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Dear readers,

Let me take the opportunity to introduce myself to you as a new editor-in-chief of the Science & Military journal. First of all, I would like to thank prof. Dipl. Eng. Marcel Harakaľ, PhD. for his long-standing work he dedicated to the journal. Professor Harakaľ will continue to be a member of the editorial board.

Scientific papers are essential for promotion of research. They profoundly influence improvement and expansion of human knowledge. Not only do research, drawing of scientific conclusions and academic writing have a positive effect on authors' profiles - their prestige in the scientific world – but they also improve reputation of institutes and universities they work for. Results of research are mostly published in scientific journals that present the enormous information potential. That is why we want to pursue continuous quality improvement regarding the Science & Military journal. However, what we need for accomplishment of this goal is publication of quality papers suitable for international peer discussions. These papers should present their authors' own points of view and attitudes of researchers who work in particular research fields.

Dear readers, the second issue of the 2020's Science & Military journal was compiled in difficult times when the coronavirus pandemic broke out throughout the world. It paralysed all activities within our everyday life. We are pleased by the fact that despite these challenging times our journal can offer interesting papers that have undergone a rigorous review process. I hope they will inspire you and that they will initiate scientific discussions.

The first among the peer-reviewed articles in this issue is the article written by Peter Mako titled ***„Analysis of bridging systems within Slovak Armed Forces and possibilities of their replacement"****. The main goal of the article is to evaluate and compare properties of different bridging systems in Slovakia and other NATO countries. It was found that the Slovak Armed Forces do not have bridging systems to support heavy assault vehicles of allies from NATO. The replacement of Slovak bridging systems will be necessary in the future.*

The author Lukáš Novotný wrote the article titled ***„Use of modern materials in hydrogen fuel cells"****. The aim of this paper is to clarify the principle of operation of the fuel cell, especially with a focus on hydrogen fuel cell, as a potential source of energy for driving vehicles and also to point out the modern materials used.*

Another article titled ***"Diagnostic and possible problems of anti-lock braking system (ABS)"*** *was written by Pavol Lukášik and Vladimír Kadlub. This paper deals with anti-lock braking system as one of the most important safety systems in modern vehicles. The authors dealt with failure of individual components of the system on the Mitsubishi Lancer 1.5 Inform MY (model year) 2009, where malfunction of the front right wheel rotational speed sensor and also ABS and ESP control unit occurred.*

The following article ***"A theoretical view of asymmetry in security and military sphere"*** *by Radoslav Ivančík aims to clarify, define, and use the term asymmetry. Asymmetry in the military sphere represents the planning, organization and implementation of asymmetric actions (operations) aimed at achieving own goals in a different way than the adversary. Asymmetry is reflected in the assessment and view parties involved in asymmetric conflicts (asymmetric armed conflict, asymmetric approaches and operations, asymmetric threats - weapons, information, operation, terrorism).*

*Organized crime is currently one of the most serious negative phenomena and threats in the world. The new approach to research of organized crime through game theory and its sub theories is the main topic of the article by Anna Ďurfina titled "****Research methodology of non-military threat - transnational organized crime and game theory"****.*

The final article by Jaroslav Oberuč and Mária Martinská a titled ***"Teacher's creativity in the educational process"*** *presents creativity as a part of the educational process where a teacher must be a creative personality in order to guide students to creativity. From the current pedagogical and psychological point of view, it is believed that creativity is an instrument of self-realization and an absolute fulfilment of one's meaning of life.*

Dear readers, on my behalf and on the behalf of the editorial board, I would like to wish you all the best in the upcoming year and thank you for your readers' interest.

I wish you a pleasant reading.

Assoc. Prof. Dipl. Eng. Vladimír ANDRASSY, PhD.
Chairman of the editorial board

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ANALYSIS OF BRIDGING SYSTEMS WITHIN SLOVAK ARMED FORCES AND POSSIBILITIES OF THEIR REPLACEMENT

Peter MAKO

Abstract: Slovak Armed Forces has in service three types of assault bridging systems AM-50, PM-55 and MT-55 and one support bridging system PMS pontoon bridge. All of them are in service since 70-ties of last century so their replacement is essential. Their main tactical parameters which is load capacity is deficient in comaprison to bridging systems of NATO armies and requiprements based on battle weight of heavy assault vehicles of NATO allies. Currently is possible to find several options for replacement by vehicles already serving in NATO armies or prototypes waiting for enlistment.

Keywords: Military bridge; Bridging systems; STANAG 2021; NATO; Load capacity; MLC classification.

1 INTRODUCTION

Slovak Armed Forces are equipped with several types of bridging systems. Development of all of these techniques was done in last century so right now these equipment were used more than 20 years in active service. Besides that, the equipment which is used by Slovak army is parametrically not in accordance of heavy equipment which is used by allies from NATO member states. Based on these facts is expectable that Slovak Armed Forces will need interchange of these techniques to new bridging systems. This expectation is premise to make an analysis of bridging systems which is right now in service of Slovak Armed Forces and analysis of techniques which are in use of NATO member states. The important will be specification of minimal parameters which should match with a new possible solution for Slovak Armed Forces.

2 DIVIDING OF MILITARY BRIDGING SYSTEMS

Military bridging systems are divided as follows:

- **Assault bridging systems:** Mobile bridging technique used for direct support of fighting units in tactical zone. Assault bridging systems are built on wheeled or tracked chassis with possibility to build a bridge over wet or dry obstacle in quite short time (several minutes) by superstructure. These systems consist from vehicle, folding (laying) device and bride bay.
  - Wheeled assault bridging systems: Assault bridging systems built on wheeled chassis, mostly with 6 or 8 wheels.
  - Tracked assault bridging systems: Assault bridging systems built on tracked chassis, also called "Armored vehicle-launched bridge (AVLB)".
- **Support (floating) bridging systems:** Support bridging systems are used in tactical zone to ensure movement of units to support assault units. Building time of these bridging systems are several tens of minutes. Mostly support bridging systems are working on floating principles. The bridge consists from several floating parts anchored to both sides of the river. Mostly there is a possibility to build a "Ferry", which is overcoming wet obstacle without anchoring to coast.
  - Pontoon bridging systems: The Bridge consists from floating parts called pontoons. These pontoons can be equipped with own engine or the whole bridge is equipped with boats which ensuring building of the bridge.
  - Floating amphibious vehicles: Floating amphibious vehicles are equipped with own engine and can move on land or water independently. They can create the bridge in the similar way like pontoon bridging systems with connection of several floating amphibious vehicles together.
  - Other support bridges: Bridges built on mechanical principles, which are not using buoyancy forces of water and which can be used for dry gap also.
- **Logistic bridging systems:** Bridging technique used in rear, not directly in tactical area. The bridge itself consisting from more parts. Building of this kind of the bridge is taking longer time interval (several hours). Bridge is used for longer period than assault or support bridges. [1]

3 BRIDGING SYSTEMS WITHIN SLOVAK ARMED FORCES

Slovak Armed Forces are actually equipped with all types of bridging systems except floating amphibious vehicles.

3.1 Wheeled assault bridging systems of Slovak Armed Forces

AM-50: The AM-50 is a vehicle built on the Tatra 813 8x8 chassis with a bridging superstructure consisting of laying device, a bridge and a hydraulically operated telescopic pull-out support. The bridge is a scissor type. AM-50 entered into equipment of Czechoslovakian Army in 1977. The length of single bridge bay is 13,5 m and allows to bridge obstacle

with length of 12,5 m. Maximum road width is 4 m and load capacity 50 t for tracked vehicles and 70 t for wheeled set. These techniques allow the connection of up to 8 bridge bays with an overall bridging length of 106 m and an obstacle depth of 5.15 m. This device was not classified in accordance of STANAG 2021. The AM-50 vehicle can be considered not only as assault bridge but as support bridge as well. [2]

Fig. 1 Bridge vehicle AM-50
Source: [3].

PM-55: Bridge transporter PM-55 is a vehicle built on the Tatra 813 8x8 chassis with a bridging superstructure consisting of laying device and scissor type of the bridge. Vehicle is laying same bridge like bridge tank MT-55. PM-55 entered into equipment of Czechoslovakian Army in 1976. The length of single bridge bay is 18 m and allows to bridge obstacle with length of 17,5 m. Maximum road width is 3,3 m and load capacity 50 t. This device was not classified in accordance of STANAG 2021. [4]

Fig. 2 Bridge transporter PM-55
Source: [5].

3.2 Tracked assault bridging systems of Slovak Armed Forces

MT-55A: Bridge tank MT-55A is a vehicle built on T-55 tank chassis with a bridging superstructure consisting of laying device and scissor type of the bridge. MT-55A went into service of Czechoslovakian Army in 1975. The length of single bridge bay is 18 m and allows to bridge obstacle with length of 17,5 m. Maximum road width is 3,3 m and load capacity 50 t. This device was not classified in accordance of STANAG 2021. [6]

Fig. 3 Bridge tank MT-55A
Source: [3].

3.3 Pontoon bridging systems of Slovak Armed Forces

PMS: The pontoon bridge set PMS is a folding structure on floating supports. The bridge uses buoyancy to create bridging of the water barrier. It is especially designed to overcome large watercourses. Compared to the AM-50 or MT-55 to build the bridge it is necessary to fit several vehicles with a laying mechanism. The bridge consists of 2 coastal parts and several river sections according to the length of the bridging. The maximum length of this bridge is 227 m for load capacity 60 t for tracked vehicles and 90 t for wheeled set and for maximum road width of 6,5 m. Compared to the AM-50 and MT-55, it offers variability in the width of the road. It allows constructing of a narrower bridge with a width of 3,29 m and a length of 382 m for light vehicles up to 20 t. [7]

Fig. 4 PMS bridge
Source: [3].

4 BRIDGING SYSTEMS OF NATO MEMBER STATES

NATO members are using several models of bridging systems. In this article are mentioned the newest bridging systems of countries which are important allies for Slovak republic. In following chapter is possible to find bridging systems of USA, Great Britain, France, Germany and Poland.

4.1 Selected wheeled assault bridging systems of NATO armies

PTA 2-SPRAT: Vehicle PTA 2-SPRAT entered into service of France army in 2009. Vehicle is built on

new chassis 10x10. Chassis is carrying laying device and bridge which is consisting from two parts. Total length of folded bridge is 26 m and allows overcoming barrier with maximum length 24 m. Bridge is classified by STANAG 2021 to category MLC 85 for tracked vehicles and MLC 100 for wheeled set. Road width of the bridge is 4 m. [8]

Fig. 5 Vehicle PTA 2-SPRAT
Source: [9].

MS-20 Daglezja: First vehicles were delivered to Polish army in 2012. Laying device and bridge is placed on towed trailer not on vehicle as PTA-2 or AM-50. Bridge is scissor type with total length 23 m which allows overcoming barrier with length of 20m. Road width of bridge is 4 m. Bridge was classified in accordance of STANAG 2021 to category MLC 70 for tracked vehicles and MLC 100 for wheeled set. [10]

Fig. 6 Vehicle MS-20 Daglezja
Source: [11].

LEGUAN bridge laying system: This bridging system is giving opportunity to have a same type of the bridge on wheeled and tracked vehicle also. LEGUAN Bridge was already placed on MAN 8x8 or SISU 10x10 chassis but on the same time on tracked chassis of Leopard 2 or M1A1/A2 Abrams. System can fold one bridge with 26 m length or two bridges with 14 m. Bridges can be used like combination also. The maximum obstacle width which can be overcome by two 26 m bridges is 40 m. Single 26 m span can overcome 24 m gap. Bridge is classified in accordance of STANAG 2021 to MLC 80 for tracked vehicles and MLC 110 for wheeled set. Maximum road width is 4 m. [12]

Fig. 7 LEGUAN Bridging system on SISU 10x10 chassis
Source: [12].

4.2 Selected tracked assault bridging systems of NATO armies

MG-20 Daglezja-G: First prototype of this vehicle was delivered to Polish army in 2012. The vehicle is built on chassis of T-72 tank. Chassis is carrying laying equipment and bridge. It is an exactly same bridge as MS-20 Daglezja and both systems are compatible together. [13]

Fig. 8 Vehicle MG-20 Daglezja-G
Source: [13].

TITAN: First vehicle was delivered to UK army in 2006. Vehicle is built on Challenger 2 tank chassis and can carry standardized UK bridge system No10, No11 or No12. Bridges are scissor type. The longest bridge has maximum length 26 m and can overcome barrier with length of 24,5 m. Bridge was classified in accordance of STANAG 2021 to category MLC 70 for tracked vehicles and MLC 100 for wheeled set. [14]

Fig. 9 Vehicle Titan
Source: [14].

M104 Wolverine / Beaver: Both vehicles are using the same Leguan bridge laying system. The main difference is chassis. M104 Wolverine is using

chassis of US M1A2 tank and Beaver is using chassis of tank Leopard 2. M104 Wolverine is in use of US Armed forces and Beaver is in use for example in German army or Canadian army. [15]

Fig. 10 Vehicle M104 Wolverine
Source: [15].

4.3 Selected pontoon bridging systems of NATO armies

Motorized floating bridge PFM: First bridge entered into service of French army in 1980. Bridge consist from floating parts with maximum length 10 m and maximum width 10,2 m. Each floating part is equipped with engine. Based on that the bridging system does not need boats for moving on water surface. Bridge can overcome barrier with maximum width of 150 m. Maximum road width of the bridge is 4 m. System is classified in accordance of STANAG 2021 to category MLC 80 for tracked vehicles and MLC 96 for wheeled set. [16]

Fig. 11 PFM floating bridge
Source: [16].

Improved Ribbon Bridge IRB: IRB bridge system entered into service of US army in 2002. Set is consisting from interior bay and ramp bay. Both parts have same length 6,92 m and width 8,63 m. For road width 4,5 m the bridge is classified as per STANAG 2021 to category MLC 80 for tracked vehicles and MLC 96 for wheeled set. In case of two-way traffic the maximum road width is 6,75 m and maximum load capacity of the bridge is MLC 20. One set of IRB can overcome barrier with width of 210 m. [17]

Fig. 12 IRB floating bridge
Source: [17].

5 COMPARISON OF BRIDGING SYSTEMS OF SLOVAK ARMED FORCES AND NATO ARMIES

Basic parameters of military bridges mentioned by their producer also and important as per STANAG 2021 are load capacity of the bridge for tracked vehicles and wheeled sets, maximum road width, maximum length of obstacle for single bridge bay and in case of possibility of connection of more bridges the full length also.

Tab. 1 Comparison of basic parameters of wheeled assault bridging systems

	Bridging systems				
Parameters	AM-50	PM-55	PTA2	MS-20	Leguan
Load capacity tracked vehicles (t)	50 t	50 t	MLC85/ 77,11 t	MLC70/ 63,5 t	MLC80/ 72,57 t
Load capacity wheeled set (t)	70 t	50 t	MLC100/ 90,72 t	MLC100/ 90,72 t	MLC110/ 99,79 t
Max. road width (m)	4 m	3,3 m	4 m	4 m	4 m
Max. obstacle length single bridge (m)	12,5 m	17,5 m	24 m	20 m	24 m
Max. obstacle length multiple bridge (m)	106 m	Not	Not	Not	40 m

Source: author.

Tab. 2 Comparison of basic parameters of tracked assault bridging systems

	Bridging systems			
Parameters	MT-55	Mg-20	Titan	Leguan (M104 Wolverine/Beaver)
Load capacity tracked vehicles (t)	50 t	MLC70/ 63,5 t	MLC70/ 63,5 t	MLC80/ 72,57 t
Load capacity wheeled set (t)	50 t	MLC100/ 90,72 t	MLC100/ 90,72 t	MLC110/ 99,79 t
Max. road width (m)	3,3 m	4 m	4 m	4 m
Max. obstacle length single bridge (m)	17,5 m	20 m	24,5 m	24 m
Max. obstacle length multiple bridge (m)	Not	Not	Not	40 m

Source: author.

