.

Warming will lead to increased soil erosion. Ukrainian agriculture, on the one hand, is capable of developing new crops and harvesting two or three crops a year, and on the other, farmers will be forced to fight for water, protect crops from new pests and unpredictable weather anomalies [4]. In addition, new diseases that are now common in the tropics will come to Ukraine.

Moreover, according to IPCC forecasts, Ukraine is not one of the countries that will face the most severe consequences of global climate change [2]. Therefore, we believe that the *biggest challenge to Ukraine's national security and global threat will be climate refugees*: internally displaced people from the southern territories and foreign climate migrants from the most climate-vulnerable countries. By the middle of the century, up to 250 million climate refugees are projected to appear, for which Ukraine and Europe will look very attractive. According to a Germanwatch study, the largest flow of climate migrants will be from Africa (Guinea, Sierra Leone, Nigeria, Angola, Chad, Sudan, Somalia, etc.), the Middle East (Libya, Iran, Iraq, etc.), Asia (Afghanistan, Pakistan, India, Bangladesh, Sri Lanka, etc.) [7].

Conclusions. Thus, the effects of global climate change further aggravate the climate crisis - in addition to warming, rising sea levels, lower drinking water and anthropogenic emissions, people themselves become an additional threat factor.

For agriculture, energy and other sectors of the economy, the solution of climate challenges is the implementation of adaptation and mitigation projects (for example, switching to renewable energy sources, spreading green spaces, switching to intensive agriculture, etc.). The solution of the issue of climate refugees, which are a challenge and a threat to the national security of Ukraine, lies on a political plane. This includes the adoption of a national climate policy, the introduction of a unified state system for monitoring and controlling the flows of climate migrants, and the appropriate training of the armed forces, civil defense forces and internal troops of the country.

Keywords: *global climate change, national security, climate refugees, mitigation, adaptation.*

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Addressing the Threats to National Security. Poland's Experience

Eugeniusz Cieślak¹

*Siedlce University of Natural Sciences and Humanities, Faculty of Social Sciences,
Institute of Security Sciences, ul. Żytnia 39, 08-110 Siedlce, Poland,*

Introduction. Recent decades have become a period in which threats to national security have changed significantly. In addition to threats in the sphere of cyberspace, information threats have appeared, and climate change has been becoming an existential threat for a number of countries. Traditional security threats have not disappeared, but in combination with the new ones, they have created a qualitatively new situation in the security environment. Such a situation makes efforts to ensure national security more and more difficult. Ensuring state security requires precise identification of threats, determining their impact on state security, and then taking actions to eliminate specific threats. Contrary to popular belief about the priority of states' actions to counter security threats, the situation seems a bit more complicated.

New security threats have been not always treated with due care. Spectacular security events have been needed to discover the potential impact of new threats on the security of the state and its citizens. On the other hand, addressing traditional security threats has often required taking actions that radically affected the social order and have not been favourable to the ruling elites. As a result, addressing threats to national security has been often undertaken with delay and the scope of efforts has been limited by political, economic and social factors. This situation may be exemplified by actions taken by Poland over the past two decades in relation to threats to cyberspace security, information threats, energy security and environmental protection.

Method of investigation. The research objective is to analyze and evaluate selected actions taken by Poland to minimize security threats. The analysis has been conducted using an unified research framework for selected security threats, taking into account the stages of threats identification, shaping legal and organizational solutions for countering threats, and implementation of actions addressing the threats. The assessment tries to take into the effects of efforts or lack of them to address specific security threats. The analysis and assessment of Poland's efforts in addressing specific threats to national security has been based on the recent public administration documents regarding the assessment of security threats and ways of addressing them. The assessment confronted the assumptions of governmental conceptual documents (strategies, policies) with the analysis of the effectiveness of governmental actions carried out by the Supreme Audit Office, recognized academic centres and analytical studies of selected think tanks.

¹ * Corresponding author.

E-mail address: eugeniusz.cieslak@uph.edu.pl

Investigation Results. The analysis of the ways in which Poland has addressed the threats to its national security allows identification of specific patterns of actions. Identification of threats and assessment of their impact on national security has usually been a long-term process subjected to a number of intertwined conditions, primarily of a political nature. Development of the legal and organizational frameworks to address specific threats to national security took time and often took place by trial and error, and the preliminary solutions were not always optimized for a specific threat. In addressing threats to national security, Poland has sometimes faced problems with the development and implementation of long-term strategies and policies, as well as with their stable and sufficient financing. As recent experience suggests, while addressing emerging threats to national security, Poland may react with a certain delay and the initial actions may not be fully adequate to the nature of these threats and their potential effects on national security. In short term, Poland's actions to address security threats may be influenced by ad hoc political decisions related to the priorities of the state's policy, which may hinder the coherence of actions aimed at addressing security threats in a long term perspective.

Conclusions. Ensuring an acceptable level of national security by Poland has required coherent, long-term efforts that minimized adverse effects of security threats. The analysis of Poland's experience in addressing threats to its national security suggests that a broad spectrum of intertwined factors influenced first the identification of security threats and their impact on state's security, then development of legal and organizational frameworks for addressing threats and finally the implementation of strategies and policies. Based on the assessment of recent experience, some predictions may be made on how Poland will address emerging security threats to national security and how effective those efforts may be.

Keywords: *national security, security threats, security policy, Poland.*

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Russian Command and Control – from C2 to C4IRTAD

Daivis Petraitis^{a1}

^aThe General Jonas Žemaitis Military Academy of Lithuania, Silo str. 5A, LT-10322 Vilnius

Introduction. A commanders ability to command and control own troops like an ability of a state government to govern the entire state depends on a system they possess to receive an information about an ongoing situation, to analyse it, to make the most effective decision, to pass it to subordinates and finally to be able to track how it is performed. There are four sub-system elements of new Russian Command and Control system: structures (organisations), communication means, means to analyse information and produce decisions and concepts prescribing how decisions are made and executed. Two of them heavily depend on technological development of the country.

Since the early 2000s Russians military analysed western Network-Centric-Warfare (NCW) theories and expanded own C2 to the C4IR system based on NCW principles. In this C4IR different NCW sub-systems are arranged according different swarming approaches. Since the military reform started, Russians kept building a new system, which was tested and now is being implemented not only in the military but also in the entire state.

As it has been mentioned two of them (enablers): communication means and means to analyse the information and produce decisions depend on technologies very much, so the emphasis in this presentation will be put on exploring what technological achievements Russians used to move own Command and Control to the highest level of efficiency. The other two will be only briefly mentioned here due to mostly being the deliverables not from technologies but from theories and culture of commanding and governing.

Until the recent years, structural sub-system of Russian military (and state) Command and Control system was quite simple and straight-lined. Commanders and managers were placed at different levels (strategic, operational and tactical) and all the communications they had among themselves was adequate. Despite available communication means information and orders fluctuated according established hierarchical lines. Today the structural sub-system of Russian C4IR is built following a Hierarchical Swarming approach and crowned by National Defence management center (NDMC) who in own turn is back up at all levels.

Two other C4IR sub-systems (enablers) – communication means (radios, radio relay, satellite, line and fibre optic lines etc.) and means allowing analysing data and making effective decision (automated Data Systems (ADSs) and Automated Command Systems (ACSs) relay on technologies. In Russian case both are built into C4IR by following the Distributed Swarming approach, which allows the information, the data and commands and orders to be distributed to all players in the system simultaneously.

¹ * Corresponding author.

E-mail address: Daivis.Petraitis@lka.lt

In previous years Russian communicational means were built on such a way what interoperability among them was difficult and almost absent. As soon as technologies allowed Russians to move to fifth (multiple) and sixth (Software Design SD) generation radios, all the information and data started to fluctuate between different levels (from tactical to strategic) simultaneously. At tactical level sixth generation SDR "Äzart" became the main system and next to fifth generation "Akveduk" and "Ärtek" and sixth generation "Stilet", "Shans" and "Strelec" systems allowed all players to communicate among themselves and with higher echelons. At operational and strategic levels other systems like "Redut", "Antey", "Liven" or "Baryer" finalised an establishment of the unified communicational net backed up by adequate line, radio relay or other means.

Another story is about the sub-system for analysing data and making effective decision (ADSs and ACSs). Previously Soviets had numerous ADSs, which belonged to different military services (Land, Air, Naval, etc.) and worked independently at different levels. However they were not interoperable, so analysed situations and data had to be transferred to other systems and summarized at higher levels (HQs). Developed in Russian new unified ACSs like "Ändromeda-D", or "ÄCY-3 Sozvezdya" are not only unifying all tactical level players in one net but also are fully interoperable with a higher level ACS "Akacya-M" and even the strategic level ACS. This allows all the players included in the C4IR to get a real time information, situation awareness, directives and orders assigned. An additional capabilities and support to those ADSs and ACSs became available due to a huge computing capabilities developed by Russian and installed in the NDMC. So called "Program Apparatus Complex -PAC" allows the General Staff to work out a draft decisions based on previous historical cases or theoretic calculations. Today Open Sources claim that close to 180 draft situation response plans and decision sets are worked out and available to the NDMC duty shifts. Even more, there are indications showing that an artificial Intelligence (AI) is also being used to make this PAC to work out potential solutions and formulate adequate orders in the future without humans even being involved.

The fourth sub-system of the new C4IR is a concepts bloc. Here the technology plays lesser role, because concepts depend more on military philosophy and a way commanding structures do the planning and perform activities. Because of long lasting Russian military culture which emphasize detailed planning and synchronization of activities, concepts used to prepare solutions and decisions and the way they are distributed according the Orchestrated Swarming approach.

As it has been mentioned this C4IR system is being build right now, but this is not the end. There are a lot of evidences and facts showing that in future, then the system is fully developed and technologies matured, Russian are planning "to plug" "a kill element" consisting of target acquisition (sensors) and destruction (weapon) means into this system at all levels. This would transfer the system into Command, Control, Communications, Computers, Information, Reconnaissance, Target Acquisition and Destruction (C4IRTAD) mode. Later, with AI introduced into this mode the lethality of the system will increase in number of times due to some response to any situation taken automatically and people would be released from dealing with details of the battle and left to concentrate on more wide and important tasks.

Keywords: *Russian Command and Control system, Network-Centric-Warfare, C4IR system*



Czech Army and Security Policy of the Czech Republic

Jiri Stodola^{a1}

*^aUniversity of Defense in Brno, Faculty of Military technology,
Kounicova St. 65, 662 10 Brno, Czech Republic*

Introduction. The contribution deals in brief with information characterizing real state in the area of risks and providing the Czech Republic security 20 from after entering NATO. They are analysed goals of the Czech Army as a basic guarantor and main powerful force providing the defence of the Czech Republic against military threats. In 1999, the Czech Republic became a full member of NATO and during this period the most significant changes in this organization took place. A dynamically changing strategic environment with persisting “classic” risks, supplemented by completely new risks after September 11, 2001, and the threats grow into a global threat, so the current World can be characterized.

Peace, security, human rights, economic stability, etc. are attributes of security, resp. the very existence of humanity. Uneven economic, demographic and educational development, uncontrollable population growth, economic problems, famines, incurable diseases and epidemics, uncontrollable migration, the danger of war conflicts including the use of the weapons of mass destruction, organized crime and global terrorism are causes threatening security and human being itself. The UN, OBSE, EU, NATO, etc. were created to solve fundamental problems of the World [1]. The membership of the Czech Republic in NATO is a new policy, a new strategic concept of stability and security in the 21st century, based on openness to all countries that share democratic values and principles. Existing Euro-Atlantic and European organizations and institutions are the fundamental fundamentals of the security architecture.

The aim of the Czech Republic and the Czech Army is to promote national interests, ensure peace, stability, prosperity, security and human rights. The Czech Republic and the army of the Czech Army contribute to this issue from a broader and longer-term perspective, especially in relation to the tasks arising from membership of the NATO Alliance [2].

A specific the Czech Army is generally defined by the state security policy, alliance and national defence tasks, security risk analysis, force analysis, etc. in the area of state defence, these are the five main features: determining the importance of air superiority; decisive importance in the field of information the need for technological superiority, high-precision weapons that destroy only military (terrorist) targets without harming the civilian population and ability to perform ground strikes immediately after air strikes that can break any defence [3].

¹ * Corresponding author. Tel.: + 420 973 442 278.
E-mail address: jiri.stodola@unob.cz

Method of investigation. In solving the problem, the system approach was chosen, which included a methodological procedure using a combination of scientific methods of general content analysis of national and international documents, comparison of the current state of the problem at the Czech military level with selected NATO member states and V4 countries. We took into account the location of the Czech Republic in the center of Europe, our capabilities, experience, alliance commitments and expected security policy solutions [4]. It can be stated that the whole process is dynamic and respects the specifics of the Czech Army, a country with limited resources, but a highly developed defense industry and an army that has alliance capabilities and relatively rich experience with foreign missions [5].

Investigation Results. Objective priorities of the construction, preparation and use of the Czech Army include [6]:

- ♦ introduction of modern weapon systems with emphasis on special forces and ground troops,
- ♦ fully implement Alliance's operational leadership principles with emphasis on resilience of command and control systems;
- ♦ to prepare and train on the basis of the analysis of combat capabilities of the ACR, to solve the preparation of active reserves,
- ♦ cultivate the factual profile of our NATO membership based on the capabilities of different types of troops, our contractual obligations and policy documents;
- ♦ in the area of planning and resources on the basis of possible scenarios of probable use of Czech army and its interaction with other parts of the state, to impose priorities for military research and science with the aim of comprehensive modernization of all weapon systems,
- ♦ to make a defensive concept conditional on strategic political and military decisions, where it is essential to stabilize the Czech army as a professional army with optimized target numbers, organizational structure and location.

Conclusions. Security issues around the world are now closely tied to NATO's mission and objectives. Membership in the Alliance is of particular importance for the Czech Republic, where after years of instability, we have secured our future. But NATO membership also has a special responsibility. In addition to each country's commitments to each other, each country participates in the Alliance's commitments to the international community as a whole. We can responsibly state that the all-round involvement in NATO is today the Czech Republic main contribution to ensuring security in the world. The Czech Republic considers the Strategic Concept of Stability and Security an inevitable process, its implementation is likely to be closely related to the future inevitable acceptance of the new UN competences, its fundamental restructuring and the formation of the UN as a broad democratic collective instrument of global power. For the Czech Republic, membership in the Alliance constitutes an institutional framework for military defence, but it is also important in other areas outside military defence, such as crisis management and emergency planning, counter-terrorism, humanitarian aid, arms control, control and non-proliferation of weapons of mass destruction, industrial and scientific cooperation, etc.

Keywords: *strategy of security, global risks of threat, activity and goals, the Atlantic Alliance defence.*

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Security Studies in European National Political Science Communities: Consolidation Driven by Geopolitics?

Giedrius Česnakas^{a1}, Irmina Matonytė^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania, Silo str. 5A, LT-10322 Vilnius*

Introduction. In the less predictable geopolitical context the relevance of the specialized security studies and, subsequently, of their experts, is ever-increasing. Security studies is essentially the sub-field of political science (with “power” as the object of academic interest). Security experts often (or, inevitably) also deal with matters, pertaining to international relations (international security, covering military, economic, statecraft or hard security, at the same time security studies refer to soft security: human security, migration, societal, information and other broad spectrum of issues).

Alongside, security studies attract specialists of public administration, management and governance. Any social, technological, natural or material issue which can be “securitized” becomes an object of security studies. Barry Buzan argues that security issues “encompass a whole domain, rather than just a fixed point, and for this reason cannot be defined in any general sense” [1]. The inter-disciplinary character of security studies is emphasized: it is impossible to define the essence of security since security is always related to other concepts [2]. In terms of normative expectations and evaluations, it is necessary to relinquish the idea that security has an essential meaning or fixed condition [3].

Therefore, security concept is contested and has “no overall agreement in academic circles as to its exact meaning” [4]. Within this complex conceptual disciplinary scholarly debate worldwide, the experts of security studies become more visible in the public eye and more authoritative as policy advisors. In the US this trend is observed for more than a century with an increasing number of think-tanks and their affiliations with parties or particular decision makers. A closer scrutiny of the emerging “tribe” of security experts in Europe also yields thought-provoking insights.

The *object of the study* – structural characteristics of national communities of security experts in Europe.

The *aim of this study* is to check if geopolitical conditions have an effect on researchers’ identification with security studies in European countries.

Hypotheses:

H1. There are more researchers who identify with security studies in national political science communities in great European powers (the United Kingdom, France, Germany and Russia) than in the middle sized and small states.

1 * Corresponding author.

E-mail address: giedrius.cesnakas@lka.lt

H2. The higher level of democracy in a country, the more its researchers identify with security studies (for instance, in Nordic countries there are more security experts than in Southern-Eastern European countries).

H3. Researchers from ex-Soviet countries tend to identify with security studies to greater degree than the researchers from the rest of Europe.

Methodology of investigation. The research is based on “Professionalization and Social Impact of European Political Science” COST Action 15207 survey which was conducted in spring 2018 in 38 European countries (all 28 EU member states, Balkan countries, Russia, Ukraine, Iceland, Israel, etc.). Total sample of respondents (N= 2258) encompassed representatives of national political science communities, defined as those who have a PhD, teach political science subjects in a tertiary education establishments and/ or publish academic texts nationally and/ or internationally and / or provide professional advice on political matters to decision-makers and / or comment political matters to public audience. In the following analysis, the respondents who mentioned “security studies” as their teaching field were classified as “researchers who identify with security studies” (the respondents could mark up to 3 fields in which they have been delivering university courses during the last three years). The COST survey data set was complemented by additional variables, indicating great-medium-small power classification of a country in the international system, the state of democracy and the presence/ absence of Soviet legacies. Descriptive statistics and correlation analysis were conducted.

Investigation Results. First, European great powers do not have significantly more security experts: their share in national political science communities is similar everywhere (around 10%); thus, H1 was not confirmed. Second, there is only weak connection between the state of democracy (level of freedom) [5] and the size of the “tribe” of security experts in national political science communities. Indeed, the correlation is negative -0.104 indicating that less free societies have more security experts; thus, H2 was falsified.

Finally, there are more security experts in ex-soviet states (excluding Russia): 25% on average (in Latvia 54%). In the former socialist countries (ex-Yugoslav countries included) average is 12%, while in Western European countries the average is 8%. Thus, H3 is confirmed. This finding leads to the insight that the geographical proximity to Russia (one of major threats in current geo-political context) is a strong predictor of the size of national security studies communities in Europe. This interpretation is further illustrated by the case of Israel, with 22% strong security researchers’ community, functioning in a highly breakable geopolitical context.

Conclusions. Identification with security studies in European countries is pretty low (around 10%). Security studies have strong connections with international relations – 2/3 of those who teach security studies also teach international relations. Lecturers of security studies focus mostly on “hard” security issues (56% of security lecturers give policy advice on international affairs, development aid and EU-matters and 41% of security lecturers are solicited on matters pertaining to “defence”). The share of security lecturers who advise on “soft” security issues is 16%. The geopolitical situation is a strong predictor of the size of security experts’ community in European countries. In less democratic countries more researchers identify with security studies.

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Keywords: *Political science, security studies, Europe, state of democracy, geo-politics, Russia.*

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Structural Trends of Defence Expenditure in the Baltic Countries

Gitana Dudzevičiūtė^{a1}

^aThe General Jonas Žemaitis Military Academy of Lithuania, Silo g. 5A, LT-10322 Vilnius

Introduction. Defence is controversial, because people have different views about protection, security and threats [1]. Defence output, which is provided in the form of security, is military production function with inputs of capital, technology and labour [1]. Defence sector should be investigated as a combination of the human resources, manufacturing, research and development [2]. Most countries tend to spend more on defence because of global insecurity and power politics [3]. The relationship between defence expenditure and economic growth has been examined in a large number of empirical researches [4, 5, 6, 7, 8, 9, 10, 11], but the investigations have not showed uniformity among results. There has been controversy in the scientific literature over whether defence spending has a positive, negative or no relation impact on economic growth [12]. In examining the relationship between defence and economic growth, it is possible to distinguish 4 types of links as follows: 1) a link showing impact of defence spending on economic development, 2) a link demonstrating influence of economic growth on the level of defence expenditure, 3) a feedback between variables analysed and 4) non-existence of any links between anticipated variables [13]. Odehnal and Neubauer (2012) have identified possible links between defence expenditure and economic growth in selected NATO countries from 1950s to 2009. The research has revealed that economic growth causes defence spending in Germany and Portugal. Moreover, defence expenditure causes economic growth in Belgium, Denmark, France, Germany, Italy, the Netherlands and Portugal [13]. The study of Yilgör et al. (2014) has revealed that in the long term there exists a relationship between defence expenditure and economic growth. The authors have found that defence expenditure is a factor in economic growth. Finally, the research has concluded that defence expenditure in economically developed countries positively contributes to their economic development [12]. Huang et al. (2014) also agree that increasing the share of defence expenditure is favourable for economically strong countries [14]. The study of Duella (2014) has examined the causal relationship between defence spending and economic growth in Algeria for the period 1980-2010. Empirical estimates have indicated that economic growth in the long run is negatively related to defence spending [4]. The examination of the link between the defence expenditure and economic growth has provided different results in the EU countries. Broadly, in economically strong countries, the researchers have detected a bidirectional and unidirectional causality running from defence to economic growth. In economically weaker countries, the causality has appeared to run from economic growth to defence or non-existent [15]. Defence spending has been determined by political, strategic and economic factors [1]. Defence could be as preventative expenditure in case some foreign

1 * Corresponding author.

E-mail address: gitana.dudzeviciute@lka.lt

power starts becoming aggressive [2].

The paper has investigated the patterns of defence expenditure in the Baltic countries, such as Lithuania, Latvia and Estonia during the period of 2004-2018. Distribution of defence expenditure by main category has been analysed and the main tendencies have been provided. The author has done this by applying total expenditure and decomposition approaches. Firstly, the author has calculated the intensity rate of defence expenditure's structural changes in order to assess which country's defence spending structure has been more dynamic over the period analysed. Secondly, Finger-Kreinin indicator has been used to compare defence expenditure distributions and determine their dissimilarities among the countries under consideration. The author believes that the research highlights key structural trends of defence expenditure and could be helpful for policy makers.

Method of investigation. The investigation has been based on NATO information. It has provided a possibility to compare NATO countries by different defence indicators. The research has involved three main steps as follows: 1) descriptive statistics; 2) estimating of intensity rate of structural changes; 3) calculation of the Finger-Kreinin dissimilarity.

Investigation Results. During the period 2004-2018, Estonia devoted the largest share of GDP to defence compared to Latvia and Lithuania as well. On average, it amounted to 1.82 percent, while in Latvia and Lithuania it was 1.31 and 1.18 percent respectively. During 2004-2018, Latvia has had more dynamic structure of defence expenditure than Estonia and Lithuania. This has been mainly due to a significant increase of the defence spending share for equipment and decrease for personnel. Assessing the pairs of the countries, the most significant dissimilarity has been revealed between the defence expenditure structures of Estonia and Lithuania in 2004 and 2018 as well. Moreover, in 2004, Estonia and Latvia had the most similar structures of defence expenditure. In 2018, Latvia and Lithuania were the most similar countries in term of defence expenditure structure.

Conclusions. The following results of the investigation have been obtained:

- ♦ The examination of the link between defence and economic growth has provided different results across the countries. Broadly, in economically strong countries, the researchers have detected a bidirectional and unidirectional causality running from defence to economic growth. In economically weaker countries, the causality has appeared to run from economic growth to defence or non-existent. Defence spending has been determined by political, strategic and economic factors.

- ♦ In Estonia, other defence expenditure, including operations and maintenance spending, dominated over the period of 2004-2018. In Latvia and Lithuania, expenditure for personnel, including military and civilian spending and pensions, prevailed in the total defence structure.

- ♦ Over the period analysed, Latvia has had more dynamic structure of defence expenditure than Estonia and Lithuania. This has been mainly due to a significant increase of the defence spending share for equipment and decrease for personnel. The intensity of changes in Latvia's defence spending has been more than three times higher than in Estonia and 1.5 times higher than in Lithuania.

- ♦ The most significant dissimilarity has been revealed between the defence expenditure structures of Estonia and Lithuania in 2004 and 2018 as well. In 2004, Estonia and Latvia had the most similar structures of defence expenditure. In 2018, however, Latvia and Lithuania were the most similar countries in term of defence expenditure structure.

Keywords: *defence expenditure, structural changes, economic growth.*

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Dilemmas of Defense Policy-making: an Aspect of the Development of Military Structures

Gintautas Razma¹

The General Jonas Žemaitis Military Academy of Lithuania, Department of Political Science, Šilo str. 5A, 10322 Vilnius, Lithuania

Introduction. Recent discussions about the ‘war’ have opened up ontological issues. Is violence really a prerequisite for ‘war’? [1], [2, p. 23] Is ‘war’ just an act of physical violence? Or does it also include the dimension of non-physical violence? Is ‘war’ in general just a matter of military and politics? Do the western and the non-Western societies understand, interpret and apply the *nature of war* in the same way? These questions challenge the explanation of Clausewitz, a classical military science theorist, who argues that *violence* is a central element of war [1, p. 9]. Also, same questions challenge Šlekys’ interpretation of Clausewitz work, who argues that the *nature of war* is not changing, only the *character of war* is changing [2, pp. 25, 144]. The interpretation of ‘war’ as a social phenomenon has never been so uncertain than it is now. Today, uncertainties about ‘war’ are also enhanced by the rapid pace of globalization and technological advances [3]–[7]. But most of all the concept of ‘war’ is influenced by the liberal ideology that dominates the Western society [2], which took mainstream ground after end of the Cold War [8, p. 196]. According to Šlekys ‘war’ is marginalized and heavily oppressed by liberal ideology [2, p. 28]. This is matter that is “*pushed aside*” and mainly excluded from the development of western states issues. This is particularly noticeable in most of Western defense policy practices, where ‘offence operations’ or ‘attack’ elements is simply excluded from warfare and adopted ‘pure defense’ strategies [2, p. 99]. But the same is not seen on the non-Western states’ side [4]. In addition, the concept of “war” is more widely seen and used by non-Western policymakers [4], [9].

