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Possible directions of Hungarian Defence Forces' military engineering support in the 21st century during force protection, with special regard to countering improvised explosive devices

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Introduction

My choice of topic was basically motivated by the scientific processing of my decades of practical experience in the field of military engineering support. In order to achieve the various goals of engineering support, the effective use of engineer forces and tools was an important aspect in all periods. With the organisational changes implemented in recent decades, the representation of military engineers at the military and strategic levels has also been lowered or eliminated.

The authors of the book, which deals with the history of engineer troops, characterized the conditions that existed in 1990 as follows: *"In 1990, before the first free parliamentary elections, the Hungarian armed forces were characterized by ideological motivation, oversized and offensive character."* [1] The authors of the book point out that the first significant phase of the transformation of the Hungarian Defence Forces (hereinafter referred to as HDF) ended in 1997, or as the authors put it: "the *macro-level rearrangement has been completed."* [2] The macro-level rearrangement practically meant that the Hungarian People's Army, which numbered 155 thousand people in 1989, was reduced to 53150 by almost a third. The objective of the reorganisations is to harmonize the HDF with the requirements of NATO, which aimed to develop a smaller but well-prepared and equipped armed force.[3]

The objectives of the transformation of HDF were comprehensively achieved, however, as I have already indicated, the professional management of the technical teams has practically ceased as a result of the transformations and rationalizations carried out during the indicated period. Engineer officers are still present in the armed forces and in the staff of the Hungarian Defence Forces Command (hereinafter referred to as HDFC), the structure of which is still changing, and they support the preparation of the leaders' decisions. However, the professional officers working separately in the HDFC organization have information only in one sub-area, so they do not have a comprehensive picture of the overall situation of the profession, nor do they have the right or competence to manage the field of the engineering profession that they are familiar with.

The lack of engineering staff with the right and authority is increasingly noticeable in almost all areas of engineering support. My finding is supported by the construction of a technical border lock established in 2015 on the Serbian-Hungarian and Croatian-Hungarian

[1] Tibor KOVÁCS – József NYERS – József PADÁNYI: *We build, we protect, we create. History of engineer troops from 1945 to the present*. Zrínyi publishing house. Budapest, 2012. p. 189.
[2] Ibid. p. 190.
[3] Ibid. p. 190.

border sections, *"officially known as the temporary security border closure for border surveillance purposes"*.[4] As is known, "*one of the dominant groups of technical locks is non-explosive locks, especially fences"*, which is basically an engineer support task performed to impede movement. However, the task was carried out on the ground by the Chief of Staff of the Joint Forces Command (hereinafter referred to as the JFC) and the adjoining staff, given that the JFC or HDF did not have the appropriate engineering professional staff with the rights and competence to manage a basic engineer support task.[5]

Looking at engineer support from an international perspective, we can conclude that the document set out by the NATO Military Committee on engineering assistance guidelines[6] also points out that the coordination of increased support needs must be carried out by a technical staff, as I have already pointed out in my previous publication.[7]

The launch of the Zrínyi National Defense and Force Development Program (hereinafter referred to as NDDP) provides an opportunity to incorporate well-founded, innovative proposals for the engineering field into the program.[8] The opportunities offered by the NDDP make the elaboration of my thesis even more timely and justified. The need for comprehensive research in this area is supported by the demand made by the HDF and the Ministry of Defense (hereinafter referred to as MoD) to determine future developments, in addition to examining the wars of the present, and to predict future conflicts. By comprehensively examining the conflicts of the present, as well as by analyzing research on the wars of the future, it is also possible to determine the future directions of engineering support, on the basis of which the development needs of the HHP for the technical field can be determined on a scientific basis.[9] On the other hand, organisational modernisations through the HHP also require a review of organisational structures. Research into engineering support for future military operations (including the use of practical experience) can provide research results that are timely and can

[4] József PADÁNYI: Technical lock at the border. Engineering Military Gazette, Vol. 25, No. 3, pp. 21-33, 2015, p. 29.
[5] Ibid. p. 21.
[6] NATO Military Committee Guidelines for Engineer Support to Operations 2017, Military Committee Policy on Military Engineering (MC 0560/2).
[7] Attila CSURGÓ Engineer support for the force protection, Military Engineering Gazette, Vol. 29, No. 4, pp. 119-132, 2020, p. 119.
[8] 1298/2017 (VI. 2.) Government Decision on the implementation of the Zrínyi 2026 Defence and Force Development Programme, National Defence Gazette*:* http://www.kozlonyok.hu/kozlonyok/index.php?m=0&p=kozltart&ev=2017&szam= 7&k=13 p. 679. (Accessed July 14, 2017).
[9] József BODA – Gábor BOLDIZSÁR – László KOVÁCS – Zoltán OROSZ – József PADÁNYI – István RESPERGER – Zoltán SZENES: Directions, priorities and topics of military science research, 2016. online: http://hdl.handle.net/20.500.12944/7247 (Accessed August 12, 2021).

also facilitate the development of engineer officer's training at the Faculty of Military Science and Army Officer Training of the National University of Public Service.