Tab. 3 Comparison of basic parameters of pontoon bridging systems

	Bridging systems		
Parameters	PMS	PFM	IRB
Load capacity tracked vehicles (t)	60 t /20 t	MLC80/ 72,57 t	MLC80/ 72,57 t MLC20/ 18,14 t
Load capacity wheeled set (t)	90 t / 20 t	MLC96/ 87,09 t	MLC96/ 87,09 t MLC20/ 18,14 t
Max. road width (m)	6,5 m / 3,29 m	4 m	6,75 m
Max. obstacle length (m)	227 m / 382 m	150 m	210 m

Source: author.

The figures above are giving main information that bridges which are used by Slovak Armed Forces are not able to take the same load as bridging systems of NATO armies. The maximum load capacity of AM-50, PM-55 and MT-55 is 50 t which is equivalent to category MLC 55 which is not official MLC category as per STANAG 2021. NATO bridges are classified to category MLC 70+ for tracked vehicles and MLC 100+ for wheeled set. PMS has load capacity 60 t for tracked vehicles and 90 t for wheeled set which is equivalent of MLC 66 and MLC 99. In this case NATO bridges are classified in to category MLC 80+ for tracked vehicles. For wheeled set the PMS should be comparable to NATO bridges.

In 2000 was published habilitation work of Associate Professor Eng. Pavel Maňas, PhD. where was done classification of PMS bridging system as per STANAG 2021 for Czech army. Based on the result of this work the PMS bridging system of Czech army was classified to MLC 70 for tracked vehicles as per STANAG 2021. [18]

The PMS bridging system of Czech army is exactly the same bridging system which is used by Slovak Armed Forces. If the authorities of Slovak Armed Forces will accept and implement results which was gained in Czech Republic than the PMS bridging system could be considered as comparable to actually used support bridging systems in NATO armies.

6 IMPORTANCE OF LOAD CAPACITY FACTOR

Slovak Republic is part of the NATO since 2004. The basic principle for NATO collective defence is possibility for cooperation of the armed forces of its member states. This interoperability is important not only between equipment of fighting units but between heavy equipment and bridging or enginery technique as well. Most of the allies of Slovak Armed Forces from NATO have different types of the heavy battle technique. In general, is valid that allies from NATO are equipped with heavier technique than Slovak Armed Forces. Below is table with main battle tanks of NATO allies. [3]

On Fig. 13 is visible comparison of tanks battle weight among NATO member states and Slovak Armed Forces bridging technique load capacity. Yellow line is marking actual load capacity of AM-50, PM-55 and MT-55. Green line is representing actual valid load capacity of PMS for tracked vehicles. Based on these results is possible to evaluate that Slovak Armed Forces need for its interoperability with allies from NATO in field of bridging systems equipment which will be classified by STANAG 2021 to minimum category of MLC 70 (63,5 t). With this minimum value of load capacity the bridging systems should be able to provide support to most of assault units of NATO armies.

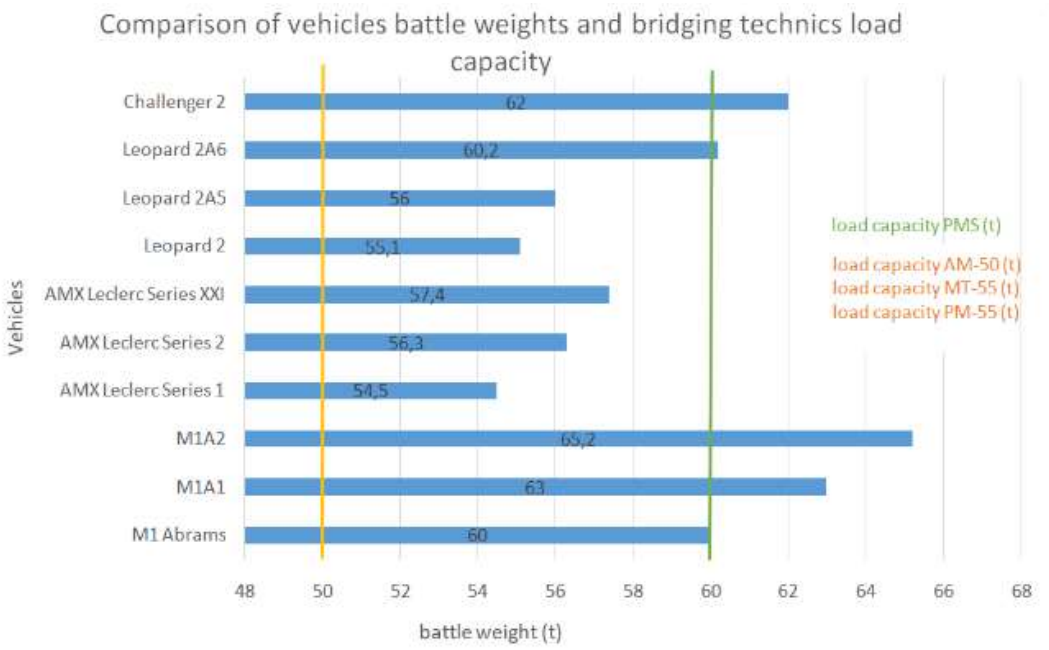

Fig. 13 Comparison of tanks battle weights and load capacity of bridging systems of Slovak Armed Forces Source: [3].

Tab. 4 Battle weight of several main battle tanks in use of NATO member states

Vehicle	Battle weight (kg)
M1 Abrams	60 000 kg
M1A1	63 000 kg
M1A2	65 200 kg
AMX Leclerc Series 1	54 500 kg
AMX Leclerc Series 2	56 300 kg
AMX Leclerc Series XXI	57 400 kg
Leopard 2	55 100 kg
Leopard 2A5	56 000 kg
Leopard 2A6	60 200 kg
Challenger 2	62 000 kg

Source: [3].

7 CONCLUSION

In equipment of Slovak Armed Forces is possible to find two types of wheeled assault bridging systems AM-50 and PM-55, one type of tracked assault bridging system MT-55 and one type of support bridging system PMS. By comparing of the load capacity of each of them and maximum battle load of main battle tanks of NATO armies was found that Slovak Armed Forces nowadays do not have bridging systems to support heavy assault vehicles of allies from NATO. AM-50, PM-55 and MT-55 can support vehicles with maximum weight of 50 t (MLC 55) but minimum requirement based on the result of comparison is MLC 70 for tracked vehicles as per STANAG 2021. This fact is supported also with comparison of bridging systems within Slovak Armed Forces and selected bridging systems of NATO forces where minimum load capacity of both assault bridging systems was MLC 70 for tracked vehicles and MLC 100 for wheeled set.

Support pontoon bridging system PMS is special case. Slovak Armed Forces are using this bridging system as per ŽEN-24-10 which is limiting load capacity for tracked vehicles to 60 t (MLC 66) and 90 t for wheeled set (MLC 99). In that case limit for tracked vehicles is not enough. If the Slovak authorities will accept and apply the results of classification as per STANAG 2021 which was done in Czech Republic by Asociate profesor Eng. Pavel Maňas, PhD. for the same bridge then the PMS can be considered as comparable to selected NATO bridging systems.

Current bridging systems of Slovak Armed Forces entered into service in 70-ties of last century and therefore their replacement will be sooner or later necessary. In article is presented possible equipment which is serving in other NATO armies and can replace existing bridging systems to comply minimum current requirements for bridging equipment especially load capacity and classification as per STANAG 2021. For all Slovak bridging equipment is existing NATO alternative with higher load capacity except AM-50 which can be consider as assault but also support bridging system. Solution could be a prototype of AM-70EX built in Czech Republic which is classified to category MLC 70 as per STANAG 2021 but still not in service of any NATO member state. [19]

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USE OF MODERN MATERIALS IN HYDROGEN FUEL CELLS

Lukáš NOVOTNÝ

Abstract: With the increasing trend in the volume of transported persons and goods, the total amount of greenhouse gases produced by vehicles is increasing. One possible environmental solution for alternative propulsion is the hydrogen fuel cell as an energy source instead of fossil fuels. At the same time, the fuel cell can be used in a variety of military applications to replace conventional power sources. The aim of this work is to explain the principle of fuel cell function and description of polymer membranes used in fuel cells.

Keywords: Power cells; Hydrogen; Polymer membranes; Nafion; Polybenzimidazol.

1 INTRODUCTION

Increasing air purity requirements, in line with the increasing oil shortage, pose a challenge to ensuring human mobility. One possible solution to this problem is in the development of electric drive systems [1]. This solution can satisfactorily address both environmental and economic mobility requirements.

The current development of vehicles is moving in two directions, the way of hybrid vehicles and the way of production of clean electric vehicles [2]. In both cases, electrical energy is important to achieve the desired driving parameters, especially its spectrum of properties such as source capacity, its specific energy or specific energy density [1].

We know three kinds of electrochemical power sources. The first group consists of primary cells - batteries, in which discharging the reactant cells consumes products that cannot be charged, i.e. by external current, to be converted again to the original reactants. The second group consists of secondary cells - accumulators, in which the reaction products can be converted to the original reactants by the external current. The third group is fuel cells in which the cold combustion of fuel takes place, generating electricity. Fuel cells operate continuously when fuel is supplied from the tank and oxidant from the ambient air [1]. The most suitable source of electric power for the electric propulsion of vehicles today is a polymer electrolyte membrane (PEM) fuel cell in which several types of materials are used as a membrane. One of the perspective materials is a solid organic polymer.

2 FUEL CELL

None of the current propulsion systems meets the requirements for 21st century propulsion systems. All vehicles in which internal combustion engines operate, charge the environment with exhaust gases and burn fossil fuels. As an alternative, electric vehicles are suitable. However, it still has shortcomings, such as the range of electric vehicles and the length of the charging cycle [1]. This is conditional on the way energy is stored, in the form of electrochemical energy in traction batteries. Therefore, an adequate replacement or supplementation to accumulators is a fuel cell in which the cold combustion of the fuel takes place. The vehicle is capable of refueling in a short time, e.g., hydrogen, methanol, or natural gas, enough for many hours of driving [2]. The efficiency of such a system is up to twice that of an internal combustion engine and no nitrogen oxides or carbon monoxide are produced. Carbon dioxide is only emitted if it is a carbon fuel.

The first fuel cells were invented in 1893, but the first commercial use was during NASA's space program to generate energy for the satellites. The Geminis fuel cell in 1962 had an output of 15 kW. Today, a fuel cell is introduced to generate energy along with heat exchangers in the range of 200 to 300 kW of electrical power. The same small systems, with an output of up to 5 kW, are offered for households where the waste heat generated by electrochemical reactions is used for heating [1].

Commercial use for electric vehicles began with a strategic alliance of Daimler-Benz and Ballard Power Systems in 1997. Later, other motor vehicle manufacturers also joined. Toyota Mirai is one of the first commercially sold fuel cell vehicles on the market. According to the dealer, approximately 3,500 of these vehicles were sold in the United States by the end of the year. The current range of the vehicle being sold is 500 km per hydrogen tank [1].

2.1 Operating principle of fuel cell

Fuel cells belong to a group of power sources in which the internal energy of the fuel is converted directly into electrical energy by electrochemical processes. Thus, they are similar to primary cells (batteries) or secondary cells (accumulators). The fundamental difference between them is that in the case of fuel cells, the active chemicals are not part of the anode or cathode but are continuously supplied to them from outside. Both electrodes act solely as catalysts for chemical metamorphisms, they are virtually worn-out during cell operation and their chemical composition does not change. The electrodes are inert. On their surface, electrode reactions take place, which are accelerated by means of catalysts (most commonly used platinum or its alloys) [1].

The operating principle of the fuel cell is shown in Figure 1. The negative electrode, which is called the fuel anode, is supplied with the active substance - fuel. Here, it oxidizes, its atoms get rid of one electron from the valence layer, and the released electrons, which represent the electric current, move through the outer circuit towards the positive electrode - cathode. On the positive electrode, where the oxidant is fed, on the contrary, a reduction takes place, the oxidizing atoms receive free electrons, while reacting with the positive ions that penetrate the electrolyte. If the external load circuit is interrupted, the ongoing reactions will stop due to lack of electrons [3].

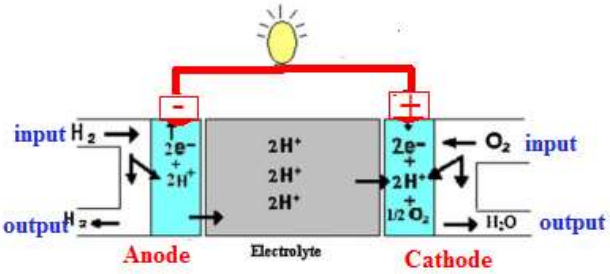

Fig. 1 Principle of operation of hydrogen fuel cell
Source: [3].

In a fuel cell, chemical energy is converted, without a thermal expansion process, into electrical energy (the so-called cold combustion). The gaseous fuel, in this case hydrogen, and also the gaseous oxidant, for example oxygen, are fed to the electrodes via channels equipped with a catalyst. Between the two electrodes there is an electrolyte made of a special polymeric film, solids, either an acidic or alkaline base. Its task is, among other things, to prevent direct contact of both gases. The electrolyte is an electrical insulator ensuring the exchange of electrons only through the external circuit. This creates a difference in electrical potential between the two electrodes, which is equivalent to an electrical voltage of approximately 1.23 V for a hydrogen-oxygen fuel cell [1].

2.2 Polymer-electrolyte fuel cell

A solid polymer, such as an electrolyte, eliminates the risk of corrosion and adverse phenomena common to liquid electrolyte cells. The electrolyte is a thin ion-exchange membrane. It acts as an electron insulator and at the same time as an excellent conductor of hydrogen cations [1]. One of the materials which could be used is a carbon and fluorine-based polymer similar to Teflon, the commercial name of which is Nafion [4].

Both electrodes are equipped with a fine channel plate made of graphite on opposite sides. The walls between the channels provide electrical contact with the back of the electrode and conduct electrical current to the external circuit [1]. The chase themselves distribute the oxidant at the cathode.

The anode and cathode are made by applying a small amount of platinum black to one side of a thin sheet of porous graphite paper that has been pre-coated with Teflon anti-wetting layer. The polymer electrolyte membrane is sandwiched between the anode and cathode electrodes and all three parts are joined together under heat and pressure. This assembly, which is the central component of the fuel cell, has a thickness of less than 1 mm [1].

The central components consist of modules that represent several hundreds of these cells with a size of e.g. 40x40 cm mutually included in the so-called. fuel beam. The number of cells gives the total voltage of the beam, the area of the individual cells the size of the current, respectively the capacity of the cell. Today, using high-quality membranes, ambient air is used as an oxidant instead of pure oxygen, which has made it easier to use in automotive technology because of the need to carry only fuel [1].

During the reactions, water is formed on the cathode side, which can be removed either in liquid form or as water vapor with air. PEM cells already supply about 50 % of their full power at room temperature. Their working temperature is between 70° C and 90° C, it means below the boiling point. This is important because the membranes have to reach from 20 to 40 % water to ensure the moving of hydrogen ions [5].

Polymer electrolyte cells have established themselves as power sources for electric vehicles. Although the cost of the membranes is still too high, this fuel cell construction has the following substantial advantages over other fuel cells:

- The cells contain a small amount of materials which can be aggressive for other materials. This is particularly important for peripheral parts of fuel cells, such as pumps, valves, or heat exchangers, which otherwise cannot contain any corrosive materials.
- The ion conductivity of the membranes is generally less than that of the aqueous solution, but the low thickness of the polymeric films again remedies this disadvantage.
- Low temperatures do not cause problems, problems occur below -25° C.
- The production of individual links is simple as the films are easy to assemble.
- The cells can withstand relatively high pressures and large pressure differentials, thus providing high performance, compact construction and optimum performance.
- Can be operated with high dynamics over the full power range from idle to full load.
- The fuel cell device is easy to start and stop [1].