However, defense policy strategies cannot simply be explained by Western and non-Western or liberal and non-liberal dichotomies. For example, there are significant differences in defense policy strategies and practices in the United States, the United Kingdom, Switzerland, France and Germany. Also, differences are seen in non-liberal states, such as Russia, China [10], [11]

Differences are also noticeable in military structures development approaches. The political and military elites of some states use traditional ways of developing military structures, while others use hybrid methods [12]. Also ‘traditional’ or ‘hybrid’ ways differ, which creates different *combat power* for military structures. Differences are noticeable even in states, which share similar historical, geographical and geopolitical situation. For example – Baltic states, share similar internal and external risks, geographical and geopolitical reality [13], however defense policy and developed military structures differs [14].

¹ * Corresponding author.

E-mail address: gintautas.razma@lka.lt

In the light of these statements, *a problem arises in this study* - the lack of an analytical model to explain what determine the directions of defense policymakers when developing national military structures.

The *object of this study* is the dominant narratives of national defense policy that likely determines the direction of defense policy makers in the development of national military structures.

The *aim of this study* is to generate a consolidated list of the dominant narratives from official defense policy-making documents that likely determines the direction of selected states defense policy makers in the development of national military structures.

Method of investigation. This study was carried out mainly using official defense policy-making document analysis and focused military relevant literature review method along with, already conducted, “*A Modern Warfare Paradigm. Reconsideration of Combat Power Concept*” study [4]. Official defense policy-making documents (National ‘white books’, defense strategies, doctrines, etc.) was analyzed based on depth qualitative research by grouping dominant narratives. Focused relevant literature review was combined with other qualitative methods: analysis and systematization. This study was conducted in the case of selected states.

Investigation Results. This study revealed three dominant narratives that likely determines the direction of defense policy makers in the development of national military structures:

- ◆ Threats and risks situation awareness narrative;
- ◆ Geospatial situation awareness narrative;
- ◆ Geopolitical situation awareness narrative.

Although this distinction of dominant narratives seems promising in explaining defense policy-making in the direction of development of military structures. However, this consolidated list of dominant narratives has limitations and it must be refined and tested in future studies.

Conclusions. Attitudes towards military structures are significantly changing, however military structures still remain an important component of defense policy. In face of the changing understanding of war, it is important to understand what determines the direction of military structure development and how it can be explained.

Keywords. *Defense policy, military structure, military development, combat power, dominant narrative.*

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Rescue in the Polish National Security System in the Context of the Evolution of Non-military Threats

Henryk Wyrębek¹

*Siedlce University of Natural Sciences and Humanities, Faculty of Social Sciences,
Institute of Security Sciences, ul. Żytnia 39, 08-110 Siedlce, Poland*

Introduction. The Polish national security system contains, in addition to universal solutions typical of all countries, certain specific elements resulting from internal and external conditions, history, tradition, culture and values recognized as superior in our country. The main function of the state is to provide its citizens with protection of life, health and property by effectively counteracting military and non-military security threats. Rescue is one of the elements of the Polish national security system. Rescue aims at saving human health and life, helping people in danger and protecting material goods.

Changes in the nature, intensity and frequency of modern non-military threats necessitate the improvement of rescue activities to include forms of involvement, cooperation and coordination of various services and resources. Poland is developing system solutions, structures and tools for efficient and effective rescue operations in the event of non-military threats to the security of its citizens. The effectiveness of rescue in Poland, especially in the face of new non-military threats, is assessed as not sufficient. This applies above all to rapid atmospheric phenomena and crisis situations related to interruptions in the functioning of key social services. The shortcomings in the rescue system have encouraged a broad scientific discourse and activities undertaken by public administration aimed at improving the rescue system in Poland.

Method of investigation. The purpose of the article is to analyze and evaluate the Polish rescue system and the organization and cooperation of institutions and services carrying out tasks in the field of saving and protecting life, health and property, with particular emphasis on changes in non-military threats to Poland's national security. The analysis and assessment of the rescue system in Poland has been conducted on the basis of the latest public administration documents regarding the assessment of non-military threats and analysis of the operations of the rescue system, including audit reports of the Supreme Audit Office, reports and publications of the Government Security Centre and analytical studies of selected think tanks. The assessment of the rescue system in Poland has taken into account conclusions and recommendations of representative scientific studies on the issues of crisis management and rescue. The considerations were narrowed down to the issues of rescue related to civil protection and crisis management in Poland in peacetime.

¹* Corresponding author.

E-mail address: henryk.wyrebek@uph.edu.pl

Investigation Results. The rescue system in Poland ensures effective implementation of tasks in the field of saving and the protection of life, health and property in situations of most non-military threats to Poland's national security. The main shortcomings of the rescue system in Poland are related to the lack of fully consistent legal regulations of the statutory level related to civil protection, and, as a consequence, executive acts enabling effective rescue operations in the event of non-military threats. Warning and alarm subsystems need improvement to be more reliable and timely. It is also necessary to modernize the equipment used in rescue operations as they requirements for such operations grow and there were no significant modernization efforts undertaken during recent years. Improved training for the public administration and emergency services is important to assure effective operations of the rescue system. The importance of educating the public about non-military security threats and rescue operations must be also stressed.

Conclusions. Rescue services play an increasingly important role in Poland's national security system in peacetime. This is due to the evolution of non-military threats, including the increasing incidence of violent atmospheric phenomena and related interruptions in the functioning of public services. To increase the effectiveness of rescue operations in Poland, it is necessary to improve legal regulations and organizational solutions, as well as to expand educational activities for society related to counteracting non-military security threats.

Keywords: *rescue, Poland, civil protection, non-military security threats.*

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The Global Distribution of Power After the Cold War. A Powermetric Approach

Robert Białoskórski^{a1}, Mirosław Sułek^b

*^aSiedlce University of Natural Sciences and Humanities, Faculty of Humanities, Żytnia 39;
08-110 Siedlce, Poland*

*^bWarsaw University, Faculty of Political Science and International Studies, Krakowskie Przedmieście
3, 00-047 Warsaw, Poland*

Introduction. In the concept of realism, the states (countries) are playing game of power and interest in the international system (IS) to survive and develop. In this game, the states compete to take the best position in the ranking of power. This allows to pursue their national interests more effectively. States with the greatest power (top states) decide on the polar structure and geostrategic nature of IS at every level (global, regional, local). Investigating the structure (static research) and nature (dynamic research) of global distribution of power (IDP) after the Cold War three types of power: economic power, military power and geopolitical power were taken into consideration. The results of theoretical and empirical research are relevant to the decision-making process of the political system of states directly or indirectly involved in the international security.

Method of investigation. The empirical research is based on theoretical grounds of powermetrics. Powermetrics is a new term, introduced by Prof. Mirosław Sułek (co-author of the paper), combining two concepts – ‘power’ and ‘metric’. It has been adopted on the ground of Polish science. Powermetrics is an applied science, dealing with the measurement and evaluation of the power of political units, especially states (nations) and forecast the relation between them on a global, regional and local scale using of models and simulations scientific methods.

See: Powermetric Research Network (<http://prnet.org.pl/en>). In this respect, synthetic formal model of measuring the power of states was applied. Three types of power measurement formulas have been applied: (1) economic power, (2) military power, (3) geopolitical power. To determine the polar structure of IS an algorithm of comparing the ratios of the largest powers of states in the ranking has been implemented. Based on a power measurement results, the dynamic power status (PS) has been investigated. In this case, the measuring scale from the smallest 1 to largest 5 (1-local power, 2-regional power, 3-great power, 4-world power, 5-superpower) in relation to a percentage of the global value has been applied. The polar structure of IS has been investigated in relation to 2018, and the dynamic nature - in period of 1992-2018. The source data from: The World Bank (<https://data.worldbank.org>) and The Military Balance (London: International Institute for Strategic Studies, 2019) during research have been applied.

1 * Corresponding author: Tel.: +48 695 800 101.
E-mail address: robert.bialoskorski@uph.edu.pl.

Investigation Results. The IDP in three dimensions, according to: (1) economic, (2) military and (2) geopolitical power has been determined. Among the top states of power rankings, the states with pole status have been specified. The key indicators determining these systems have been also examined. The dynamic power status enabled tracking changes and assessing their impact on these systems.

Conclusions. The following results of our investigation were obtained:

- ♦ There is no one 'universal' concept of the international system (IS) – these studies require a vector (dimensional) approach;

- ♦ According to state power measurement based on the latest available data (1992-2018), there are three types of global IS: (a) bipolar economic international system with China and the United States; (b) unipolar military international system with the United States, still in the role of a hegemon, but with the dynamic increasing China's military power on the way; China is undoubtedly the potentially second pole of the military international system in the coming decade; (c) bipolar geopolitical international system with the United States and China.

- ♦ The Russian Federation and the states of Western Europe (Germany, France, United Kingdom and Italy) are the biggest losers of the global IS in Post-Cold War era.

Acknowledgements.

Keywords: *international system, powermetrics, economic power, military power, geopolitical power*

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Detection of Negative Impact on the Personnel through the Mass Media, Mass Communications, Social Networks

Valerii Korol ^{a1}, Veronika Karpenko^b, Olena Nikiforova^c

^a*Military Institute of Taras Shevchenko National University of Kyiv,
Lomonosova str. 81, 03022 Kyiv, Ukraine,*

^b*Military Institute of Taras Shevchenko National University of Kyiv,
Lomonosova str. 81, 03022 Kyiv, Ukraine,*

^c*Military Institute of Taras Shevchenko National University of Kyiv,
Lomonosova str. 81, 03022 Kyiv, Ukraine*

Introduction. The need to apply sociolinguistic and communication-content methodological approaches to the detection of negative impact on the personnel of the troops through the media, mass media, social networks and available public augmented reality in a predetermined geopositioning location, which has a permanent civic component, caused primarily by the extreme conditions, collectives, taking into account peculiarities of linguistic behavior in typical social and communicative situations. These situations are directly related to the geopositioning features of the territories where the various activities take place, and the operational tasks and the accomplishment of the specific mission.

Investigation results. During 2018-2019, Research Department of Military Institute Kyiv National University named after Taras Shevchenko conducted “Research of public-content negatives in the modern dynamics of different forms of hybrid aggression practices”.

The study considered, in particular, the topic of sociolinguistic features in the activities of the Armed Forces of Ukraine. Sociolinguistics as a science and practice focuses in particular on such pressing problems of today as the relevance of communication, above all interpersonal, hierarchical-managerial, public, micro- and macro-social groups, different linguistic groups, etc. In the current conditions of the Joint Forces Operation (JFO), the function of sociolinguistics implies, first of all, the development of effective forms of social and speech behavior, effective discourse styling, brand presentation flows of functional activity, that is, a certain complex that would meet a fast and high quality.

With the growth of dynamic processes in the information space, the emergence of new types of mass communications, including social networks, public augmented realities (blogosphere, digital content sources of constant and non-permanent action, infrastructure and service platforms of global reach: Nimsis, Telegram, Amazon, Netflix, etc.), first of all, there is a fact of increasing negative influence on the moral-psychological and mental-cultural state of the Armed Forces of Ukraine personnel. This influence often (preferably) has the delayed action

1 * Corresponding author. Tel.: +380931380310
E-mail address: ValKOR2005@ukr.net

potential (on the methodological scale of the negatives of communication-content processes: challenge, risk, threat), when summation of certain information have a meaningful effect within a given period.

Based on the result of the work, which examined, which investigated the information activity of the 20 Armed Forces brigades, proposals were developed for the implementation of state information policy in the Ministry of Defense and the Armed Forces in general, as well as proposed models of effective use of alliances information potential for positioning the Armed Forces in society and at international arena.

Conclusions. Sociolinguistic (language groups) and communication-content (streaming-dynamic content dimensions) techniques should be employed simultaneously, which will give a synergetic effect of understanding the real morale of a given military personnel.

Sheer necessity for a sociolinguistic and communication-content nature of working with linguistic means in the Armed Forces units is that we pay attention to the weight and quality of the word, idiom, linguistic-mental form, or cultural and personal stylistics of the use of the word.

Sociolinguistic tools, communication-content services and infrastructure solutions in the Armed Forces and the defence and security sector of the state can be an important complement to the personnel protection system.

Keywords: *pressing problems, communication-content, sociolinguistic tools*

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Improving of Effectiveness in the Army Management for the Automation of the Geoinformation Component

Nataliya Lytvynenko^{a1}, Oleksiy Fedchenko^b

^a*Military Institute of Taras Shevchenko National University of Kyiv,
Lomonosova str. 81, 03022 Kyiv, Ukraine,*

^b*Military Institute of Taras Shevchenko National University of Kyiv,
Lomonosova str. 81, 03022 Kyiv, Ukraine,*

Introduction. The issue of improving the effectiveness of military command in the short term is one of the most important and priority in the command system development of the Armed Forces of Ukraine. Control system is the troops command and control authorities, that is actually the control part of the system (the first level information subsystem of a complex system decomposition), that controls the executive part of the system (the first level resource subsystem of a complex system decomposition). In this case, the purposeful information function of the control part is identified with the feature of the entire information management process in the system, which also involves the executive (resource) part. The executive information function is implemented by a resource part that “consumes” the information of combat missions and transforms it during the action of forces (on the operational level) into the current situation information, which is “consumed” by the control part (control of the compliance of the forces action process with their combat task).

Investigation Results. One of the ways to improve the quality and efficiency of the control system operation is the process of control automation, which, in turn, influences the improvement of troops (forces) combat effectiveness [1]. In order to implement the process of military control automation, it is necessary to use a single geoinformation framework and specialized geospatial data processing software.

Compared to the Armed Forces of the leading countries of the world, the current state of providing the Armed Forces of Ukraine with terrain and objects information it is characterized by insufficient use of the huge opportunities of information technologies in the processes of geospatial information creation and processing. The constant increase in the information required amount and the reduction in decision-making time make it urgent to develop a military geoinformation system, that is an integral part of modern automated military and weapons control systems, and use them in planning and the management of combat units of the Armed Forces.

In today's context, the volumes and variety of data used in the planning, organization, and conduct of military operations have grown significantly. The composition of information

1 * Corresponding author. Tel.: +380-68-593-21-75.
E-mail address: n123n@ukr.net

required by management and staff in the process of their activities is constantly supplemented by various types of data. Already today, the necessary varieties of data in the required volumes cannot be accepted, processed and integrated with the use of existing software and hardware by the military authorities in making operational decisions to conduct operations and use of weapons.

The process of managing troops in terms of information transmission and processing is conditionally divided into a series of successive steps. They are organizational and process-related. Only the direct preparation of troops for combat tasks is full of practical measures that cannot be minimized in time. Therefore, a real advantage over the enemy can only be obtained by reducing the time to process information directly in the military. The implementation of automation and digital geoinformation management systems will accelerate the decision-making process.

In the traditional approach, there are two problems in the work of the headquarters. The first is to display the whole military unit of the plan on the map and to bring it to the officers of the unit management. The second is related to the mutual informing of the deputies and chiefs of the troops and services about the contents of the graphic unit, approved by the commander of the unit of proposals. In the conditions of automation and use of electronic maps, these problems can be solved by allocating the powers of the management unit officials to the collection and sequence of drawing the situation on the commander's electronic map. Also, designing and creating hardware and software that will meet the special requirements of the troops will minimize the combat cycle [2-5].

Conclusions. Thus, the essence of the military control automation will not only be in equipping troops with digital communications, especially in the purchase of expensive software and hardware, but in reducing the time to process information and automate those work performed by staff officers manually through implementation geoinformation and special information component in the process of military management.

Keywords: *geoinformation component, special information component, process of automate, geoinformation technology, army management.*

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Private Military Companies in the Russian Federation Foreign and Security Policies in 2014–2019

Aivaras Giedraitis^{a1}

*^aThe General Jonas Žemaitis Military Academy of Lithuania, Department of Political Science,
Šilo str. 5A, 10322 Vilnius, Lithuania*

Introduction. As the nature of war changes [1], the military tools and strategies of states change too [2]. Increasingly, private military and security companies (PMSCs) or private military companies (PMCs) are being deployed to pursue states interests rather than regular forces. Nowadays, Russian PMCs are being hired to operate in regions such as Syria, Africa, Ukraine and Venezuela [3] and to pursue Kremlin objectives [4]. The importance of PMCs has increased since Russia's invasion in Ukraine and annexation of Crimea in March 2014 [5]. Reliance on PMCs is not the main strategy of Russian policy, but it covers a substantial part of it. Revealing the motives and features of involvement of mercenaries would provide the basis for research which would allow defining how Russia employs PMCs, what its goals are and what results it has achieved.

The analysis is conducted applying principal–agent theory, would begin to explain state choices and behaviours of Russia and PMCs in its strategy. According to the principal–agent theory, delegation is a cost–saving tool useful for the principal who lacks the knowledge and expertise associated with the task [6]. The micro theory explains the circumstances of delegation and the interests of the state that determine the use of PMCs. The case of Russian Federation is analysed, based on these factors.

The object of the study – use of private military companies in Russian Federation foreign and security policies 2014–2019, in the regions of: Syria, northeast and central Africa, Ukraine and Venezuela.

The aim of this study is to disclose goals and traits of using private military companies in Russian Federation foreign and security policies in 2014–2019.

Defensive statement – the use of private military companies in the Russian Federation's foreign and security policy is close to that of conventional forces, avoiding responsibility for its actions.

Method of investigation. To reveal motives, goals and traits of using PMCs in Russian Federation's foreign and security policy in 2014–2019, qualitative research method is applied. The case study approach seeks to assess Russia's assumptions on reliance on PMCs, the cases selected for the study are limited by period (2014–2019) and within the regions of Syria, northeast and central Africa, Ukraine and Venezuela.

1 * Corresponding author.

E-mail address: Aivaras.Giedraitis@lka.lt

Investigation Results. In general, Russian PMCs pursue strategic and operational interests in all regions, but not all hotspots are financially beneficial. The regions are in geographically uncomfortable locations, except for Ukraine, which is likely to be the most convenient region to pursue Russian Federation's strategic goals. Kremlin is controlling the port of Sevastopol and consolidating its position, providing strategic deterrence to US missile defense systems deployed in Romania. While Syria and African states are faraway regions, with access to the Tartus port and Egyptian airway, Russia is free to supply PMCs fighting in area. In both regions (Syria and Africa), Kremlin seeks to control natural resources, maintain the image of a dominant state and gain regional influence. Venezuela meanwhile is potentially the most uncomfortable region because access to the area is only possible by air or sea. By recruiting PMCs rather than regular forces in different regions, Russia avoids not only responsibility for its actions, but also conflicts with the USA, which is beneficial and effective for Moscow's foreign policy. Analysing the use of Russian PMCs in the regions, it was noticed that the state is not able to directly challenge more powerful states. It is also known that Kremlin is not fully responsible for PMCs, as Russia selects those it mandates to oversee hired groups. One of Russia's trustees, Yevgeny Prigozhin, finances PMCs through parent company (Concord) he controls. Regardless of who the mercenaries belong to, they are poorly controlled but well equipped with weapons of Russian origin, so it is easy to distinguish who possibly supplies them. Even though Kremlin uses Ukraine as place for the selection of competent PMCs, the problem of agency slack occurs, which means mercenaries are lack in discipline. It was noted that Kremlin fails to achieve its goals effectively when hired PMCs are not efficiently controlled.

Conclusions. The defensive statement put forward in the research can be affirmed, but it should be emphasized that the investigation noted Russia's tendency to hire PMCs for combat than security-related tasks. According to the specifics of the forces and the scheme of diversity in social deviations, PMSCs are similar to regular forces. It is difficult to determine whether the motives for using both types of forces are the same; there are similarities because both choices achieve more or less the same tasks. Although the control of regular forces is simpler due to the disciplined military structure, PMCs, unlike conventional forces, help Russian Federation avoid direct responsibility for delegated work.

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Keywords. *private military and security company, private military company, mercenary, foreign policy, security policy, Russia, conflict.*

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Procedure and Principles of Information and Psychological Operations in the North-Atlantic Alliance (Based on NATO Documents)

Ivan Nevmerzhytskyi¹

*Research Fellow, Linguistic Research and Development Department, Research Center,
Military Institute of Taras Shevchenko Kyiv National University*

Introduction. The information component of the modern course of life, as it became apparent after the specific manifestations of the hybrid aggression of the Russian Federation in Ukraine in 2013, operates not only concepts and data, but also directly determines the development of mankind in all its aspects. Given the combined factor of Ukraine's current military and political course, the hybrid aggression of the Russian Federation, the processes of rapid and intensive development of the Armed Forces in accordance with NATO standards, and the dynamic orientation of non-military entities and institutions to NATO practices and procedures, there is a need for specific action psychological operations by NATO nations.

The scattered efforts and visions, the inconsistency of the approaches and procedures of the structures and institutions of Ukraine responsible for informational and ideological immunization of the population, the fight against propaganda and misinformation, as history has shown, proved to be fatal to the national and cultural integrity of the Ukrainian people.

Method of investigation. Considering a wide attention to the domain of informational wars in general, current field activities in this area and the domestic context, such methods as empirical observation, analysis, comparison and extensive reference to the topical sources and documents were used in this research.

In recent years, in particular since the Russian aggression inception, the subject of information and psychological operations has received special attention – namely, in the context of the use of information and psychological operations (PSYOPS) and misinformation against both the civilian and military populations of Ukraine. The essence, practices and procedures for their implementation in terms of domestic and Soviet approaches are revealed in the works of such scientists as: A. Manojlo [1], O. Saprykin [2], Zharkov [3], I. Vorobyov [4], I. Slyusarchuk [5], V. Khoroshko [6], L. Chistokletov [7]. A. Stadnik conducts a comprehensive comparative analysis of PSYOPS models by Western structures (Britain and the USA) with the Russian model, which covers both military and civilian conceptual spheres [8].

We also drew from the works of the experts whose achievements contribute to a better understanding of information operations and PSYOPS practices and procedures, such as R. Marutyanyan, V. Petryk, I. Golovin, I. Panarin, N. Kostin, S. Komov, M. Popov, V. Gudim,

¹ * Corresponding author.

E-mail address: translating@gmail.com

V. Telelim, V. Fomin, A. Chernyak, V. Bogush, A. Ros, P. Chernik, A. Shumka, O. Feklistov, V. Tsigichko, D. Vedeneyev, V. Ostroukhov and others.

Yet the main sources for this research, due to their consolidated representation and regulatory nature, which specifies and pretexts the peculiarities of the information operations and PSYOPS in Ukrainian realms, are the NATO documents - Allied Joint Publication AJP-3.10.1, Allied Joint Doctrine for Psychological Operations [9] and Allied Joint Publication AJP-3.10, Allied Joint Doctrine for Information Operations [10].

Investigation Results. The article contains systematization of principles, peculiarities and procedures for carrying out information and psychological operations in NATO countries. It provides the definition of the concepts of psychological operation (PSYOPS) [9, p. 1-1], information operation [9, c. 1-1], [10, c. 1-5], strategic communications [9, c. 1-2], as well as their distinction and functional interrelations in the context of domestic perception of these processes.

The following basic principles of PSYOPS are explained: truthfulness, orderliness, consistency, coordination, understanding, timeliness and efficiency, assessment, attribution [9, c. 1-6]. The following peculiarities of PSYOPS are mentioned and explained: interaction with other units and components of military operation (civil-military cooperation, intelligence, military public relations, force protection), operational planning, targeting, operation evaluation, and consequence management [9, c. 1-12].

It describes the process of coordination, planning and organization of information activities, and also specifies their differences in the context of the domestic experience realms of information and psychological operations. In particular, the main tasks of the PSYOPS planners are mentioned: assessment of the future PSYOPS; assistance in making changes to the general military operation program; determination of material needs, sources of provision and the budget of PSYOPS; mission analysis with changes to the commander's critical information requirements and planning guidelines; participation in the development of courses of action; 6) participation in the development of the operational plan; making changes to the operational plan in accordance with the PSYOPS tasks; review of other functional requirements in accordance with the PSYOPS tasks; determination of requirements for forces (divisions)/capabilities; development of the PSYOPS plan.

Conclusions. Among the current developments in the field of information warfare, this article was the first to systematize and adapt the provisions of the North Atlantic Alliance guidelines that determine the procedure for carrying out information, psychological operation activities. The article analyzes and organizes the principles and procedures for conducting NATO information and psychological operations. Fundamental differences between them were revealed, which were not covered properly by the Ukrainian media subjects; a resource was provided to secure and consolidate a common vision and approaches to conducting information and psychological operations in the interests of ensuring the ideological and cultural-intellectual protection of the population of Ukraine.

The article presents a wide opportunity for broader coverage on various scientific horizons. In particular, prospective researchers should attach particular importance to adapting or modifying the structures of NATO's information operations units in accordance with national realities and practices, the procedures for determining and measuring the effectiveness of

such events, and the ways to ensure a stable and effective coordination between military and non-military actors during their implementation.

Keywords: *information operation, psychological operation, NATO, strategic communications, psychological influence, hybrid war, NATO Standard, military operation, subject of influence, object of influence, target audience.*

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Governance of Military Geospatial Data and Cartographic Products in Baltic States in Changing Security Environment

Vytenis Žilevičius^{ab1}

^aThe General Jonas Žemaitis Military Academy of Lithuania, Department of Political Science, Šilo str. 5A, 10322 Vilnius, Lithuania

^bMilitary Mapping Centre of Lithuanian Armed Forces, Muitinės str. 4, LT-54359 Domeikava, Kauno r.

Introduction. Why the coordinate system used in military topographic maps is different from civilian maps? Why is the private sector more involved in the production of Lithuanian and Estonian military geospatial data than in Latvia? To what extent does the membership in the European Union (EU) and the North Atlantic Treaty Organization (NATO) influence the principles of geospatial data governance? These and similar issues to look at the structural causes and motives behind describing, explaining and predicting solutions of geo-spatial data design, projects under development and their possible evolution. Much of the production and management of military geospatial data and cartographic products depends on the material-technological capabilities and expertise of the country. However, the situation is inevitably influenced by the international environment, geopolitical situation and organizational structures and politico-military traditions within the country, in the region and in the EU and NATO.

The principles for mapping are laid down in the Law of the Republic of Lithuania on Geodesy and Cartography [1], which integrates the provisions of the European Parliament and Council Directive on Infrastructure for Spatial Information (INSPIRE) [2]. Meanwhile, the maps created for military purposes must comply with NATO standards – STANAG [3], which are managed by the NATO Bureau of Standardization [4], and its implementation in Lithuania is controlled by the Lithuanian Armed Forces.