1.Formulation of the scientific problem

How has engineer support for military operations changed from the end of the 20th century to the present day? What are the differences in emphasis in engineering support for military operations during this period? How are HDF engineer forces adapting to the changed circumstances of operations support? How will our changed security environment in the 21st century, as well as the transformation of the characteristics of warfare, affect the future directions of military operations? What engineering support capabilities are needed to support future military operations from an engineering point of view?

When examining the engineering support of international peace-support military operations, József Padányi points out that engineering support is implemented in two distinct areas, which have a decisive influence on the targeted use of available forces and means.[10]

"Combat support (engineering support for combat), i.e., well-defined engineering support in space and time for subunits and units fighting directly in battle. It relates to ongoing or upcoming land, air, naval operations and primarily meets needs at the tactical level."[11]

"Engineering preparation and maintenance of the theatre of war. Engineering support tasks requiring longer-term preparation of future operations (transfer of strategic bridge stocks between operations, allocation of human and engineer resources) and indirect engineering support for ongoing operations. It primarily meets operational and tactical needs."[12]

Padányi's study details the engineering support experience of military operations in the Balkan,[13] Afghanistan[14] and Iraqi theatres of war.[15] In all the theatres of war he studied, his defining activity was the system of creating and maintaining freedom of movement and maneuverability. In the theatres of war in Afghanistan and Iraq, tasks related to the construction,

[10] József PADÁNYI: Experience of engineering support for military operations, Military Science, Vol. 15, No. 2, pp. 72-81, 2005, p. 73.
[11] Ibid. p. 73.
[12] Ibid. p. 73.
[13] A NATO its first major crisis response operation, which was carried out by partner countries, including Hungary, in addition to the then NATO members. The first stage of operations is carried out by the "realizing force" Implementation Force (IFOR) 1995 - 1996.), while the second stage of the "stabilizing forces" Stabilization Force (SFOR) 1996-2004. implemented. For details, see: https://www.nato.int/cps/en/natolive/topics_52122.htm (Accessed November 18, 2020).
[14] Operations in Afghanistan 2001 - 2021, which was also supported by HDF, for more information, see: https://www.nato.int/cps/en/natohq/topics_8189.htm (Retrieved 09/12/2021);
[15] NATO's involvement in Iraq has taken various forms from 2004 to the present. The reference refers to the first period 2004 - 2011, for more information, see: https://www.nato.int/cps/en/natohq/topics_166936.htm (Accessed December 09, 2021).

equipment and operation of military camps, as well as the decontamination of ammunition and explosive devices, have increased. The author highlights the importance of national inclusive support, however, that due to the poor economic and infrastructural and lack of national resources in Afghanistan, the support tasks had to be solved mainly with the available military resources. Illustrating the diversity of theatre tasks, he also highlights that the multifacetedly trained technical soldier proved decisive in the effectiveness of technical support.[16]

Different phases of military operations in the Iraqi theatre of operations were dominated by different technical support tasks. At the initial stage of operations, the main direction of technical support was the equipment of the field sections of the launch and the equipment of military camps that provided protection and rest for the incoming troops.

The following periods were dominated by the elimination of obstacles to freedom of movement and maneuverability, due to which technical troops were also directly involved in the fight for armed struggle. *"The effectiveness of combat training for technicians needs to be increased because, on the one hand, they can be assigned combat tasks in a number of cases."* points out Padányi.[17]

In parallel with the movement and maneuver support tasks, tasks related to the restoration and operation of critical infrastructure also appeared. *"Increased attention has been paid to the protection and restoration of oil, water and power line systems." [18]* Overall, it can be concluded that the multifaceted capabilities required to carry out the tasks of technical assistance are also supported by the experience of international military operations. The shifts in emphasis shown above characterize the technical support of military operations, therefore, the preparation of technical soldiers should not be limited to knowledge of one specialty, including proper combat training, which implies survival and success in tasks.

Padányi also draws attention to the experience: *"the expectation is a technical soldier with several purposes and preparations.* " The stated expectation could also facilitate the adaptation of technical troops to future military operations.[19]

In terms of training, the picture of training for technical teams is no longer so clear, although experience in operational areas is being processed, the situation is made more difficult by the fact that the harmonisation of technical regulations with NATO instructions has only been done partially or sometimes not at all. The lack of instructions and controls is the main

[16] PADÁNYI: Experience with engineering support for military operations, 2005. op. cit. p. 77.
[17] Ibid. p. 77.
[18] Ibid. p. 76.
[19] Ibid. p. 76.

obstacle to determining the future directions of training, which is basically due to a significant decrease in the representation of the engineering specialty. The above shortcomings are also evidenced by the finding that the effectiveness of the tasks of "*engineering support is determined by the quantity and quality of available engineering resources."* [20] Indicators that determine quality:

a) *"Leadership and organization of engineer forces"*, the safe operation of which is established by the restoration of direct representation of the engineering profession at the military command levels.[21]

b) *"Level of preparation, training", the achievement of the* appropriate level is facilitated by knowledge of the Allied order of procedure, knowledge of the operational and military issues of engineering support. [22]

c) *"State-of-the-art engineering means"*, the direction of necessary modernisation is determined by experience in the field of operations and risk analysis for the current and future security environment and military operations.[23]

d) *"Cooperation with the Alliance" is* to ensure a continued presence in NATO's engineer fields, learning about the experience gained by other nations in engineering support and new directions for development.[24]

Based on all this, I understand the scientific basis for engineering support for military operations in the fact that while the HDF as a whole is undergoing significant changes in the areas of command and control, training of troops and modernization of engineering equipment, there is a significant postponement in the area of engineering. Therefore, a comprehensive analysis and examination of HDF's engineer troops, operational capabilities and activities is timely.