3 POLYMER MATERIALS USED IN FUELL CELLS

Since the beginning of commercial use, several types of materials have been used as an ion exchange membrane. Each has its features, pros and cons of use, as the main drawback in the use of natural materials is the high operating temperature of such a cell. Polymers appear to be the most promising material for the production of fuel cell membranes used in automotive technology [6, 7].

3.1 Nafion

Nafion is a trade name for a sulfonated tetrafluoroethylene fluoropolymer copolymer, which was discovered in the late 1960s by Walther Grot. Nafion is a brand of Chemours. It is the first material from the group of synthetic polymers with ionic properties called ionomers. The unique ionic properties of Nafion are the result of incorporation of sulfonate-terminated perfluorovinyl ether groups on the tetrafluoroethylene (PTFE) backbone. Nafion has received considerable attention as a fuel cell proton conductor due to its excellent thermal and mechanical stability [6].

The chemical basis of the excellent conductive properties of Nafion remains the subject of research. The pores allow cations to move, but the membranes do not carry anions or electrons. The Nafion can be made with different cationic conductivities.

Fig. 2 Example of fuel cell using Nafion membrane
Source: [4].

Nafion derivatives are first synthesized by copolymerization of tetrafluoroethylene (TFE) (a monomer in teflon) and a perfluoro derivative (alkyl vinyl ether) with sulfonyl fluoride. The latter may be prepared by pyrolysis of the appropriate oxide or carboxylic acid to form an olefinic structure [4].

The resulting product is a $-SO_2F$-containing thermoplastic that is extruded into films. Hot liquid NaOH converts these sulfonylfluoride groups ($-SO_2F$) to sulfate groups ($-SO_3^-Na^+$). This form of Nafion, referred to as neutral or saline, is ultimately converted to an acid form containing sulfonic acid ($-SO_3H$). The Nafion can be cast into thin layers by heating in aqueous alcohol at 250° C. In this way, Nafion can be used to make composite films, coating electrodes or to repair damaged membranes. However, this manufacturing process is relatively expensive [8].

Nafion has proven to be an effective material used as an ions-exchange membrane (PEM) fuel cell membrane by allowing the transport of hydrogen ions while preventing electron transfer. The fuel cells, which are produced by joining electrodes on both sides of the Nafion membrane, conduct the electrons through a process requiring energy and return to hydrogen ions to react with oxygen and produce water. Here, Nafion acts as an obstacle for the electrons to pass directly between the electrodes, which would lead to a short circuit of the fuel cell [8].

Due to the properties of Nafion, it is necessary to provide the required membrane moisture when using this material in the hydrogen fuel cell. Normal Nafion will dehydrate (and thereby lose the conductivity of protons) when the temperature is above 80 ° C. This limitation makes fuel cell construction difficult because higher temperatures are desirable for better platinum catalyst efficiency and tolerance. To Nafion, various chemical reactions are silica and zirconium phosphate to raise the working temperature above 100° C [5].

3.2 Polybenzimidazol

PBI (polybenzimidazole) fiber is a synthetic material with excellent high temperature resistance. The chemical composition of PBI was discovered by the Americans Vogel and Marvel in 1961, in 1969 NASA used PBI for astronaut suits, and in 1996 Performance Products began selling worldwide PBI fiber products. It is used in many industries, for example as a protective layer in firefighting suits, but has also been used as a new material for use in hydrogen fuel cells [9].

Polybenzimidazole can be coupled by chemical reactions to groups of strong acids that modify its properties. Reaction with phosphoric acid makes it a conductive material for protons, ensuring a possible application to high temperature fuel cells. The performance test of fuel cells with such a membrane shows good stability for 200 hours at 150 ° C [10]. It is also more efficient to use in direct methanol fuel cells because of better water / methanol selectivity over existing membranes. The high temperature PBI fuel cell has several advantages. Elevated temperature increases the kinetic reaction rates of the fuel cells. It can also reduce the problem of poisoning the catalyst with adsorbed carbon monoxide in the case of a methanol cell and minimize the problems caused by electrode flooding with water. PBI / H_3PO_4 is conductive even at low relative humidity. These properties contribute to the fact that PBI / H_3PO_4

membranes are superior to some traditional electrolytes such as Nafion. In addition, the membrane maintains good mechanical strength and toughness. This means that thinner films can be used, thereby reducing ohmic loss. However, research into the use of this material for use in fuel cells has only begun, so not all the pros and cons of the end use are yet available [11].

4 CONCLUSION

The aim of this work was to clarify the principle of operation of the fuel cell, especially with a focus on hydrogen fuel cell, as a potential source of energy for driving vehicles and also to point out the modern materials used. Even for a relatively short period of practical use of fuel cells in practice, however, due to the need for a new and efficient energy source, significant progress has been made in this field of new materials.

There are several companies that are trying to develop materials with increasingly better properties, but due to the complexity of cold fuel combustion processes and the magnitude of the reactions that take place, research is considerably limited. Some phenomena are not yet reliably explained.

Nafion has been the most promising material for use as a membrane in fuel cells over the past few years. However, due to its need to keep the operating temperature below the boiling point of the water, and also due to the complex management of the membrane wetting, new materials such as the mentioned polybenzimidazole are being developed.

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DIAGNOSTIC AND POSSIBLE PROBLEMS OF ANTI-LOCK BRAKING SYSTEM (ABS)

Pavol LUKÁŠIK, Vladimír KADLUB

Abstract: Anti-lock braking system is one of the most important safety systems in modern vehicles. Malfunctioning sensor or other part of this system can result in a skid on the road or an accident. We also dealt with failure of individual components of the system on the Mitsubishi Lancer 1.5 Inform MY (model year) 2009, where malfunction of the front right wheel rotational speed sensor and also ABS and ESP control unit occurred. Gutmann MegaMacs PC from producer Hella (Fig.4) was used for reading diagnostic codes.

Keywords: Brake system; Anti-lock brake system - ABS; Electronic stability program ESP; Diagnostic; Malfunctions.

1 INTRODUCTION

According to a study carried out in the United States, the introduction of ABS in vehicles has reduced the number of accidents by 15 %, fatalities by 24 %, injuries by 14 % and fatalities with cyclists and pedestrians by 27 %. [1]

The main function of the ABS system is to control the speed of the wheels when the brake pedal is pressed by checking whether any of the wheels decreases its speed faster than the others. This means that there's a possibility of a wheel "block". The modern equivalent is called "Stability Control" which is much more advanced than the standard ABS. New cars are fitted with anti-slip system, which basically works conversely to the ABS. When one wheel has a higher speed than others during acceleration, braking effect is applied to reduce its speed and match other wheels. When the anti-slip system is activated, the torque also changes (the control unit reduces the vehicle's power). [2]

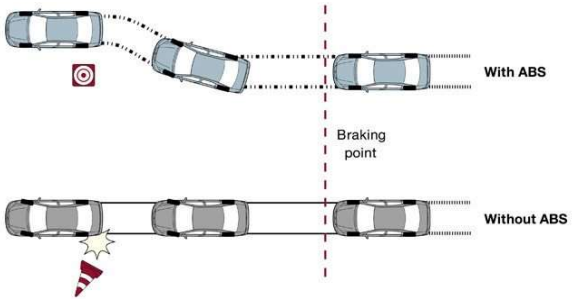


Fig. 1 Braking performance comparison of vehicles without and with ABS system
Source: [2].

Before, during or after activation of the ABS, the indicator does not flash due to not perceiving this operation as a fault, but as a normal operation of the ABS. The difference between the braking distance of the vehicle and it´s stability can be seen in the figure (Fig. 1), where a vehicle with ABS avoids an obstacle. [2]

The first working electronic anti-lock brake system (ABS) was developed by Mercedes-Benz in 1970 and used in 1978 in Mercedes-Benz S-Class vehicles. In the EU, this system is mandatory for all cars manufactured since 2004. [3]

2 ABS/ESP OPERATING PRINCIPLE

ABS consists of three main elements:
- Wheel rotational speed sensors,
- Electronic control unit (ECU),
- ctuator – hydro-pneumatic unit.

Each controlled wheel is fitted with pinion and inductive sensor comprising a permanent magnet and a coil (Fig. 2). Rotation of the pinion induces AC voltage in the coil sensor, which frequency is proportional to the angular speed and the number of teeth of the wheel.

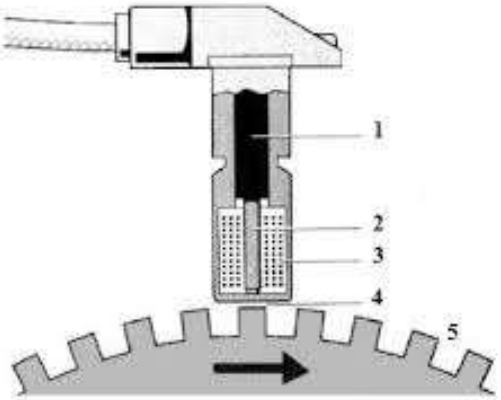


Fig. 2 Inductive (passive) wheel rotational speed sensor
1 – permanent magnet, 2 – magnetic soft pole adapter, 3 – winding, 4 – air gap, 5 – gea
Source: [4].

The Electronic Stability Program (ESP) ensures safe car behavior in critical situations, especially when cornering. It supports the driver in almost all critical driving situations. [10] Includes the function of the ABS anti-lock brake system and the ASR anti-slip system, but also something extra. Global studies have shown that ESP can significantly reduce the likelihood of a vehicle being involved in a serious or fatal accident in a single vehicle. [5]

The first vehicle to be equipped with ESP was the Mercedes E in 1995. However, it needed several more years of improvement before it became the basic equipment of higher-class cars. In the United States, every new vehicle must be equipped with ESP from 2012, in the EU from November 2011, and all newly registered cars must have ESP from November 2014. [5]

Fig. 3 Disassembled faulty hydraulic unit with integrated regulator (hydraulc control modulator) Source: authors.

The hydro-pneumatic unit (hydraulic control modulator) contains the accumulator, electro-hydraulic pump and valves. Individually adjusted valves are stored in pairs for each wheel; normally open inlet valve and normally closed outlet valve. [8]

3 ABS/ESP FAILURE DIAGNOSTICS ON THE VEHICLE

The Mitsubishi Lancer 1.5 Inform (Fig.5) was connected to a comprehensive diagnostics of the central control unit (CPU) due to warning messages from the driver's dashboard. During vehicle operation, two faults occurred in the vehicle's brake system - a speed sensor failure on the front right wheel at 100,621 km and an ESP hydraulic unit failure at 149,980 km. Thanks to the powerful Hella Gutmann MegaMacs PC diagnostic kit, these faults were reliably detected after connecting to the vehicle On-Board Diagnostics (OBD) connector.

The list of brake system faults is shown in the figure (Fig. 6), where two faults are shown from the total fault demand: digit 1. The digits 0 indicate the fault-free state of the systems. The list of brake system faults is shown in the figure (Fig. 6), where two faults are shown from the total fault demand, i. j. digit 1. The digits 0 indicate the fault-free state of the systems. A dash („-“) indicates that the systems are not a part of the vehicle equipment. Failure of the hydraulic module with pump and ESP control unit is a less common, but financially demanding – couple hundreds euros. The diagnostics of this module is also complicated.

The figure (Fig. 7) shows that the diagnostics cannot communicate via test of action element, which actually indicates a malfunction of the module. Probable causes of failure of this module are shown in the figure (Fig. 8), where it can be e.g. wire breakage, short circuit, high resistance in the electrical circuit, faulty pump motor, hydraulic fault, or faulty control unit (which is the most probable cause). Faulty control unit is shown in the figure (Fig. 3).

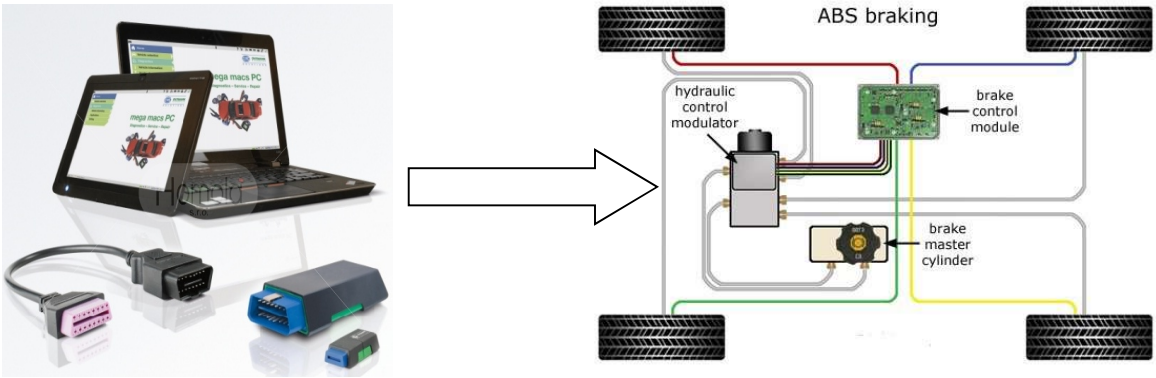


Fig. 4 Diagnostic system ABS/ ESP with program Hella Gutmann Mega Macs PC Source: [2], [6].

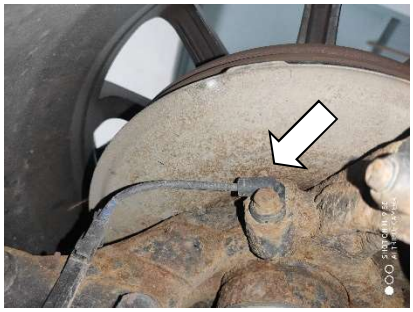
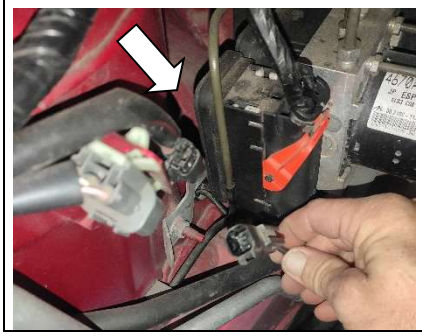
	Mitsubishi LANCER 1.5 Inform • Type: 10th edition Lancer • Date of production: 9/ 2009 • Country of origin: Japan • Emision standards: EURO 4 • Odometer reading - faulty ABS: 100 621 km • Odometer reading - faulty ESP: 149 980 km • Gearbox: manual, 5 gears, top speed: 191 km/ h • Engine: 4-cylinder, petrol, 80 kW, 143 Nm [7]
	**ABS warning message on the driver's dashboard** If a fault occurs in the ABS system, the ABS warning light comes on and the message "SERVICE REQUIRED!" appears in the information panel of the multifunction display. The warning message indicates that the ABS system is not working and only the standard braking mode will work. It is recommended to visit the service and check the brake system as soon as possible. [7
	**ESP warning message on the driver´s dashboard** If an error occurs in the ESP program, the ASC OFF warning light comes on and the message "SERVICE REQUIRED!" Appears in the information panel of the multifunction display. The warning message indicates that the ESP system is not working. It is recommended to visit the service and check the brake system as soon as possible. [7]
	**Front right wheel rotational speed sensor** Wheel speed sensors are located on each wheel and are among the most faulty components of ABS / ESP. Each sensor has an impulse ring that rotates with the vehicle wheel. Inductive speed sensors (measured vehicle) or Hall sensors are used. [8] A more detailed description of the passive inductive sensor is given in the figure (Fig. 2).
	**Wheel speed sensor connector and hydraulic unit with integrated regulator (hydraulic control modulator).** Electronic Stability Program (ESP) contains the following subsystems: • Anti-lock brake system (ABS) • Anti-slip regulation (ASR) with engine torque control (MSR) • Electronic brake force distribution (EBD) [8]

Fig. 5 Diagnosed vehicle Mitsubishi Lancer 1.5 Inform with ABS / ESP fault
Source: authors.