In order to assess the weight of different players and rules that shape the policies in this area, it is useful to carry out geospatial data and cartographic product governance analysis. Governance [5] in this context refers to the processes of interaction and decision-making among the actors involved in a collective problem solving that lead to the creation, reinforcement, or reproduction of social norms and institutions [6].

Over the past decade, EU-NATO relations with Russia have changed significantly, economic sanctions have been imposed [7], and several agreements restricting military armaments have been withdrawn [8, 9]. These political decisions have led to establishment of new NATO elements, such as the NATO Forces Integration Unit (NFIU) [10] or NATO Enhanced

1 * Corresponding author.

E-mail address: vytenis.zilevicius@mil.lt

Forward Presence Battlegroups (eFP) [11] in three Baltic States and Poland. Ensuring the initial provision of military geospatial data and cartographic products is of paramount importance for the smooth functioning of these newly established NATO elements. At the same time, implementation of principles and procedures for the sharing of this ever-changing data and products is a key to enable the geospatial domain support effectively (leading to the consolidation of the NATO information superiority).

Lithuania, Latvia and Estonia (the Baltic region) have accelerated the process of updating national military geospatial data and cartographic products and adapting them to the EU and NATO standards. These attempts lead to creation and reinforcement of social norms and institutions in this peculiar policy domain. Geospatial data formats; metadata, delivery timelines, quality requirements are being streamlined and tightened, new units and institutions are being set up.

The object of the study – governance of the military geospatial data and cartographic products in Baltic States.

The aim of the study is to check what impact the changing security environment has on the governance of military geospatial data and cartographic products in Baltic States.

Method of Investigation. The subject of the study (dependent variable) is the governance of military geospatial data and cartographic products (GDGP), the unit of observation is the defence systems of three Baltic States. In the phase of theoretical modelling, a series of political factors that may shape the actions of nation-states with regard to governance of the GDGP are distinguished:

- ◆ NATO factor. The evolution of NATO institutions against the backdrop of new international security challenges;
- ◆ EU factor. Evolution of EU defence policy;
- ◆ National factor. National level developments of security and defence policies;
- ◆ Regional factor (three Baltic States [12] and Poland). Assessing the synergy, complementarity or competition among the selected.

An analysis of the impact of these factors on the governance of GDGP enhances understanding of their differentiated effects and suggests guidance for further improvements of cooperative development. Analysis of relevant official documents was combined with participant observation and expert interviews.

Investigation Results. Evolving arrangements of national-regional-European-Western power institutions, changing concepts of war as well as turbulences in international relations induce transformation of the governance of geospatial data and cartographic products, aimed to assure collective regional defence and security. Recent geopolitical changes in Europe had huge impact on the governance and production principles of GDGP, leading to such innovative solutions as, for instance, establishment and deployment of new NATO elements (NFIUs, eFPs, etc.) in the territories of three Baltic States (and Poland).

Conclusions. Analysis results and factual data of all factors influencing the study subject dependent variable - GDGP governance in the Lithuanian, Estonian and Latvian defence systems significantly expands the research of the topic. Study presents comprehensive material as a changing security environment, changing military concept, new international security challenges, political decisions to integrate into international organizations and technological

development driven changes have affected the geospatial provision in Baltic States in general, and in Lithuania in particular.

Keywords: *Governance, geospatial data, cartographic products, NATO, EU, Baltic States.*

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Improvement of Change Resistance Management in Professional Military Service Unit

Donatas Milinskas^{a1}, Jolanta Sabaitytė^b

^{a,b}*General Jonas Žemaitis Lithuanian military academy,
Šilo str.5A, LT-10222, Vilnius, Lithuania*

Introduction. As globalization increases in the modern world, society is changing faster than ever, organizations are implementing tools for better flexibility. The national defense system (further - NDS) is not protected from such a state either. Managing personnel is responsible for the improvement of the system within the limits of their competence in professional military service units. As a result, new developments have to face up to their management and above all, face resistance to new developments. Differentiating aspects in organizational change management has been viewing change in terms of its size and impact, identifying the transformational and incremental elements and the necessary steps in achieving such change [1]. Vanagas [2] analyzing change, stresses the concept of alternation, which can often also be used as a synonym for change. The change, from the author's point of view, is the world's most constant existing process, which analyses the past to find out the factors of the present that are important for the future. Refer to changes that are made to improve or even fundamentally change some or other elements of an organization's lifestyle. In order to respond successfully to these changes, to make use of them to improve the organization's performance, it is necessary to understand the causes and possible trajectories of their occurrence.

The management of change in the organization is studied from various perspectives and the results of the studies are summarized. The specificity of studying change management suggests examining four parts of change as context, content, process and outcomes [3]. Managing change is an unavoidable necessity and it is therefore unequivocally accepted that there is no single and unique definition of managing change. In literature, there is often a classic presentation of the change management model by Kurt Lewin which is widely considered the founding father of change management, with his unfreeze–change–refreeze or 'changing as three steps (CATS) [4,5,6].

Videikiene [7] defines change management as anticipation of change, elimination of its potential negative consequences and use of positive advantages. Further this article analyses changes in the organization leading to deliberate and unconscious resistance to them. It's a common situation where the organization's managers and employees are making a huge effort to assess the situation and determine what changes the organization needs, but very often changes don't happen as planned or at all. According to the author Videikiene [7] organizations that do not pay enough attention to managing change are confronted with this

1 * Corresponding author. Tel.: 370-6-57-47-878.
E-mail address: donatas.milinskas@lka.lt

problem. There is currently no strategy in the army describing the implementation of change and its board. Nor does the system of stimulating change exist. There has been no research in the army into what obstacles and the problems encountered to innovate or other innovations. The biggest problem seen from practice is bureaucracy, people's apathy or resistance to change, at whatever level, whatever sphere it is in. Resistance to change has usually been recognized as a significant factor that can influence the outcomes of an organizational change effort [8]. The aim of the research is to create conception model for resistance of changes management in military perspective.

Method of Investigation. The investigation of this research focus on establishing factors affecting resistance to change in a division of professional military service. In order to achieve the objective of this article, literature analysis, analysis of the factors of resistance to change, analysis of other social factors may influence the tendency to resist change was carried out.

The research is divided into steps:

- ◆ Literature analysis. The literature review was carried out to define the concept of resistance to change, to distinguish between its forms and possible contrasts to reduce resistance to change;
- ◆ Analysis of the factors of resistance to change;
- ◆ Developing and adapting a model for reducing resistance to a professional military service unit.

Literature lacks of information on the introduction of change and its management in professional military service. At this point has any investigations in the NDS been detected in relation to this area.

Investigation Results. Analysis of the literature shows that organizational changes have their own causes and drive power. In beginning to start with individual qualities and to finish with social reasons. Main answer can be found in factors. Compared all factors can be seen in the parallel presence of the private sector and NDS. Some of the factors for example like economic probability may not materialize directly, but in all NDS funding from the country gross domestic product. Successful implementation requires making changes in to preplanned changes. Develop a strategy for implementing change so that it can be taken step by step an obsessed goal.

Conclusions. The following results of our investigation were obtained:

- ◆ Each resistance has its own sources and is divided into individual and organizational;
- ◆ Resistance is divided into expression forms which may be open, concealed and delayed, each of them may have similar causes. And his expression is more influenced by man's personal qualities.

Keywords: *Resistance to changes, change management, national defence system, organizational behaviour,*

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Geopolitical Situation in Russia – Recent Changes and a Role of Technologies in Centralizing and Strengthening the Governing of the Military and the State

Daivis Petraitis^{a1}

^{a1}The General Jonas Žemaitis Military Academy of Lithuania, Silo str. 5A, LT-10322 Vilnius

Introduction. Today Russia is a country discussed at different forums almost every day. One has to accept, that since the beginning of the millennium Russia demonstrated more and more boldness and behaved provocative and this was due to some essential changes the country passed through. Technologies have an important role to play here. They were “a secret weapon” and a clue then a Russian military reform was initiated more than a dozen years ago. Alongside a structural reorganisation of the military, technologies and as a consequence new equipment introduced at first into war fighting units and formations and later into the MOD life became the way the MOD changed. And all this have been done despite sanctions imposed on Russia after the occupation of Crimea.

Russian military managed to boost development of technologies and to substitute missing high-tech components for new arms with nationally produced ones simultaneously creating an efficient management system, again built on new technologies. As a consequence country's political leaderships realised that the success of those military developments could be used and introduced into civilian spheres as well by this making an entire country stronger and management of it more efficient.

During the military reform the MOD started centralizing its military Command and Control (C2). Theoretical foundation for the new C2 development started as early as 2000s then, to prepare the country for future wars, Russians military began analysing western Network-Centric-Warfare (NCW) theories and later adopting them into a national usage. The MOD established a National Defence Management Centre (NDMC) which became the first Russian institution very heavily relying on computers and modern communications.

First items were purchased from other developed countries but later began being created and made domestically. As a result an old C2 grew up to a level of the C4IR, where not only passing commands and orders but also sharing information and data and employing all this into a decision production process became the essential. But the most importantly the NDMC incorporated not only MOD forces but other Russian institutions, federal bodies and even companies as well.

1 * Corresponding author.

E-mail address: Daivis.Petraitis@lka.lt

Today Russian Armed Forces are at a comparatively high level of digitalisation and interconnectivity. And this is valid at all levels starting from a tactical one and ending at the top – at the NDMC. Russians moved from old analogue communicational equipment to digital fifth (multiple) and sixth (Software Design SD) generation radios which allows the information and data to fluctuate between different levels of command on real time mode. A tactical level sixth generation SDR "Äzart" became the main system alongside to fifth generation "Akveduk" and Ärtek" and sixth generation "Stilet", Shans" and "Strelec" systems. At operational and strategic levels systems like "Redut", "Antey", "Liven" or "Baryer" finalised an establishment of the unified communicational network.

Technologies effected analysis and decision making as well. While talking about this we have to note that the digitalisation made both processes absolutely different compare to what they used to be in the past. A creation of new unified Automated Command Systems (ACSs) like Ändromeda-D", or "ËCY-3 Sozvezdya" in tactical level, an ACS "Akacya-M" in operational and so called "Program Apparatus Complex - PAC" at strategic levels allowed players included in the C4IR to digest a real time information, to do situation awareness, to develop decisions and to draft proposals for directives and orders. Huge computing capabilities developed by Russian and installed in the NDMC allows to speed up an entire management and functioning of the entire military system. The General Staff now is able to concentrate more on working out a set of draft proposals for decisions based on previous historical cases or theoretic calculations. Open Sources claim that today already close to 180 draft situational response plans and decision sets are worked out and available to the NDMC duty shifts to use at any time.

Technologies in Russia are involving more application of Artificial Intelligence (AI) as well. There are indications showing that the AI is being used in the military to make this NDMC's PAC to work out potential solutions and formulate adequate orders in the future with less or even no human involvement. As one CEO from Russian company involved into the development and implementation of new technologies and AI stated in an interview to "Echo of Moscow" radio a smart city type project – the project which allows to collect, combine, analyse a real time data and information coming from numerous sensors and to respond to any situations instantly according prescribed algorithms - began to be tested not only in Moscow city, but also in the ministries of Emergency and Defence.

New technologies and achievements while implementing them motivated and forced the MOD to develop new operational concepts, where political factors become secondary and a primary role is devoted to managing ADSs, ACSs and AI. This becomes especially important in the recent world where situations might change so fast that there is not enough time to have political discussions so certain responses have to be already preplaced. This increases the role of professionals who directly control the systems and those who develop algorithms for programs of the systems. This makes the daily governing more stable, effective and ... less politically motivated. Of course political involvement retains the importance in special cases and in preparing political guidance for those "preplaced decision".

An important particularity while describing the recent geopolitical situation in Russia is a fact of the MOD becoming a leading institutions transferring own experience and expertise in a military command and control into a civilian state management. In April 2019 as a civilian clone if the NDMC a first new regional managing centre for Moscow region was established in Tula. At the end of January 2020 Putin visited the centre and was demonstrated how computerised

management helps municipal authorities to solve problems reported by citizens (or at least to account them) almost instantly. The centre received Putin's approval and a encouraging to other regions to move the same way. Similar structures technologically advanced, digitalised, interconnected and using especially designed software are being established at federal level as well. The MOD is followed by the ministries of Emergency, Ministry of Interior and state services like Russian revenue service. The last under the leadership of Michail Mishutkin became one of the most technologically advanced institutions in Russia. As it was mentioned, all they are integrated into the NDMC network so the plan to transfer an entire country into a digitalized state operating in the military and civil information communication network is prevailing.

Technologies have an impact on people and political environment as well. The executive leadership of Russia is changing. More and more people from the military and militarised organizations, possessing a certain institutional culture which appreciates involvement of technologies into functioning of institutions and young technocrats, familiar with technologies and eager to implement them into a life, are getting employed by political leadership to run the country. All they understand and see a value of centralising high technological governing of the state. The new Russian Prime Minister Mishutkin already announced that this technological progress will help the government to fulfil presidential projects. Political consequences are also seen.

Putin feels quite confident that with the power of new technologies and through the NDMC (or other potential supervising structures) he could maintain an overarching control over the country. He feels that his new political initiatives allowing (and suggesting) redistribution of powers among political Olympus players would have minimal effect on technocratic management of the state done by loyal professionals and this simultaneously allows him to keep a real control.

Keywords: *Russian military reform, new technologies, Artificial Intelligence, geopolitical situation.*



Lithuanian Emigrants Approach to National Security: Case Study

Mindaugas Gvildys^{a1}, Rolanda Kazlauskaitė Markelienė^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania, Silo str. 5A, LT-10322 Vilnius*

Introduction. Many countries in the world have been greatly affected by the processes of globalization. Emerging growth has influenced the growth of emigration, not exception and Lithuania. Being able to move freely within the European Union not only enables you to travel, but it do also work and study. Recently it has been stated that emigration in Lithuania is only increasing and this, of course, creates a number of economic, demographic and social problems. The state already referred to as a “walking country”, following intimidating migratory trends scientists use the term “brain drain”. These problems are likely to lead to lack of security in our country.

Population emigration is considered serious threats to the country’s demographic development, economic growth and the preservation of cultural identity. Emigration to the West is leading to a huge demographic and intellectual decline, constraining knowledge and the loss of public investment in their education. This threatens Lithuania’s social, economic and political stability and economic development.

21st Century emigration from Lithuania exceeded 3 percent border and pose a serious danger to the country for national security. This is confirmed by the data of Statistics Lithuania. The number of emigrants has been decreasing in recent years, but remains relatively high: in 2015year 44.5 thousand persons emigrated from Lithuania, 2016 year – 50,300 thousand, 2017year – 57.2 thousand, while in 2018 year – 32.2 thousand. Population of Lithuania in 2018 year there were less than three at the end millions (2,810 million). Today, the country’s emigration data per thousand population is one the largest in the EU. Over 800 thousand people have emigrated from Lithuania in the last 25 years. These people make up a quarter of the country’s population.

Lithuanian emigrants approach to national security is relevant because increasing emigration means loss of investments in human capital and constrains expansion of knowledge based economy via huge leakage of demographical and intellectual capacity and hence threatens national security, social and economic stability. This research is innovative and unique – one can find economic analysis of emigration in literature, but emigration has not yet been analysed from national security point of view. This angle becomes more and more crucial with continuing emigration, therefore study aimed to identify how Lithuania retains its young and motivated part of population.

1 * Corresponding author.

E-mail address: Mindaugas.Gvildys@lka.lt

Method of investigation. This work consists of: analysis of various sources of literature, that makes theoretical background for interrelatedness of emigration and national security; documentary analysis, that reviews relevant legislation; statistical analysis, that searches for correlation among number of emigrants and the pool of economic data; quantitative research in terms of the questionnaire, that estimates emigrants stance on national security; comparison and summary of theoretical and practical aspects on the topic.

Investigation Results. Long term emigration, that lasts longer than a year, has more impact on the country, because most of long term emigrants do not return. This is confirmed by the data, which reveals that most of emigrants live abroad for ten years or longer. Short term (under one year) emigration can be qualified as search for temporary financial improvement. That is in particular visible under financial crisis, where loss of working places and emigration leads to increase in search for personal income and new experience abroad. Most of participants of this research (94 percent) identify themselves as long term emigrants, and 76 percent of them have higher education. That means the loss of educational investment and qualified labor force.

Conclusions. The research reveals that most of respondents do not expect to return because they do not trust government authorities. They also think it is not reasonable to increase funding for The Armed Forces as well as the return of conscripts. The research confirms insights that emigration is a real threat for Lithuania's national security.

Keywords: *national security, long term emigration, human capital, economic stability, migratory trends.*

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Lithuanian Emigration Assessment in Pro-Russian Media

Remigijus Simonavičius^{a1}, Rolanda Kazlauskaitė Markelienė^b,
Nerijus Maliukevičius^c

^{a,b,c}*The General Jonas Žemaitis Military Academy of Lithuania, Silo str. 5A, LT-10322 Vilnius*

Introduction. Many foreign researchers study immigration and its impact on a specific country [1; 2]. Illegal immigration, terrorism and other crimes are the most common and most widespread issues threats, socio-economic aspects, etc. [3; 4]. But emigration the issue is rarely discussed as a tool manipulated to confront the country to put society against one another. To date, much research and significant material has been collected on the use of different methods to assess the impact of migration on key components of the country: economy, national security, social welfare, etc. European researchers are particularly interested issues related to international migration caused by new humanitarian crises [5], and these problems have become more acute over the years. Extensive research focuses on how migration affects the structure of the labour market and political decisions [6; 7]. Many foreign scholars study migration only at a theoretical level, for example, presenting this types of phenomena and review them, describe areas of security concern, discusses how the European Union views the phenomenon of migration, why it is important to regulate immigrant flows and pay close attention to it, huge expatriate flows, cases [8; 9].

Although depiction of Lithuanian emigration in the press is discussed, this process has not been studied as a tool used for this purpose real media channels for certain purposes. In particular, there was no detailed study of how hostile forces (in this case, the pro-Russian press) invoke the theme of Lithuanian emigration to the public to oppose, to present the negative face of the country and politicians. Emigrations processes do not exist in this context are not fully understood. Thus, the scientific approach requires additional data, deeper analyzes, and the results that flow from them to better understand emigration role in shaping public attitudes, the face of the country.

Method of investigation. These investigations were focused on descriptive, primary and secondary sources analysis and comparative methods. Descriptive method was used for the presentation of others the results of the authors' research into the propaganda of the media, describing certain concepts, related to the phenomenon of readership manipulation. Analysis of primary and secondary sources was essential researching the publications of scientists, information in books, analyzing on the Internet portal articles submitted, etc. The comparative method was necessary in parallel or in the appointment of scientists' attitudes, research, results of analyzing the meaning and importance of propaganda in texts.

1 * Corresponding author.

E-mail address: remigijus.simonavicius@lka.lt

In the empirical part of the work the method of discourse analysis was applied by integrating it into the manual data processing. Quantitative and qualitative methods were also used: the former applies calculating the distribution of the means of expression of propaganda in the texts analyzed by propaganda subject; the second is the interpretation and description of the statistics produced and the diagrams drawn.

Investigation Results. Therefore, the aim of these investigations was to analyse and present the ways that pro-Russian media uses the topic of emigration in Lithuania to spread propaganda. The subject was the spread of propaganda based on the topic of emigration in Lithuania in pro-Russian news site sputniknews.lt. In order to achieve the aim, five objectives were set. In summary, they were as follows: to describe the measures that the media uses for forming society's stance; to present existing types of propaganda and techniques for recognising them; to draw up the plan of propaganda analysis; to analyse and describe the means of expressing propaganda in emigration-related articles, which were published on the pro-Russian news site sputniknews.lt; to, based on the results, justify or deny hypothesis.

The hypothesis that was raised at the beginning of the investigations, which states that a pro-Russian news site sputniknews.lt presents the phenomenon of Lithuanian emigration as a clearly negative process that causes a great threat to the country, and the emigrants as citizens who disrespect and despise their country, was only partially confirmed. The phenomenon of Lithuanian emigration is presented as clearly negative; however, the stance on emigrants is positive. All of the negativity and criticism is aimed towards the government, it is done in order to influence the society and compromise politicians, make the citizens of the country turn against them.

Conclusions. After conducting scientific research on how Lithuanian emigration is presented in a pro-Russian news site sputniknews.lt, firstly, one can come to an essential conclusion that emigration is chosen as a tool for spreading misinformation and inciting hate in society. It is done by using rhetoric devices (such as words and word combinations, phrases, sentences, images, keywords, final remarks, etc.) and technical devices (such as headlines, subheadings, layouts, placing on the page, quotes, etc.). The most frequently used devices for spreading propaganda and manipulating people are multiple words combinations, quotes where the source text is paraphrased in the author's words, and pictures containing authoritative persons and symbols that are significant to the country. Also, for achieving their aims, propagandists frequently use headlines, which, in the analysed texts, are always negative, short and coherent.

Keywords: *national security, Lithuanian emigration, pro-Russian media, spreading misinformation.*

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Public Education on the Topic of National Security in Lithuania

Paulius Kerulis^{a1}, Rolanda Kazlauskaitė Markelienė^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania, Šilo g. 5A, LT-10322, Vilnius*

Introduction. National interests and national security and their declarations in the modern global world are often levelled and become fierce the object of criticism. The ideas of “cosmopolitanism” are becoming more important than the imperative of state and jam specific interests – political, economic, social, cultural, etc. to the background, visas focuses on the interests and security of the international community. The role of influence and authority of the nation-state are correspondingly reduced with increasing non-governmental organizations, international financial and economic clusters.

It is particularly difficult to preserve national identity and identity under these conditions small states which, on the one hand, seek to protect their territorial integrity, and political independence by joining collective defense blocs (such as NATO); the other side - trying to emphasize its uniqueness, specificity, historical in every possible way and cultural exclusivity, and seeks to protect its language, traditions and customs from extinction. Flipping between national and international interests is a reality in today's small states. The success of such dressage depends on the political will of the elite and the resilience of society changes and readiness to defend the country's national interests.

Public Education in National Security aspects is new enough in Lithuania. To uncover and further develop this theme to date no separate attention was given. However, more detailed, systematic analyzes of public education in the context of national security so far this topic has not been carried out in Lithuania.

As for the methodological and theoretical experience of other countries in the field of public education from the security point of view, Western countries attach great importance to the civic education of soldiers, based on the requirements of postmodern society for the training, training and education, highlighting the development of patriotism as an integral part of civic education, revealing the importance of moral, ethical and civic values in the military. Society Military patriotic education and its importance for national security are often actualized in Russia scientific publications which emphasize that “the country has a high level of national security depends in part on the moral and value spirit of its citizens. Estonian National security studies distinguish between the military-citizen model.

The relevance of this research is attributable due the fact that national interests and national security in the modern globalising world often becomes a subject of fierce criticism. The preservation of national identity and mentality becomes more difficult. Education, as a flexible

1 * Corresponding author.

E-mail address: paulius.kerulis@lka.lt

and effective form of exchange of knowledge, ideas, thoughts, also happens to be a strong tool of propaganda (in a good sense). This tool can be used for different age and social groups, in terms of national security, enhancing the awareness of realities, in which the state exists, and familiarising it with the threats and hazards found in the realm of national security.

Method of investigation. The research was carried out using the method of systematic literature review, which is for making sense of large volumes of information. Additionally, the content analysis of documents and the comparative analysis. Furthermore, the qualitative research method – the semi-structured expert interview was used according to the investigation object and to the design of these type interviews. The semi-structured expert interview data collecting method is open, allowing new ideas to be brought up during the interview as a result of what the interviewee says.

Investigation Results. The study found that national security is a vision of the country for its own sake identity, identity, uniqueness in the international arena. The basis for this vision is formulated threats and challenges to national security. National Security Education in turn is a process of teaching, educating and educating the public, during which both the national interests of the state, its cultural, social and economic interests are promoted identity, highlighting threats to national security and identifying ways and methods, how to increase national security from preserving the identity of nation and country.

Expert interviews revealed that national security education in Lithuania's educational institutions is not currently sufficient; it lacks the cooperation between the National Security Office and the Ministry of Education as well as the competence of educators, the concreteness and specificity of information provided. Threats to national security are not adequately perceived and evaluated. Contemporary Lithuanian society has changed – the need arose for information about national security and the threats that the country is facing.

Conclusions. The subject of this research was the public education on the topic of national security and its perspectives in Lithuania. The aim of the paper is to examine the theoretical and practical reflections of public education on the topic of national security in Lithuania. The scientific literature review let us to establish that national security is a vision of a country in terms of its identity, mentality and uniqueness on international stage. On the basis of this vision the threats and challenges to national security was formulated. In turn, public education on the topic of national security was considered to be a process of public education, development, and training, during which state's national interests are declared and advocated, its cultural, social, and economic identity is promoted, threats to national security are emphasized while ways and methods of how to enhance national security and preserve national identity were estimated.

Keywords: *public education, national security, semi-structured expert interview, contemporary Lithuanian society*

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Values and Identity of Contemporary Military Officer in the Context of National Security

Paulius Balsys^{a1}

^aThe General Jonas Žemaitis Military Academy of Lithuania, Silo g. 5A, LT-10322 Vilnius

Introduction. After the World war two contemporary society faces values change. Modern Western European society is marked with such values attributes like individualisation, hedonism, and liberalization. Transformation of values is especially relevant in previous soviet bloc countries where transformation might be more pronounced. Values change is characteristic for Armed forces too. Military organisation as a smaller part of contemporary society faces new challenges successfully implementing it's tasks in the modern world because of social changes [4]. In general, nowadays military organization needs to cope with new type officers corps (officers from contemporary society). The traditional norms that usually were taken for granted in the armed forces, (like respect for authority, tradition, striking hierarchy) are not such typical attribute nowadays [1].

The problem of this report is - how the military organisation is able to implement function of national security combining individual officers and collective organisational values in the context of contemporary society?

The aim of this research is to represent value aspects of contemporary military officers' identity which show the conflict between personal (individual) and organisational (collective) values.

Research results. Military is an institution which is one of the most significant national security guarantees. As authors claim, for the proper national security assurance, organization must be successful not only ensuring national and international levels (collective forms) of security. Individual dimension is a primary and concrete component of national security [2]. Individual dimension which must be secured might be understood as personal freedom or self-expression, ability to have and express your own interests, opportunities to have private life. Embodiment of these aspects might be crucial not only in the national defence strategy, but also in the strategy of the military organisation. Lithuanian armed forces military psychologists findings² of soldiers who leave the service before time³ show that the main reason is that organisation is not able to ensure individual needs of personnel. Soldiers who leave the army before time claim, that they are not satisfied with conditions and abilities to combine home environment, family (individual life) with service issues.