Publications and doctoral dissertations have been produced in certain areas of engineering support, which I will describe in detail in the chapter summarizing the relevant literature of the thesis. However, a comparative analysis that takes into account threats from changes in the security environment and warfare, and would examine current and expected threats based on a risk analysis based on a risk analysis based on the operational approach of force conservation, has not yet been prepared.

[20] PADÁNYI: Experience with engineering support for military operations, 2005. op. cit., p. 79.
[21] Ibid. p. 79.
[22] Ibid. p. 79.
[23] Ibid. p. 79.
[24] Ibid. p. 79.

2. Research hypotheses

In accordance with the title of the thesis and what is described in the *chapter section "formulation* of the research problem", in order to define the central topic of the research and to present the approach to the research problem, I will put forward the following research hypotheses:

1. I am convinced that the effectiveness of engineering support for future joint operations will be influenced by challenges in the main areas of security and by the warfare procedures used in future military operations.
2. In my opinion, due to the development and widespread availability of information technology (hereinafter referred to as IT), the range of users and the stage for the use of improvised explosive devices is expanding, and the resulting threat must also be taken into account in the engineering support of future military operations.
3. In my view, the evaluation of improvised explosive devices used in military operations and related combat procedures, the summation of practical experience, and the examination of improvised explosive devices combining novel technologies are necessary for the future planning of the training of HDF sappers and EOD subunits, to determine the development directions of the necessary engineering support capabilities.
4. I am convinced that the elimination of future threats to our country will be carried out within NATO framework; In order to ensure the effectiveness of the security of military operations, all forces involved must interpret the rules of conservation of forces according to uniform principles.
5. I believe that in the future, security will increasingly be threatened by challenges arising from unconventional warfare procedures below the threshold of war, in that future security environment the operational security of critical infrastructure will be appreciated, and that the operational security of infrastructure that is crucial for military operations will be ensured by the development of flexible resilience based on a system of force protection.
6. I am convinced that in military operations of the 21st century, engineering support is influenced by the capabilities available to directly support combat and provide general support to troops, therefore, the conclusions drawn from the comparative analysis of separate areas will help to determine the future directions of engineering support for military operations.

7. I believe that the effectiveness of engineering support for future joint operations should be assessed in terms of the quantity and quality of engineering capabilities available; It is necessary to analyse the elements of quantity and quality – the leadership and organization of engineer forces, the level of training, the state of the art of engineer troops – and to summarize practical experience in order to identify the needs of future engineering support capabilities.

3. Objectives of the research

In developing my thesis, I undertake to examine the factors affecting future military operations, in particular the threats arising from the future development of improvised explosive devices and their application. On this basis, I highlight the risks to the security of military operations and the possibility of managing them by interpreting the rules and procedures for the protection of forces in a uniform manner and by introducing them in order to increase security. On the basis of the results of the tests carried out, I will determine the directions of quantity and quality of forces and assets necessary for the implementation of future engineering support for military operations, the developments necessary to make engineering support capabilities more effective. To achieve all of this, I have formulated the following research objectives:

1. By processing domestic and international experience, I examine the processes in the main areas of security, their characteristics and their impact on the warfare procedures used. I analyse the security and operational environment of the future and the changes in the warfare procedures used in order to identify the challenges that will emerge in the joint operations of the future.
2. I analyse the threats posed by improvised explosive devices and their effects on the operational environment of conflicts. I systematize and interpret the structure and basic elements of explosive devices, as well as the concept and characteristics of the IED, the combat procedures related to its application, their impact on the security environment of military operations. Based on all this, I prove that the use of improvised explosive devices in an unconventional operational environment will have to be reckoned with in the future.
3. I analyse the current directions of development and application of improvised explosive devices, the new technologies used when they were delivered, in order to prove that the safe detection, identification and deactivation of explosive devices placed and/or produced by improvisational methods require continuous quality improvement of domestic capabilities in this direction.

4. I explore and investigate the relationship of force conservation with other functions that determine the planning of joint operations. I analyze the military scientific interpretation of force conservation and review the process of risk analysis for the operational environment and its aspects. On this basis, I demonstrate the need for a uniform interpretation of the protection of forces in order to enhance the security of military operations.
5. I systematise security threats in military and sub-threshold operations in order to explore the possibilities of introducing procedures based on the protection of forces, based on a security approach to operations carried out within a national framework and based on a risk analysis to protect forces.
6. I analyse the forms, characteristics and objectives of the capability-based implementation of military operations. I systematize capability-operated areas of engineering support to engineer capabilities for military operations to determine future directions for engineering support.
7. I analyse the quantitative and qualitative indicators of HDF's current engineer capabilities in order to formulate, based on the conclusions drawn, recommendations for the development of the training, technical equipment and leadership and management of the engineer troops to ensure effective technical support for future joint operations.