3.1 Initial comprehensive diagnostics of the vehicle control unit - the complete demand for errors

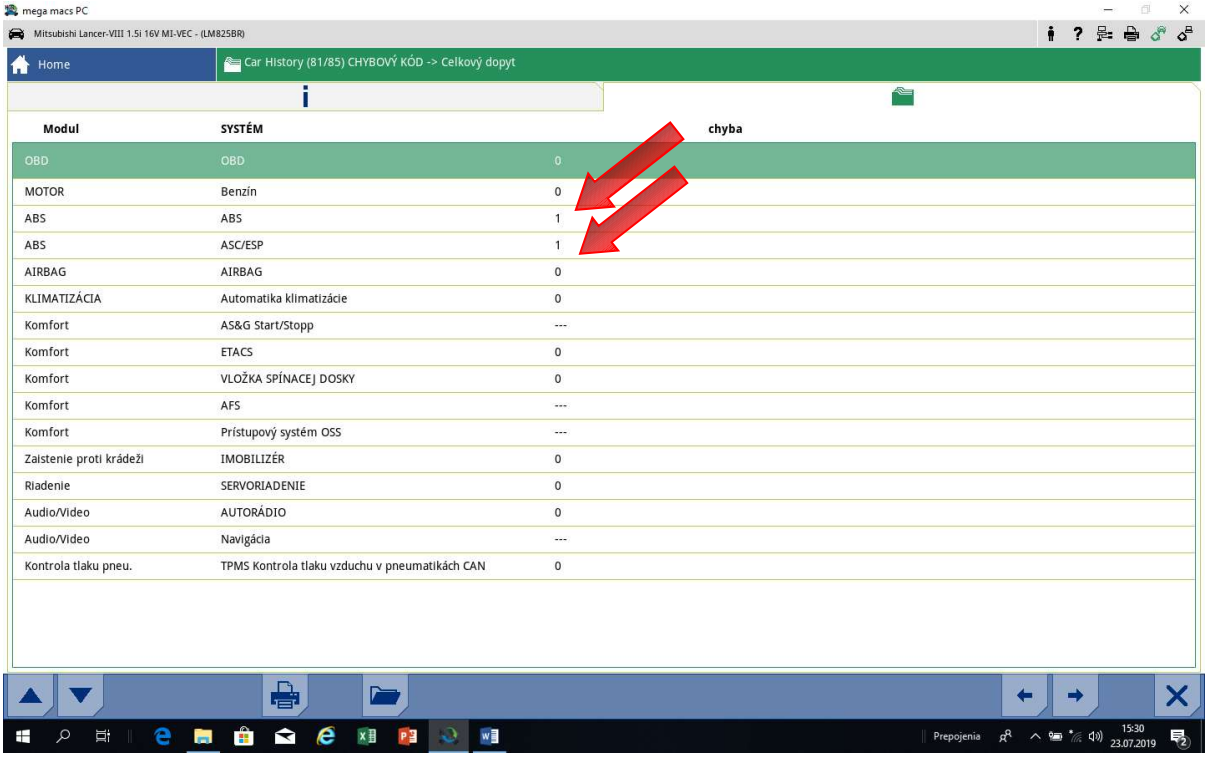


Fig. 6 List of all faults from the vehicle's central control unit (CPU) - Mitsubishi Lancer 1.5 Inform
Source: authors.

3.2 Diagnostics of faults in the Electronic Stability Program (ESP)

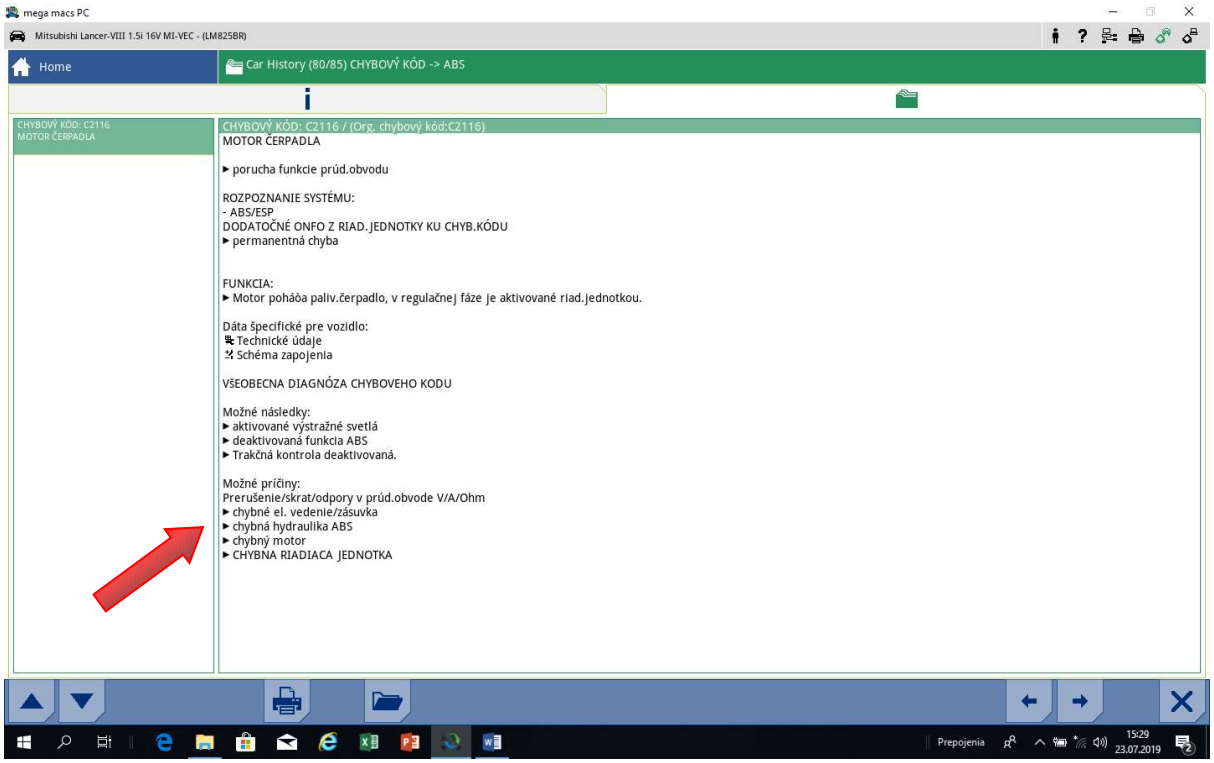


Fig. 7 Extract from the fault code (ESP pump motor) and possible causes of this fault on the Mitsubishi Lancer 1.5 Inform
Source: authors.

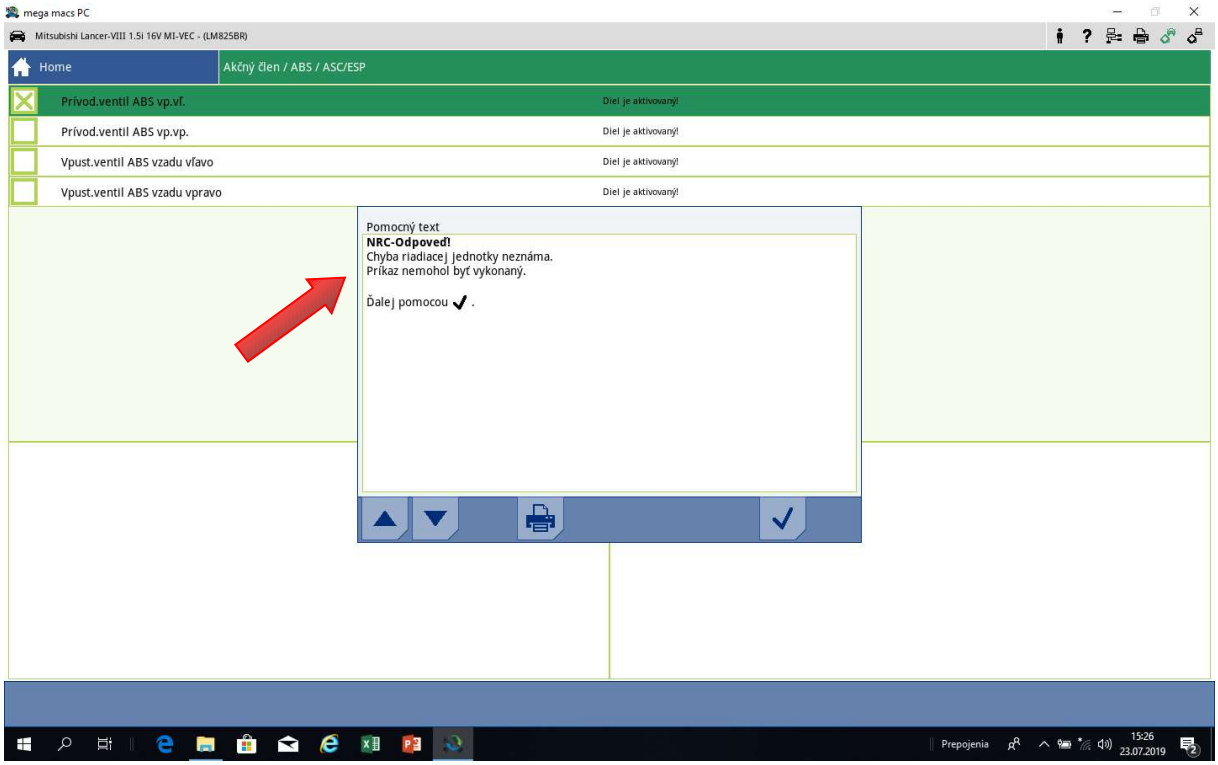


Fig. 8 Test of action element (ESP pump motor) on Mitsubishi Lancer 1.5 Inform
Source: authors.

3.3 Diagnostics of faults in the anti-lock system (ABS)

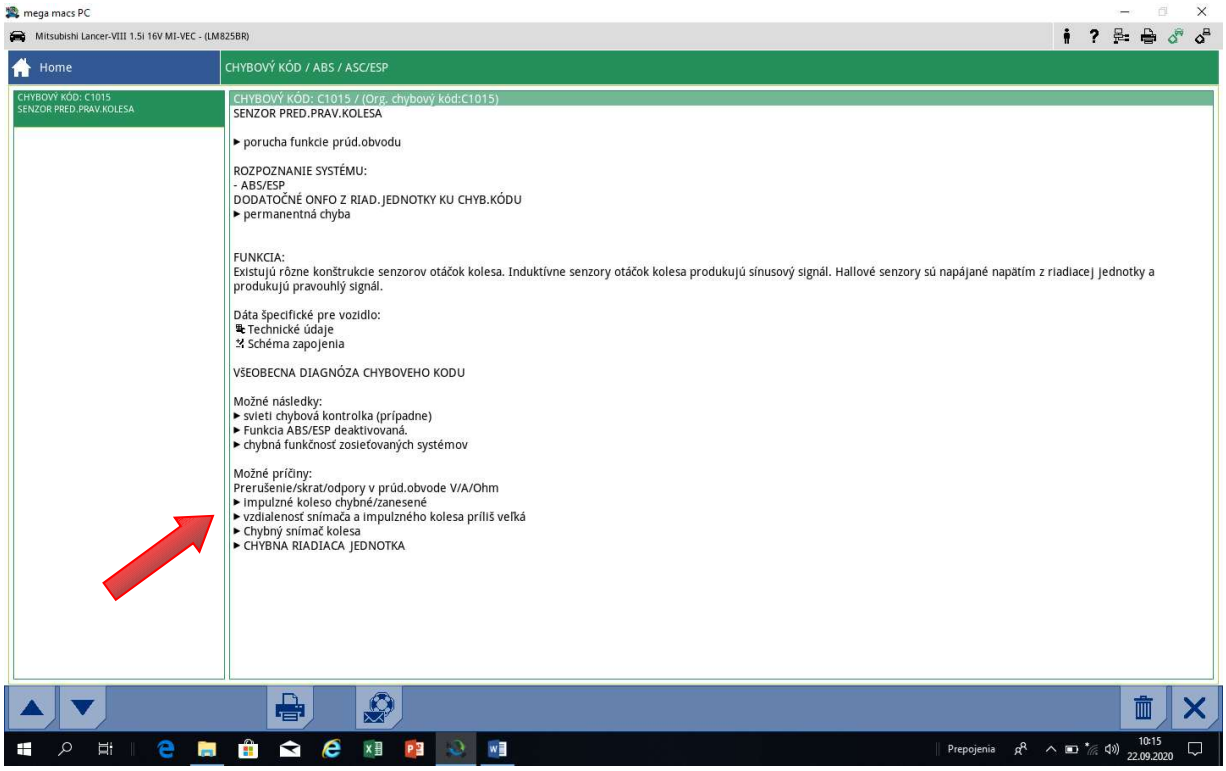


Fig. 9 Extract from the error code (front right wheel speed sensor) and possible causes of this fault on the Mitsubishi Lancer 1.5 Inform
Source: authors.

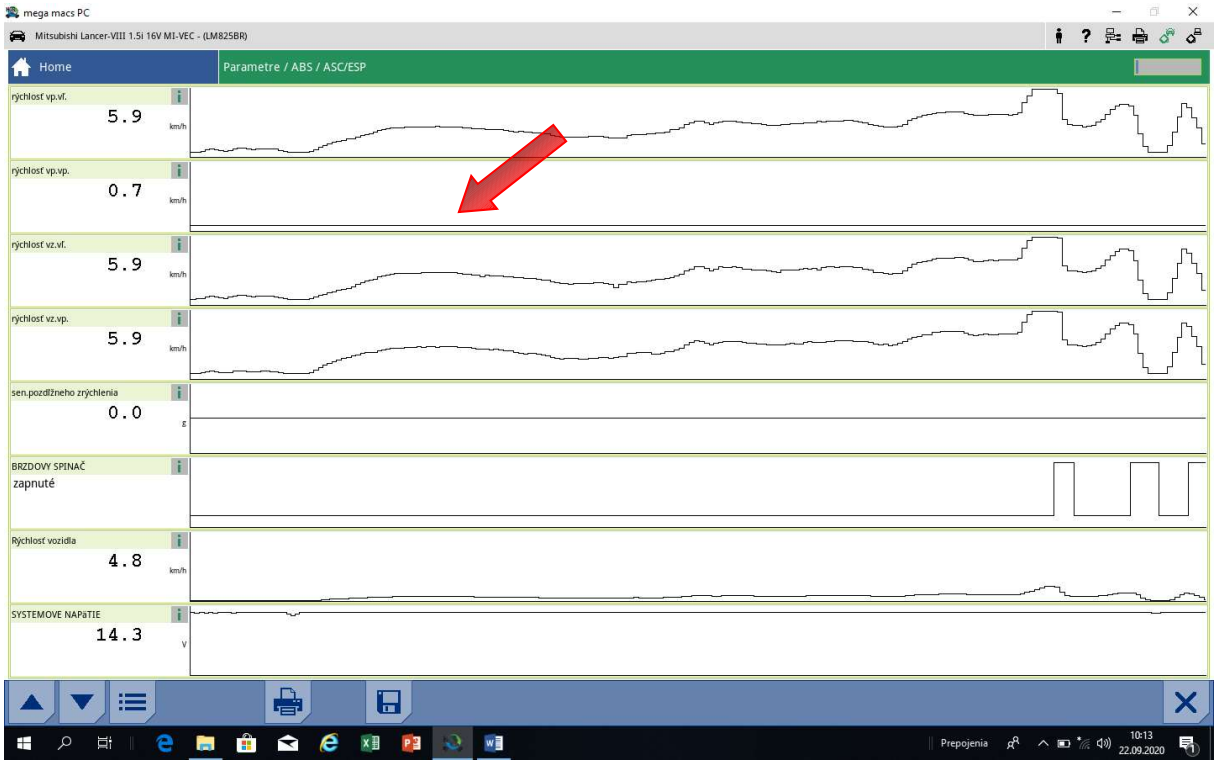


Fig. 10 Dynamic characterisitic of chosen parameters with a malfunctioning speed sensor of the front right wheel on the Mitsubishi Lancer 1.5 Inform
Source: authors.