Conclusions. The collective values which lay in the normative documents (statutes, military laws) of the army is still important and play relevant role in soldiers' duty. The discourse of sacrifice for higher good (country) which lays in normative documents is still relevant in the

¹ * Corresponding author.

E-mail address: Paulius.Balsys@lka.lt

Armed forces. But according authors, identity of nowadays military officer is not shaped only by institutional norms which was typical for the past [5] Nowadays military officer is also a member of a modern society which shapes him as an individual with his own interests, private life, self-expressions [3]. Each military officer has to combine embodiment of institutional, collective values of military and their self needs. Last, but not least this coordination between collective norms might be problematic not only for the officer but also for organisation too. Military officer in his daily routine has to combine culturally diverse collective organisational and individual personal norms. The qualitative research reveals aspects of values which coordination into contemporary officers' routine is conflictic.

Key words: individual, collective, military, identity, values.

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The Experience of Lithuanian National Defense Volunteer Forces and Contemporary Territorial Defense

Rokas Kalvaitis^{a1}, Audrone Petrauskaite^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania, Silo g. 5A, LT-10322 Vilnius*

Introduction. The ever-changing geopolitical situation encourages both Lithuanian governmental institutions and the military to seek new solutions in the organization of state defense in order to prevent modern threats. The Armed Forces of the Republic of Lithuania have shifted their defense plans back to the country's territorial defense model, in which the National Defense Volunteer Forces (NDVF) play one of the key roles. The role of the NDVF will increase significantly in the future, as the Lithuanian Armed Forces Commander has appointed forces to carry out intelligence tasks for military operations. The NDVF were established on 17 January 1991, when the Supreme Council of the Republic of Lithuania legalized a volunteer force formed on the principle of voluntary participation of citizens and were organized on a territorial basis. The NDVF has started to act in the difficult political and economic situation of the country and its main functions were to ensure the security of important state and economic entities, to assist border guards in guarding the border and to assist the police in maintaining public order and territorial defense. From the very first days of its establishment, the NDVF not only had to organize the headquarters and units, but also to carry out tasks, including intelligence tasks throughout the territory of Lithuania. The case study of NDVF in the year 1991-1993 is an opportunity to investigate the intelligence history of the Lithuanian Armed Forces and to understand how intelligence tasks were performed at a critical time for Lithuania.

The *object of research*. Intelligence activities of the NDVF in 1991-1993.

The *aim of this study* is to analyze NDVF intelligence activities and accomplished tasks in 1991-1993, revealing the specific features and peculiarities and updating historical experience in the context of modern Lithuanian territorial defense organization.

Methodology of research. The study combines different methods - quantitative and qualitative. The quantitative research methods (case study, historical analysis, document analysis, contextual analysis and structural analysis) used to investigate and describe the development of NDVF intelligence and the intelligence activities during 1991-1993. The quantitative survey method (content analysis of documents) helped to collect actual data on monitoring and operational logs data recorded in 1991. The logical analytical approach used to understand sources and current approaches to NDVF intelligence organization development, activities, and intelligence terminology. A triangulation approach helped to design the study

1 * Corresponding author.

E-mail address: Rokas.Kalvaitis@lka.lt

and combines qualitative and quantitative methods to gain a deeper understanding of NDVF as an exploration phenomenon between 1991 and 1993 and to create the concept of future NDVF intelligence activities.

Research Results. A qualitative study found that the NDVF had a military intelligence structure and was carrying out intelligence tasks between 1991 and 1993. The functions of the NDVF intelligence - military intelligence and counterintelligence - were defined. A system and methodology for gathering and transmitting intelligence were being developed. The NDVF Headquarters Information Unit was tasked with providing information to Information Service of the Department of National Defense (in 1991), for Immunity Service of the Ministry of National Defense (in 1992) and for the Intelligence and Counterintelligence Department of the Ministry of National Defense (in 1993). Structural and functional changes in the NDVF intelligence were linked to the end of the withdrawal of Russian troops in 1993. A quantitative study based on the content analysis of NDVF staff records made in 1991 revealed that 56% of the registered information was intelligence and that this information was received from 38 districts, what accounted 82% of the territory of Lithuania (72% all intelligence information was received from the city of Vilnius and its region). Without the ability to determine what made up 51 percent of information providers (i. e. that only 49% information providers have been identified) it was difficult to approve the thesis who was the main domain of intelligence information - civil population or NDVF units. Undoubtedly, 27% of the registered information came from NDVF units. Obtaining intelligence about the USSR military forces was directly related to the NDVF's structural and organizational development, as the organization of standby units in the NDVF significantly increased the intelligence obtained from volunteer soldiers. A quantitative study carried out partially supported the working hypothesis that National Defense Volunteer Forces conducted military intelligence in 1991-1993.

Conclusions. The NDVF carried out intelligence tasks throughout the territory of the Republic of Lithuania in 1991-1993: monitored the radio interception of the USSR force structure, covert surveillance of Soviet military objects and military technicians, tracked the Soviet institutions archives. The NDVF had a well-developed structure and good savings with the population, so their intelligence could be obtained under the conditions of the actual occupation of Lithuania. The NDVF intelligence model for the implementation of the Territorial Defense missions has been developed using historical NDVF intelligence activities and in coordination with current Volunteer Force structure and tasks.

Keywords: *intelligence, military intelligence, National Defense Volunteer Force, Territorial Defense.*

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Ethnic Minorities and National Defense: the Case of Lithuanian Armed Forces

Viktoras Buiva^{a1}, Audrone Petrauskaite^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania, Šilo g. 5A, LT-10322, Vilnius*

Introduction. Economic, cultural and social integration processes make it increasingly difficult for most countries to retain their uniqueness. The effects of globalization have led many countries to strive to preserve their nationality and foster their civic identity. Issues related to the preservation of national identity and ethnicity and the promotion of national identity are receiving increasing attention. All of these issues are particularly relevant in small and multicultural countries, which find it extremely difficult to find appropriate models and methods to uphold their statehood while respecting the needs of their ethnic minorities, fostering civil society and defending the distinctiveness of cultural and ethnic minorities. This is especially important for Lithuania, as the emigration rate remains high, with emigrants gradually changing from other ethnic groups and cultures. Despite the various measures taken to try to liberalize the policy of ethnic minorities, non-integrated representatives of such minority groups can become a factor not only in national but also in international instability. The topic of the civic identity of ethnic minorities as a subject of scientific research is new to Lithuania. There have been no studies looking into the civic identity of ethnic minorities serving in the Lithuanian Armed Forces to date. After a thorough evaluation of the civic identity of ethnic minorities of the Lithuanian Armed Forces, directions and forms of improvement of civic education of the Lithuanian Armed Forces could be envisaged. This would ensure the national security and defense of the country and could also serve as a basis for strengthening the resistance of the entire Lithuanian society to modern threats.

Methodology of the research. A quantitative research study was carried out to determine the civic identity of ethnic minorities serving in the Dragoon Battalion of the Lithuanian Armed Forces. Study method – questionnaire survey, which was given both to professional military servicemen (PMS) and individuals in compulsory military service (ICMS). PMS and ICMS of both Lithuanian and ethnic descent were surveyed for comparison.

Research Results. The study conducted at the Dragoon Battalion showed that civic and patriotic education at the Lithuanian Armed Forces is being implemented unsystematically and lacking a programme developed by experts. The shaping of civic identity relies on the initiative and understanding of military commanders. During attempts to shape the civic identity of Lithuanian troops and integrate ethnic minorities into society, it is imperative to rely on certain experts and develop civic and patriotic education programs for individual battalions that would be approved by the Chief of Defense of the Republic of Lithuania.

1 * Corresponding author.

E-mail address: Viktoras.Buiva@lka.lt

Data collected during the study indicates that despite certain problems related to the social integration of ethnic minorities, conditions necessary for preserving the identity of ethnic minorities in Lithuania are sufficient. On the other hand, ethnic minorities living in Lithuania are slowly integrating on the basis of civic identity.

Conclusions. It should be noted that the development a mature civic society in Lithuania, where citizens of all ethnicities who love their country and are determined to protect and defend it against any dangers would live in harmony, necessitates not only appropriate public policy regarding ethnic minorities, but also the cooperation of all state institutions in its implementation. It is imperative to foster the intercultural competence of Lithuanian citizens, including troops, and encourage tolerance and understanding in the public sphere in order to properly integrate representatives of other cultures into social life and develop their individual civic identity. This is one of the key conditions necessary to ensure national safety in the face of modern dangers. It is important to develop an appropriate attitude to Lithuanian history and its cultural heritage, which would promote respect for cultural diversity and emphasize the positive influence of different religions, ethnic groups and ideas on the development of Lithuanian history. Therefore, a compulsory “Lithuanian Armed Forces Civic Education Program” should be prepared, the curriculum of which should include topics related to the development of military cultural competences. It is necessary to develop intercultural competence of Lithuanian citizens, especially people who come into contact with representatives of national minorities in their work (personnel of educational institutions, officials, of Interior service, militaries, etc.).

Keywords: *ethnic minorities, identity, national security, resilience, contemporary threats.*

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Factors Enhancing Human Resilience in the Armed Forces

Gediminas Indrasius^{a1}, Audrone Petrauskaite^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania, Šilo g. 5A, LT-10322, Vilnius*

Introduction. The process of globalization, economic, political, military crises can cause both internal and external conflicts affecting security of neighboring countries and threatening regional security. With the changing nature and extent of threats, conflicts have become more asymmetric, open fighting move into densely populated areas and gets shorter but more active. The international and national security forces combat unpredictable and unidentified enemy who uses all means to achieve the goals. Along with the changing threats to the international security, the Armed Forces have transformed itself into new post-modern forms of organization. Non-standard methods of conflict resolution affected by a changed military culture. Harnessing human potential through participation in the 21st century is becoming increasingly relevant in military conflicts. This encourages reflection on the transformation of military pedagogy and more effective use of human potential in the context of unconventional warfare. Great attention is paid to the professional development of the soldier by providing theoretical knowledge and practical skills. The demands of a postmodern army encourage the transformation of military education through the development of a future warrior model that includes the concept of “a warrior diplomat” and “a fully resilient warrior”.

The object of the research: factors that increase human resilience in the Armed Forces during the military mission.

Aim of the study: to analyze the factors that increase people's resilience in fulfilling the mission of a military organization.

Research Hypothesis: In the face of complex, non-standard and unpredictable conflicts, human resilience is critical to ensuring the effectiveness of armed forces performing routine military tasks.

Methodology of the research. A qualitative research study was carried out to determine the factors which could enhance human resilience in the Armed Forces. An expert survey (interview) was conducted to investigate and analyze this issue. This qualitative survey was prepared on the results of comparative analysis of scientific literature and military documents. This is an individual, two-person interview initiated by the researcher in order to obtain the information needed to clarify the research objectives. A general survey design was made for the study, but during semi-structured interviews, both sides had access to additional questions. The experts interviewed during the research are directly and indirectly related to the activities of Lithuanian and foreign military units. The research involved experts in decision-making (operational / strategic) and executive (tactical) positions. The experts were

1 * Corresponding author.

E-mail address: gediminas.indrasius@lka.lt

selected on the basis of the following criteria: service (work) experience (combat units, staffs, training institutions, participation in combat activities), field expertise, interface with the Regular Forces and the SOP. The interview study was conducted in 2018. March - April.

Research Results. The experts highlight effectiveness of the military mission depends on the performance well-trained leaders who are capable of operating in a dynamic, complex and unstable environment. A positive organizational culture promotes and shapes the core values of the organization and strengthens unity, coherence, loyalty and organizational commitment, reduces military person turnover and provides stability. But effective leadership and positive organizational culture alone are not enough to succeed in carrying out tasks in a military organization. Facing modern threats, a warrior must have a fully developed resilience (physical, emotional, spiritual) skills that provide more opportunities to survive in extreme conditions and operate effectively in an uncertain environment. It is anticipated that the non-standard nature of future conflicts will require a different (revolutionary) approach to the use of human recourses in warfare along with technological advance. A great deal of attention is paid to the concepts of resilience developed by the Special Operational Forces who are in the lead of human capital development. Unstable and complex geopolitical environment identifies necessity of implementing resilience programs in the military educational process.

Conclusions. The complexity of today's and tomorrow's strategic environments requires not only the highest levels of war fighting expertise but also wide scale of universal knowledge and skills (cultural, communicative, leadership, etc.), moral maturity and all dimensions of social resilience (coping, adaptive and transformative capacities). It discusses the philosophy of contemporary warriors resilience model, which increases ability to adapt in different environments and effectively operate in uncertain and stressful situations. In order to analyze the significance of the education and use of human capital in a military organization. In the Lithuanian Armed Forces, insufficient attention is paid to military resistance training programs, their physical, psychological, spiritual, social resilience development

Keywords: *human resilience, postmodern military, unconventional warfare, contemporary threats.*

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The Effect of Territorial Planning on the Assurance of Public Security

Kristina Mikalaukaitė-Šostakienė^{a1}

^a *The Academy of public security, Mykolas Romeris University, Maironio str. 27, LT-44298 Kaunas*

Introduction. One of the goals behind territorial planning is formation of a secure living environment and provision of complete living conditions in residential areas. Security is one of the major criteria of quality of life. Formally, public security is referred to as a priority area of respective municipalities and police. Security issues, however, may be addressed by consistent development, cultivation of social order and territorial planning rather than police efforts. Inappropriate territorial planning may contribute to greater social exclusion; encourage violation of interests of the society and criminal conduct, thereby compromising on public security. Obviously, without the public feeling secure, the state itself becomes more vulnerable and less resistant to external threats. The territorial planning process is complex and complicated, as the needs and interests of natural and legal persons with regard to the use of the respective areas are constantly being faced. It is often in the interest of private persons to provide, in territorial planning documents, for conditions for the use and management of the area that is favorable to them and that is not at the best interests of the public. Territorial planning objectives must take into account the needs of society, the landscape and biodiversity of the site, its geographical location, geological conditions, existing urban, engineering, transport, agrarian systems, the interests and rights of land and other property managers, users and third parties, architectural, environmental, public health, nature, heritage, state and public safety, defence and other needs.

The object of the study: the effect of territorial planning on the assurance of public security.

The aim of this study is to put forward improvement of legal regulation involving the mandatory establishment of security-related specifications to territorial planning documents by engaging specialists in charge of public security into the process, in view of the completed analysis of legal regulation, territorial planning documents, and results of empirical studies.

The methodology of research. In the course of reaching the objective of the research were employed the methods of systemic, analytical-critical, and comparative analysis. In addition, the methods of documentary analysis and generalization were used.

Research Results. The objective of each State is to ensure the safe, sustainable, purposeful and consistent development of the entire area of the State. One of the most important and fundamental instruments that are a prerequisite for achieving this goal – is proper, effective and efficient legal regulation of territorial planning.

1 * Corresponding author.

E-mail address: kristina.mikalaukaite@mru.lt

Conclusions. Territorial planning as a process affects both public and national security. The requirement to take security and defence needs into account in territorial planning is enshrined in various documents. When analysing documents, it is obvious that one of the ways to ensure the safety (public and State's) is to establish proper and correct legal regulation of spatial planning. The legal regulation of territorial planning is not sufficient to ensure safety and it is recommended to improve it.

Keywords: *Public security, State security, Territorial planning, legal regulation*

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Vision of Leadership in the Police

Rūta Adamonienė^{a1}, Laima Ruibytė^b, Lienite Litavniece^c

^{a,b}*Mykolas Romeris University, Academy of Public Security,
Maironio str. 27, LT-44298 Kaunas, Lithuania*

^c*Rezekne Academy of Technologies, Atbrīvošanas aleja 115, LV-4601, Rezekne, Latvia*

Introduction. Modern organizations need leaders who are strategic and knowledgeable about what changes are needed, and who see the organization's vision [3,5,6]. In many empirical studies, the essential qualities of a leader can be divided into personal qualities such as leader capital, spiritual qualities, and specific activity-related qualities of a leader [4,5,6]. The statutory organization is formalized and regulated by law, so the functions of an effective manager are indirectly limited as well as the whole social services system, which is too oriented to the bureaucratic formalization [7,8]. Although police activities and the functions of the police leaders are regulated strictly by law the modern vision of leadership are being implemented in Lithuanian police [1,2]. In order to ensure effective police work, leaders must possess not only work-related knowledge but also have certain leadership qualities, strategic competences and a vision of leadership [1,2,4]. Key features of a future leader include strategic, critical thinking, ability to inspire subordinates, pursuit of goals, ability to communicate, create a good corporate atmosphere, and respond to subordinates' needs. The modern police organization is undergoing profound changes because of the transformation of values and activities - from a reactive to a proactive response strategy, focus on community policing and mind-based rather than purely power dimensions. Modern policing demands a transfer of leadership ranging from top managers to the low-level executives. Leadership skills are needed by the head of any statutory organization, and their attitude and understanding of the leader's vision also depends on the implementation of that vision [1,2,9]. However, the vision seen by a leader alone is not sufficient to create an organized movement or to make a major change in an organization. Subordinates will only follow leaders if they accept his vision as their own. [10]

The peculiarities of statutory organization leadership in scientific research have been little explored, however, leadership phenomena in police organizations have recently been analyzed as well as statewide staff attitudes towards values, which includes the attitudes of police officers towards leadership [1,2,4]. With the police playing an important role in public life, leadership is becoming a modern factor in the development of a statutory organization. For this reason, it is important to clarify police officers' own attitudes towards leadership and possible leadership features that determine effective police management. The aim of this study is to reveal the police officers' vision of police leadership and to determine their attitudes towards leadership aspects within their organization.

Methodology of research. The study used a quantitative research method to find out the manager's dependence on leadership, the significance of the leader's influence on police

1 * Corresponding author.

E-mail address: ruta.adamoniene@rmu.lt

activities, to determine the personal attitude of the staff towards police leadership, the most important leadership qualities and the attitude of the manager in the police. Territorial police officers participated in the research. The purpose of the study is to find out which model of a leadership - transactional or transformational- is more acceptable and more favorable to police officers (first line officers, middle level officer and senior officers).

Research Results. An empirical study of police officers showed that police officers want to be led not only by managers who are well-versed in police activities, but also by leaders capable of inspiring subordinates, achieving goals, communicating, creating a good corporate atmosphere, responding to subordinates' needs qualities such as critical thinking, problem solving, responsibility, diligence, honesty, communication. Most of the police officers point out that police must be led by a leader with transformative qualities: diplomatic, polite, emotionally stable. Less pronounced transactional qualities: rigor, responsibility, diligence. Senior officers tend to have a transactional leadership model in the police, dominated by leader's ambition, responsibility, critical thinking.

Conclusions. The police are a formalized organization and its activities are regulated by law. This means that the activities and functions of police managers are restricted by specific requirements and sub statutory acts. However, modern police are experiencing drastic changes in management. The changes in the attitudes of police officers can facilitate the realization of a modern vision of leadership. To ensure effective police work, managers must possess the characteristics of a transformational leadership model: be able to inspire subordinates, achieve goals, communicate, create a good corporate atmosphere, and respond to subordinates' needs.

Keywords: *leadership, police organization, leadership models, officers.*

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Risks and Challenges for Human Rights Raised by Artificial Intelligence

Aurelija Pūraitė^{a1}, Rūta Adamonienė^b

^{a,b}Mykolas Romeris university, Maironio str. 27, LT- 44298 Kaunas

Introduction. Artificial Intelligence (AI) refers to systems that are programmed to work and act like humans. The evolution of AI is a 21st-century opportunity, challenge and phenomenon that affects all dimensions of social life - philosophical, social, legal, administrative. Inevitably, human rights concerns are also affected. The rapid growth of AI also raises important questions about whether our current policies, legal systems and methods to protect the rights of human beings are still effective and substantial. Usage of AI may be considered as an advantage to society (for example, by facilitating more personalised education), but at the same time expansion of artificial intelligence tools and its inclusion in daily life may threaten certain rights, for example, the right to equality, the prohibition of discrimination, the right to privacy. On February 5th, 2020, a court in the Netherlands ruled that a government system that uses artificial intelligence to identify potential welfare fraudsters is illegal because it violates laws that shield human rights and privacy[8]. The ongoing fight against coronavirus in the People's Republic of China has revealed the unprecedented use of different tools that could be attributed to the concept of AI (facial recognition systems and high-end cameras, computerized systems that track ID cards), and numerous violation of human rights have been recorded. Therefore it is obvious, that in the nearest future national legal systems will face the necessity to evaluate the impact of AI on the development of their legal regulation and implementation on existing norms, as well as to consider the correlation between AI and protection of fundamental rights.

The object of the study is possible or existing violations of human rights by artificial intelligence. *The aim of this study* is to analyze how human rights are affected by artificial intelligence revealing how the human rights framework may contribute to the governance and regulation of AI. The special attention will be paid to use of AI by law enforcement institutions, analysing the implications of police data and technology on human rights.

The methodology of research. The study combines different methods - quantitative and qualitative. Case study, historical analysis, document analysis, contextual analysis methods were used to investigate and describe the development of artificial intelligence concept and its correlation with the concept of human rights. The content analysis of documents was used to collect actual data and examples on recent violations of human rights by the usage of AI, especially by law enforcement institutions. The logical analytical approach was used to understand the challenges and opportunities presented by AI, big data and associated technology from a human rights perspective. A generalization approach was used to design the

1 * Corresponding author.

E-mail address: Aurelija.Puraite@rmu.lt

study and combine qualitative methods to gain a deeper understanding of AI as a phenomenon having a huge impact on change and development of fundamental rights concept.

Research Results. The use of AI technologies can affect different sectors and areas of life, such as education, the labour market, social care, health care and law enforcement activities. There are several ways in which AI can enable significant improvements in the protection of human rights in many areas of life, and be a substantial tool for assuring national security. However, it is also necessary to consider the possibilities for AI to undermine or violate human rights protection.

Conclusions. It is crucial to emphasize the integrity and transparency of state institutions when using AI. However, it is necessary to emphasize the human rights-based approach to the design, development and use of AI. The human rights-based approach requires that existing, internationally established, international legal principles are applied to the design, development and use of AI. This is an essential condition for avoiding the existence of AI as if in a legal vacuum. It is vital that public authorities and private actors put in place prevention, monitoring and accountability mechanisms. The state must also ensure that individuals adversely affected by the use of big data and AI have the legal means to defend their rights in court. As state regulation and management of AI is currently only in its creation stage, a human rights-based approach must be taken into account when designing AI regulation.

Keywords: *artificial intelligence, human rights, legal regulation, law enforcement.*

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Applicability of selected mathematical statistics methods during decision activities within Joint CBRN Defence COE

Břetislav Štěpánek^a, Pavel Otrísal^{a,b1}, Šárka Hošková-Mayerová^c

^aPalacký University, Faculty of Physical Culture, třída Míru 117, Olomouc, 771 11, Czech Republic

^bUniversity of Defence in Brno, Nuclear, Biological and Chemical Defence Institute, Sidlistě Víta Nejedlého, 682 03 Vyškov, Czech Republic

^cUniversity of Defence in Brno, Department of Mathematics and Physics, Kounicova 65, 662 10 Brno, Czech Republic

Introduction. Mathematical-statistic methods provide proved instruments, suitable for analyzing problems by means of relevant information acquisition to determinate possible consequences of variant decisions [1]. However, it is impossible to affirm that application of these methods in decision activities makes possible to find solutions of all problems with them we meet in environment of NATO. But these methods can provide some important information [2]. Gained information have to be correctly interpreted, appreciated their reliability and determined possibility of their maximal utilization. However, this way gained information represents only one part of decision activities [3].

Every manager problem is to be examined in terms of quantity and quality. Quantitative criteria use direct appreciation and comparison of variants on the basis of predefined values [4]. We use them at the time, if we require measurement of quantities and to determine reliably. If some qualitative criteria should be used, these are to be transformed on measurable values. For example the qualitative feature „reliability” can be expressed in intervallic scale. Next step is sorting and variant selection, where we use various methods and techniques. Needed information must be acquired at the same time and considered in light of certain problem [5]. The aim is on the basis of these two informative sources to find optimal solving variant.

Method of investigation. Methods of useful cost analyze has been studied by decision activities within NATO international military organization Joint CBRN Defence COE. For international environment of NATO, there are suitable support methods - useful cost analysis (cost-output methods), namely from following reasons:

- they make possible to measure inputs (costs on the actions under consideration of public policy) in relation to expected outputs (results of public policy),
- application of these methods is relatively easy and provides at the same time relatively enough needful information for final decision,
- mentioned methods are based on criteria application of economy, efficiency and useful-

1 * Corresponding author. Tel.: +420-973-452-335
E-mail address: pavel.otrisal@unob.cz

ness, so on criteria, that every manager of public sector is obliged to trace, who uses public funds.

Investigation Results. Methods of cost utility analyze are suitable instruments for the best variant selection. Each of mentioned methods highlights a specific criterion. We should consider the choice of appropriate method with regard to appraising criterion.

For cost output methods is characteristic that all mentioned methods measure inputs (costs) in monetary units. Than it means, if we want to use some of mentioned method for variant appreciation, we have to know cost quantification for the actions given by policy. It's a real prerequisite, because we can find needed data in costing to given action, in budget, or in accounting.

Conclusions. Possibilities of cost analyze methods application during decision activities in international environment within Joint CBRN Defence COE are during evaluation and selection of „complex system projects of defence”, i.e. projects, when we consider technical, personnel, military-special, economic, political and others targets. To utility determination is then important to consider priorities of individual targets, or importance of individual utility properties.

Above all can be recommend using of Costs and benefits analyze method, namely for arguing assistance during political discussions about contribution of extensive military projects in NATO (e.g. purchase of new armored vehicles, airplanes etc.), because this method gives possibility to regard on query in light of general structure of military costs and social benefits.