In fulfilling the above research objectives, my intent was to develop a material that, on the one hand, increases the effectiveness of engineering support for future military operations and on the other hand, supports the objectives of the Zrínyi National Defense and Force Development Program for the development of the domestic military industry.

4. Research methods and activities

In order to prove or disprove the hypotheses, I set out in my objectives in the thesis and I have used a number of research methods but basically, I relied on general research methods. Within this, the analyses were carried out using inductive and deductive procedures and research synthesis. In the course of my research activities, I studied and processed the relevant domestic and foreign literature, took into account the relevant doctrinal environment, as well as other relevant NATO regulations in the fields related to my research topic. I compared the collected previous and current literature by analytical method, both within each field and with the doctrines of other areas relevant to my thesis.

Taking advantage of my position in the international organization[25] and the opportunities provided by domestic and international conferences, I constantly talked with domestic and NATO experts familiar with the subject, who helped to develop my thesis by presenting the context of their respective fields.

5. The structure of the thesis and applied research methods

In order to justify or disprove my research objectives and formulated hypotheses, my thesis consists of four main content chapters, at the end of which I summarize the partial results of the research work and formulate partial conclusions.

In the first chapter, I analyze changes in warfare and the operational environment in the light of security. In this chapter, I analyze the security environment of today and tomorrow, as well as their expected military aspects and related changes in the procedures used in warfare. My aim is to verify the links between the challenges in the main areas of security and the warfare procedures used in present and future military operations, and to point out the expected directions of future military operations by drawing conclusions from the investigations. In the chapter, I will show that the constantly changing security and operational environment will determine the future directions, tasks, and strength and equipment needs of engineering support.

In the second chapter, I examine weapons that support unconventional warfare, improvised or improvised explosive devices that are widespread in domestic terminology. In this chapter, I interpret the challenges arising from the use of improvised explosive devices and their effects on the operational environment of conflicts. Inorder to achieve a uniform interpretation, I examine the definitions of improvised explosive devices, as well as analyze the properties of this device and its relationship to information and other emerging technologies. The aim of the study I have carried out is to explore the impact that the use of this type of tool will create a specific operational environment in the future conflicts. The purpose of the further investigation is to explore how to protect against it, which will affect the future system of tasks of engineering support, the training and preparation of the engineer and EOD subunits in this direction.

[25] NATO Centre of Excellence Defence Against Terrorism (COE DAT) Capability Development Unit, Head of Unit Ankara, Turkey (2018 – 2022). In my work, I directed the "Eradication of Terrorism Network" course as the course director of the course, and as an invited speaker at the Centre of Excellence Countering Improvised Explosive Devices (C-IED COE, Hoyo de Manzanares, Spain) in Madrid, by using these opportunities, I was able to consult with a number of NATO trainers and experts.

In chapter three, I presented and analyzed the joint function of force protection, which is an essential element in the development of operational safety. In this chapter of my dissertation, I seek to answer the question of how the challenges and dangers derived from the characteristics of 21st century warfare, including the future use of improvised explosive devices, have changed or will affect the tasks of force protection, and how these will manifest themselves in domestic operational capabilities. My conclusion is by the changes in the security environment the military power alone can no longer fully address the challenges of our time and the future. Therefore, the nation's resilience needs to be developed. In the second part of this chapter, I examine how the regulations designed to protect forces can be adapted to build the resilience of national critical infrastructure, which also determines the success of military operations.

In chapter four, I analyzed the engineering support for military operations on the basis of the conclusions drawn from the investigations of the previous chapters. I examine the basics and conceptual changes of military engineering support with reason, which is also resulted significant changes in the NATO doctrine. In the following, I systematized the areas of military engineering support and related capabilities, the possibilities of their application to support joint functions. I analyse related areas of force conservation and technical assistance, technical capabilities necessary to protect forces in war and/or crisis response operations, in order to determine the quantitative and qualitative need for domestic capability. On the basis of the analyses carried out, I made suggestions for development directions that will contribute to the effectiveness of future technical support. In order to achieve this fundamental objective of research, I proposed the qualitative and quantitative needs of the engineer capacities required for engineering support tasks in war and/or crisis response operations. In addition, I propose ways to develop and complement capacities.

To conclude the thesis, I summarize the research sub-results contained in each chapter, drawing conclusions from them. I presented new scientific findings in my research, as well as made recommendations for further possibilities for using the thesis.

6. Overall conclusions

The basic purpose of the studies carried out in the thesis was to establish what qualitative and quantitative improvements would be required for effective engineering support for future military operations. The timeline of the investigations is particularly justified by the current phase of the Zrínyi NDDP, which makes it necessary to define the future tasks of engineering

support in order to formulate proposals drawn up on a scientific basis that indicate possible directions for the development of engineering support.

In line with the stated objectives, in the *first chapter* of the thesis, on the assumption that the effectiveness of engineering support for future joint operations will be influenced by challenges in the main areas of security and the warfare procedures used in future military operations, I drew the following conclusions.