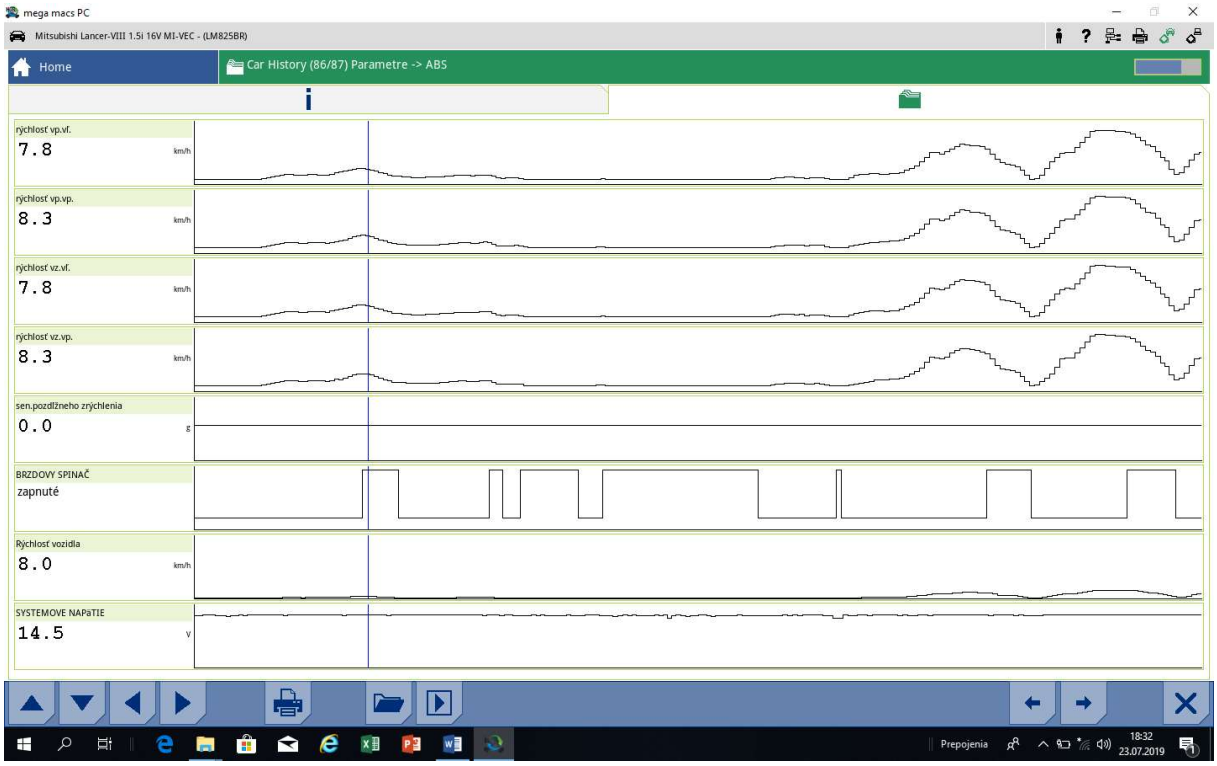


Fig. 11 Dynamic characterisitic of chosen parameters after replacement of a malfunctioning front right wheel speed sensor on the Mitsubishi Lancer 1.5 Inform
Source: authors.

Failure of the front right wheel speed sensor is a relatively common failure within ABS systems. Probable causes of failure of this module are shown in the figure (Fig. 9), where it can be e.g. wire breakage, short circuit, faulty or clogged impulse wheel, large distance between sensor and impulse wheel, or faulty speed sensor (which is the most probable cause). The fault in the right front wheel speed sensor is shown in the figure (Fig. 10). The figure (Fig. 11) shows the correct functioning of the system after the fault has been rectified (sensor replacement). Diagnosis of the speed sensor is relatively simple and the cost of repair is only tens of euros.

3 CONCLUSION

The great advantages of today's safety systems in modern cars, despite the high reliability, are associated with a certain failure rate. According to the German company ADAC (Allgemeiner Deutscher Automobil-Club), statistics show that up to 40 % of all vehicle failures were electrical equipment failures, with other failures accounting for a significantly smaller proportion (mechanical failures 16 %, ignition failures 10 %, injection failures 8 % , wheel and tire failures 7 %, cooling and air conditioning 5 %, clutch and transmission 4 %, exhaust tract 2 %). [10]

The diagnosed vehicle Mitsubishi Lancer 1.5 Inform is no exception. The first electrical faults have begun to emerge after passing a 100 000 km odometer reading, indicating that electronic components and sophisticated electrical circuits are also exposed to great stress during car operation.

As the brakes are the most important system of the vehicle, faults were diagnosed in time. The subsequent repair of faulty components consisted in their replacement with new pieces.

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A THEORETICAL VIEW OF ASYMMETRY IN SECURITY AND MILITARY SPHERE

Radoslav IVANČÍK

Abstract: Recently, in connection with reports on the negative effects of ongoing globalization processes and the ongoing deterioration of the global security environment, we are increasingly confronted with information on the emergence of new asymmetric security threats, asymmetric conflicts, asymmetric operations, asymmetric fighting, or asymmetric approaches to conflict resolution or achievement objectives set. Therefore, an author, in his contribution, aims to clarify, define, and use the term asymmetry.

Keywords: Asymmetry; Security; Environment; Conflicts; Threats; Globalization.

1 INTRODUCTION

The dynamic development of mankind, the ongoing processes of deepening globalization, social and economic modernization, political, economic and social liberalization of the society, together with the rapid onset of scientific and technological development, particularly in the area of communication and information technologies, generated many unfavourable accompanying the phenomena that are today strongly contributing to the ongoing deterioration of the global security environment. The ever-increasing economic and social disparities in the development of human society, the failure of state structures in the third world and their lag behind development, together with the inability to quickly adapt to the new situation, create the right conditions for asymmetry. That is why we have been experiencing more and more often information about asymmetric security threats, asymmetric conflicts, asymmetric operations, asymmetric opponents, asymmetric fighting, or asymmetric approaches to conflict resolution or achievement of set goals.

2 CLARIFYING THE CONCEPT OF ASYMMETRY

The word asymmetry has its origins, as many other words, in Greek. It is the antonym of the word symmetry (συμμετρεῖν – symmetría), expressing a lack of equality, regularity, or symmetry. In Slovak, the Short vocabulary of the Slovak language characterizes the asymmetry by words such as disparity, inequality, irregularity [1]. The Lexicon of the Slovak language and the Great Dictionary of foreign words also explain the asymmetry as an inequality or irregularity [2].

In English, the Oxford Dictionary explains asymmetry similar to Greek as a lack of equality, regularity and symmetry [3]. The Cambridge Dictionary explains asymmetry as a concept that expresses the difference between two halves, sides or parts that are not the same in shape or size. Other sources characterize asymmetry as the absence of symmetry, or even its violation or non-compliance [4]. In other languages, such as German (asymetrie), French (asymétrie), Spanish (asimetría), Italian (asimmetria), or Russian (асимметрия) have the same meaning as in Slovak or English.

The Terminology vocabulary of selected basic concepts and abbreviations from the security environment says that asymmetry represents a disparity in the area of security, manifested in numbers, means, abilities and effects, and expresses a significant difference in achieving the objectives of security activities. The team of authors of the vocabulary adds that achieving asymmetry is the essence of military art and a prerequisite for victory. Similar definitions that do not change the meaning of asymmetry or derived words can be found in other publications, documents or sources dealing with military or security terminology [5].

3 ASYMMETRY IN SECURITY AND MILITARY SPHERE

The gradual worsening of the global security environment, the growth of new security threats, as well as the inadequate solution of global human problems have meant that states should now, in defence of their freedom, sovereignty, independence and territorial integrity, protect their interests and ensure the security of their citizens, to face not only military but also non-military threats. Negative manifestations of deepening globalization are already causing that the non-military, asymmetric threats are beginning to dominate over military threats, and their predominance even will more likely grow in the future.

Globalization – phenomenon, which represents a dynamic expansion of economic, social, political and other activities across national boundaries, an increase in the intensity of the interconnectedness of the actors involved in this process, and, at the same time, the acceleration of cooperation at the transnational level, brings except of many positives also many negatives, for example in hostile activities in conflicts, terrorist attacks and other asymmetric security threats. It is, therefore, very likely that the number of asymmetric conflicts and the use of various asymmetric means, methods, forms, actions and activities will increase.

3.1 Asymmetric armed conflict

Before the characterization of an asymmetric armed conflict, it is necessary to characterize a symmetric armed conflict. Military experts define a symmetric armed conflict as an extensive military confrontation of the participating states' regular armed forces, coalitions, integration groups (alliances, pact, etc.), the outcome of which is mostly easily measurable, such as the liberation or occupation of a particular territory, the destruction, the defeat or the elimination of a known enemy, the achievement of the stated goals, etc.

Unlike a symmetric armed conflict, asymmetric armed conflict is a military confrontation of relatively small scale or low intensity where parties differ significantly in strength and tactics. It is mostly a conflict in which a superior external military force, represented by a state (alliance, coalition), enters a military confrontation with an inferior internal military force represented by the state or non-state actors on whose territory the conflict takes place. As the "weaker" party cannot succeed in an open military confrontation because its capabilities, capacities and available resources are at an incomparably lower level, it seeks to achieve success through asymmetric operations and forms of struggle (eg terrorist actions undermine fear and morality of soldiers, the fear of the civilian population and the spread of anti-war moods affecting support for further military operations in their home countries).

The term asymmetric armed conflict can be seen as a conflict in which unexpected and unconventional practices are used to disrupt and undermine the enemy's greater strength, overcome its strengths and threaten it by using its vulnerabilities through unprecedented modernized technologies or means. At the same time, an asymmetric armed conflict can be understood as an asymmetric stretch deviating from standard conflicts and approaches to influence the balance of opposing standing forces [6].

In the United States National Security Strategy, which is one of the basic documents dealing with the US security policy, asymmetric war is defined as unconventional approaches that obviate or distort power by using vulnerabilities [7]. However, as there are currently no major military confrontations, the above definition only applies to a limited extent and does not adequately explain the concept of asymmetric warfare. In addition, it can be said that the asymmetric war can also be understood as a strategy, tactics, and method of conducting armed conflict in which it is necessary to understand asymmetric approaches and ways of conducting combat and be prepared and able to respond to it.

A typical example of the asymmetric armed conflict represents the so-called "the second Iraqi war", which has clearly become the most controversial war in the post-conflict period. The great military victory of the US and its allies did not lead to peace, but it turned into a long asymmetric war with a number of asymmetric, especially terrorist, actions and attacks, not only at combat sites but also in other countries of the world [8].

3.2 Asymmetric approaches and operations

Based on the above, it is possible to conclude that the goal of an inferior (weaker) party in an asymmetric conflict is by means of untraditional and unpredictable actions carried out by smaller units or groups, in some cases even by individuals, to hit the vulnerabilities of the superior (stronger) party, to reach a disproportionately large effect, to undermine the adversary's will, to weaken his efforts to continue the conflict, and fulfil its own strategic goals.

The term "disproportionately large effect" in this case represents that part of objective reality, which expresses the successful achievement of strategic goals by deploying relatively small amounts of resources and resources. Strategic goals can be achieved in this case by a very small or even unsuccessful asymmetric operation, but with a great psychological effect. The asymmetric approach is therefore most effective when it can significantly affect and influence the opponent's will and psychology and compensate qualitative and quantitative shortcomings on the part of the attacker.

Military terminological dictionaries define asymmetric operations as operations conducted by regular armed forces against irregular enemy forces whose methods of combat and methods used, or the means are in conflict with international war law and generally accepted ethical and moral principles [9]. Based on the above information, asymmetric operations can also be defined as actions of smaller tactical or operational forces made with the aim to hit vulnerable enemy positions, achieve a disproportionate effect, undermine his will, weaken his efforts to resist and continue the conflict, and fulfil his strategic goals. The methods used in asymmetric operations correspond to the tactical level, but the psychological effect corresponds to the strategic level. Focusing on the strategic effect is therefore a basic sign of asymmetry.

As a result of the asymmetric approach and the success of asymmetric operations, efficiency plays a very important role in achieving the objectives set. An effective asymmetric approach will allow not only to achieve its own goals, but by using both physical and psychological elements, it also captures the system of command and control of the adversary, and prevents it from achieving its set goals. The asymmetric operation is the more effective, the greater is effect and the greater the damage it will cause compared to the forces and means expended.

Asymmetric methods of combat are used at all levels of conflict management (war). The greatest effect has an asymmetric approach that is aimed at

having strategic implications regardless of the level at which it was used. This means that there is a difference between the level at which the action was taken and the level at which its consequences are manifested. The aim is to influence the highest possible level.

The strategic level most affects asymmetric operations that directly affect national security and foreign interests. These operations also give the most attention because their goal is to influence the basic outcome of the conflict. Operations at tactical and operational level can also have strategic implications, which is basically an asymmetric approach.

A typical example of such an asymmetric operation was the 1983 Beirut bombing at US Barracks (tactical level), resulting in the withdrawal of the US Armed Forces from Lebanon in 1984 (strategic level). Both tactical and strategic surprises were achieved, and the price that the attacker had to pay (probably Syria) was minimal compared to the subsequent paralysis of American will. This tactical operation had an enormous strategic effect, while preventing Americans from performing conventional weapons reprisals, because it was not possible to identify (prove) who actually stood behind the attack [8]. Another, more familiar, example of an asymmetric operation are the terrorist attacks of September 11, 2001, in which the economic damage, but especially the psychological effect and their consequences, were absolutely incomparable with the forces and means expended.

4 ASYMMETRIC THREATS

Asymmetric threats are generally understood as threats originating from non-state security actors or arise in relationships between different (non-major or strong) state security actors and may result in the use of armed violence to achieve political goals. They are mainly associated with terrorism, organized crime, but also with possible raw materials or information wars, etc. Potentially, these threats can affect any area of defence and security, because they are based on an attempt by economically, politically and militarily weaker subjects to overcome the prevalence of other entities deemed hostile. They focus on their weaknesses, applying methods that differ from the norms and customs of international relations, do not respect existing international treaties and agreements, etc.

Within the framework of established military terminology, asymmetric threats are defined as threats resulting from the possible use of different means or methods aimed at obviating or suppressing strong enemy sites while using its weaknesses to achieve an inappropriate outcome. The largest asymmetric threats are, in particular, weapons of mass destruction (nuclear, chemical and biological weapons), information operations and terrorism in all its forms.

4.1 Nuclear weapons

Although it is realistically possible to obtain nuclear material on the world market from the huge reserves of the former Soviet Union, but also from other countries, nonetheless, the owners of nuclear weapons are only states. Excluding the option of theft or purchase, no non-state actor has a combination of capabilities, technical means, theoretical knowledge, and organizational potential to produce them. The production of nuclear weapons is also very demanding for industrialized countries. That is why the number of states that own or have allegedly managed to produce these weapons will be very small in the future. Of these states, only the USA, Russia, France, the United Kingdom and, most likely, China are also capable of intercontinental attack.

4.2 Chemical weapons

Although chemical weapons are a means of causing massive loss of life, debilitating troop combat, and wading combat techniques and terrain, these weapons are considered to be the least harmful of all weapons of mass destruction. On the other hand, chemical weapons are the easiest to get. In history, they have been used many times, largely for example during the Iranian-Iraqi war, but also against the raging Kurds in Iraq. Although a large majority of countries have joined the Chemical Weapons Convention, chemical weapons still have a large number of states. In addition, several states are suspected of keeping their secret stocks.