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Keywords: *mathematics, statistics, cost, benefits, analyze, decision, activities, methods, application, projects.*

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A Case Analysis of Military Leadership Development in Lithuania

Viktorija Simanauskiene^{a1}, Rasa Smaliukiene^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania, Silo str. 5A, LT-10322 Vilnius*

Introduction. Military leadership is a dynamic element of military power and one of the most important components of the ethical modern armed forces in Lithuania. However, this perception of military leadership as a concept and practice did not occur by itself, but emerged over time after the restoration of Lithuanian Army in 1992. During the first decade of the restored Lithuanian Army, military leadership was treated as an integral part of the military command and then gradually, by acquiring good practices and experience of other countries, the separation of the concepts occurred. The influence of France, Germany, Sweden, and Russia (including historical past) was certainly significant in the formation of the military leadership in the Armed Forces of Lithuania, but the good military leadership practice of Denmark, the United Kingdom (UK) and the United States of America (US) had greatest impact.

Research methodology. The case study research, which helps address the challenges, has been chosen to analyse military leadership development in Lithuanian. The following data collection methods were applied: partly structured expert interviews, qualitative content and document analysis. In view of the fact that probabilistic (random) sampling for the study of military leadership in the Lithuanian Armed Forces is not suitable and, unlike in quantitative research, does not improve the data quality of the qualitative analysis [1], a targeted selection of experts was performed. Information-rich cases were therefore identified and selected [2].. An expert is considered to be an individual with specific know-how and insights due to his professional position and also specific professional knowledge and information about his field of activity; subsequently, his status allows him to speak on behalf of a certain industry or represent the field [3, 4]. The participants in the research were selected according to their professional experience (more than 10 years of experience), command experience and expertise in military leadership education and training. Therefore, the diversity of positions with respect to the researched object was ensured, the likely significant difference in experience [5] was reflected, and additional information which would allow the researchers to distinguish new categories and subcategories was collected.

Findings. Four historical and cultural reasons were identified that explain the uniqueness of military leadership, as a concept and as a thematic area of military education in Lithuania.

1. The formation of the military leadership process in the LAF was and still is under multilateral influence. Good military leadership practices of Denmark, the UK and the US have had a particularly significant impact.

1 * Corresponding author.

E-mail address: viktorija.simanauskiene@lka.lt

2. Cultural differences have determined that no due attention was paid to military leadership for a long time focusing only on the military command concept. It took several decades to eliminate the negative connotation before the military leadership started to be understood as a dynamic and one of the most important components of military power.

3. In spite of the efforts made to define the leadership concept, one of the challenges is clarification of the definitions, their adaptation to the requirements of the Lithuanian language, and standardisation of their use.

4. The perception of military leadership in the LAF is not finite, it is subject to continuous improvement and update. The strategic and doctrinal documents of the Lithuanian Armed Forces adopted at different points in time (the oldest – in 2010, the latest – in 2018) reflect the development of leadership definitions, concepts and principles. The first Doctrine Command was published in 2018 and is one of the most important proofs that the agreement on military leadership and military command concepts has taken place quite recently.

Conclusions. The Lithuanian military leadership development case study provides a broad context based on both the historical analysis of military leadership – development of the perception and concepts of military leadership and military command – and the empirical analysis of military leadership training at the military academy. The Lithuanian case study reveals efforts of the Lithuanian Armed Forces to achieve rapid progress and its aspirations to build a distinctive military leadership practice that integrates NATO values, attitudes and military standards. Within the context of the diversity of the best foreign practice methods and models, the challenge for Lithuania is to choose and integrate the best elements. Constant dynamics of the military leadership training has both advantages and disadvantages. Fast adaptation of new segments and innovative methods build the military leadership training system open to changes in the geopolitical environment. In the context of permanent change it is difficult to measure the suitability of the elements at a given moment, but the advantages and disadvantages of the system distinguish the unique Lithuanian case of military leadership development from other countries and is worthy of an in-depth analysis.

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Keywords: *military leadership, leadership development, Lithuanian Armed Forces transformation.*

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Construction Features and Analysis of Warfar Information Model with Markov Switchings under Levy Approximation Conditions

Igor Samoilenko^{a1}, Anatolii Nikitin^b

^{a,b}Taras Shevchenko National University of Kyiv, Glushkov av. 4D, UA-03680, Ukraine

Introduction. The Lotka-Volterra model of prey-predator interaction is one of the main models for simulation of many processes in applied mathematics, social sciences and economics [3], [8 – 11]. Application of this approach to information warfare model was proposed in [4]. Authors regard some social community of quantity N_0 , potentially exposed some information threat (InfT) of two types, that is, for example, the threat of a negative change in its state by transmitting some information relevant to this group by information two different channels. The values $N_1(t)$, $N_2(t)$ – the numbers of “adherents” depending on time t who accepted the new information, ideas, norms, etc. of the type 1 and 2 respectively. These are the main current characteristics of the degree of prevalence of InfT. We construct and study a continuous time model describing the conflict interaction between two complex systems with non-trivial internal and external structures. The external conflict interaction is based on the model of alternative interaction between a pair of non-annihilating opponents. The internal conflict dynamics is similar to the one of Lotka-Volterra model, namely information warfare model. We propose some propositions where the generator of limit process has built in explicit form. We also give some interpretation of our model.

Model construction. As we know, the outside world speaks with us the language of probability theory, so the deterministic model (1) is only part of the real situation. That is why we are building a model that describes a model of information warfare that has not yet been explored, that is, a model based on contingencies, and contingencies of different types:

$$dN^\varepsilon(t) = C(N^\varepsilon(t), x(t/\varepsilon^2))dt + d\eta^\varepsilon(t), \quad (1)$$

where

ε – small series parameter;

$N^\varepsilon(t)$ – a two-dimensional vector of solutions, components of which are the strategies of information struggle of rivals;

$x(t/\varepsilon^2)$ – uniformly ergodic Markov process;

$\eta^\varepsilon(t)$ – impulse perturbation process under conditions of Levy approximation [1], [5], [6], [7];

1 * Corresponding author.

E-mail address: nikitin2505@univ.kiev.ua

$$C(N^\varepsilon(t), x(t/\varepsilon^2)) = \begin{pmatrix} -\alpha_1(x) + \beta_1(x)N_0(x) - \beta_2(x)N_1^\varepsilon(t) & -\alpha_1(x) - \beta_1(x)N_1^\varepsilon(t) \\ -\alpha_2(x) - \beta_2(x)N_2^\varepsilon(t) & -\alpha_2(x) + \beta_2(x)N_0(x) - \beta_1(x)N_2^\varepsilon(t) \end{pmatrix} \begin{pmatrix} N_1^\varepsilon(t) \\ N_2^\varepsilon(t) \end{pmatrix},$$

where the rate of change of the number of adherents $N_1(t)$ and $N_2(t)$ (that is, the number recruited into the unit time) consists of:

- external recruitment rate (it is proportional to the product of the intensities $\alpha_1(x)$ and $\alpha_2(x)$ on the number of individuals who are not yet recruited $N_0(x) - N_1(t) - N_2(t)$), that is, $\alpha_1(x)(N_0(x) - N_1(t) - N_2(t))$ and $\alpha_2(x)(N_0(x) - N_1(t) - N_2(t))$ respectively;
- internal recruitment rate (it is proportional to the product of intensities $\beta_1(x)$ and $\beta_2(x)$, on the corresponding number of active adherents $N_1(t), N_2(t)$ and on the number non-recruited $N_0(x) - N_1(t) - N_2(t)$), that is, $\beta_1(x) \cdot N_1(t) (N_0 - N_1(t) - N_2(t))$ and $\beta_2(x) \cdot N_2(t) (N_0 - N_1(t) - N_2(t))$ respectively.

Investigation Results. We apply the approaches to the construction and analysis of complex systems proposed in the works of Koroluk V.S. [1], [2] and his followers, in particular, we apply the following scheme:

1. Construction of the compensating operator of the Markov additive process.
2. Asymptotic form of compensating operator acting on some kind of test functions
3. Solving of singular perturbation problem.

Conclusions. The following results of our investigation were obtained:

- ♦ a model that is more accurate than the existing ones has constructed
- ♦ the limit generator of the dynamic system has built.

Interpretation. Our research demonstrates the behavior of similar social systems that are exposed to external and internal information influences. Fluctuations around the averaged trajectory and jumps of two types are also studied: rare high jumps and low jumps with high probabilities.

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The Problem of Staff Turnover in Lithuanian Defence Institutions

Gediminas Dubauskas^{a1}, Vaidas Pečeliūnas^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania, Silo g. 5A, LT-10322 Vilnius*

Introduction. Lithuanian military institutions, like many other state institutions, are currently facing difficulties concerning personnel control, with the number of military personnel changing by more than a third in some land units over a two-year period. Negative demographic trends in the country over the past decade, as well as steadily rising salaries in the private sector, only exacerbate the problems of personnel development and management in the national defense system. Personnel management in the Lithuanian Armed Forces is also encouraged by personnel management elements such as motivation, reward, leadership style or teamwork.

The object of this research is the phenomenon of personnel change in Lithuanian defense institutions. The aim of the research is to investigate the influence of personnel management in the organization concerning the staff turnover of Lithuania's defence units. Objectives of the research are: 1. to analyze organizational staff change management concepts; 2. To carry out research on personnel turnover and personnel management problems in Lithuanian defense institutions using questionnaire method. 3. To summarize the survey results obtained during the questionnaire survey and to investigate the influence of personnel management on employee turnover. Research methods include: methods of scientific literature analysis, questionnaire survey, methods of statistical - mathematical analysis.

The paper suggests that in order to reduce personnel turnover in military units, key attention must be focused on the following elements of personnel management; a command style, stress management, improvement of payment system and working conditions, recognition of military servants career perspectives and monitoring inquiries of the military personnel in order to keep updated on the most important issues.

Method of Investigation. The following methods have been selected based on the chosen research objective and problems; - Questionnaire survey method was selected for three main reasons, such as availability of respondents, reliability of survey data and ease of data analysis. The questionnaire is simple and clear. The anonymity of the questionnaire leads to greater openness of the respondents and allows the processing of the collected information by various statistical methods; - the statistical method used in the statistical evaluation of the survey data. The research data were processed by software using a computer-based statistical analysis program, and a spreadsheet program was used to graphically represent the data. Data were processed using descriptive statistics (averages, percentages).

1 * Corresponding author.

E-mail address: Gediminas.Dubauskas@lka.lt

Investigation Results. A representative sample of individuals was selected to participate in the survey that corresponds to the general population in line by the distribution of their members' characteristics. According to Bury (2017), sample size is an important statistical factor that determines statistical accuracy, which measures the characteristics of the population (in the case of the study, the study group - professional military service troops). Sample size is determined by two factors - population size and sample error. When planning surveys, authors suggest following the recommended sample size, where the sample size depends on population size and sample error.

Conclusions. Modern organizational theories call for greater efficiency in delivering the desired results in the development process of the public sector, so personnel management is of paramount importance to the operation of a defence organization. The defence structure, like many other public (state) institutions, face significant staff turnover due to free market trends, which not only negatively affects the efficiency of the organization itself, but also entails high financial costs problems. From the theoretical point of view, the influence of personnel management on staff turnover in organizations was analyzed and seven areas of personnel management having a decisive influence on staff turnover in organizations were identified: management methods and style; motivation; job satisfaction management; labor relations management; teamwork management; job evaluation and salary. Greater attention to these seven areas of personnel management would significantly contribute to retarding personnel change processes in Lithuanian defense institutions.

Keywords: *staff turnover, motivation, pay, stress, organizational culture, teamwork.*

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Theoretical and Practical Aspects of Lithuanian Convergence in the European Union

Jadvyga Ciburiene^{a1}, Jurate Guscinskiene^b

^a*Kaunas University of Technology, School of Economics and Business,
Gedimino st. 50, LT-44239, Kaunas, Lithuania,*

^b*The General Jonas Žemaitis Military Academy of Lithuania,
Silo st. 5A, LT-10322 Vilnius, Lithuania*

Introduction. Economic differentiation among the European Union (EU) Member States is widely discussed in various aspects in the scientific literature of foreign and Lithuanian authors [1; 2; 3]. This problem is also relevant in view of the fact that EU Member States are classified into six groups according to the date of their accession to the EU. In practice, economic and social disparities between individual EU Member States show that scientific literature raises questions about the convergence of national economic development trends and opportunities at international and national levels [3; 4; 5], individual sectors of the economy (e.g., energy, agriculture, etc.) [4; 5] and so on. As an economic and political union, the EU seeks to create a single market, free movement of people, goods, services and capital. The realization of this goal in the long term must lead to the reduction and elimination of the differentiation of the economic and social indicators of the EU Member States. Various terms are used to describe this dynamic of economic processes, such as: economic convergence, convergence, cohesion, economic integration, catching-up effect, economic harmonization, and so on. Another aspect of the analysis is the different factors of economic convergence identified in the scientific literature (e.g., real gross domestic product per capita (RGDPpc), technological progress, exports, imports, foreign direct investment, labor productivity, employment, etc.) [6-9], types of convergence (e.g., economic, structural, normative) and their evaluation criteria. The investigation of indicators of economic convergence factors in Lithuania compared with the average results in the EU-28 countries in the period of year 2004-2018. Both absolute and relative amounts of analyzed convergence factors indicators are compared. The method of base indicators comparison is used, whereas the first year (e.g., year 2004, when the new EU Member States or the fifth group joined the EU) of the analyzed period is chosen as the base year, which used to evaluate the results and dynamics of changes. The results of theoretical research part are summarized and illustrated by statistical indicators and the theoretical predictions made are checked with practical research.

Method of investigation. There were used several scientific research methods seeking to identify the research aims of the paper: analysis of scientific literature, logical analysis, induction and deduction, method of comparison, systematization and generalization, statistical data collection, classification and illustration, e.g., table and graphical analysis.

1 * Corresponding author. Tel.: +370-613-43-624.
E-mail address: jadvyga.ciburiene@ktu.lt

For the evaluation of the indicators of the convergence in the period of year 2004-2018 the year 2004 was chosen as the base.

Investigation results. The research showed the types, tendencies, factors and indicators of the convergence of Lithuania in the context of the EU member states integration. The paper summarized the scientific literature on the question of the convergence and analyzed the problems and risks of economic growth and social exclusion in Lithuania. The results contain elements of classification of convergence, grouping and comparison of the EU member states according to the year of the involvement into the EU. The Lithuanian government policy seeking both to increase the RGDPpc, to reduce social exclusion, unemployment and emigration; and both to increase the wage level gives an impetus to be in the line with EU member states economic indicators. The comparison of situation in Lithuania and the EU-28 allows determining the direction and the rate of changes of economic indicators and comparing with expectations of population.

Conclusions. The following results of our investigation were obtained:

- ♦ The convergence, including economic convergence, its factors and indicators identified in the research can be used to analyze the process of economic development, which is especially important to national sustainability of the country;
- ♦ The economic convergence of Lithuania in the context of EU-28 can help eliminate social exclusion in Lithuania and its regions;
- ♦ We argue that there is a need for comprehensive analysis of economic convergence factors and their impact for economic development in Lithuania.
- ♦ The above observations allow us to summarize that the determination of different types of convergence, various factors of economic convergence helps to increase economic harmonization in the EU-28, including Lithuania.

Keywords: *convergence; economic convergence; economic integration; cohesion; economic harmonization; types of convergence; factors of convergence; economic growth; social exclusion*

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Military Field Camp Installation Improvement Solutions

Andrejus Krivcovas^{a1}, Svajone Bekesiene^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania, Šilo str. 5A, 10322 Vilnius, Lithuania*

Introduction. The Military Field Camp is described as a place where soldiers live, eat, sleep, work, train and rest. There are three types of outdoor camps:

- ◆ Patrol Base [1],
- ◆ Operational Camp (up to 80 days) [2],
- ◆ Long-term camp - battalion-sized units are located there.

The Military Field Camp has a logistical function, which consists of operating, storing various supplies such as: food, water, ammunition, medical supplies, etc. The size of the field camp to be set up depends on the type (number of troops and duties) of the troop unit there. The size depends on how many tents there will be, and the purpose of the unit depends on how much and what equipment the unit needs to carry and store. (Ezell, 2001) Military camps are usually set up in the case of long-term (weekly and more) military exercises. Military outdoor camps must be equipped with roads, canteen, accommodation, showers, washrooms, work areas, warehouses, laundries, helicopter parking, communications center, medical aid station, vehicle parking and repair shops, fuel depots, medical station, morgue (in the case of war), fire-fighting rooms containing various means of extinguishing a fire.

Observation towers and bunkers are very often built in the camp for security reasons. Turret troops on standby can see the danger, and resting soldiers could hide in the bunkers from artillery attacks or any similar life threat. All hazardous materials and equipment must be stored and stored indoors away from the living and medical facility. There are also toilets and rooms where soldiers eat (canteens), study or work. Warehouses shall be constructed in such a way that vehicles can be approached and unloaded or loaded as easily and simply as possible. (Raymer, 2017).

Since 2015, the number of field exercises has increased significantly due to the commencement of the call to the Lithuanian Armed Forces. As the exercise increased, there was a great need for military field camps. Improperly equipped military field camps can take into account the comfort, health and motivation of soldiers to perform assigned tasks. For this research under investigation was the IRON WOLF 2019 military field camp in Švenčionėliai, the processes and activities of the Lithuanian Grand Duke Vytenis General Support Logistics Battalion for setting up a military field camp. The aim of the research is to identify the main problem of the military field camp and to provide solutions for the military field camp installation

1 * Corresponding author.

E-mail address: Andrejus.Krivcovas@lka.lt

Method of investigation. The research developed a focus group survey analysis method to identify weaknesses in the military field camp setting process, accomplished an in-depth interview analysis method with four Lithuanian Grand Duke Vytenis General Support Logistics Battalion Field Camp Installation Experts, and was accomplished a comparative analysis to compare military field camps plans. In addition an operational process analysis approach is used, which depicts the installation of a military field camp from planning to unit deployment. There were two diagrams, one showing the installation with the existing problem and the other diagram showing the installation after solutions to the problem. The deep cause analysis method was also used, which identified the main problem – the inadequate setting up of the military field camp and the cause - the change of the plan of the military field camp, lack of cooperation, insufficient resources.

Investigation Results. Following the choice of analytical methods, the main problem with the installation of the Military Field Camp was identified – the inadequate setting up of the Military Field Camp. The main causes of the problem were:

- ◆ Modifying the military field camp plan;
- ◆ Lack of cooperation between departments;
- ◆ Untested equipment prior to setting up a military field camp;
- ◆ Military field camps are not set up on a regular basis;
- ◆ Insufficient human resources to set up an outdoor camp;
- ◆ Shortage of specialists;
- ◆ Insufficient transport.

Conclusions. The findings of the research revealed that in order to improve the equipment of the military field camp when ordering the field camp from the logistics battalion, each unit should maintain cooperation, transport, financial, human and time resources should be properly distributed. Each soldier must be trained how to use the equipment they are assigned. Each vehicle and equipment must be inspected before being used at the military field camp site.

Keywords: *military field camp; resources; military field camp installation; Lithuanian Grand Duke Vytenis Logistics Battalion.*

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Energy Use and Energy Consumption in Military Camps

Petr Dvořák^{a1}, Jiří Štoller^b

^{a,b}*University of Defence in Brno, Faculty of Military Technologies, Kounicova 65, 662 10 Brno, Czech Republic*

Introduction. The article deals with the topics of significant energy consumption and low energy effectiveness in the military camps and facilities that are built and operated during field exercises and foreign operations. For a long time now, several NATO countries have been already trying to decrease their strong reliance on fossil fuels and some of them are even considering the zero carbon footprint during their military activities in the near future. There are also several similar activities in progress under different names, for example Green defence, Go green, or Smart energy, but all of them have the same aim, which is to reduce energy consumption and energy costs [1].

The Armed Forces of the Czech Republic are also looking into possible areas where energy of any form could be saved and consumed more effectively with regard to environmental sustainability. The lower the energy consumption, the lower financial costs, and logistical burden for military units' deployment. The paper primarily focuses on the possibilities of usage of the methodology of energy audit in the military environment that is already widely applied in buildings and facilities in the Czech Republic. As an energy management system is an important part of any energy audit, it is also mentioned in the article.

In general, it might be suggested that, the concept of the energy audit is a special kind of energy review, which is stated by the Czech technical standard ČSN EN ISO 50001 Energy Management Systems [2]. According to this technical standard, the energy review is based on the methodology and criteria that should be developed by the organization pursuing better energy use and energy consumption. From the methodology point of view, the energy review consists of three basic steps:

- ◆ an analysis of energy use;
- ◆ an identification of major areas of energy consumption;
- ◆ and an identification of possible areas for improvement.

In the Czech Republic, the concept of the energy audit was introduced in 2000 by an act No. 406/2000 Coll., on Energy Management, which has been amended on the 25 January 2020 [3]. Furthermore, the numerous paragraphs of the act have been specified by several regulations [4, 5]. Additionally, some requirements are quantified by related Czech technical standards [6, 7].

1 *Corresponding author. Tel.: 00420-973-443-344.
E-mail address: petr.dvorak@unob.cz

Method of Investigation. The energy audit must contain at least two options for better energy performance in the examined facility. There are two possible areas for improvement in any building or compound regardless of its structure, operation mode, or lifespan:

- ♦ the first one is for the construction itself and its basic structural elements, which are in direct contact with outdoor climate, for example walls, roofs, doors, and windows;
- ♦ and the second one is for technical systems inside the building, for example heating, ventilation, air conditioning, and hot water preparation.

The measures in the first area need high investment and they are not suitable for the military environment because planning and acquisition are long-term processes, which would not deliver energy savings in the short time period. The second area offers more low-cost opportunities, for example to replace old electric devices or to introduce energy management system.

Investigation Results. The good use of the energy management system within military facilities can also made the handover/takeover procedures between the lead nations easier and faster because all energy related processes would be well documented and recorded. Moreover, the Allied Tactical Publication called Deployed Force Infrastructure, which was promulgated by the Standardization Agreement STANAG 2632 in 2018, also recommends it [8, 9].

Conclusions. Energy use and energy consumption in military camps and facilities are a critical part of environmental protection and sustainability of NATO exercises and operations. Moreover, it is also a kind of strong commitment to the host nations to use their territory responsibly. The implementation of any energy management system in the military could undoubtedly result in a significant decrease of operation costs and a smaller environmental footprint.

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Keywords: *energy use; energy consumption; military camp; energy management system; energy audit; sustainability; environment.*

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Assessment of Military Energy Behavior Factors: a Conceptual Framework

Gintaras Labutis^a, Rasa Smaliukienė^{b1}, Aušrius Juozapavičius^c

^{a,b,c}*The General Jonas Žemaitis Military Academy of Lithuania, Silo g. 5A, LT-10322 Vilnius*

Introduction. Military operations significantly depend on uninterrupted energy supply while happening in a restrictive environment. Therefore, various solutions are devised to reduce energy consumption. The efforts are mainly focused on three pillars: i) design and implementation of tailored Military Energy Management Systems (EnMS) or Environmental Management Systems (EMS) together with advanced energy data solutions (1,2), ii) design and installation of advanced energy-efficient technologies, and iii) efforts related to engagement of soldiers and other military personnel and enablement of a better energy management(3). In this paper we focus on the interventions that affect the military personnel engagement and enablement, namely the interventions which aim to change soldiers' behavior and thus to reduce non sustainable energy behavior. There is a clear evidence that the targeted interventions on personnel behavior can reduce the energy usage (4). Presently a number of attempts were made to prove the success of targeted interventions in the military sector by employing behavior change interventions (5,6). However, there is a lack of clear understanding on how the behavior change interventions influence on the reduction of energy consumption among the soldiers in a military installation. This paper directly addresses the existing need to design the behavior change interventions framework for tailored interventions applicable to a military environment.

Method of investigation. We adopt the COM-B (Capability-Opportunity-Motivation-Behavior) model (7) for the targeted interventions in the area of military energy savings. The specific factors applicable to military that influence on the behavior of soldiers and other military personnel are analyzed and included into this classical behavior change model. As the COM-B testing in military is limited, this paper analyses the applicability of COM-B model to specific military energy behavior that is an inseparable part of military capability. Deeper analysis of military specifics elaborates on specific targeted intervention areas such as Coercion, Modelling, and Enablement. The analysis incorporates the specific military culture and military ethos into the holistic framework that provides the soldiers with valuable social and physical opportunities in energy saving behavior. The proposed framework is designed to be implemented in the empirical research of future studies on saving energy behavior in the military.

Investigation Results. An intervention on pro-environmental energy behavior is defined as intentional efforts to reduce an individual's impact on the surrounding environment including the reduction of the usage of energy. Besides the managerial (Command and

1 * Corresponding author.

E-mail address: rasa.smaliukiene@lka.lt

Control) interventional approach, the energy behavior is linked to physical and psychological factors and therefore a comprehensive behavioral intervention is needed. The most extended approach in this context is created by Michie et al.(7) and tested in numerous studies. In the presented behavior change (or COM-B) framework, factors of expected behavior are arranged into a 'COM-B system' (Capability, Opportunity, and Motivation that leads to expected Behavior) which refers to an individual's psychological and physical capacity to engage in the related/expected behavior.

In addition, according to Michie et all (7), within Capability, Opportunity and Motivation, there are subdivisions: Opportunity is subdivided into physical and social opportunities; physical Opportunity refers to environmental structures around us and social Opportunity refers to cultural aspects of the behavior. According to the authors of the model (7) there are nine Intervention factors (Functions) that describe the key areas of behavioral interventions. Those are: i) Education, ii) Persuasion, iii) Incentivization, iv) Coercion, v) Training, vi) Restriction, vii) Environmental Restructuring, viii) Modeling, and ix) Enablement. It has to be stated that multiple intervention functions are aligned with each area of the COM-B model, namely Capability, Opportunity, and Motivation.

Below we discuss two of those factors that are most relevant to military context.

The first intervention factor we stress in is persuasion. Persuasion is defined in COM-B as "using communication to induce positive or negative feelings or stimulate action" (7) that results in a better energy management and lower energy usage at the military unit. In particular, a viable direction could be methods that underline the military energy ethos based on a unique military culture (8) stressing the responsibility of each soldier in a unit. This direction would promote the responsibility and energy sustainable behavior that is close to civil 'ethics of sustainability'.

The second factor is coercion. It is the process of creating an expectation of punishment if energy usage becomes uncontrollable. In the COM-B model, Coercion is described as 'creating expectation of punishment or cost' and this is related to a specific military C2 (Command and Control) culture where the Commander's intent and orders are non-disputable.