Processes that currently have an impact on the security environment, highlighting as examples the limited access to critical resources and raw materials, demographic changes, but also the widespread of information technology advances or global threats from urbanisation and climate change, will also have an impact on the security environment of the future. Global security challenges are also expected to affect the security of our country, the management of which will become an increasingly social task as a whole, but military power will continue to play an important role in addressing these challenges in the future.

Another component of security is our alliance membership, but the basis of alliance effectiveness is a uniform interpretation, interoperability, which necessitates consideration of NATO directives in addition to domestic requirements when developing military capabilities.

In view of the crucial role of military force in addressing security challenges, I examined changes in warfare, from which I concluded that quantitative and qualitative asymmetry between the opposing parties results in unconventional warfare procedures. In future operations, cities will become the main arenas of asymmetrical conflicts under the influence of increasing urbanization.

Based on the studies carried out in this chapter, in one version, based on the conclusions drawn from the analysis of the security environment and warfare, I determined the types of future military operations.

In the second chapter, I examined the evolutionary history of IEDs, the characteristics of the threats they evoke, the impact of technological progress on the modification of IEDs. On the one hand, the need for a comprehensive examination of the IED was justified by the fact that domestic and international publications drew attention to the six-space reduction of research and development devoted to C-IED activities, pointing out that even in the USA, the organization that accomplishes research and development, which previously managed billions of dollars, was liquidated. On the other hand, it is the phenomenon within NATO (including our country) that increasingly identifies C-IED activity as an engineering support task.

In examining the study on the basis that the threat posed by the IED should also be taken into account in engineering support for future military operations, and contrary to the current

NATO trend, engineering support plays a leading role among IED activities only when identifying and disarming the IED. Therefore, I focused only on identifying the possibilities of preparing for it and on technical developments that facilitate secure identification.

In the analysis, I clarified the aspects that can be taken into account in the military science interpretation of the IED, regardless of the method and purpose of application and the components used. There are many examples which demonstrate that the development of IED as a tool and as a combat method is determined by the possibilities provided by information and other emerging technologies, such as the common media. The IED is basically a weapon of choice a non-state actor engaged in unconventional "indirect" warfare, which also has an impact on the specific operational environment. At the same time, it is increasingly appearing in the toolbox of a state actor too in operations below the combat threshold. Starting from future trends that will affect security, such as the development and widespread availability of information technology or asymmetric opposition, I have pointed out that these processes can lead to an expansion of the circle of IED users. Consequently, we must count on the use of IED in both domestic and NATO military operations, which we must conclude in the future as a threat to collective security.

By systematizing and comparatively analyzing the basic elements and characteristics of the C-IED activity, I developed possible future tasks of engineering support in relation to countering IED activities.

Based on the experience of urban and subsurface operations, the primary future task of engineering support is to detect IEDs. However, the metal detectors currently used in HDF are no longer effective in urban operations, so the military use of explosive detection sensors capable of detecting the primary component of the IED becomes necessary. Increasing the efficiency of IED detection can be achieved through the development of currently regular EOD robots, as well as the use of sensors mounted on drones.

In order to maintain and expand the practical experience of the engineering and EOD subunits in previous military operations in detecting and disarming IEDs, I have proposed the implementation of training, based on existing IED databases, as well as the organization of joint exercises and trainings with allies with international experience, in particular the V4 member countries.

In the *third chapter*, I examined the joint force conservation function, which ensures the capability-based implementation of military operations planning by correctly interpreting the conclusions from the analysis of challenges and threats (risk analysis) (risk management). The

planning of military operations based on risk analysis and the correct management of risks during the period of fighting help to establish operational security.

Drawing on the conclusions of the first chapter, I demonstrated that the future security challenges facing our country will be addressed in a NATO manner. The effective operational application of troops arriving on the territory of our country to deal with threats is created by inclusive national support.

Risk analysis and risk management based on a system of conservation of forces will help the inclusive national support to be effective. However, the domestic adaptation of the operational function of protecting forces has not yet been carried out, which hinders the preparation of an alliance operation involving our country. The full domestic introduction of the NATO doctrine of conservation of forces would create a uniform understanding of the effective implementation of inclusive national assistance and promote a security-based approach to operations carried out within a national framework based on risk analysis.

In the second part of the chapter, on the basis of the appreciation of the operational security of critical infrastructure in the future security environment, I examined the design of the operational security of infrastructure that is crucial for military operations, based on the system of force protection.

Relying on an analysis of the domestic regulation of critical infrastructure, the relationship between the sectoral criteria on which the regulation is based, including the sectoral and sub-industrial interconnections that determine operational security, I found that the operational safety of certain critical components of the sectors is ensured by the smooth operation of even several sectors and subsectors, for which it is not possible to establish comprehensive protection, and therefore the modulators are flexible it is necessary to build its resistance.

When developing flexible resilience, a comprehensive risk analysis and risk management from the point of view of force conservation can be adapted. Given that the host national support (including ensuring the freedom of movement of the troops), both operational and non-operational, relies predominantly on our country's national transport network. The critical components of the transport network, the bridges of the Danube and Tisza rivers in terms of our country, therefore their flexible resilience fundamentally facilitates the effective effective implementation of inclusive national support and military operations.