In the early stage of a regional conflict at the operational level, the very threat of using chemical weapons, like the threat of nuclear weapons, can cause unexpected successes. A regional aggressor may threaten the territory of neighbouring countries with chemical weapons, which can have a significant strategic effect at a relatively low price.

4.3 Biological weapons

While the greatest threat of the 20th century was nuclear weapons, there is a realistic assumption that in the 21st century these weapons will be considered second-hand and their place will engage in biological weapons. Reasons are several. Dynamic developments in the field of genetic engineering and continual improvement of manufacturing techniques in the area in question has made it possible today to produce not only a larger number of different toxins and virulent organisms but also their genetic modification to acquire non-pathogenic organisms of a pathogenic nature and their spread previously only by natural means is possible today through various infectious and toxic agents [10]. At the same time, biological weapons are much cheaper than nuclear weapons, they are also lethal, easier to move, easier to hide in sight of inspectors, and most importantly,

they can be deployed in a way that prevents anyone who is behind the attack.

The Convention on Biological Weapons of 1972 does not allow ownership, but there is convincing evidence that the Soviet Union and some of its successors have continued to work on military biological programs at least until 1992. At the same time, it is possible that other states, such as China, Iran, Israel, Libya, Syria, North Korea, or Taiwan's biological weapons have been manufactured or even still manufactured them.

The use of biological weapons at the tactical level is the same as that of chemical weapons. Their use against the civilian population can have the same impact as the use of chemical weapons, as the use of only a small amount of anthrax can block the whole health infrastructure. And if this threat is given enough publicity by the media, it can trigger a change of strategic decision.

The basic advantage of biological weapons is that it is not possible to reliably determine who is responsible for the attack. If special units or terrorists would use them, it would be very difficult to prove the connection of a certain power with a particular attack. Even if that power had an incentive for such an attack or even suspected of committing such an attack. That's why biological agents are an ideal asymmetric weapon. The attack can be done at the operational level, but its impact will be strategic.

4.4 Radiological weapons

A radiological weapon, or more specifically a radiological disperse weapon, is known to the public as a dirty bomb. The basic material is a highly active radioactive substance with suitable chemical and physical properties, which are dispersed at the place of use using a classical explosive or other means, depending on the nature of the substance. The required radioactive material can be obtained at workplaces where strong radiators are used in a variety of applications, for example in radiotherapy or in the industrial irradiation industry. In a number of countries with insufficient infrastructure, such workplaces are not adequately secured, which makes it possible for the resources to be stolen relatively easily, either directly from the workplace or during the transport of these emitters. At present, it is a global challenge to prevent the illegal transport of radioactive substances that could potentially serve to produce a dirty bomb [11].

The characteristic features of radiological terrorism is that it could be implemented in places with a high concentration of persons (eg in meters, in vehicles, at stations, airports, business centres, sports or cultural facilities, etc.), important objects (eg. in various offices, hospitals, banks, media, production plants, etc.) or, to a lesser extent, using systems considered hermetic (eg. in drinking water). As a result of the attack, there would be a large number of affected persons (mainly civilians), not equipped with the necessary means of protection and, on the other hand, not prepared for similar cases. Another specific element of these attacks is the fact that they would be done without warning, without warning and anonymous [12].

4.5 Information operations

Rapid and reliable transmission of vast amounts of information together with their effective exchange currently affect all spheres of human society and significantly affect the vast majority of work activities. This means that the environment in which we are already running, but especially in the future will be information operations, is located all around us, from individual personal computers, through public and private, official or corporate computer networks to global information networks and databanks. This environment also includes all means of communication and mass media.

Mass media are not only an ideal goal, but also a tool for conducting information operations, because mass media can spread distorted or even totally untrue information, which eventually leads to a huge number of potential victims. The spread of disinformation through mass media can effectively manipulate public opinion. Combining real-world information and real-world information operations can achieve a very strong synergy effect as what people see, hear and read, shape their perceptions of the facts presented, and thus influence their judgment of which conflict is in the law or not to mention who is the attacker and who is injured, etc.

Information operations will be conducted through computer and social networks. Both open and protected systems (both military and civil) will be invaded, because well-protected military and civilian information systems are largely dependent on public communications and communication nodes. In general, two basic types of operations can be used. In the first case, the information systems themselves may be aimed at destroying primary information systems and systems that are directly dependent on them. The second type of operation uses information technology as a tool for manipulating and exploiting foreign information systems, for theft and modification of data, or for overload and congestion of information systems.

4.6 Terrorism

Terrorist actions have been and will be carried out by various state-sponsored terrorist organizations, organized crime and various non-state organizations that operate outside the legal framework of international relations. Terrorist groups that are supported by non-state organizations generally do not have material equipment as state-supported terrorist groups, but their members are also willing to use

radical technologies that would be unacceptable to any state. Given that the availability of different weapons, which until recently owned only states, is increasing in the world, terrorist groups are able to achieve "great success" with minimal losses.

Therefore, it is necessary to realize that at present it is not the terrorism that has existed on the ground for centuries, but the terrorism that can now affect anyone, anywhere and at any time, and which is aimed at the mass destruction of material values and the mass murder of innocent civilians. The terrorist is no longer a specific murder in a particular place. In particular, they want to alert themselves, warn their opponents and inspire their supporters. Therefore, today is not so important when and where there is a terrorist attack, it is important that mass media representatives arrive in a short time.

There is evidence that at present the terrorist groups are very serious about not only the acquisition of knowledge but also the possibilities of producing weapons of mass destruction, especially chemical and biological weapons. These weapons are much cheaper compared to nuclear weapons and their production is not associated with such a technical and technological difficulty. In addition, the whole process of preparation, production and transport to the destination can be much easier to conceal than for nuclear weapons.

It follows that if terrorist groups decide to use weapons of mass destruction, chemical or biological weapons would most likely be used. It is less likely that nuclear weapons would be used. Nuclear weapons are both very expensive and difficult to access. The know-how of nuclear weapons production is still the best secret, their production requires special materials and technologies and, moreover, there are still some moral barriers to their production.

The threat of the use of biological and chemical weapons by terrorist organizations increases in particular the relatively good availability of biological and chemical materials. For biological agents, it is sufficient to have at least a minimum quantity of a large quantity of biological weapons. Some chemicals can cause death within minutes after the release, and even immediate medical help is not always effective enough. Radioactive, poisonous and biological agents are not detectable by human sensibilities and must be detected by means of detection. The rate of detection is very different in these cases. While it's almost instantaneous for radioactive substances, it takes from several seconds to dozens of minutes for poisonous substances, but it's not fast enough and reliable for biological agents.

5 CONCLUSION

Asymmetry in the security and military fields is not new. It is not the result of the collapse of the bipolar world after the end of the Cold War, nor the consequence of strong globalization processes. In international relations, asymmetry has manifested itself very much since their inception, being closely linked to the existence of the empires, the powers and superpowers on the one hand, and the medium or small states on the other, and of course directly related to differences in their military, political and economic potential, as well as their military, political and economic interests.

Asymmetry not only includes its military forms, it can range from classical partisan tactics through civil uprisings to the use of chemical, poisonous or biological substances and terrorist activity. Inferior forces do not pose a comparative importance to the superior forces of the adversary, even in the area of the quantity and quality of the used weapon and weapon systems, nor in the area of quality, training, armaments or staffing. And so the inferior forces use all the available forms of combat for them. Asymmetry, besides its military dimension, also includes dimensions of politics, science and technology, psychology, sociology, ethics and, last but not least, economics.

Based on all the above information and facts, several generally valid conclusions can be drawn:

- Asymmetry in the military sphere represents the planning, organization and implementation of asymmetric actions (operations) aimed at achieving their own goals in a different way than the adversary.
- In asymmetric conflicts, opponents at different qualitative and quantitative levels encounter different goals, approaches and ways of fighting.
- A key prerequisite for success in asymmetric combat is to eliminate strong and maximum use of enemy weaknesses to maximize the benefits.
- The primary objective of asymmetric actions is to maximize the effect of minimizing exhaustion of their own human, material and financial resources.
- Asymmetric actions can take place at all levels - political, strategic, military, strategic, operational, tactical, and combined, including all levels.
- Asymmetric actions can achieve (complete or partial) the achievement of the set goals even through unsuccessful operations.
- Asymmetric actions include both physical (material) and psychological (mental) aspects.
- Asymmetry is also reflected in the assessment and view of parties involved in asymmetric conflicts. While one party considers an indivi-dual fighting on the opponent's side as a terrorist, a criminal or a mass murderer, the other side designates him as a hero, rescuer, freedom fighter, etc.

Finally, although there is no comprehensive and effective concept of fight against asymmetric threats, study of past as well as ongoing asymmetric conflicts and the analysis of asymmetric activities threatening the security of society, and, certainly, effective action at all levels, implementation of new doctrines and

tactical procedures, adaptation to the new situation and adequate preparation to meet the full spectrum of new security and defence challenges can prevent an asymmetric opponent from using asymmetric ways of fighting to threaten our security and to change our strategic decisions. Of course, maintaining the security of the state and its citizens as one of the main priorities of each government and the earmarking adequate resources are the basic prerequisites for fulfilling these tasks.

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RESEARCH METHODOLOGY OF NON-MILITARY THREAT – TRANSNATIONAL ORGANIZED CRIME AND GAME THEORY

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Abstract: Organized crime has been developing since ancient times, and is currently one of the most serious negative phenomena and threats in the world. Organized criminal groups are no longer localized, thus limiting the borders of individual countries or continents, but are shifting their activities to a wider regional or global space. It is therefore necessary to pay attention to the research and to analyse the currently known, dominant methods of transnational organized crime research and to critically evaluate them. From this point of view, there is necessary to present new approach to research of organized crime through game theory and its sub theories, which can provide us with answer whether or not groups cooperate with each other. Thus, there is not possible to analyse all the research methods in this paper, mainly mafia or society paradigm and network-based theory will be taken into consideration.

Keywords: Methodology; Non-military threat; Organized crime; Game theory.

1 INTRODUCTION

The Gang by F. Thrasher is generally referred to as the very first scientific study targeting the organized crime [1]. Concept of this publication was challenged by the same problem areas as many researchers dealing with this issue even years later.

Undoubtedly, the perception of organized crime in the area of criminal policy and, in particular, criminology is very complex. Predominance of politics & media-conceived ideas about organized crime and the research of the organized crime concept have highlighted three main challenges for a thorough and trivial analysis of basic phenomena, which can subsequently serve as empirical reference points in researching the organized crime. Firstly, it is a problem of defining organized crime as a research object, since the organized crime is not a clearly recognizable empirical phenomenon. Even though, today it is still not possible to find consistency in its basic nature and in what characterizes the organized crime as a whole. Therefore, it is obvious that many researchers in creating structures and events tend to assess them at different levels and in different combinations, which are then covered by the basic defining concept of organized crime. In view of the vagueness of term "organized crime", it is clear that in the past this phenomenon was also separated from social reality [2]. So sociologists had to face then the challenge of "duality" of organized crime as one of the aspects of social reality and as well as of a separate social construct.

The second problematic area of the organized crime research is, as we have already indicated, a rather significant inconsistency in the terminology in the field. For example, in various scientific studies, the concepts of criminal organization and criminal network have gradually become interchanged, while in other scientific circles these two categories are strictly separated [3]. In this context, ambiguous definitions remain in the area of organized crime terminology.

The third problematic area in transnational organized crime research is mainly related to the fact that the general view of the reality of organized crime is in direct contradiction to the empirical research of this phenomenon. Often, the concept of organized crime is presented by the media, politicians and law enforcement authorities as a clear fact, but in deeper research, this concept may prove to be wrong. Similar misconceptions about transnational organized crime, created by the repetition of a common concept, can also be found within the informal financial sector, or in investigating the effects of illegally obtained profits within the legal economy. Research is thus often at odds with the presentation of the concept of transnational organized crime by the media, politicians and law enforcement authorities.

Despite this background, however, the emergence and further dissemination of communications and collaboration across networks that connect researchers in transnational organized crime in different countries is observable over the years. At the same time, we perceive international cooperation in transnational organized crime research as essential. Researchers who focus their attention on national organized crime are often dispersed within their national scientific communities, and so only an international forum could help to communicate effectively and progress in the field. Thus, in the long term, it can be recommended that effective cooperation be based on (at least potentially) general knowledge of organized crime following the accumulation of facts, to which various actors can contribute.

2 BASIC PARADIGMS OF ORGANIZED CRIME

The problem in basic research could be identified as the fact that transnational organized crime research is more or less limited to the term "organized crime" itself, so conceptually the basis of research remains non-binding. In our opinion, some degree of reciprocity in transnational organized crime research has been achieved by using the concept of mafia as a starting point, narrowing thus the concept of organized crime as such, or by defining only individual components, mainly through illegal

markets focusing on defining illegal companies. These two approaches then represent competitive paradigms with conflicting consequences for the research of transnational organized crime itself. Undoubtedly, we also see these concepts as important, especially as they can support the research by narrowing the broad scope of organized crime and defining the term itself.

The "mafia" paradigm focuses mainly on the aspects of structure of organized criminal groups (OCG). Thus, organized crime is directly linked to organized criminal groups, which are defined by clear organizational features. However, the heuristic value of presenting organized crime as a kind of honour that is granted to certain organized criminal groups proving the necessary degree of organization is largely limited. In addition to this, this approach is extremely dependent on the validity of the presenting mafia as a measure of organized crime. There are such clear facts that limit the concept in question as a basis for transnational organized crime research to a large extent in its universality.

Contrary to the first paradigm of the concept of transnational organized crime, there is a paradigm of "society" which is based on the dynamic perspective of organized crime. In a given paradigm, the process - activities and not the structure of an organized criminal group is considered. The question then is not how organized criminal groups gain control of illegal markets, but as individual entities organize their illegal activities and adapt (survive) in these illegal markets. Contrary to the mafia paradigm, the paradigm of society offers several concepts that have been borrowed from the real functioning of the economy, and which in turn can serve as essential aspects for the development of a theoretical construct [4]. In this context, the paradigm of society can thus form the basis for cumulative knowledge creation in the area of organized crime. On the other hand, economic concepts have a logically limited ability to comprehensively analyse this phenomenon. As in the case of the Mafia paradigm, the second analysed paradigm tends to ignore the dynamics that arise in collective criminal behaviour, and therefore, through the society's paradigm, it is possible to overlook those structures of criminal groups, existing or arising under circumstances other than the dynamics of illegal markets.

Certain expert groups now see it as essential to move away from the need to define the term “organized crime“, but in the sense of sociology it is extremely difficult for long-term phrases or definitions to disappear [5]. In our opinion, instead of adding more confusing definitions, it is necessary to use the term of organized crime as an open, multidimensional and dynamic concept.

Following the analysis of the genesis of organized crime research, the following brief recommendations should be made. Transnational organized crime research should be based on three basic concepts:

1. The area of research should be built not only on the outputs of the scientific community, but should also rely on opinions and experiences based on the realities of organized crime.
2. Subsequently, there is a whole range of sub-themes that need to be carefully defined and classified in such a broad framework of research.
3. The aspects that we can cover under the concept of organized crime should not be considered static.

Interconnecting the research with real-world experience and development is also directly related to the need to focus the attention on rational committing of criminal offences, regardless of the social status or motives of the offenders. In this connection, the differences between economic crime and organized crime, between organized crime and terrorism are disappearing.

Secondly, there are many aspects that can be explored in transnational organized crime research, namely the types of criminal offences committed by an organized crime, the characteristics of organized crime offenders, the concentration of power in the environment of illegal markets, the patterns and models of cooperation between organized criminal groups, or the social basis organized criminal group´s structure. Instead of raising academic contradictions about the nature of organized crime, it is necessary to pay special attention just to this specific concept of this phenomenon under research.