Conclusions. This paper laid out elements of the elaborated model of behavior change interventions that can be most successful at saving energy and extracted two of them that are highly relevant in a military installation. We presented the categories of interventions that create social and physical opportunities for soldiers to reduce energy consumption. The categories were based on COM-B model and present a conceptual framework for behavioral change intervention in military. Additionally, it is stressed that energy savings in a military unit depend not only on the individual and collective actions of soldiers, but also on the attitude and engagement of commanders and on a wider organizational context.

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Human Factor Failure in Hybrid Warfare and its Impact on Airport Security

Miroslav Janošek^{a1}, Zbyšek Korecki^b, Blanka Adámková^c

^a*University of Defence in Brno University, Department of Air Forces, Kounicova 156/65, 662 10 Brno, Czech Republic*

^b*University of Defence in Brno University, Department of Air Forces, Kounicova 156/65, 662 10 Brno, Czech Republic*

^c*Ministry of Defence, Tychonova 221/1, 160 00 Praha 6, Czech Republic*

Introduction. The human factor is a source of errors that arises not only in airports activities but also in the process of internal and external communication.

The hybrid campaign consists of a spectrum of classic tools, called DIMEFIL, which affect the dimensions of power in seven areas (diplomacy / politics, information, armed forces, economics, finance, intelligence, public order and the rule of law) [1]. Hybrid threats are a complex and multidimensional threat caused by the convergence and interconnection of various elements of social life [2].

The hybrid threat aim is to weaken mutual ties and conduct different types of espionage. Espionage can be part of the attack preparation, mostly in a latent form, or to get information security technological progress. Determining the level of cyber security requires investigating phenomena and activities that could pose real or potential threats to the internal and external communications of critical infrastructure [3, 4].

Modern society is not only connected by computer networks, but we are increasingly dependent on technical infrastructure. The interconnectedness of the infrastructure systems creates a dependency where the failure of one infrastructure subject affects the functionality of other infrastructure elements [5]. Mutual multilevel infrastructure systems inter-connection is a modern society development basic prerequisite.

Assessing the level of infrastructure vulnerability is directed in two ways, technical and human failure. The authors analysed an aerospace technical infrastructure inter-connectivity and an internal communication vulnerability. The authors analysed the elements of an inter-connectivity level protection of aerospace technical infrastructure and an internal communication vulnerability. The authors concluded that by reducing the disconnection point's number and splitting internal ways, they are a possible solution to cut the penetration possibility into the internal network of air transport entities.

The results of the research show that interdependent systems should have internal systems divided into open systems for outdoor and indoor access, with no external access. Protection against intrusion is the first phase and requires the firewalls and antivirus programs

1 * Corresponding author. Tel.: +420 732 184 492.

E-mail address: miroslav.janosek@unob.cz; zbysek.korecki@unob.cz

implementation in the critical infrastructure network.

The monitoring systems implementation is the most suitable solution to protect against data leaks, which is the most risky area, by employees and visitors. The authors believe that the ongoing use of penetration tests [6] based on a simulated hacker attack is a proper method of verifying the level of cyber security.

Method of investigation. The concept of Human Reliability Analysis (HRA) expressed the fact that people and systems are not fault tolerant and that increased reliability requires an understanding of error problems, leading to the innovative strategies implementation and overall mitigation of human error [7].

The goal of HRA is to quantify the probability of human error for a given task. The HRA can help find vulnerabilities within a defined task and provide information on how to increase reliability in performing that task. Evaluation of human reliability involves the use of qualitative and quantitative methods to assess the degree of human responsibility to risk. [8] In general, HRAs calculate the error chance for a particular task type, taking into account the impact of performance factors [9].

Quantitative techniques use a database of human-performed tasks and work with error rates to calculate the average chance of error for a particular task. The aim of the method is to make an estimate of the failure chance when using data in the long-term [10].

Hierarchical task analysis performed for critical activities, (ie activities with the potential to cause a dangerous event) and begins by identifying each task and steps within the activity. A typical quantitative approach first identifies the nominal error rate for a task type [7].

The types of tasks vary between tools and are very specific or general. Further, the performance factors calculate for the task. Performance factors can increase or decrease errors chance for a given task. The human factor interaction and technical means in the security process at the airport then uses the graphical presentation of relationships by the SHELL model [11].

The authors use five quantitative factors in possible the human error assumption (HE) in Tecnica empirica stima errori operatori method. Factors take advantage of lean logistics knowledge and represent the human factor intersection with work environment requirements where: K1 - The action taken type, K2 - Planned working time, K3 - Preparatory phase (time), K4 - The worker emotional state and K5 - Ergonomic environment.

The authors analyzed the necessary internal communication for selected areas of air traffic security. The use of coefficients, especially planned working time, can be used by the TESEO method to decide the worker reliability for a selected task type, which he / she performs in a defined time interval by default. The HE probability in the TESEO method using the formula: $P = K1 K2 K3 K4 K5$, where there are time-related coefficients.

The Human Error Assessment and Reduction Technique method (HEART) takes into account the tasks of the operator and the environment (ergonomic and environmental factors). The method also works with conditions that have a negative impact on human actions. In this way, the safety management process may include a worker's level of experience.

The Human Cognitive Reliability (HCR) method allows you to determine worker reliability with respect to time constraints. The HCR allows to decide worker reliability with respect to time constraints. Factors such as experience stress level and ergonomic quality used

objectively during the analysis. The lack of response chance obtained as a system analysis result that defines the chance worker will not do the process within the required time.

Investigation Results. Using the TESEO, HEART and HRA methods, we have found 0.042 a difference in the defined area.

It is advisable to build three independent circles of internal communication with different access rights, thus preventing the interaction of security areas.

♦ Reducing the level of exposure to cyber attack can be achieved by implementing best practices based on increasing the level of employee knowledge in the areas of:

- ♦ Computer threats,
- ♦ Vulnerabilities of control systems and paths of attack,
- ♦ Design of secure architecture,
- ♦ Implementation of internal documents.

Knowledge of cyber threats of the control system is realized by persons who attempt to unauthorized access to the device or by using the control system networks via data communication path. Potential carriers within the organization can be trusted users, while at the same time connecting from a remote location to an unknown person using the Internet. Hostile governments, terrorist groups, dissatisfied employees and individuals, or groups deliberately acting as sources of potential deliberate threats to control systems can be the source.

Conclusions. Critical infrastructure protection is increasing in many areas, including cyber-security. Both the civilian and military segments are taking steps to respond to threats and risks.

The Czech Republic is gradually implementing two ways to increase the level of cyber security. The first area is the continuous education of people in internal and external communication and the second area is the efficient setting of processes in all areas of air traffic. The aim is to eliminate communication and automate activities.

The Civil Aviation Authority and the Army of the Czech Republic respond continuously to the recommendations of the National Cyber and Information Security Agency by establishing processes or structures for fighting in a cyber-environment. Army of the Czech Republic creates Cyber Forces (CF) to monitor, plan and conduct operations in cyberspace and information environment at the tactical level and support planning and management of strategic communication.

The aim of CF will be to increase resistance to cyber-attacks (including prediction, detection and response) in communication and information systems and especially in weapon systems used in the Army of the Czech Republic.

CF will be able to support other types of forces in comprehensive management of information operations using the full range of legal tools. Information operations will be fully integrated into the ACR joint operations.

Strengthening cyber security presupposes an increase in the level of coordination from the level of national authorities, which must subsequently be supported by research, technological innovation and cyber security education.

The area of elimination of human errors should be supported by the establishment of several areas of internal communication, which will limit the possibility of external entities entering

the internal communication network.

Acknowledgements. This work was conducted within air critical infrastructure security area dealing with internal and external communication.

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Keywords: *critical infrastructure protection, cyber security, human error, human Reliability Analysis, TESEO.*

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Methodological Approaches to Measuring Intercultural Competence

Dalia Prakapienė^{a1}, Romas Prakapas^b

^a*Department of Strategic Management, The General Jonas Žemaitis Military Academy of Lithuania, Šilo g. 5A, LT-10322, Vilnius*

^b*Institute of Educational Sciences and Social Work, Mykolas Romeris University, Ateities 20, LT-08303, Vilnius*

Introduction. Intercultural competence in terms of scientific cognition is unique due to its versatility, i.e. it combines several separate components such as culture and competence. Despite the fact that different scientific fields present different views on the concept of culture, it is generally understood as an indicator of the individual's maturity, the realization of his or her creative and spiritual powers as well as the totality of social achievements, valued in all spheres of life. Thus, culture, human general competencies and experience are interlinked. The term intercultural competence is often used in scientific literature to link it with knowledge and understanding of local, national, regional, European and global cultures and their expressions, including language, heritage, traditions and specific cultural products. The importance of intercultural competence is also highlighted in the military field. The Military Strategy of the Republic of Lithuania [1] states that Lithuania, as a member of NATO and the European Union, has a responsibility to also ensure the security and stability of the Euro-Atlantic area. That is to say the Lithuanian Armed Forces are required to be ready, together with their allies, to respond to emerging international security challenges. Since 1975 more than 30 scales for the assessment of intercultural competence have been developed, validated and presented in scientific literature.

Research problem. Given that intercultural competence covers a wide range of fields, it raises a question of how useful the developed scales are for the management science, how often and which ones are used in management research. Research aim is to analyse scientific preferences with regard to scales for the assessment of intercultural competencies in scientific publications on management.

Research method. The research was carried out using the method of systematic literature review, which, according to Pittaway [2], is for making sense of large volumes of information. The chosen research objective focused on managing large amounts of information in an attempt to find answers to one or another question. Another feature of the method that led to choosing it is that it enables the situation to be assessed by distinguishing opportunities and threats. The selected SAGE database of research articles is a leading independent, academic and professional publisher of innovative, high-quality content, known to the scientific world since 1965 and has published over 1,000 scientific publications (<https://uk.sagepub>).

1 * Corresponding author.

E-mail address: dalia.prakapiene@lka.lt

com/en-gb/eur/home). Also, said database, besides publishing and citing scientific articles, pays much attention to methodology and presentation of research methods. Considering the instruments presented in scientific literature to study intercultural competence [3], publications from 2010 to 2020, which analysed the research data collected and studied using the aforementioned measurement scales, were reviewed in the SAGE database. They were selected by publication titles and abstracts, using the data filtering and sorting tools. Out of the total data set, only those publications that had the word management as the subject and met the criteria of relevance in addition to being published within the specified period were selected for deeper analysis.

Research results. Research data showed that out of the extremely high volume of scientific publications (over 9,000 units) published between 2010 and 2020, only about 400 of them can be linked to the management science. This shows that intercultural competence is relevant to not only management science, but also psychology and communication. It should be noted that no direct research on security or the military field, using search criteria for specific scales, was found. However, after changing search terms and reading the research methodology in addition to the title and the summary of the publications, the use of some of the scales was detected. Therefore, methodological scales are used in the military sector and have been acknowledged by various scientists [4; 5; 6]. Individual authors, using different scales, have evaluated the expression of troops' or officers' intercultural competence in various areas.

Conclusions. It is manifested in the most diverse spheres of modern society and, thus, is relevant to not only social sciences but also researchers of other fields and disciplines. Analysing intercultural competencies from the perspective of management research, it is important to focus on developed and validated research instruments. One of the most reviewed and widely used scales for the evaluation and analysis of intercultural competencies in management literature are Personal Communication Worldview Scale, E-model Scale for Intercultural Effectiveness, Global Awareness Profile (GAPtest) and Intercultural Sensitivity Scale (ISS). When conducting management research related to intercultural competencies and looking for specialized literature for independent research, it is worth paying more attention to those scientific publications that mainly publish research results related to the presentation of intercultural competencies in management.

After analysing the situation of the application of methodological scales of intercultural competence in the military context, it can be concluded that such research is carried out; however, other information platforms or databases should be used to search for such publications. In order to justify specific and most appropriate methodological research instruments that reveal managerial opportunities for developing or realizing intercultural competence in the military context, it is necessary to analyse other scientific databases and conduct systematic analysis of scientific articles, with the focus not only on summaries, but also on presentations of research methods, descriptions of methodologies, presentations of the results as well as descriptions of scientific discussions as different authors convey information differently and do not always tend to present research instruments in the same way.

Keywords: *intercultural competence; intercultural competence in military, measurement scale; SAGE database*

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Simulators Usage Assessment for Higher Military Readiness

Gediminas Prūsevičius^{a1}, Svajone Bekesiene^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania, Silo str. 5A, LT-10322 Vilnius*

Introduction. Highest Military readiness training is one of the main tasks of each country's military. The purpose of this training is to train modern troops capable for properly analyzing situations and to ensure national security. Nowadays the technology has reached a sufficiently advanced level and the armed forces of NATO countries are actively implementing simulation systems into the military training process. Simulators help to save resources and allow troops to train in situations that would be very dangerous or impossible to create in the real world. Properly trained soldiers are the key part of strong and challenging army.

The combat training of Lithuanian soldiers is constantly being improved and new methods which would ensure the highest quality process of the development of soldier's competencies are being searched for. Lithuanian military training is constantly being improved and new methods are being sought to ensure the highest quality process to develop soldier's competence. According to the National Defense System Strategic Action Plan for 2019 – 2021, the Lithuanian Armed Forces School of Stasys Rashtix and ARCTC (General Adolfas Ramanauskas Combat Training Center) plan to train up to 2541 civil servants in specialty and refresher training courses every year. Therefore, the solutions for the use of simulators in the training of soldiers will not only be constantly updated, but will be enhanced by expanding the use of simulators in the military training process according to the requirements placed by the Lithuanian Armed Forces. The aim of this plan is to use the simulators for developing soldiers' competencies, and according to NATO standards to train modern troops that will be able to operate in a complex operational environment. The simulator is one of the most modern and important military training tools. So, the inefficient use of simulators is one of the biggest problems in soldiers' preparation for real combat tasks. The training of LK soldiers is regularly improved in accordance with NATO standards, but the Lithuanian Armed Forces face troop training problems due to inefficient use of simulators.

The research main goals were few. The first – to properly evaluate the effectiveness of the simulators used for the Lithuanian Armed Forces training, and the second – to determine the simulators value for soldiers' preparation to be possible analysing situations properly and to be modern in combat. The object of this research analysis were chosen the simulators used for soldiers' individual and collective training at the Lithuanian Armed Forces General Adolfas Ramanauskas Combat Training Centre.

1 * Corresponding author.

E-mail address: Gediminas.Prusevicius@lka.lt

Method of investigation. There was used the primary data collection and analysis. To achieve this goal, was chosen survey method – survey questionnaires. From the methodological point of view there was chosen the PCA (Principal Component Analysis). PCA is a multivariate technique for transforming a set of related (correlated) variables into a set of unrelated (uncorrelated) variables that account for decreasing proportions of the variation of the original observations. The rationale behind the method is an attempt to reduce the complexity of the data by decreasing the number of variables that need to be considered. The PCA helped to identify the latent (invisible) factors affecting the soldiers' individual and collective training with simulators quality.

Additionally was used experts' survey. This method was chosen because of its logical analysis of the problem, and was the most appropriate to evaluate the factors influencing simulators usage effectiveness. The statistical software package SPSS version 26 was used for the collected experts' data analysis and for the PCA analysis as well [14].

Investigation Results. The results of these investigations showed that the simulators used or purchased by the Lithuanian Armed Forces meet the NATO requirements, but the combat training needs and expectations of the soldiers serving in the Lithuanian Armed Forces are unsatisfactory. The main causes, according to the experts opinion, training of the soldiers using simulators is not effective, because preparation of exercises with JCATS simulator takes too long and old MILES equipment and non-mobile (I-HITS) control unit affects the number of exercises performed using LK ARKRC simulators.

Conclusions. The relevant suggestions were formulated to help solve the identified problems. The following results of our investigation were obtained:

- ♦ these investigations showed that complex problems and shortcomings are encountered in the training process using simulators;
- ♦ there were identified fields for improvement the use of existing simulators related to military training;
- ♦ Based on the results of the study, a project for a more effective use of simulators in the military training was developed.

The above observations allow us to provided rational solutions how to eliminate identified problems of military training.

Keywords: *NATO standards, individual and collective military training, JCATS simulators, MILES (I-HITS) simulators, efficiency*

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Improvement of AFU Linguistic Training System

Inna Vanovska ^{a1}, Andrii Halchus^b, Vadym Kosiak^c

^a*Military Institute of Taras Shevchenko National University of Kyiv,
Lomonosova str. 81, 03022 Kyiv, Ukraine,*

^b*Military Institute of Taras Shevchenko National University of Kyiv,
Lomonosova str. 81, 03022 Kyiv, Ukraine,*

^c*Military Institute of Taras Shevchenko National University of Kyiv,
Lomonosova str. 81, 03022 Kyiv, Ukraine*

Introduction. Military Authorities of Armed Forces of Ukraine (hereinafter - AFU) (authorities of personnel policy and military education) developed changes concerning AFU training programme of those, who were engaged in peacekeeping operations. Nowadays, AFU linguistic training is a result of a long term process of challenges and mistakes. AFU language training system establishment largely related to our country's participation in United Nations peacekeeping operations that took place in the late twentieth century. The need for trained military personnel to participate in peacekeeping operations has grown because of the fact that Ukraine views participation in international peacebuilding as an important component of its foreign policy [1].

Method of Investigation. Analysis of academic literature and governance documents on research issues; analysis of linguistic training system status at intensive foreign language courses at The National Defense University of Ukraine named after Ivan Cherniakhovskiy; generalization, systematization, evaluation and interpretation of obtained theoretical and empirical data.

Investigation Results. For the purpose of impartial and qualitative selection of candidates for peace-making positions the training centre staff of MoD military education developed organisational tips on organizing and conducting of AFU language testing and assessment (based on NATO STANAG 6001, which was used to determine the foreign language level of NATO member states' armed forces personnel). Contrary to the previous language assessment methodology, language testing according to NATO STANAG 6001 separately evaluated student ability to write, read, speak and understand (hearing) appropriately adapted, depending on the level of difficulty, foreign language. Due to this innovation, after completing the language courses, students passed a new language format test according to the evaluation criteria -standardized llinguistic levels (hereinafter - SLL) from SLL-1 to SLL-5 and received foreign language proficiency certificates [2]. From a practical perspective, this approach allowed the authorities of MoD and the General Staff of the AFU to obtain reliable information on the candidates' foreign language proficiency level for the service in the international peacekeeping units and in the positions of peace-making personnel [3].

1 * Corresponding author. Tel.: +380970228383
E-mail address: vanovskaya@ukr.net

Considering Ukraine's military-political course on joining NATO, language training in the Armed Forces has gradually become a priority area for the training of all AFU personnel.

Conclusions.

1. AFU language training system establishment is due to its participation in UN and NATO peacekeeping operations;
2. Armed Forces reforming facilitated the development of structural units whose activities were related to the AFU personnel linguistic training;
3. AFU personnel linguistic training was the largest project implemented in the military education system with the assistance of NATO member countries and at the expense of Ukrainian state budget.

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Keywords: *linguistic training, peace-making, personnel, military-political course, NATO STANAG 6001*

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Solutions for Cyber Security Specialist Competencies Development

Dovydas Saročka^{a1}, Svajone Bekesiene^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania
Šilo str. 5A, 10322 Vilnius, Lithuania*

Introduction. Today's world is no longer imaginable without information technology, smart devices and the digital space. Along with innovations that make everyday life easier, there are new threats and challenges, such as cyber-robberies, hacking of private data, password collecting, and attacks on various websites or even spreading viruses into the public domain. Also, these capabilities have been deployed not only by individuals or allied groups, but also by states in their own interest, thus being able to strike strategic strikes at enemy infrastructure or influence their populations. In 2016 at the NATO Summit in Warsaw, cyberspace is officially recognized as the fifth military domain. For these reasons, cyberspace defense and security has become a national priority, with responsibilities not only for the military or the National Defense System, but also for other organizations, companies and businesses. However, recent global trends indicate that the shortage of cybersecurity professionals is very high and will increase, further exacerbating cyber security concerns. This problem is also compounded by the fact that the military and state institutions are unable to pay cyber security professionals competitive salaries compared to the private sector. Every organization or institution must have competent staff in order to do the job quickly and efficiently. No exception is cybersecurity (CS) professionals, who must equally meet certain criteria, otherwise known as competencies. For all of these reasons, it is crucial to prepare and train the best available cybersecurity professionals to achieve the high qualifications and competencies required.

This paper analyzes the competencies of the Lithuanian Armed Forces cyber exercise “Amber Mist 2019”, how cyber exercises affect them and what needs to be changed in the exercise organization process to make them more effective.

The main goal of this research is to determine whether cybersecurity exercises are organised in an appropriate manner, whether they improve the competencies of cybersecurity professionals. The object of the work is the competencies of cyber exercise participants and the exercise process. The aim is to provide (Amber Mist 2019) solutions for improving the organization of cyber exercises that develop participants' competencies.

Method of investigation. In the theoretical part the method of literature analysis is applied. The following research methods are used for these investigations:

- ◆ Expert survey. An interview with cyber security exercise experts was conducted.
- ◆ Benchmarking of the document. An analysis of the results of the final evaluation

1 * Corresponding author.

E-mail address: Dovydas.Sarocka@lka.lt

of this year's cybersecurity exercise "Amber Miš 2019" was conducted and last year was organized "Amber Miš 2018".

- ◆ Questionnaire survey. Interviews with cybersecurity specialists participating in the "Amber Miš 2019" cybersecurity exercise.

Investigation Results. In order to achieve the goal, this research was focused on several directions. The investigation results helped to identify the main problems and:

- ◆ defined cyber security competencies, their development methods and methods;
- ◆ described cyber exercises, their types and differences based on scientific sources;
- ◆ examine participants' competency growth during cyber exercises;
- ◆ identify issues that prevent participants from developing effectively during cyber exercises;
- ◆ provide solutions for cyber exercise development.

Conclusions. The study found out: Active Reserve troops face various problems during service; participants lack competencies, ineffective training week, and repetitive weakest competencies such as firewall configuration, network analysis, threat hunting and Linux OS.

In order to solve the identified problems, the levels of competence of the participants must be separated, refocused training week, improvement of active reserve soldiers service conditions.

Keywords: *cyber security; cyber exercises; cyber security competencies, cybersecurity professionals.*

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The Ethical Problems of Digital Education Administration for the Safety of the Information System

Ibraim Didmanidze^{a1}, Ibraim Bagrationi^b, D. Didmanidze^c

*^{a,b,c}Batumi Shota Rustaveli State University,
32/35 Rustaveli/Ninoshvili st, Batumi, 6010, Georgia*

Introduction. It is generally known, that digital learning is any type of learning that is accompanied by technology or by instructional practice that makes effective use of technology. It encompasses the application of a wide spectrum of practices including: blended and virtual learning. Digital Learning is sometimes confused with online learning or e-learning, digital learning encompasses the aforementioned concepts [3]. The goal of the educational administrator is to keep the school's overall process flowing smoothly, making decisions that facilitate successful student learning. The administrator identifies and articulates a school's mission and goals and makes them happen by implementing programs, delegating tasks and allocating resources. The effective leader is visionary, collaborative and passionate about the field of educational administration [1].

As we know, protection of data in computer networks in economics and business becomes one of the most open problems in modern information systems. For today it is formulated three base principles of information safety which problem is maintenance: Integrity of data - protection against the failures leading to loss of the information or its destructions, confidentiality and availability of the information to the authorized users. Today's business cannot exist without information technologies. It is known, that about 70% of a world cumulative national product depend that or otherwise on the information stored information systems. Universal introduction of computers has created not only known convenience, but also problems, most serious of which is the problem of information safety. Considering the problems connected with protection of data in the network of economics, there is a question on classification of failures and unsanctioned access that conducts to loss or undesirable change of data. It can be failures of the equipment (cable system, disk systems, servers, workstations, etc.), losses of the information (because of infection computer viruses, wrong storage of contemporary records, infringements of access rights to data), incorrect work of users and the attendants. The listed infringements of work in a network have caused of creation of various kinds of protection of the information. Conditionally they can be divided into three classes: means of physical protection; software (anti-virus programs, systems of differentiation of powers, software of the control of access); administrative measures of protection (access to premises, development of strategy of safety of firm, etc.) [7].

1 * Corresponding author.
E-mail address: ibraimd@mail.ru

Investigation Results. These investigation outlines that business leaders must realize the importance of information safety learn to anticipate trends and manage them. Alongside with elements of management for computers and computer networks the standard pays the big attention to ethical questions of development of policy of safety, work with the personnel (employment, training, dismissal from work), to maintenance of a continuity of production, educational requirements. There were analyzed the few objects: the information safety of professional work of the organization and the maintenance of organizational information safety. In scientific work it is planned to create the educational project of the administrative decision on the organization of information safety on the basis of really existing organization.

Conclusions. From the above-mentioned we may conclude that: today the question on the organization of information safety excites the organizations of any level – since large corporations, and finishing businessmen without formation of the legal person. A competition in modern market attitudes it is far from perfect and it is often conducted not by the most legal ways. Industrial espionage prospers. But are frequent also a case of inadvertent distribution of the information concerning a trade secret of the organization As a rule, here plays a role a negligence of employees, misunderstanding of conditions by them, otherwise, «the human factor».

In the paper on the organization of information safety the project of the administrative decision is presented to the limited company “LASPI”. The project mentions three basic spheres of the organization of safety: Documentary sphere (access to the materials presented on paper carriers, with differentiation of this access); computerized safety; Safety by way of employment of new employees; It is necessary to consider, that though the given project and is developed under the concrete organization, its positions can be used and for the organization of safety in other firms concerning the category of averages.

Keywords: *employment, training, educational requirements, strategy of safety*

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The Aspects of Teaching Government Finance at the Master Programs

Gediminas Dubauskas¹

The General Jonas Žemaitis Military Academy of Lithuania, Silo g. 5A, LT-10322 Vilnius

Introduction. Master degree studies in management and other programs prepare students for independent financial management competence using research seminars and workshops (Spigarska, 2017). The economic image of each state could be represented by revenues and expenditures of the government, also described as a national budget. The economic assessment of the state is based on the share of national budget revenue and expenditure from the gross domestic product. Nations moving from planning to a market economy face unique challenges in many areas, including taxation and public finances. The methods of collecting the revenue required to finance government services varied widely within the centrally planned authoritarian system.