By analyzing the concept developed by NATO in 2020 in the "Warfighting Capstone Concept", I presented the possibilities of developing the layered resilience of national

infrastructures. The development of layered resilience and the safe and flexible resilience of national critical infrastructure ensure the effective management of operations below the war threshold, which is increasingly characteristic of today.

Based on the design and operational procedures for the conservation of forces, I *developed* the construction of security layers that support the flexible operation of an operationally critical system element and the aspects of their application. The multi-layered security-based architecture and functioning of infrastructure constituents increases the resilience of the constituent and supports the efficient conduct of military operations.

In the defining *fourth chapter of* the thesis, using my achievements in previous chapters, I examined the areas of engineering support for future military operations. VI have excited the basics and conceptual changes of engineering support, systematized the tasks that arise within the areas of engineering support, the capabilities necessary for their implementation, to determine the future quantitative and qualitative components of engineering support. Changes in the operational environment and forms of warfare resulted in changes in NATO guidelines for engineering support and a revision of NATO's doctrine. The NATO's Doctrine, published in 2021, refers to engineering support as a capability to support joint functions, but the domestic adaptation of the doctrine has not yet taken place.

Clear conclusion can be drawn from recent military operations that the tasks in the areas of engineering assistance have been expanded, the available military capacities are no longer sufficient, and that their complementarity is necessary, in particular, to solve the tasks in the field of general engineering support for troops. Domestic research identified the engineer tasks performed by the troops mainly as direct support for the struggle, which was the result of the experience of peace support operations characteristic of the past period. However, based on the results of my research, engineering support for future military operations should essentially be organized on a capability basis, within which the engineer forces are able to directly support combat and/or provide general engineering support to the troops. Based on the studies I have carried out; I am convinced that effective engineering support for future military operations will be determined by the capabilities available to directly support combat and provide general support to troops.

In order to facilitate future capability-based testing of engineering support, I *have developed* the capability-based concept of engineering support and *proposed* a capability-based grouping of engineering support tasks.

The developed definition, as well as the grouping of engineering support based on area-based capabilities, facilitated the examination of the quantitative and qualitative components of domestic engineering support, which provided an opportunity to formulate proposals for the development and complementarity of capacities for effective engineering support of future military operations. On the one hand, the proposed organizational and device developments will help the objectives of the Zrínyi HHP for the development of the domestic military industry, as well as the flexible resistance of critical system components belonging to the road transport infrastructure of Hungary. On the other hand, they increase the capabilities that can be used to deal with natural disasters that have hit the country.

The examination of the domestic capabilities of engineering support also showed that the targeted effective application of the remaining capacities, as well as the processing of doctrines or the technical preparation of the country's defense, are hampered by the lack of leadership and management in the field of domestic engineering support. The role of the chief engineer and the coordinating role of the engineer staff is also highlighted by domestic and international research and operational experience.

In order to effectively use the domestic capacities available for the implementation of engineering support tasks, I developed in one version the proposed theoretical structure of the HDFC's engineer headquarters.

7. New scientific findings

Based on my research work to develop the thesis, I evaluate the followings as new scientific achievements:

1. The comparative analysis of the basic elements and characteristics of the counter-IED activity, I identified the engineering support tasks in the field, which helped to develop proposals for the quality components of future engineering support for IED control. In particular, joint training based on IED databases international and domestic, as well as the implementation of effective and secure detection and identification of IEDs, including exploring the possibilities of technical modernization to facilitate the detection of explosives.
2. Demonstrate the need for domestic theoretical and practical adaptation of a new NATO doctrine on force protection, which promotes a security-based approach based on risk analysis of operations carried out within a national framework and creates a standardized understanding for forces to effectively implement inclusive national support.

3. Conceptual development of multi-layered, security-based architecture on key infrastructure influencing the success of military operations, ensuring the resilience of the operationally critical component, thereby facilitating the success of military operations and the resilience of domestic critical infrastructure.
4. Capability-based definition of engineering support in order to set engineer support tasks on the basis of capabilities, which facilitated the identification of the quantitative and qualitative components necessary for engineering support for future military operations.
5. Capability-based examination of engineer support areas, which has enabled the development of complementary proposals in key areas of engineering support. The proposals increase the effectiveness of engineering support for future military operations, while at the same time supporting the objectives of the Zrínyi NDDP focusing on the development of the domestic military industry.

8. Recommendations, areas for further research

Given the complex nature of the topic being researched, the thesis focused on a number of subfields that could be researched independently and on exploring the relationships between them and those that would affect the engineering support of future military operations. Due to the complexity of the task, I recommend further research in a number of sub-areas.

1. The future changes in the production of IEDs, directions of countering them, in particular, the use of drones and infocommunications tools. Detection of the contents of the suspected IED explosive from a safety distance in order to perform EOD tasks safely and effectively.
2. Build a multi-layered security architecture for critical infrastructure, develop the resilience of critical infrastructure constituents and examine the security-based functioning of the military tasks of host national support.
3. To process the experience gained from recent military operations in cities, in particular with regard to the examination of engineer support tasks for underground operations, in order to further define the city-specific quantitative and qualitative components of engineering support.