The third concept in transnational organized crime research is linked to the need to emphasize the fluidity and diversity of the criminal behaviour of transnational organized crime groups. The given approach is then in direct contrast with tendency to directly focus on one specific interplay of certain aspects, for example, to the fact that organized criminal groups use violence and corruption to become monopolies on illegal markets while minimizing the risk of their detection. This means that organized crime needs to be explored in the widest possible social and historical environment, such as the activities of groups or the boundary between legal and illegal environments that change in space and time in addition; and in what combination these aspects occur.

3 CHOSEN METHODS OF TRANSNATIONAL ORGANIZED CRIME RESEARCH

At present, the process, which is introducing the concept of organized crime as a basic category of criminal policy doctrine has entered a new phase. For decades, it has focused on determining the definition of organized crime when, in spite of the need for interdepartmental and international co-operation of law enforcement authorities, the differences in reality and perception of the definition of organized crime

hindered the agreement and the creation of a unified basic characteristic of the phenomenon. In addition, sceptics in the process of organized crime research have been in favour of the view that organized crime itself is a pure fictional concept that helps law enforcement authorities legitimize violations of civil rights and freedoms. On the other hand, advocates of the concept of organized crime believed in the past that they would suppress this criticism by adopting a general definition of this negative phenomenon.

In recent years, research attention has gradually begun to shift from the need to define the concept of organized crime to the actual measurement of this form of crime, which now and in the future presupposes leaving the debate on necessity of defining organized crime. There are a few quantitative and qualitative methods of organized crime research, but we will pay attention to only a chosen one, which can directly show how to preside in future development of methodology.

In this case, there is undoubtedly the network-based research methodology, which can provide us with interesting outcomes. This methodology assumes that social interconnections are part of a dynamic and variable network of personal relationships. The notion of "network" has been known as an analytical concept since 1950, when it subsequently began to influence also the development of organized crime research in the coming decades. According to J. Scott, a modern methodology based on network access to organized crime has only begun to develop in the later period, as a synthesis of three science schools and their approaches - sociometric analysis using the graph theory; exploring patterns of interpersonal relationships (Harvard School) and exploring the structure of relationships from an anthropological perspective (Manchester School). [6]

In the following development of this methodology, the attributes, conditions and perspectives used in investigating criminal group systems were incorporated, and modern network analyses were gradually applied also to the area of organized groups. However, in our opinion, a modern methodology based on network structure research in transnational organized crime research is still at its early stage. In the last decades, a methodology based on network analysis, according to K. von Lampe, "has developed into sophisticated scientific efforts, bringing a new level of methodological approaches to transnational organized crime research." [7] The situation is, in our opinion, caused by the research studies by C. Morselli, M. Natarajan and A. Malm who looked at the structures of organized criminal groups, their different development, or the possibilities of their operation by different optics. [8, 9] In some of the studies using the methodology analysed here, the network analysis was extremely effective and beneficial, for example, in answering the question of how certain legal entities are tied to criminal structures, how the risk is managed in organized criminal groups, and issues of vulnerability and power in criminal structures. [10] Despite the fact that most of the analysed studies based on the network analysis are focused on the frequency of contacts, the exceptions are comprised by the selected studies by M. Natarajan and P. Campana, which focused on the content of communications recorded by law enforcement authorities and on the context of relations between the recorded entities. [9, 11] In general, a network-based methodology is basically useful as a basic descriptive tool that deals with overlap and interconnection of social relationships, and thus stands in direct contrast to monolithic hierarchical structures that currently dominate traditional organized crime research as well as in its media image.

Despite the above analysis, when we assessed the network analysis quite positively, this methodology also has some pitfalls and serious limitations. Indeed, it is impossible for us to collect all possible attributes (of individuals) and boundaries (links between these individuals) in a criminal structure without making these individuals involved in the research. Undoubtedly, the secret, illegal nature of organized criminal structures makes it impossible to explore the necessary factors by using a network analysis methodology. In addition, what remains hidden is the group´s decisions, assumptions, and previous knowledge that influence data selection and their interpretation. Creating a theoretical framework based solely on such data can create the notion of a stable community, rather than volatile market-based and ever-changing collaborations. Therefore, network analysis is limited and, there is no research on transnational organized crime from the point of view of linking these groups in a particular network or structure. The decision of the group to cooperate or not to cooperate with another organized group can thus be captured through a network analysis only from a very limited part, through the definition of available relationship variables.

Organized crime is undoubtedly a phenomenon whose research is extremely complex. As we have already stated in the paper, traditional expert studies on organized crime research present mostly two basic approaches to this issue. On the one hand, the research is based on the definition of organized crime in terms of the activities of organized criminal groups, and on the other hand it is based on the definition of this phenomenon through the organizational structure of offenders of organized crime. While we can consider both of these approaches to be relevant to the research, we still consider it more important to rely on research of organized criminal activity. While transnational organized crime research is a relatively dynamic area, the absence of exploring the modus operandi and logistics of organized crime group activities is quite common. Deeper analysis of how organized crime is being performed, and what are the internal relationships between organized crime

offenders, are more an exception than a rule in transnational organized crime research. The globalization processes that affect all areas of human society undoubtedly affect the various possibilities of linking organized crime as such. Organized criminal groups are becoming extremely flexible, which means that they are not only involved in various forms of crime, but in our opinion, they are also linking their activities to each other. It is a logical consequence of the need to streamline the activities of individual organized criminal groups, when a certain group can perform a selected phase of activities more effectively, faster and thus with less risk of being disclosed. While in the past such interconnection of the activities of individual organized criminal groups was uncommon, especially following the strict ethnic principle of forming organized criminal groups, today these groups are also opening up to opportunities to streamline the process of illegal activities carried out within their portfolio. Organized criminal groups are becoming more flexible and adaptive in terms of identifying new opportunities brought by the global economic crisis and they do not have to define their activities within the limits of legal principles, and therefore their possibilities are sufficiently variable. Organized criminal groups are becoming more and more interconnected networks and performing the activities in the group towards leadership is more strongly based on a flexible hierarchy. Consequently, this phenomenon makes it possible to create flexible networks between organized criminal groups.

4 NEW METHODOLOGICAL APPROACH TO ORGANIZED CRIME RESEARCH

Many methods used in the research of transnational organized crime reveal the possibilities of further direction of detection and consequently also of the possibility of punishing this crime. Nevertheless, each of the analysed methodologies creates some limitations in the area of transnational organized crime research. Organized criminal groups are dynamic entities, not static subjects. In this context, they can change the essence of the criminal activities they conduct, as well as their strategic decisions in creating cooperative relationships with other organized criminal groups. Moreover, transnational organized crime research must also clearly focus on the issues on conditions under which organized criminal groups are able to cross international borders, as well as cultural and linguistic barriers within their transnational action. Based on one of the studies on transnational organized crime, the author K. von Lampe synthesized the results of cross-border mobility research of the three major cigarette businesses. [12] Three investigated organized criminal groups have implemented a strategic decision to create new routes for trading in unknown territory. The members of these groups did not have direct knowledge of the countries in question, they did not speak the language of the country in question, nor did they have any personal contacts in that country. Instead of trying to get information on the territory by their own actions, all three groups decided to recruit individuals who subsequently acquired other people and companies that were present in the target country in question. At the same time, it turned out that most of the individuals who were approached were members of the management or members of organized criminal groups in the selected country. The decision of the three investigated organized criminal groups was clearly influenced by some internal and external factors. However, defining these factors is an extremely complicated process, and consequently it is impossible to predict which of the factors influenced the organized criminal group to favour cooperation in performing that kind of illegal activity in question with other groups in the selected country. Therefore, it is essential to find a new methodology that can predict the behaviour of organized criminal groups in question. The development of cross-border activities of organized criminal groups is undoubtedly influenced both by external factors, to which we can include global security threats, but also by internal factors such as group size, structure, risk level of their illegal activities and so on.

The strategic decision-making of organized criminal groups following the interconnection of activities with often even competing groups is currently not elaborated in any known and available research or in the methodologies used for transnational organized crime research. Although, as we have already stated, network analysis is partly concerned with research and the answering of relationship questions and network structures within organized criminal structures, there is no area of relational or procedural linking of individual groups within this methodology

In this context, we decided to present a new approach to the researched issue, using directly the methodological instrumentation of sub-theories of the game theory as an original approach to the research of selected processes of multinational organized criminal groups. None of the known research approaches to this negative phenomenon can capture and subsequently explain all the phenomena and characteristics of transnational organized crime. This is a logical consequence of the need for abstracting certain variables so that research can focus on defined aspects of research. Even when using methodological instrumentation of game theory, it is not possible to conceive all phenomena and variables that characterize organized crime or the activity of multinational organized criminal groups. However, based on analyses within our research, we are currently in a situation that can be explained by the so-called inflection points, i.e. points that present the necessity of the required change of strategy, emerging in all systems of society, and thus also

in the system of transnational organized crime research, or the setting of the criminal policy system under this dynamic development of this type of crime. The development of transnational organized crime, as one of the security threats of the current world, suggests that we are in a certain turbulent system of society. The given state is simplified in presentation within Figure 1.

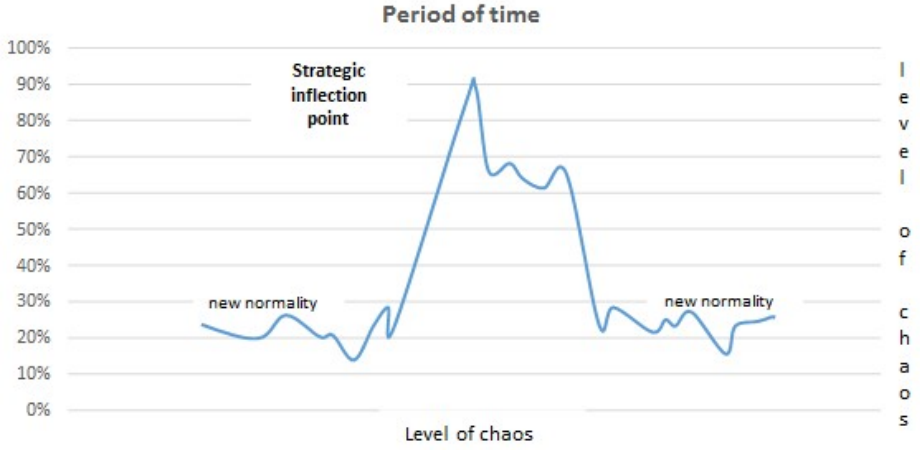

Fig. 1 Chaos interrupted by so-called New normality
Source: author.

So-called chaos, present a state that draws attention to a number methods which, however, cease to be sufficient to explain the real state and consequently the need to change the perspective of research on the issue of cooperation between organized criminal groups.

6 CONCLUSION

As we presented in this paper, although many methods investigate organized crime and also bring positive outcomes for understanding this phenomenon and its subsequent detection, there is now a clear demand for extending research into organized crime from the perspective of the missing aspect of investigating the links between organized criminal groups. In connection with the need to identify and define the possible interconnection of OCG and their activities in practice, it is effective to use theoretical modelling that will help us to uncover the individual elements of the process. In this connection, we present a methodological instrumentation of game theory as a mathematical theory usable in the security field, which in our opinion provides a suitable theoretical basis for researching the interconnection of activities of organized criminal groups. R. J. Aumann applied attributes of repeated games to atypical cases of cooperation or non-cooperation among subject. [13] Repeated game and analysis of decision rationality can be thus applied to strategic decision making and activities of transnational organized criminal groups in mutual interaction. As this concept has not been yet further elaborated, we therefore believe that it is necessary to develop research of transnational organized crime through a selected methodological instrumentation of sub-theories of the game theory.

The main premises are that we consider transnational OCG as rational entities, and we assume that the strategy they agree on interacting will correspond to Nash´s equilibrium and this equilibrium has the characteristics of Pareto balance. The strategy is then accepted if, according to groups, it leads to achievable goals with a high degree of probability; the strategies chosen, whatever their form, lead to the same desired benefit; the outcome of the interaction is independent of irrelevant alternatives, and the benefit of cooperative play is symmetrical for all involved OCG. In our opinion, the cooperative or non-cooperative games themselves have defined that transnational OCG, especially in repeated games and long-term interaction, choose a cooperative strategy that brings them higher benefits in the long run. We use the concept of game theory itself not from purely mathematical point of view, but rather from a philosophical point of view, which is bringing the possibility of using the sub-theories of the methodology in the transnational organized crime research. However, we must point out that the original approach to the research provided in this paper is a starting point for the development of this methodology in future. There is necessary, for the practical application of the game theory, to create a modelling of the activities of transnational OCG, from which the institutions and bodies responsible for combating organized crime could draw information. Therefore, it is necessary to start simulating the mathematical modelling of different variables and their different values in order to move forward with the original methodology which we presented in this paper.

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TEACHER'S CREATIVITY IN THE EDUCATIONAL PROCESS

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Abstract: A teacher is a qualified, educated professional of pedagogy who teaches, performs immediately organized educational activities in school or other educational facility. They are a model for students, but also a mediator of new information and knowledge. They are the person who teaches students to learn and leads them to be interested in acquiring the knowledge. Because the teacher has to deal with a multitude of objects and situations in their diverse combination, they must not only be simply executors of directives and instructions from methodological papers, but must directly create the process and, through this process, the students' world itself. This determines the nature and place of the creative activity of the teacher in the whole educational and student upbringing.

Keywords: Teacher; Educational process; Creativity.

1 INTRODUCTION

Learning process is an interaction between the teacher and the student, which takes place mainly in the direction from the teacher to the student, but also creates the student-teacher feedback. Teaching is a process that depends mainly on the teacher's organization, on the use of methods and organizational forms of work. Teaching always has two aspects: explanation - interpretation by the teacher and learning by the student. In today's school, there does not always have to be the first part, the teacher's interpretation, but instead, there is a briefing that precedes the students' independent work. However, most of the curriculum is still explained by the teacher first and then the students learn.

Learning has a dual meaning, in a broader and narrow sense, both of which has a role. By learning in the broader sense, we understand the reaction of the living organism to external and internal impulses, from their birth to their death. This type of learning explicitly tends to preserve the organism in relation to life, to nature, to man and to society. Learning in the narrow sense is typical for humans because it is a process in which a student acquires knowledge under the guidance of a teacher. It is a conscious activity of students which is managed by the teacher, although it continues outside the school, at home, in voluntary activities and the like.

In order to achieve a goal in the educational process, another condition must be fulfilled - to establish the right relationship between the teacher, the students and the cognitive reality. In the classroom, students are often presented the curriculum via language, that is, the teacher's speech or printed word in the textbook. In this form, the reality is reflected in the curriculum reflects only indirectly, in a generalized form. The aim of the educational process, however, is not only such verbal learning of the curriculum, but also knowledge of the real context and relationships. This can be achieved by letting students to observe and explore the phenomena they are learning about, either directly or with the help of teaching aids, and by teaching them how to handle them in various practical activities. Among impressive features of the teacher is also patience in contact with the students, ability to develop their curiosity and to create a favourable atmosphere in the classroom.

2 TEACHER IN THE EDUCATIONAL PROCESS

In the teaching process, the teacher is an essential factor because, as a qualified pedagogical worker, they are responsible for its preparation, management, organization and results. (Oberuč, Ušiak, Sláviková, 2013). Of course, the spirit of the school is very important, but that does not live in the school's walls or on paper, but in the nature of most teachers and is further reflected in the character of their students.

The important role of the teacher in the teaching process was clearly, concisely and undoubtedly expressed by K. D. Ushinskij - no organizational regulation and curriculum, no artificial mechanism of any quality, even the most sophisticated one, could not replace a personality in education. Without an immediate personal influence of a teacher on a student, it is not possible to truly educate, to help form a character. Only personality can influence the development and learning of personality, only character can shape character.

Pedagogical science of Pedeutology is concerned with the personality of a teacher - it is the theory of a teaching profession. It was created as a result of forming thoughts about teachers, which has been appearing in the works of educators since ancient times. In ancient Greece, Socrates was formulating thoughts whether human virtue is teachable and who is the one that should teach others.