Recently, Lithuania is spending more resources than its revenue, thus forcing the country to borrow, which does not benefit the country's prosperity. In this context, the revenue and expenditure of the government budget is a relevant issue as it concerns not only leaders of the state but also ordinary citizens (MoF of the Republic of Lithuania, 2018).

The governmental budget is the main instrument through which governments collect resources from the economy, in a sufficient and appropriate manner; and allocate those resources responsively, efficiently and effectively. Public finance management is an instrument of government's policy. The economic profile of each state is the revenue and expenditure of the state, otherwise described as the national and governmental budget (Djurovic-Todorovic, 2009). The economic assessment of the state is based on the share of national budget revenue and expenditure to domestic product. The paper presents the advantages and disadvantages of different tax choices for national, government, and municipal budgets in relation to the tax burden on different segments of the society. It also aims to teach students the principles of government budget and taxation. Of the many benefits, the most important may be that the scheme illustrates very clearly the different treatment of budget expenditure and tax diversification as an interrelated issue (OECD, 2012). That is, the amount of budget expenditure is strictly correlated with and dependent on taxable and non-taxable revenue's structure. Overall, the results are promising and show that these educational resources make the learning process more efficient and dynamic.

Method of investigation. On the basis of the materials prepared and presented by the different budgets, an overview is offered of how certain specified generic competences are perceived, what teaching/learning methods are or could be used to encourage their development, and

¹ * Corresponding author.

E-mail address: Gediminas.Dubauskas@lka.lt

how they are assessed. Further aims are to see how they are perceived by (or, possibly, what their importance is for) students and to investigate whether there are teaching learning methods used in financial areas, or in some countries or in some institutions which can usefully be proposed as models of good practice or which can be of interest more generally in developing new insights into competence-based curriculum design and delivery. Additional research methods include the analysis of scientific literature, the comparative analysis, the visual representation and statistical data analysis. Methodology also used case studies and comparative budget analysis. Moreover an individual discussion with a group of students was used for implementing the working syndicates for different budgetary projects. An additional value probably was created for students from the graduate studies at human resources management classes when they were included in the case analysis and study of the national and governmental budgets, particularly for studying public sector management. In the future, similar studies could also be implemented to students of other social sciences programs.

Investigation Results. A case study in the master's program analyzes the government budget assessment from the 2014th to the 2018th. Government budget revenue is a revenue to the state, that budget receives from taxes paid in the country (value added, profit, personal income, excise duties, etc.) and non-tax revenue (property, income of budgetary institutions, etc.). The overviewed master study's case covers the five years period of the government budget's revenue (MoF of the Republic of Lithuania, 2014-2018). A more detailed examination of the structure of budget revenue is discussed also. At last the research on government's budget assignments is analyzed in the studies program. An appropriation is the amount approved by the government budget (or the municipal budget) for expenditure and the acquisition of long-term tangible and intangible assets (hereinafter - assets), which the assignment manager is entitled to receive from the government or municipal budgets to finance approved programs (2014-2018).

Conclusions. Learning about public finance and government budgets for master program studies of human resources management and national security programs students could be necessary for their independent thinking. The budget is a revenue and expenditure plan for the current state for the year, consisting of state and municipal budgets. Correct budgeting requires compliance with the basic principles of budgeting: reality, integrity, publicity, completeness, generality, balance and programming. Each budget has its own functions: economic regulation, redistribution of national income and gross domestic product (GDP), control of centralized monetary resources and financing of state functions. Budget revenue comprises tax and non-tax revenue. Tax revenue is further divided into direct and indirect taxes. Most of the revenue of the Republic of Lithuania comes from taxes such as: value added tax (VAT), personal income tax (PIT), excise duties and corporation taxes. There are several ways to classify costs, such as: departmental, branch, economic, mixed, target, functional, and economical expenditures.

Keywords: *State budget, public finance, financial literacy, government spending, university studies.*

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New Electronic Technologies Facilitating the Second/ Foreign Language Teaching and Learning at the Mal

Dileta Jatautaite^{a1}, Jelena Kazimianec^b

^{a,b}*The General Jonas Žemaitis Military Academy of Lithuania, Silo g. 5A, LT-10322 Vilnius*

Introduction. New methods, techniques and strategies of foreign language teaching methodology are essential in coping with any pendulum issues that the instructors experience while teaching the second foreign language. Moreover, the proliferation of digital media is being engaged in content production and linking among learners. For example, the implementation of electronically mediated communication into language teaching and learning process is increasing. The effective use of electronically mediated communication is ultimate for the language instructors to cope hard with the decisions of making the right choices of a particular method, strategy or technique. Thus, the article asserts that electronically mediated communication (EMC) is an inevitable part of globalization, which is changing standardized teaching and learning in the classroom. Furthermore, as a response to globalization, language instructors are forced to reconsider the ways teaching and learning are organized so that to promote appropriate pedagogical flexibility and creativity in classrooms.

Furthermore, language instructors are all aware of the necessity of the quest for new methods and techniques of teaching foreign languages in order to advance with new technologies in particularly by implementing multimedia or visual aids into the language teaching and learning process. Therefore, the authors of the article scrutinize the benefits of beneficial application of electronic technologies into the language teaching and learning process especially teaching the military at the Military Academy of Lithuania. These days new generation of the military at the MAL are very technology savvy and capable of much faster information acquiring and applying. Moreover, intensive computerization of teaching the military is very much proceeding in the foreign language teaching and learning settings of the MAL thanks to new global challenges. Thus, it is very expedient to apply all of the gadgets in developing new language learning habits of a learner. This meets the current state of methodological science and the rapid development of the military community with advance level of a second foreign language knowledge as a whole. In the article, the researches develop second foreign language acquisition through language meanings, functions and uses of language structures. Thus, in the research, language-teaching techniques are implemented via communicative language teaching and task based methods. Herein, the best means of electronically mediated communication method herein could be interpreted as visual aids.

The analysis of the advantages of this method application is presented in the article, as well as the requirements for authentic audio-visual materials based on multimedia are applied for educational purposes; methodological development of authentic video or audio is described in the article too.

1 * Corresponding author.

E-mail address: Dileta.Jatautaite@lka.lt

Method of investigation. This research aimed to investigate the impact of using visual aids for teaching second foreign languages such as German, English, Russian and French. It was conducted from September 2016 to May 2017 with the cadets and students who attended language courses at the Military Academy of Lithuania. The teachers of English and other languages were part of population who participated in the research. This research employed true experimental research method with two groups, an experimental group (EG) and a control group (CG).

Investigation Results. In collecting the data, the tests were designed by the testing group methodologists from the Institute of Foreign Languages and the lecturers from the Department of Foreign Languages. The score of the results from Final Achievement Tests from the EG was 73% which was higher than that of the control group at 54%. Moreover, the knowledge evaluation test was given the same but the score of EG was higher than that for the CG (19%) which meant that the improvement in the EG was significantly higher than the achievements of the CG. The EG students, who were taught by using authentic visual aids, achieved higher results than the CG ones taught with audio compact discs (CD).

Conclusions. The result confirms that to btain > ttablefor both groups was $10.53 > 2.02$ for the EG and $4.03 > 2.02$ for the CG. This shows that both groups performed better in listening achievement after the treatment. Nevertheless, the result of the t-test for the EG was significantly larger than the t-test for the CG ($10.53 > 4.03$). Thus, there was much more improvement in the EG compared to the CG. The EG, taught using authentic video, got a much more significant improvement than the CG, taught using audio compact discs (CD), the usual listening aid used by the teacher for teaching listening.

Keywords: *digital media; foreign language teaching methodology; achievement tests; impact of visual aids; authentic video; MAL cadets.*

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Impact of Data Quality on Passability in Forests

Josef Rada^{a1}, Marian Rybanský^b

^a*University of Defence Brno, Faculty of Military Technology, Department of Military Geography and Meteorology, Kounicova 65, Brno 662 10, Czech Republic,*

^b*University of Defence Brno, Faculty of Military Technology, Department of Military Geography and Meteorology, Kounicova 65, Brno 662 10, Czech Republic*

Introduction. Planning of military maneuvers qualifies forests as an impassable obstacle. In more detailed view, most forest stands can be considered passable when various factors are taken into account. The key element, beside slope gradient, is inner structure of forest. The primary objective of the research is defining relation between results of analyses of forests passability and quality of input data. A subtask of the main goal is a determination of the most important layers and attributes of vegetation with the impact to the analysis of forests passability.

Method of investigation. To reach the partial goal, a study of available related data in the Czech Republic and in NATO was conducted. The major observed aspects are accuracy and density of data. Utilised methodology deal with influence of inner structure of forest to capability of military vehicles to overcome such a kind of obstacle. The essential sources used in the work were the research papers with the topic cross-country movement published by the department of military geography and meteorology of the University of Defence Brno [1], [2]. The analysis of the cross-country movement in forests is divided to a methodology of driving between trees and a calculation of capability of forced passing of trunks. The overall task is determining of influence of data quality used in terrain analyses to decision-making processes of staff and commanders by specifying uncertainty in percentage of selected results.

Investigation Results The key databases in the Czech Republic are digital model of terrain 5th generation and digital model of surface 1st generation, both with irregular network of points with density less than 1 meter. The most suitable data of forest stands are incorporated in databases of Forest Management Institute, Characteristics of Forest Vegetation and Forest Economic Plan (FEP). Foreign data sources are terrain models DTED1, DTED2 and a contemporary project TREx, all with the global coverage, nonetheless, less dense network of points [3]. Foreign forest databases do not contain required information in general for analysis of passability through forests. NATO uses its Reference Mobility Model which does not study micro dynamics of movement in forests in detail [4].

The crucial part is a determination of correct height of trees by comparing various data sources. Passability through forests is foremost defined by spacing between trees. It is determined from height of a tree and prospectively also from a type of tree by calculating number of trees per hectare. The accuracy of density values differs between data sources.

1 * Corresponding author.

E-mail address: Josef.Rada@unob.cz

The reason for that is difficult specification of creation date of databases. The solution resides in adding tabular values of height of tree in dependence of growth curve [5]. Verification of data quality can be performed only with photogrammetric measurement of trees from orthophotos or with control measurement of spacing between trees in the terrain [6]. The two selected methods of determination of height of trees and mean tree spacing (MTS) were calculation of values from DMR5 and DMP1 and direct calculation from FEP.

MTS is then used to set GO, SLOW-GO and NO-GO forests for different military vehicles according to their technical parameters [7]. Selected military vehicles are:

- ♦ personnel wheeled vehicle – LRD 110;
- ♦ heavy wheeled vehicle – T 815 6x6;
- ♦ armoured vehicle – BVP 2.

The variance in height of trees in two used methods was applied to set range of errors and displayed in maps of forest passability. Finally, the maps were corrected of vehicle capability of forced passing of trunks. Each vehicle has its own limit thickness of trunks passing. The output of the research are synthetic maps and tables for individual military vehicles with evaluated areas of certain passability, areas of uncertainty and impassable areas.

Conclusions. The findings during the research show that forests are for the most part passable for majority of military vehicles. For the smaller terrain vehicles LRD 110 or ÚAZ 469, passability between trees is easier, however, they have very limited passing through trunks. Heavier armored vehicles as BVP 2 and T-72 are limited in movement in forests by 25 meters in maximum height when passing between trees (worse parameter) and maximum 10 meters in height when passing through trunks (better parameter). Evaluated sample shows resulting uncertainty of source data 18 %, i.e. almost one fifth of selected forest stands belongs area of uncertain passability.

Acknowledgements. This work was conducted within the framework of the scientific project “Analysis of influence of selected geographic factors on cross country movement” undertaken by department of military geography and meteorology at University of Defence Brno.

Keywords: *cross-country movement, passability through forests, quality of databases, digital model of terrain, capabilities of military vehicles*

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Possibilities of Using Geographical Products in Tasks of Military Engineering

Martin Sedláček^{a1}, Filip Dohnal^b

^a*University of Defence in Brno, Department of engineer support, Czech Republic,*

^b*University of Defence in Brno, Department of military geography and meteorology,
Czech Republic*

Introduction. This paper deals with the possibility of using geographical products in the Army of the Czech Republic (ACR) for a purpose to create more efficient forms of geographical presentations with more dynamics and interaction, which can facilitate and accelerate a planning process of staff members in the selected tasks of military engineering [1,2]. At present, there is no map in the Czech Army Corps of Engineers with the possibility of interaction, which would take into account the issue of tasks of military engineering.

Digital maps with added functionality of interaction and dynamics can reflect the importance of the mutual links between natural and artificial elements of the landscape sphere [3,7,8,9]. This is a possibility where it is convenient to include in a single point a given object in a landscape that displays more relevant information. Thus, a map can contain a large amount of data and information which is clear and readily available, without having to conduct reconnaissance or retrieve data in another form. It also partially replaces data-intensive 3D maps based on interactive images included in the map data structure. Maps with interaction can contain information which fully replace the phase of the general engineer reconnaissance or at least accelerate the reconnaissance and make the information more relevant [4,5].

The purpose of this paper is not to propose final technical compatibility with the information system of command and control of Czech Land Forces and interoperability with other NATO systems, but to suggest options for how the engineer subsystem of command and control can develop using interaction and dynamics of digital maps. The relevance of the use of map background is described on the specific task of military engineering.

Method of investigation. The aim of this work is: to analyze the current state in the use of maps in the ACR, in the Integrated Rescue System (IRS) and in the public authorities; to analyze the possibilities of maps in relation to the usability for planning tasks of military engineering and to propose a map with interaction on the specific task of military engineering [7]. Knowledge gained by studying scientific literature is evaluated by methods of analysis, synthesis and comparison. The model method is used in proposing of cooperation in a map, interaction and task of military engineering.

Investigation Results. The main contribution of this work is identification of digital geospatial databases, description of geographical support in cooperation with IRS, identification of

1 * Corresponding author. Tel.: +420-973-443-872.
E-mail address: martin.sedlacek@unob.cz

tasks of military engineering, their categorization and classification with regard to usability of digital geographical data and the design of a digital cartographic model, which offers possibilities to facilitate and accelerate a planning process of staff members in selected tasks of military engineering.

Conclusions. The following results of our investigation were obtained:

- ♦ There is a large number of maps introduced in the ACR;
- ♦ There are tasks of military engineering where the use of maps with the function of interaction is expected;
- ♦ The usability of the interaction in the map is verified on the designed model.

The above conclusions confirm the usability of map with interaction in the planning process of selected tasks of military engineering by staff members or commanders in tactical level.

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Keywords: *interaction; geographic support; maps; military engineering, Czech Army Corps of Engineers.*

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Military Next Generation Networks Functionality Architecture

Agne Vencloviene¹

Information Technology Service under MoND, Silo g. 5A, LT-10322 Vilnius

Introduction. Industry 4.0 and the approaching Future Internet, known as WEB 3, challenges both telecommunications networks and data service providers and users. Such networks, also known as Next Generation Networks (NGN) enable usage of multi-broadband technologies with the high QoS where service related functions are independent from transport-related technologies [1]. Such networks offer flexible and fast user access to a variety of services, while network operators and service providers focus only on the features they need. This is especially important when it comes to providing users with the Internet of the Future (WEB 3).

IT and telecommunications experts believe that changes in the modern structure of telecommunications and data transmission are inevitable for the WEB 3 [1-5]. Networks and services are expected to have a clear separating line. There is a different view of what this separation will look like [6-10], but in any case, everyone foresees a change in the existing IT and telecommunications network architecture. A separation of networks and services is inevitable because:

- ◆ the current network architecture is not adapted to modern Internet services;
- ◆ nowadays, an operator who provides services is also responsible for network security. The safety issue is operators secondary non-profit function, which reduces the quality and efficiency of safety and security;
- ◆ with the approach of WEB 3, network operators will be unable to maintain applications and other Internet services;
- ◆ future prospects of ITU and the EU require that networks would be accessible to all users.
- ◆ As a result of mentioned above, the current IT and Telecommunications architecture will have to change to form separate stand-alone structures:
 - ◆ Transport-oriented architecture;
 - ◆ Service-oriented architecture;
 - ◆ Security-oriented architecture;
 - ◆ User-oriented architecture.

The main purpose of such separation is to reduce the cost of services and increase their accessibility to users.

Such changes in military networks will also be necessary, otherwise access to WEB 3 services will not be guaranteed.

The aim of this paper is to adapt the NGN functionality architecture in IT and telecommunications networks used for defense purposes.

¹ * Corresponding author. Tel.: 370-6-98-01-781.
E-mail address: Agne.Vencloviene@kam.lt

Investigation Results. In addition to the challenges mentioned above, nowadays IT and telecommunications network architecture will face other challenges such as mass IoT, e-medicine and other e-services. The emergence of new technologies in the military sphere will also require changes to the architecture of existing military networks. When adapting NGN to defence structures, challenges should be considered:

- ◆ compatibility and standardization;
- ◆ information privacy;
- ◆ safety and security;
- ◆ data confidentiality and cryptography;
- ◆ whole network security;
- ◆ efficiency of used radio frequency spectrum;
- ◆ green Next Generation Network.
- ◆ It should be taken into account, that:
 - ◆ military is robotizing;
 - ◆ the decision-making time in the military is shortened;
 - ◆ the amount of data in the military networks is increasing;
 - ◆ the range of services in military networks is increasing.
- ◆ Given all those above and based on inevitable functional separation of providers, the following architecture of the Military NGN is proposed:

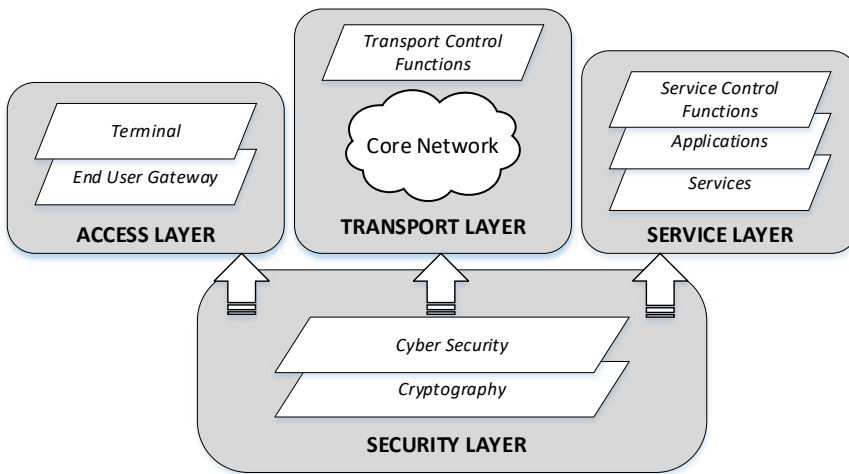


Fig. 2. Military Next Generation Network Architecture

Managers of these layers should be of different services.

Conclusions.

- ◆ Upcoming changes in IT and telecommunications will also force changes in defense networks. A clear functional separation of providers will occur;
- ◆ While deciding on architecture of military networks, not only the current situation must be considered, but also modern technologies coming into the defense sector (robotization, artificial intelligence, shortened decision-making time, etc.);
- ◆ There is proposed a Military NGN architecture consisting of four layers.

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Identification of Electronic Commerce Implementation Success Factors

Jolanta Sabaitytė^{a1}, Guoda Černiauskaitė^b

^aGeneral Jonas Žemaitis Military Academy of Lithuania, Department of Defence Technologies, Šilo str. 5A, LT-10322, Lithuania,

^bVilnius Gediminas Technical University, Faculty of Business Management, Department of Business Technologies and Entrepreneurship, Sauletekio al. 11, LT-10223 Vilnius, Lithuania

Introduction. Rapidly evolving information and communication technologies have led to changes in the organization's traditional processes. Mobile data technology encouraged active development of electronic communications [1]. The Revolution of Internet and Information Technology has created conditions for companies to develop new structures that connect organizations with consumers, suppliers and other government agencies. According to statistic, the number of Internet users has increased by 1156.64% over the last 19 years [2]. Turnover of global e-commerce, including e-commerce services, in 2019 Worldwide amounted to US \$ 3.53 trillion and is predicted to reach \$ 223 trillion by 2022, trading revenue will grow to \$ 6.54 trillion [3]. Analyzing statistics, it is clear that e-commerce is a growing, potential area that brings significant added value to the global economy. But as the potential of e-commerce grows, so does the competition. It is reported that 90% of startups in electronic systems fail within the first 120 days of realization, while the remaining 10% succeed in establishing a successful e-commerce systems implementation based processes [4]. Such a low percentage is due to important factors such as manager knowledge and expertise, choosing the right suppliers, brand awareness, system efficiency and security, current market analysis and continuous knowledge gathering and improvement [5-7]. As well, importance gain the specific characteristics of the users, involved in e-commerce activities, scientists analyze user preferences in the context of generational cohorts [8-9]. Based on the relevance of the topic and identified problem, the aim is described as identification of success factors for implementation of e-commerce system.

Method of investigation. In order to reach the goal of the article, scientific and methodological literature analysis was carried out, based on the analysis of successful models of information systems implementation, analysis of needs and behaviors of different generations of users. Results of the research are systematized and visualized. A conceptual model of e-commerce success factors is formed, consisting of eleven different components: generational differences, information quality, system quality, cybersecurity, functionality, service quality, product quality, value, trust, user satisfaction, net benefit. Research was conducted in following steps:

- ♦ Analysis of scientific and methodological literature. The literature review was conducted to define the concept of e-commerce, highlight its benefits, review the needs

1 * Corresponding author. Tel.: 370-5-210-35-53.
E-mail address: Jolanta.Sabaityte@lka.lt

and behaviors of different generations of consumers using e-commerce activities, and also highlight the critical e-commerce success factors presented in the literature.

- ◆ Analysis of E-Commerce Success Factors. The analysis and main components identification was carried out is based on the D&M Information Systems Success Model, the Technology Acceptance Model (TAM), and the Action Theory Model (TRA) found in the literature.

- ◆ Development of a conceptual model of e-commerce success factors. Newly formed conceptual model is based on an improved model of D&M information systems. The needs of different generations' users are taken into account.

Investigation Results. It can be noted that the success of e-commerce can be determined by many interrelated factors [10]. Some researchers rely on H. DeLone and R. McLean's Model of Information Systems Success in Analyzing E-Commerce Success Factors [6-7; 11-12]. These researchers highlight key success factors: system quality, information novelty, service quality, system usage frequency, usability goals, user satisfaction, individual impact, and organizational impact. Meanwhile, other researchers place greater emphasis on the quality of logistics services, web site quality, functionality, security and reliability [7; 10; 12]. However, it is noticeable that there is a lack of information analyzing the needs of different generations of consumers and the decisions they make when shopping on e-commerce platforms.

Conclusions. The following results of our investigation were obtained:

- ◆ It has been found that analyzing the definitions of e-commerce, some researchers emphasize new technologies, the use of information and communication technologies to enable business processes, and others the benefits of using an unlimited opportunity platform and increasing the efficiency of the business process chain. Meanwhile, the authors of the research define e-commerce as a modern business model based on the use of the Internet and information technology to enable organization processes in the digital space.

- ◆ After analyzing the success factors of e-commerce, it was identified that the main factors determining the success of e-commerce are: environmental factor and technological factors (internet security) and customer satisfaction. The following analysis evaluated the D&M IS success model and the TAM and TRA models that are associated with consumer behavior on digital platforms. Analysis of these models suggests that there is some correlation between consumers' preferences for, and willingness to use, new technologies. Based on this relationship, an analysis of the characteristics, needs and behaviors of users of different ages was initiated.

- ◆ The needs and behavior patterns of different consumer based on their generations were identified. It has been noticed that older consumers tend to buy in physical stores, because their confidence in digital platforms is much lower than that of younger consumers. Generation Y users have grown up in the technological era so they are more flexible and easier to make decisions than Generation X users. These factors are important for success in e-commerce.

- ◆ Analysis of the literature and statistics revealed that the largest group of existing users is composed of two different generations. Based on this analysis, a conceptual model of e-commerce success has been developed that includes the generational difference factor as a determinant of e-commerce success. In order to determine more precisely the impact of generational disparity on the success of e-commerce, additional analysis will be conducted through a consumer survey, as this factor is not sufficiently addressed in scientific sources.

Keywords: *information technologies implementation, e-business, e-commerce, technology acceptance, generational differences, consumer preferences, information systems implementation.*

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Management System Certification Challenges after Transition

Giedrius Čyras^{a1}, Jolanta Sabaitytė^b

^a Vilnius Gediminas Technical University, Faculty of Business Management, Department of Business Technologies and Entrepreneurship, Sauletekio al. 11, LT-10223 Vilnius, Lithuania,

^b General Jonas Žemaitis Military Academy of Lithuania, Department of Defence Technologies, Šilo str. 5A, LT-10322, Lithuania

Introduction. After years of desperate effort to integrate badly integratable ISO management system standard brought ISO Technical Management Board's and Joint Technical Coordination Group in ISO/IEC Directives Part 1 adequate solution which avoids the need to comply parallel multiple management system standards covering separate aspects of performance and opens wide integration potential [1]. Full integration of management systems offers implementation of similar processes without reduplication or process overlapping, rather than just creating parallel systems. Elements that exist in deferent systems can be managed as common requirements. They are defined, applied and treated in the same way and without multiple, not precise interpretations in the implementation of individual standards. This should be a milestone with a significant impact on organizations, certification bodies, accreditation bodies, auditors, etc. ISO/IEC Directives, Part 1, Consolidated ISO Supplement 2015, issues out the rules to be complied within ISO and the IEC in technical work, by standards development in technical committees and subsidiary bodies. Annex SL of the directives settles "Proposals for management system standards" and defines High-Level Structure (HLS): 1. Uniform chapters and subchapters titles - the main 10 chapters with titles in equal sequence. 2. Uniform text and common terms – include subchapters titles as well as text within the sub-chapters. 3. Basic definitions for application in Management Systems Standards (ISO/IEC, 2015 and ISO/TMB, 2013). ISO technical committees revise the standards every five years to ensure that the standards are up to date and relevant to the market. In 2015 also the standards ISO 9001 and ISO 14001 have been redesigned to comply with Annex SL and respond to the market requirements. IAF issued "Important information for Certification Bodies regarding the transition to ISO 9001:2015" which determines that from 15 March 2018, conformity assessment bodies had to provide all ISO 9001 and ISO 14001 initial, surveillance and recertification audit only to the versions 2015 [2]. The undergoing successfully transition the organization has to apply 4 steps:

- ◆ define the scope of the management system;
- ◆ perform gap analysis and develop an implementation plan;
- ◆ update the existing quality management system and related documentation;
- ◆ implement new requirements and provide training [3] [4].