9. Practical applicability of research and scientific results

I propose to use my achievements in the following areas:

1. in the training of troops implementing the engineering support of the Hungarian Defence Forces;
2. in harmonizing the organization and management of engineer troops with NATO principles and in increasing efficiency in domestic joint operations;
3. in the capability-based modernization of the ground engineer forces of the Hungarian Defence Forces, by purchasing equipment to promote the efficiency of future engineering support;
4. in the preparation and further training of engineer officers and sub-officers.

10. Author's publications on the subject

Scientific publications:

1. Dr. Norbert Daruka – Attila Csurgó: *Military explosive ordnance – The bomb*. In: Beňovský, M (ed.) Trhacia technique 2017. Zborník prednášok z 29. medzinárodnej konferencie na počesť 390. výročia prvého použitia výbušnín na svete v podzemí Banská Bystrica, Slovakia: Slovenska spolocnost pre trhacie a vrtacie prace. pp. 44-55;

2. Dr. Norbert Daruka – Attila Csurgó: *The use of animals in military operations*. In: Beňovský, M (ed.) Trhacia technique 2017. Zborník prednášok z 29. medzinárodnej konferencie na počesť 390. výročia prvého použitia výbušnín na svete v podzemí Banská Bystrica, Slovakia : Slovenska spolocnost pre trhacie a vrtacie prace. pp. 32-43;

3. Attila Csurgó: *Force Protection, the basics of protecting forces*. Engineer Military Bulletin 2018, Vol. 28, No. 1. pp. 209-217. ISSN 2063-4986;

4. Attila Csurgó: *Establishing the defense of military camps, force protection against the effects of improvised explosive threat*. Engineer Military Bulletin 2018, Vol. 28, No. 2. pp. 264-276. ISSN 2063-4986;

5. Attila Csurgó: *Military engineering support in the age of asymmetric warfare, with special emphasis on the fight against improvised explosive devices.* KNBSZ Professional Review 2018, Vol. 16, No. 3 ISSN 1785-1181;

6. Attila Csurgó: *Possible directions of HDF engineering support in the 21st century during the force protection, with special regard to countering improvised explosive devices.* In: Klementina Kozma (ed.) Military Science and the XXI century. Budapest, National Association of Doctoral Students, Department of Military Science (2019) 255 p. pp. 96-111.;

7. Dr. Tibor Kovács – Attila Csurgó: *The resilience, shaping the military camp against IED threat.* Counter – IED Report Spring/Summer 2019 Edition. pp. 27 – 36. ISSN 2050-6732 (Print);

8. Attila Csurgó: *The impact of the operational environment created by IEDs on the development of means of transport providing freedom of movement in order to protect forces.* Army Review Vol. 147, No. 6/2019, pp. 42-52;

9. Attila Csurgó: *Engineering support for force protection.* Engineer Military Gazette 2020, Vol. 29, No. 4. pp. 119-133. doi: 10.32562/mkk.8.4.2019;

10. Attila Csurgó: *The role of the national security services in planning the tasks of protecting forces.* Scout Review Vol. XVIII, No. 3, pp. 81-94. 2020.ISSN 1588-242X ISSN 2063-4986;

11. Attila Csurgó: *Force protection in today's operational environment.* Army Review, 2021/3 DOI 10.35926/HSZ.3.2021;

12. Dr. Tibor Kovács – Attila Csurgó: *Directions of C-IED in today's operational environment*. Engineer Military Gazette, Volume 31, 2021, No. 2. 111 – 125. doi: 10.32562/mkk.9.2021;

13. Attila Csurgó: *Analysis of the engineering support tasks to be carried out for force protection in today's operational environment.* Dr. habil. Ildikó Szelei (ed.): Military Science and 21st Century Study volume. 2021. National Association of Doctoral Students, Department of Military Science Budapest 19- 34. – online: https://hdi.uni-nke.hu/document/hdi-uni-nke-hu/hadtudomany-es-a-21-szazad-kotet-2021.pdf;

Lectures, conferences:

1. Attila Csurgó: *Advances in countering improvised explosive devices!* Combat Engineer 2017. Conference in Nuremberg, Germany. 07/11/2017/English;

2. Attila Csurgó: *Examining requirements to enhance amphibious Counter-IED capabilities.* Military Engineering conference, London, United Kingdom. 2018. 02. 28. – 03. 01. English;

3. Attila Csurgó: *Maintaining force readiness and preparing against future threat.* Countering explosive threat and demining conference, London, United Kingdom. 2018. 12. 11-13. English;

4. Military Science and the 21st Century Conference: Csanád Fekete: *Armed conflicts of the future - in the light of the information age* (opposition) NKE 21-22.02.2018;

5. Attila Csurgó: *Possible directions of HDF engineering support in the 21st century during the force protection, with special regard to countering improvised explosive devices.* (talk) Military Science and the 21st century. Century Conference; NKE 27-28.02.2019;

6. Attila Csurgó: *Analysis of the engineering support tasks to be performed for force protection in today's operational environment.* (talk) Military Science and the 21st century. Century Conference, NKE 24-25.02.2021

Scholarship Applications:

1. Attila Csurgó: *Possible directions of HDF engineering support in the 21st century during the force protection, with special regard to countering improvised explosive devices.* Cooperative Doctoral Program (KDP 2020) for doctoral student scholarship; Ministry of Innovation and Technology, 15/09/2020;