We can state that the interest in the study depends on the personality of a teacher, their ability to attract the attention of the students, the ability to synthesize knowledge from various scientific disciplines, the ability to stimulate the initiative and motivation of the students. Teacher should be a person who has studied the theory and has experience in teaching, is passionate about their work, and, at least to some extent, has a charismatic nature with a high moral code. Creative, dynamic and flexible personality of a teacher, willing to teach, is more likely to motivate

students and to develop their personality within the key professional competences. The importance and usefulness of personal contact for both sides of the educational process is undeniable. Discussion between a teacher and a student develops the student's thinking and communicative skills. From all this we can see the necessity and irreplaceability of a good teacher in a professional, as well as personal development of a student. A teacher who sets a good example by their behaviour is the best thing that helps to shape the knowledge, creativity and a character of a student.

Geoffrey Petty (1996), a renowned British expert in teaching methods, in his book Modern Teaching states - The Bridge from chaos to order leads through four arches, and if a teacher wants to cross them with his class, each of these arches must be in place. Specifically, Petty meant the following four conditions:

- effective lessons based on a well-designed curriculum,
- good organisational skills of a teacher,
- good interpersonal relationships between a teacher and a student,
- discipline which cannot be achieved without meeting the first three conditions.

A precondition for the profession of a teacher is their own knowledge and ability to pass it on to students. Some teaching positions require accreditation, backed up by an examination and confirmation of a sufficient level of knowledge and competence of a teacher for a specific field. At present, a profession of a teacher is distinguished between:

- a coach (for fast professional courses),
- a lecturer (mostly in language courses),
- a facilitator (leads psychotherapeutic courses),
- a secondary school teacher,
- a Doctor (academic degree),
- a Docent (scientific and educational professional, lower rank than a professor),
- a Professor (an inaugurated scientific and educational professional, expert in arts and sciences, a teacher of the highest rank).

To be able to responsibly meet all the demands placed on them, a teacher must have a good knowledge of the subjects they teach, good professional knowledge of students' developmental characteristics, the necessary knowledge of how to organise lessons, the skills and abilities of using various teaching aids, appropriate language and speaking skills, as well as being able to evaluate students correctly and appropriately.

Every day, a teacher must be at the centre of the action, take responsibility for others, for relationships, for success and for the good atmosphere which they most often create with their teaching style. Style is a kind of ability, even art. What kind of a teaching style can be seen in practice most often? A teacher can acquire:

- an authoritative teaching style, where the teacher decides mostly on their own, does not take into account the needs and interests of the pupils. A teacher is dominant in an educational process. They are perceived as intolerant and strict by the students;
- a democratic teaching style, such teacher discusses the problem with the students, accepts their opinions, creates a creative atmosphere. A teacher is perceived as accepting and helping;
- liberal teaching style, is characterized by an uncertain and indecisive teacher. Students do not listen and respect such teacher, they are undisciplined. There are almost no rules in the classroom;
- unspecified teaching style, often characteristic for a new teacher who is using certain methods and testing their functionality in their own work with students.

A teaching style which a teacher uses and favours in their activities is very much related to how they can identify with the role of educating their students. Nowadays, many specialists are concerned with a teacher-student relationship, as well as with a process which takes place in the classroom under a teacher's guidance. However, the focus of the present school should be not only on the transfer of ready-tested knowledge, but also on a form of teaching that is based on activating methods, respecting of the individual peculiarities of students and on taking responsibility for learning. School should be involved in developing creativity. However, it is up to the teacher to apply these challenges in practice.

3 CREATIVITY IN EDUCATION

Creativity, as a major social phenomenon, has become the focus of attention since 1950, when Joy Paul Guilford pointed out the importance of its research, which leads to the creation of new and useful ideas and products. Since then, there was an information boom about creativity and, at the same time, inconsistency in the definition of the concept itself. The definitions of creativity differ, depending on theoretical concepts and orientation - on personality, ability, intellectual activity and the like.

Creativity, according to Sillamy (2001), is the ability to create that, hypothetically, exists in each individual and at any age. Pietrasiński (1972) considers creativity to be an activity that brings the unknown and, at the same time, socially valuable creations. He considers socially valuable creations such works that are valuable not only for the creator himself, but also for a certain community, but not necessarily for everyone simultaneously. Other authors, such as Průcha, Walterová, Mareš (2008),

consider creativity to be a mental ability based on cognitive and motivational processes, where inspiration, fantasy and intuition also play an important role. They are manifested in searching for solutions which are not only correct, but also new, unusual and unexpected. M. Zelina (1994, s. 129) states: *„Creativity is the interaction between subjects in which one of the subjects changes the surrounding world, creates new, useful, of a significant value for the other subject, reference group or a population.“* J. Hlavsa (1985, s.40) characterises creativity as: *„Creativity is a set of qualitative changes in the subject-object relationships where the synthesis of external influences and internal states results in the subject's alteration (through intense and special activity) and in the creative situations and products which are new, progressive, valuable, useful, truthful and communicable, which in turn forms the subject's characteristics.“* Definition according to A. M. Koršunov (1982, s. 8): *„Creativity is such an active interaction of a subject in which the subject purposefully changes the environment, creates new, socially important, in accordance with the requirements of objective laws“*

From the analysis of the concept of creativity, for the purposes of our research, we tend to define this concept according to Professor Zelina who states that "Creativity is the interaction between subjects in which one of the subject changes the surrounding world, creates new, useful, of a significant value for the other subject, reference group or a population."(Zelina, Zelinová, 1990, p. 17)

Žák (2004) in his work Kreativita a jej rozvoj (Creativity and its development) points to a summary view of this concept, where creativity can be understood as:

- ability: a) to imagine or invent something new where, as the author states, it does not involve the creation of something out of nothing; b) to create solutions, ideas by combining, changing, or other using of existing ideas;
- willingness to accept something new, to accept change, to have the courage to take risks, to play with thoughts, ideas, to react flexibly to the situation;
- a process characterized by hard work, systematic thought activity of creating new ideas, solutions, space for improvisation, but also order and discipline.

According to Žák (2004), the creative process takes place in the four basic phases described by G. Wallas (1926). This system is the first to understand the creativity as a systematic process and, for its simplicity, has become the basis for further thinking and is inherently used to this day. These are the characteristics of each phase:

1. **Preparation** - the preparation phase - at the beginning of the creative process an individual is facing a problem situation. In order to solve it, they collect the necessary information, data, relevant knowledge, and adopt solution strategies.
2. **Incubation** – ripening – if the first phase is logical, the second is intuitive. A person consciously (but this is not a condition) does not work on the creation, gains distance from problems, the information is "ripening" in one's mind. The problem is moving into the subconsciousness, where the search for solutions and consistent subconscious analysis takes place, independently of an individual. Here ideas are born, yet in an unspecified form.
3. **Illumination** - enlightenment - heuristic moment, discovering the idea of a solution. Intuition will make it clear to the subconsciousness that the idea found, the one that was being searched for in the incubation phase, is correct and it can be moved into the consciousness to work with it.
4. **Verification** - Is the solution found in response to the primary problem? This question is answered by the verification phase in which the investigator implements the solutions, applies them into practice and subsequently verifies them at the same time. If the solution is not correct, it is necessary to return to the previous points.

On the basis of the above, we can conclude that in most cases the common denominator of creativity is novelty, originality and usefulness, and the benefits of its products. The criterion of usefulness is attributed to the product by social practice - experts, economic and other criteria used for its determination, real and potential evaluators and so on.

If we should generalize the study of creativity from the perspective of psychology and pedagogy, we agree with the opinion of Maňák (1997), which states that psychology examines creativity as a certain objective psychological process, as it is manifested within the personality, it defines its characteristics and searches for the roots of its existence. Pedagogy primarily deals with the function of creativity in human life and the possibilities of influencing it with regard to ontogenetic development of a man. The researches from the first pedagogical and psychological projects (M. Jurčová, J. Kordačová, E. Kováčová, D. Kusá, M. Zelina.1994, 1995) were concerned with a wide range of factors related to creativity at the level of personality and the environment. Their aim was to contribute to the knowledge of the characteristics which act as pro-creative - that is, they improve and increase the possibilities of fully exploiting the creative potential of man, or which have the opposite - blocking effects, they reduce and prevent the possibilities of human creativity.

In a broader sense, creatogenic environment is understood as a company which supports creativity, creates enough opportunities and incentives for creative activity of people. The research was carried out on various samples of the population - students,

teachers, principals and entrepreneurs, the first owners of small businesses in Slovakia. For example, the research of entrepreneurs was aimed at clarifying the possibilities of creating an entrepreneurial culture, based on creative activity and the implementation of social resources. At school level, we can observe the trends to change education towards humanization, internalization and the search for new effective teaching strategies, which include developing creativity. The main findings are that the potential blockers of creative abilities are those factors which have a negative relationship with the basic indicators of creative potential: fluidity, flexibility and originality of thinking. On the contrary, personal characteristics which have positive interrelationships with the creative intellectual potential can contribute to its more effective use, also to irrationality and conformity.

3.1 Developing of creativity in the educational process

From the current pedagogical and psychological point of view, it is believed that creativity is an instrument of self-realization and an absolute fulfillment of one's meaning of life.

A lot of research has explored an issue of developing creativity. The results show that creativity is increasingly becoming a part of the educational process where a teacher, who must be a creative personality in order to guide students to creativity, is playing a very important role. Such a teacher should encourage courage, openness, independence and creative activity among students. They are tolerant to individual characteristics of a student, discusses problems, does not enforce activity and does not create tense situations.

Creativity in relation to school (2013) can be defined as a disposition to work in a problem situation that does not have a known solution or where a routine solution cannot be used. However, an investigator knows and has the need to identify a problem or several problems, is able to look for possible solutions and has the habit of systematically trying them out or choosing the procedure they judged to be the most suitable for the problem and conditions (Smékal, 1996)

In the school environment, the development of creativity is understood primarily as a formative impact on a student, their internal development, and development of their prerequisites for creative activity. As Jurčová states in the work of Ľ. Klindovej (1990) creative potential is the sum of knowledge, skills, abilities, motivation, personality traits, including moral qualities, that are synchronised in a creative process.

Váňová (1996) states that many researches have shown that lessons which are aimed at mobilizing students' creative powers, but where individual activities are repeated in an unchanged order and do not conform to students' interest in the activity, are not entirely encouraging.

Šťáva (1997) requires a teacher to emphasize goals, show willingness to innovate, as well as encourage courage, openness, criticality, trust and creative activity. In the educational process, the teacher should lead students to think and act independently, to seek out problems and information, to find a variety of solutions and unconventional problem-solving, to have a positive attitude towards learning, to cooperate and to provoke the student's need for self-improvement.

If a teacher is to lead students to creativity, they must be a creative person themselves. This means that they should be open and have empathy towards others, be tolerant to differing views, but at the same time be demanding and persistent in tracking problems and implementing ideas. A creative personality is expected to be curious, self-reliant, strongly motivated, but also bold and daring in thinking, liberated from egoism, conflict and stress, because creativity requires freedom also in the inner, mental world of a student. A teacher is also expected to be able to identify with the object of interest and to master the art of dialogue and classroom discussion.

Solárová (1996) concludes that if a teacher is creative in their work, they will certainly not only require their students to reproduce the information they have received, but will lead them to work independently. The relationship "creative teacher - creative pupil" arises when a teacher realises that many students are different than them and also differ from each other. This is where pedagogical creativity begins - sensitive approach to students, selection of suitable methods and forms of teaching.

In this context, Torrance (1981) draws the attention of teachers to the need to change attitudes towards creative students and recommends that they follow the following principles in their educational activities:

1. To respect unusual questions;
2. To respect unrealistic imagination and unusual thoughts;
3. To show students that their ideas are valuable and worthy of attention;
4. To give students the opportunity to learn on their own and to have confidence in the of their activities;
5. To reserve a period of unevaluated activity and learning to students without verifying the outcomes;
6. To give students the opportunity to assess, to indicate the consequences of the activity.

While respecting these principles, it should be emphasized that the key figure in the school is and always will be the personality of a teacher, who has a decisive influence on the classroom atmosphere and learning outcomes.

3.2 Creativity and a military unit

In the military environment, soldiers are in a specific formal unit, in which informal subgroups can form. Only after a while, through executions of commands from their military commander, a teacher, the group truly forms tighter relationships. Until a relatively stable system of social ties is established, conflicts can arise between soldiers who are creative and those who are not.

These contradictions arise Martinská (2002) because a highly creative soldier is characterized by personality traits which, in fact, already predict social tensions, conflicts, isolation - eg. non-conformity, independence, self-assurance, need for self-actualization, etc. In contrast to these characteristics, **a group type of a soldier** is characterized by attaching great importance to what others say and think, they are forgiving, empathetic, communicative, pro-socially oriented and able to subordinate their personal interests to the group's goals. Of a particular importance is the willingness to comply with standards and regulations, the ability to adapt well and to establish positive social ties with other soldiers. By defining these characteristics, it can be demonstrated that these are opposing personality traits of a highly creative and a group type of a soldier type. That is why problem and conflict situations arise. If highly creative individuals do not find the understanding and help of teachers, commanders, classmates, they often renounce their creativity only to be accepted by other group members. In a group, specifically in a military unit, an individual is already pushed towards conformism, where the individuality, the face, uniqueness and the personality in the true sense is being lost. In a military, incentives and sanctions should lead to the standardization of the armed forces and the unification of individuals (social groups). Currently, however, there are problems with the penetration of the so-called soft values (freedom, individualism ...) into military and these are not in line with the goals and tasks of such organization. How can the potential of a creative individual be reconciled with the need to unify a military unit? Even without the intervention of the teacher, the commander, a position of a creative soldier in a unit is strong, so it is relatively easy to actively cooperate with them. Their cognitive abilities, self-judgement, intellect are prerequisites for the positive perception by other group members. They can quickly gain the authority and respect of the unit. It is the task of the commander to adequately appreciate and motivate these individuals for the benefit of the unit. In a military, the presence of a creative individual can help to eliminate tensions and anxiety within a unit and strengthen the belief in the possibility of solving seemingly unsolvable situations and problems in critical moments that require rapid and effective innovative practices. If teachers and commanders are able to establish effective cooperation with creative individuals, they do not try to suppress their creativity, but allow them to develop it which can be an enormous benefit for the whole social group, a military unit.

To perform, a creative personality requires:

1. To be timely and well informed, have knowledge, time to study the problem,
2. To want to be emotionally involved, well-motivated and value oriented,
3. To have the conditions for development and expression of creativity.

Even in the military environment, it is necessary to pursue the development of creativity, to develop the qualities by removing obstacles which lead to suppression of creativity. The obstacles may be fear of change, the unknown, failure, mistrust or lack of understanding or respect, lack or supersaturation of information. However, unwillingness to accept different opinions and attitudes, rigidity and dogmatism of the environment can also be an obstacle. Creativity should not be an antagonistic contradiction to the need for a unification of a military unit. If there are contradictions, they need to be modelled as the driving forces of the development of creative individuals for the benefit of the entire military unit.

4 CONCLUSION

The focus of the present school should not only be on the transfer of ready-tested knowledge, but a form of teaching that is based on activating methods, respecting of the individual peculiarities of students and on taking responsibility for learning. School should have a part in developing creativity. Creativity should become one of the main teaching principles. A teacher's, a commander's creative activity form the student, their educational activities.

The concept of creativity is not at all a new concept. In recent years, the issue of creativity has been very current and significant. It is a personality trait which every person wishes to possess. However, one does not obtain it by doing nothing but waiting for it to appear. It takes a lot of effort to achieve something. Creativity gives sense to life, it distinguishes a man from an animal and a machine, creativity heals a man from diseases of modern civilization, creativity is a way of self-realization, creating something is of the greatest value for the society, creating is living.

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