1 * Corresponding author. Tel.: 370-5-274-48-83
E-mail address: giedrius.cyras@vgtu.lt

Professionals, academics and mainly certification organizations trying to find out whether companies appreciate the benefits of revisions the most popular management systems standards and how the revision will affect the certification numbers in the future. There is relatively bride research on the implementation of ISO 9001 and ISO14001 before the transition period, but only a few of them investigate the effect of revision on the nowadays national or global certification market. Fonseca research [5] outlines differences in the transition process between countries (the survey launched in April 2018 in Portugal, Romania, Switzerland, Turkey on 222 organizations certified to ISO 9001:2015). Based on the study the organizations that successfully undergone ISO 9001:2015 transition recorded the main benefit in risk-based thinking application and alignment with other management systems. The cost reduction effect provided by High-Level Structure have been assessed by 3 on a scale of 5, is in line with expectations. The obstacles have been identified in the transition process. The organizations faced major difficulty by risk-based thinking, organizational context and scope, interested parties' requirements identification. Ahnudi et al. analyzed the effectiveness of the ISO 9001:2015 transition process in the company in the range from 82% to 94% [6]. The main shortages have been identified in the area of sources management and personal competencies, planning clauses of the standard- especially handling risk and opportunities and the requirements regarded to leadership. Almost all requirements clauses with a high rate of change after revision. Other authors also point to the relevance of the new reinforced requirements. Casadesus study [7] showed the significant role of High-Level-Structure in management systems integration and leadership emphasize in new revision standards. The same situation was predicted in connection with the transition to ISO 14001:2015. Fonseca's and Domingue's research in 2017 on the Portuguese organization pointed out the lagging of the transition to revised ISO 14001:2015 [5] and highlighted as the most beneficial concepts of ISO 14001:2015 the risk-based thinking, the "life-cycle approach" and "mapping of the context of the organization". Simultaneously the same concepts generate the significant problems in transitioning to the ISO 14001:2015 [8]

Method of investigation. The study presents a quantitative overview of the quality management system standard certification during and after the last revision transition period. It presents analyses based on ISO survey data, data of the certification structure in Lithuania and particular data of broader research on adoption of an environmental management system in Lithuanian companies [9]. The data were presented in graphs and tables to outline the change of dynamics of standards usage. We compare certification markets and analyse the observable impact by the type of standard, sectors penetration and possible certification impacts.

Investigation Results. The evolution charts of the volume of certificates over time express a saturation effect and stable reduction in the dynamics of ISO 9001 and ISO 14001 standards. The analysis of certificates numbers by industrial sectors highlights a decrease in the majority of sectors, only a few of them show up a positive trend in the last two years. The results of this study should be considered indicative rather than definitive. Taking into account the assembled data, multiple questions appear about the future. The future studies could proceed in qualitative research on causes of certification reduction and the possible incentives for management system standards application in organizations to sustain a system of credibility in international trade.

Conclusions. Although many literary sources confirm that the quality management system brings significant benefits to businesses and creates confidence in supply chains we observe deceleration of certification to ISO 9001 across the world economy in almost all industrial sectors and the dynamics of the quality management certification markets worldwide decrease. Also, the standard ISO 14001 certification slows. Even the expectation connected to transition and the benefits promised in Annex SL has not yet been audited by the companies and the increase of ISO 9001 certifications related to system efficiency have not yet taken place (although we had no results number of whole transition period). In 2017, 9 months before the transition deadline, still 58% of certified quality management systems worldwide had to undergo transition. There are observable difficulties in the transition to ISO 9001:2015. Although both ISO 9001 and ISO 14001 have been growing since 2000 we observe a decline of the rate of year-on-year growth of both standards. There is different “behavior” of the standards on the market in reaction to the revision and transition period. ISO 9001 reacts more sensitive than ISO 14001. Based on the long-time investigation it can be assumed that in 2017 certificate numbers return to the pre-revision level. However, it is necessary to state that in 2017 almost all sectors witnessed the decrease of the ISO 9001 certificates.

Keywords: *quality management system, environmental management system, certification, high-level structure, ISO 9001, ISO 14001.*

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Artificial Intelligence and Defense

Vladan Devedžić^{a1}

^aUniversity of Belgrade, Faculty of Organizational Sciences, Jove Ilića 154, 11000 Belgrade, Serbia

Introduction. Artificial intelligence (AI) is probably one of the most highly hyped words in different fields of research, business and services. There is a huge debate among experts related to whether the hype is justified or not. One extreme in this debate says that “AI has changed and continues to change our lives in many ways”, whereas the opposite extreme predicts “another AI winter” on the grounds that AI has failed to fulfill many promises since the hype has started. There are also many other different opinions in between the two extremes.

However, one cannot deny the fact that the hype has been growing for quite some time. Similar hypes around other technologies typically have much shorter lifespans. For example, it is very difficult today to see a huge number of enthusiasts when it comes to advances in cloud computing, cryptocurrencies, blockchains, virtual reality, the Internet of Things (IoT) and many other technologies that have initially seemed to be “the only path to follow”.

So, what is the current state-of-the-art of research, development and application of AI in general, and specifically in the area of defense? What new doors have been open, and what are the perspectives? Likewise, what are the myths and realities, what are the mists and fogs that one should clear before deciding to embrace or not to embrace AI as “the only path to follow”?

Methodology. In an attempt to answer these questions, the author has used approaches and resources from the following broad categories:

- ◆ General AI textbooks, courses, research papers and surveys. Good examples of such resources are the latest edition of the leading textbook in AI (Russel and Norvig, 2016) and a popular EdX course on AI (Salleb-Aouissi, 2020).
- ◆ A number of research papers, analytical surveys and different reports and multimedia presentations on applications of AI in the area of defense, including (Masuhr, 2019), (Congressional Research Service, 2019), (Özdemir, 2019), (Johnson, 2019) and (Davis, 2019).
- ◆ Interesting implicitly related reports from applying AI in other fields, such as (Schawbel, 2019).
- ◆ Information from the author’s research network. Working in the field of AI for 30+ years, the author has developed a large network of professional contacts, many of which have provided valuable insights.

1 * Corresponding author. Tel.: 381-11-3950918.
E-mail address: vladan.devedzic@fon.bg.ac.rs

Results. The results of the study indicate that:

- ◆ applications of AI in defense are booming, from autonomous vehicles (including killer drones and drone swarms), to simulations and wargaming driven by big data and machine learning, to intelligence data collection and analysis, to military robotics and object identification, to cyberattacks and so on
- ◆ in the area of defense, “AI could become a major potential source of instability and great power strategic rivalry” (Johnson, 2019), as it is easy to foresee escalation in rivalry between global forces
- ◆ yet there is a great deal of misunderstanding of the real nature of AI, which leads to important implications for AI education and training in the military domain freed from all hype, marketing and abuse of the term

Conclusions. AI has become a key technology in many areas – from business and services, to science and engineering, to natural language processing and news, publishing and writing, to human resource management and education, to medicine and healthcare, to transportation and aviation, to government, military and agriculture. As the field advances and expands at an unprecedented pace, it becomes more and more difficult to distinguish between AI and other fields. Moreover, just like any other technology, AI has both its bright and its dark sides. There are a number of expectations, hopes and promises of AI that still remain to be fulfilled, yet new avenues for further development open day after day.

This talk makes an attempt to put AI developments in different contexts and shed different lights on AI applications in general, AI applications in defense in particular, and current limitations, trends and challenges in the field.

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Keywords: *AI, defense, military, applications, drones, security, training, ethics, global risks, robotics, vision.*

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Practical Evaluation of New Insensitive Munition for Military Demands

Svajone Bekesiene¹

The General Jonas Žemaitis Military Academy of Lithuania, Silo g. 5A, LT-10322 Vilnius

Introduction. The basic requirements for explosives are high energy storage stability of chemical compounds (chemical stability) and maximum safety at work, when can be reached low sensitivity to impact and thermal effects and low toxicity. The high explosives currently used in the civilian and military sectors do not adequately meet modern safety requirements and are one of the reasons for the search for new high energy compounds.

Scientific research carried out during 2014-2016 year was focused on N-(2,4,6-trinitrophenyl)-1H-1,2,4-triazol-3'-amine. These investigations aim was to create new high-energy potentially explosive materials. During the research, the modeling of new high-energy materials and their theoretical and experimental research were performed. As a result, N-(2,4,6-trinitrophenyl)-1H-1,2,4-triazol-3'-amine was synthesized. Based on the theoretical results of the investigation of this material, was determined that this material must be impact resistant and have better explosive properties than well-known TNT.

Experiments on impact resistance of this material have been performed. The get results let to confirm that the theoretical assumption that the new explosive material N-(2,4,6-trinitrophenyl)-1H-1,2,4-triazol-3'-amine is impact resistant as well as TNT. In this way the results of the theoretical studies were validated experimentally. In addition, the results of theoretical studies let to conclude that the number and position of the amine and nitro groups in the molecule influence the chemical and thermal stability and explosive properties of the new explosive. Moreover it has been found that the introduction of nitro groups improves the explosive properties of a new high-energy material, and the additional amine group in some cases improves the impact resistance of N-(2,4,6-trinitrophenyl)-1H-1,2,4-triazol-3'-amine.

Method of investigation. A synthesis of the materials needed for the experiments was performed. The melting point of the test substances was determined in open glass capillaries 1 mm in diameter using a MELT-TEMP instrument. All reagents used in this work were purchased from Sigma-Aldrich, Fluka and Merck and further used for work directly. The melting point of the synthesized materials was determined in 1 mm diameter open glass capillaries using a MELT-TEMP instrument. The progress of the reactions and the homogeneity of the resulting materials were controlled using thin layer chromatography (PSL) and silica gel 60 F254 on aluminum backing plates (Merck). IR spectra were recorded on KBr compressed tablets with a Perkin-Elmer spectrophotometer (FT-IR Spectrum BX II). LC-MS studies were performed on Agilent technologies 6246 and LCMS-2020, Shimadzu instruments.

¹* Corresponding author.

E-mail address: svajone.bekesiene@lka.lt

The structure of the molecule and its fragments has been studied by the Becke's three-parameter hybrid functional applying the non-local correlation provided by Lee, Yang, and Parr (B3LYP) [6], – a representative standard DFT method.

Investigation Results. The UV-Vis spectra of the materials under study were both measured and calculated, too. UV/Vis spectra measurements of N-(2,4,6-trinitrophenyl)-1H-1,2,4-triazol-3-amine were spectrophotometrically carried out applying Lambda 25 (Perkin Elmer, Waltham, MA, USA) UV-VIS spectrophotometer using 1.0 cm optical path cells and recording spectra with 0.4 nm accuracies in ethanol medium. IR spectra were recorded in KBr disc on a Perkin-Elmer spectrophotometer (FT-IR Spectrum BX II) at accuracies 1 cm⁻¹. The RAMAN spectra is presented in Fig. 1.

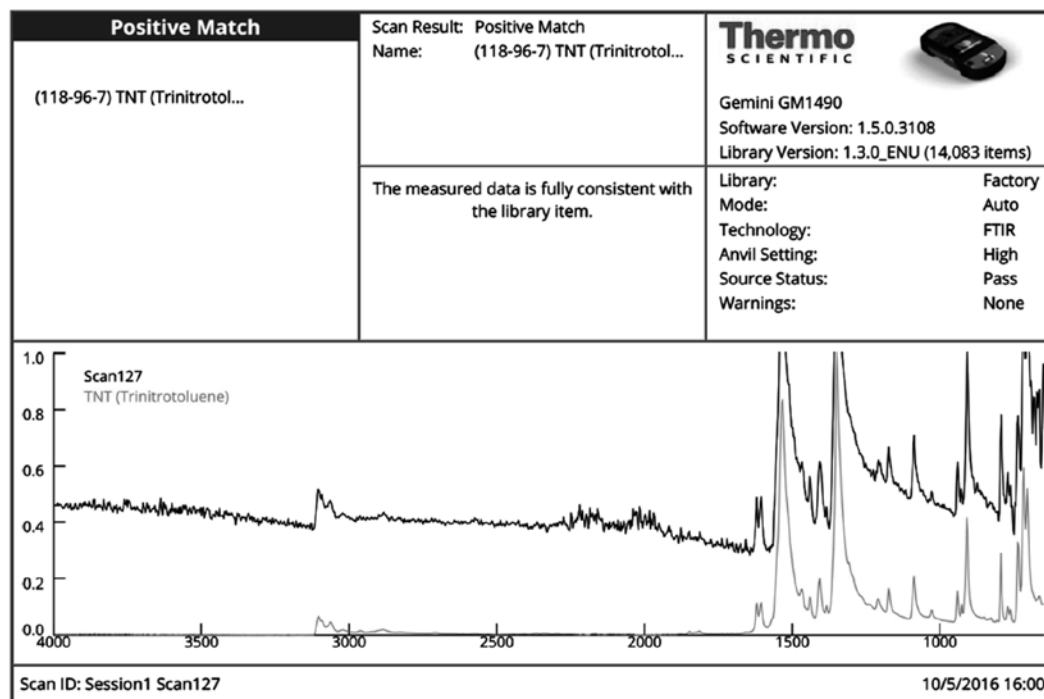


Fig. 1 The facsimile of the recorded RAMAN spectra issued by the device. The spectrum of synthesized TNT sample is shown in black line and yellow in the instrument database

Conclusions. The new high-energy (potentially explosive) materials have been created by rational molecular design. The principles of the latest quantum mechanics, organic chemistry and materials science methodologies were tested, practically applying their suitability to the development of such materials with desirable properties. Expected properties - impact resistance of new construction materials, high temperature, resistance to aging, etc. important parameters recently identified by NATO military specialists as basic in the “insensitive munition (IM)” category.

Theoretically (computer modeling) and experimental (spectroscopic, physico-chemical, mechanical, etc.) materials were further tested in preliminary but very important tests in practice, resistance to heating, hydrolysis, light exposure and contact with metals.

At the same time, a methodology for the identification of these new substances was developed, based on two basic principles: physical, - comparative spectroscopic analysis, and chemical, - new chemical analytical tests using color reactions. The key features for the identification of these new substances have been identified.

Limitations. However, further research is needed before this new material can be used in military applications as a new explosive. Such as:

- Synthesize materials for improved oxygen balance and explosive properties by transforming N- (2,4,6-trinitrophenyl) -1H-1,2,4-triazol-3'-amine and N- (3-amino-2,4,6- trinitrophenyl) -1H-1,2,4-triazol-3'-amine to their nitro derivatives, each having an additional nitro group in the triazole ring.
- Investigate N- (2,4,6-trinitrophenyl) -1H-1,2,4-triazol-3'-amino, N- (3-amino-2,4,6-trinitrophenyl) -1H-1,2,4-triazol-3'-amino and N (3') - (2,4,6-trinitrophenyl) -1H-1,2,4-triazole-3', 5'-diamine and their improved nitro derivatives dependence on their degree of compression (density).

It is hoped that, as a result of the above-mentioned studies, the new explosives will be able to be used in military practice.

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Keywords: *high energy materials; explosive detection; spectroscopy; UV spectra; IR spectra; calculations; B3LYP method.*

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On Diagnostics of Military Fortification Constructions

Eva Zezulová^{a1}, Lubomír Kroupa^b

^a*University of Defence in Brno, Faculty of Military Technology, Kounicova 65,
662 10 Brno, Czech Republic,*

^b*University of Defence in Brno, Faculty of Military Leadership, Kounicova 65,
662 10 Brno, Czech Republic*

Introduction. As a result of the changes of global security, the situation continues to deteriorate, especially for deployed forces. These changes require an adjusted approach to solving issues of missions' critical infrastructure, national critical infrastructure protection and civil protection. Changes are needed not only in the approach to the design and dimensioning of critical infrastructure elements and structures intended to protect the population, but also in the diagnostics of the existing structures status that have been subjected to extreme loads such as an explosion [1, 9]. The same problem must be solved in the military fortification constructions field. Structures that have been hit by the blast effects (pressure wave or fragments) should be assessed for their further use [7, 8, 10, 11]. It is therefore necessary to assess whether the fortification structure is capable of withstanding additional loads, or it has already lost its protective function and it can no longer be used for forces protection.

There is a big difference between a protective structure and a fortification structure. A protective structure is any structure that could protect against various effects. These effects may be: societal risks [2], environmental, physical (static and dynamic actions, wear.).

The philosophy of designing modern civilian buildings is to mitigate the risks associated with any bomb attack, especially by means of regime measures, security technologies (cameras, scanners), and the installation of restraint systems [12]. For military protective structures, the situation is different because their special focus is to protect forces against the consequences of an attack.

The objective of our research is military fortification structures and their assessment with regard to their specific military requirements for resistance to explosion effects in accordance with the criteria given by the military publication ATP-3.12.1.8 [3].

Method of research. A structure designed to protect the live force against the effects of a shock wave and projectiles it cannot be diagnosed by such a method as to break the protective structure. For these reasons, non-destructive testing methods should be preferred. Non-destructive testing (NDT) is suitable for the protective structures testing, as the protective properties of the construction are not compromised by sampling. The disadvantage of NDT

1 * Corresponding author. Tel.: +420 607 821 090.
E-mail address: eva.zezulova@unob.cz

is relatively complicated evaluation of measurement results. These methods are only partially appropriate for determining whether a military protective structure can withstand additional loads without jeopardize the concealed force. The field testing of structures and materials suitable for the construction of military protective structures is currently underway [4, 5, 6, 7, 8].

Research results. Based on the results of long-term field testing, we are working on creating a methodology for the diagnostics of military fortification structures. It has been proven that ultrasound crack detection in the structure is far from sufficient to assess the current state of the structure and to determine whether it is possible to repeatedly load the structure.

Conclusions. The requirements for military fortification construction are specific with regard to the loads these structures have to carry. The assessment of the condition of these structures is crucial to the Commander's decision as to whether or not the structure is capable of serving its purpose.

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Keywords: *defence infrastructure; military infrastructure; critical infrastructure; military fortification construction; NDT method.*

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Ethical and Legal Aspects of the use of Artificial Intelligence in Combat Operations

Saulius Japertas^{a1}, Agne Simonaviciute^b

^{a,b}*Kaunas University of Technology, Studentu 56, LT-51424, Lithuania*

Introduction. The 21st century is a breakthrough in scientific fields such as nanotechnology, neuroscience, the Internet of Things and robotics. Virtually none of these areas can be achieved without the use of artificial intelligence (AI). In the military, artificial intelligence is used in a variety of fields from planning operations and helping commanders make decisions to the installing them in combat robots or other autonomous or semi-autonomous systems. However, military robots or other similar systems can be dangerous even in non-combat operations due to software malfunctions [1]. From other hand, the use of artificial intelligence in warfare faces a number of challenges related to internationally recognized human rights, the Law of War (LOW) and the Rules of Engagement (ROE). Failure to comply with these rights, regulations and requirements may have adverse consequences for those operating such systems. As a result, since about 2004, issues related to the ethical and legal challenges of robotics started to analyze. Some moments are explored in the works [2-8].

However, as we can see, the vast majority of these works are devoted to the challenges of military robots or the use of robots as such. There is no doubt that artificial intelligence and robotics are very closely linked. However, as far as artificial intelligence in the military field is concerned, it is possible to emphasize some additional ethical and legal challenges.

The purpose of this work is to attempt to highlight certain ethical, moral, and legal issues that may be relevant to the development and use of artificial intelligence for military purposes, and to identify some of the questions that, according to our understanding, need to be answered to maximize human rights in combat operations, LOW and ROE. Since there are not enough investigations related to ethical and legal issues the use of artificial intelligence for military purposes, this paper will be based on the analysis of the use of robots.

Investigation Results. Summarizing the above papers, the following areas can be highlighted that may be relevant to the ethical, moral, and legal issues surrounding the use of artificial intelligence in combat operations:

- ◆ Social Challenges;
- ◆ Moral Challenges;
- ◆ Legal Challenges;
- ◆ Political Challenges;
- ◆ Military Challenges;
- ◆ Technical Challenges.

1 * Corresponding author. Tel.: 370-6-85-25-830.
E-mail address: saulius.japertas@ktu.lt

The proposed classification of AI ethical and legal challenges is presented in Table 1.

Table 1. Proposed classification of AI ethical and legal challenges

Social Challenges	Moral Challenges	Legal Challenges	Political Challenges	Military Challenges	Technical Challenges
Psychical and psychological	Humanism	Unclear responsibility	Lower barrier for war	Impersonalizing war	Self-defense
Technology dependency	Falling into the “bad” hands	Refusing an order	Aspiration to justify political and military action	Adherence to LOAC and ROE	Cyber defense
Intellectualistic bias	Squad cohesion	Human rights	Threat of asymmetric response	Transferring risk from combatants to civilians	Robots Running Amok
Civil security and privacy	Emotional	Robot rights	Avoidance of peace	Affect war power	Unauthorized overrides
Wining hearts and minds	Operational moral		Non-conventional use	Unilateral risk-free war	Wrong self-learning
Intercultural	Consent by soldier to risk				
	Distance of soldiers from the enemy				

Conclusions. The analysis of the ethical and legal aspects of the AI use, leads to the following conclusions:

- ◆ There are unusual challenges in ethics and justice for AI;
- ◆ The use of AI and robotic systems, ignoring the human rights and warfare challenges, can have legal and political consequences for those who use such systems;
- ◆ The technological dependence of soldiers can be a challenge for military leadership in planning and conducting operations;
- ◆ Unreasonable use of AI in military operations can lead to asymmetric resistance.

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Innovative Multi-Layer Panel with Enhanced Ballistic Properties for Military Applications

Marcin Wachowski^a, Robert Kosturek^{b1}, Lucjan Śniezek^c

^{a,b,c}*Military University of Technology, Faculty of Mechanical Engineering,
2 gen. S. Kaliskiego st., 00-908 Warsaw, Poland*

Introduction. Ensuring effective protection of objects exposed to projectiles, such as military vehicles or aircraft, requires an assumption of requirements already at the design stage. Typically, the main assumption when creating devices working in specific combat conditions is to design light, thin and the most durable ballistic shields. Recently published research results reveal the trend of production innovative ballistic panels having lower total weight, providing at least the same level of protection as currently used steel armor. Modern materials for armor usually consist of several layers of materials with different density. In the literature, there are attempts to create a laminar material with increased ballistic resistance consisting of aluminum and titanium alloys obtained by explosive welding method [1,2]. Technological development of military devices has increased significantly i.e. in the field of unmanned platforms. In order to minimize the mass and thickness of the ballistic panels, the most promising material is magnesium and its alloys. Due to the high electrical conductivity, low density, high strength and better EMI shielding ability, compared to aluminum, it has become one of the most attractive shielding materials not only in the military industry but also in civilian [3,4]. Mg-3Al-1Zn alloy (AZ31) has one of the best ballistic properties from the magnesium alloys. The most prospective structural material which can increase the ballistic resistance of the AZ31 magnesium alloy is a multilayer material obtained by combining the magnesium alloy with an aluminum alloy AA2519 and a titanium alloy Ti6Al4V by using the explosive welding method. Obtaining technologically correct joints between components requires the use of a 1050 aluminum alloy interlayer between the AZ31 / AA2519 and AA2519 / Ti6Al4V plates. The aim of the research is to obtain AZ31 / AA1050 / AA2519 / AA1050 / Ti6Al4V multi-layered material using explosive welding method. To examine the ballistic properties hypervelocity impact test was performed.

Method of investigation. Obtaining of the armor with increased ballistic resistance and ensured adequate ballistic protection in military vehicles, requires developing a technology for the production of advanced Mg-Al-Ti multi-layer material using innovative joining method. This work proposes the use of explosive welding, which is a process of high technological importance for the production of modern construction materials. The basic parameters of explosive welding are: the explosive material detonation velocity and the distance between the plates. Additionally, the impact velocity is also one of the key factors determining the quality of the joint. The parameters and the thickness of the welded plates determine the

1 * Corresponding author. Tel.: +48-261-839-245
E-mail address: marcin.wachowski@wat.edu.pl

possibility of obtaining the joints [4,5]. The correct selection of all these values allows obtaining explosively welded joints with a wavy surface. The process of explosive welding was carried out in the ZTW EXPLOMET company. A mixture of heating oil with ammonium nitrate (ANFO) was used as the explosive. Ballistic test of explosively welded laminate was performed under hypervelocity (4000 m/s) impact loading of projectile made of aluminum ball.

Investigation Results. After the joining process, the AZ31 / AA1050 / AA2519 / AA1050 / Ti6Al4V multi-layered material was obtained. The cross-section of the sample after hypervelocity ballistic test revealed penetration of the projectile through all plates except Ti6Al4V plate. Ballistic research results revealed that the projectile impact caused a large deformation of the plates and delamination of the AZ31/AA1050 and AA1050/AA2519 joints. Maximum diameter of the crater was about 30 mm. Observation revealed smooth surfaces, which suggest that the ductile shearing is as a dominant process of perforation. Projectile impact started penetration through AZ31 which is material with a lower density than other laminate components. In the first impact stage, a large amount of the projectile energy was acquired by the AZ31 plate. Further penetration was carried out through the laminate components ordered with increased density. During the penetration, the moving projectile pushed the structure directly below its nose, which caused stretching of the laminate layers. It allows to effectively dissipative energy up to stop the projectile on the Ti6Al4V plate without visible penetration. Delamination of the joints indicates that the material has reached the maximum strength limit due to perforation with the projectile and is a result of absorption of the generated energy due to the partial reflection of the shock wave from the titanium alloy. Delamination, therefore, is a phenomenon that positively affects the improvement of the ballistic properties of the produced laminate.

Conclusions. The explosive welding process allows obtaining high-quality Ti6Al4V/AA1050/AA2519/AA1050/Ti6Al4V joint free of cracks and voids. The results of ballistic test revealed that the laminate is well suited to ballistic protection applications. Observation of the cross-section of the sample after ballistic test revealed that the ductile shearing is a dominant process leading to perforation through the laminate components. Application of AZ31 magnesium alloy with proper deformation in multi-layer laminate allows obtaining armor with good ballistic properties against hypervelocity condition of firing.

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Keywords: *explosive welding, multi-layer panel, ballistic properties, armor grade aluminum*

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**CHALLENGES TO NATIONAL DEFENCE
IN CONTEMPORARY GEOPOLITICAL SITUATION**

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