Research and Experience Processing Reports:

1. Attila Csurgó: *Border security in contested environment workshop report.* 2020. Centre of Excellence Defense Against Terrorism (COE-DAT) Ankara, Turkey 47th old – online: https://www.coedat.nato.int/COEDAT_LLWSreport_BorderSecurityinContested_Environment.pdf (Retrieved 22/11/2021);

2. Attila Csurgó: *Strengthening the security and resilience of NATO and partner nation critical infrastructure against terrorist attacks*. Lessons Learned Workshop Report 2019. Centre of Excellence Defense Against Terrorism (COE-DAT) Ankara, Turkey 46th – online: https://www.coedat.nato.int/publication/workshop_reports/09-CISR_LL_WS_Report_DD_v02_final.pdf (Retrieved 22/11/2021);

Book chapter:

Mihály Bucsák – Attila Csurgó – Tibor Horváth – László Láng – Sándor Molnár – Lajos Posta – Zsolt Szatai – Mihály Vörös: *70 YEARS IN THE SHADOW OF LIFE THREATENING! The history of Hungarian EOD and mine detection formations, 1945–2015*. Zrínyi publishing house Budapest, 2015. ISBN: 978 963 327 653 2.

11. Autobiography

Colonel Attila Csurgó he was born in Szentes, on February 24, 1967. Married, father of two children.

He started his higher education in 1985 at the Kossuth Lajos Military College, Department of Engineering. He completed his college studies in 1988 and, after his inauguration, He served at the HPF 15. Independent Strategy Brigade – and its successors – in the positions of platoon, company commander, and battalion chief of staff. In 1997, he has been deputy commander and company commander of the NATO SFOR Hungarian Engineer

Contingent for road and bridge construction. He graduated as a military leader from the Zrínyi Miklós National Defence University, Military Science faculty in 2000, after which he held the position of HDF 37th II Rákóczi Ferenc Engineer Brigade, 1st Engineer Battalion Commander. 2002 – In 2003, he was an operations officer and acting chief of engineer operations in NATO's SFOR HQ Staff. After completing the NATO task, he was appointed as chief of operations of the HDF 37th II Rákóczi Ferenc Engineer Brigade. 2005 – 2006, he was assigned to the NATO Advisory Group (Tirana, Albania) as a engineer adviser and, upon his return, as acting chief of staff of the engineer brigade. In 2007, due to the reorganization of the engineer brigade, he was appointed the HDF 37th II Rákóczi Ferenc Engineer Battalion is in charge of the disbanding of the brigade and the formation of the battalion as deputy commander and acting commander.

Since 2008, he has headed the engineer headquarters training department at NATO Land Command (Madrid, Spain), which has been reorganized and he served as chief of engineering in the deployable staff of NATO Joint Force Command until 2012. From this position, he had been temporarily posted to the position of shift leader to the Operation Unified Protector's (Libya) Operations Centre, which managed NATO's operations in Libya. In 2012, the commander of the HDF Joint Forces Commander commissioned to the position of commander of the HDF 1st Honvéd EOD and River fleet Regiment, to which he was appointed on February 1st, 2013. In 2014, he was enrolled in the senior leader's course at NATO Defence College in Rome, which he successfully completed in 2015. In 2017, he had been transferred to the post of Chief of Force Planning at HDF JFC from which he moved to the NATO Centre of Excellence Defence Against Terrorism to the position of Head of Knowledge Department in 2018. From October 1st, 2022, he is the commander of the HDF 37th II Rákóczi Ferenc Engineer Regiment.

In addition to his domestic and foreign formal education, he participated in squadron and battalion commander-level exercises in the United States of America. In 2009, he successfully completed the NATO Combat Readiness Evaluation Course (NATO CREVAL). and in 2010, NATO C-IED Staff Officers' Awareness Course. He has a language exam in English and Spanish.

Since 2017, he has been a doctoral student at the UPS, Faculty of Military Science and Military Officer Training, Doctoral School of Military Science, where he obtained absolutory in 2021. He continued his scientific research on the topic of the thesis in order to deepen his professional experience in many areas of engineering support, during which he published

independently or as a co-author in 7 domestic and 3 foreign journals. In addition to all this, he published his scientific achievements in one book chapter and two edited books. In recognition of his experience in engineering support, he was invited as a guest speaker twice at the Combat Engineer's international conferences and has been invited to give a presentation at the Countering Explosive Threat and Demining conference in the United Kingdom too. The results of his scientific research work were published in the Military Science and the 21st Century, organized by the Doctoral School and the Military Science Society. In the broader academic work for his thesis, he was course director of the Countering Terrorism Networks course at the NATO Centre of Excellence for Defence Against Terrorism and co-director of the Countering Networks of Improvised Explosive Device course at the Centre of Excellence Countering Improvised Explosive Devices in Spain. In his work at the Centre of Excellence for Defence Against Terrorism, he has carried out Lessons Learned studies on the protection of critical infrastructures and the military tasks of border management.

In 2020, within the topic researched in his thesis, he won the "Cooperative Doctoral Program 2020" scholarship application announced by the National Research, Development and Innovation Office and supported by the Ministry of Innovation and Technology.