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Lieutenant Colonel Zsolt Jozsef Szatai:

Detection of conventional and improvised explosive devices, and the possibilities of defense against them in the operational environment

author's review for Doctor of Philosophy (PhD) thesis

Supervisor:

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Lieutenant Colonel Dr. habil Tibor Horvath

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INTRODUCTION

JUSTIFICATION OF TOPIC CHOICE, DEFINITION OF THE RESEARCH PROBLEM

In the past 20 years, left-behind mines alone have claimed more than 130,000 civilian lives worldwide. Clearing areas of explosive devices is a huge challenge for military units and other organizations supporting the task, as the ignition devices of these devices may lose their safety over time, and the areas they occupy may become increasingly inaccessible. Despite the ever-higher level of production and quality control requirements, ammunition manufacturers generally expect a 10% failure probability. According to United Nations reports, this failure rate can reach 30-50% in the case of cluster ammunition. The dangerousness of explosive remnants of war depends on many variables, but it can be said that their detection is crucial in order to make areas safe.

However, the danger caused by explosive devices no longer only affects the tasks of military units serving in the operational area, but far from it, it also affects people's everyday lives, since more than three decades after the breakup of the bipolar world and more than 20 years after 9/11, the reasons for the terrorist acts have not disappeared. In order to implement their goals, various extremist groups increasingly find contact with organized criminal circles, whether driven by economic, social, ethnic or religious extremism.

In the past decade, terrorist attacks in various parts of the world claimed a large number of civilian casualties and caused significant infrastructural damage. The development of the applied methods can be clearly seen by studying the actions carried out in the last decade. This period was characterized by a continuous, interactively developing process of terrorist acts and the responses to them. Even though the previously popular improvised explosive devices have been replaced by other methods in many cases due to increasingly strict government security measures that made their production and use more difficult, their use is still in the first place, since explosive devices are capable of causing many casualties in a short time due to their characteristics. and to cause a loss with great material damage.

Analyzing the military conflicts of the past decades, it can be concluded that one of the biggest challenges for military alliances is the threat posed by conventional and

improvised explosive devices and the response to it. Since 2005, preparation for activities against improvised explosive devices has had a prominent role in the training system of the Hungarian Armed Forces.

The explosive device reconnaissance capability currently appears only in parts of the military organizations of the HDF. The components were set up independently of each other. In some cases, they were created permanently as an element of beard units, but in several cases only as part of a temporary, occasional bond for a specific period and task. Because of all this, domestic and foreign experiences in this direction were only partially incorporated into the preparation system, and no analysis comparing the used tools or procedures has been prepared so far. The novelty of the research lies in the fact that by collecting, analyzing and comparing the data of the previous experience and the technical tools and methods applicable in the field, the HDF obtains completely new information, which can form the basis of the development of an explosive device reconnaissance capability. to transform its training programs as necessary, and can increase the safety of personnel serving in areas contaminated with explosive devices or participating in their detection.

DESCRIPTION OF RESEARCH OBJECTIVES AND HYPOTHESES

Due to the diversity of the specialized field dealing with explosives and explosive devices, as well as the complexity and diversity of the topic, a complete, detailed, all-encompassing examination of the field cannot be carried out in a single study, therefore I limited the collection of knowledge related to the research topic, its processing and analysis to the search for explosive devices related to land operations only. . Accordingly, in my thesis I do not describe the procedures related to the detection of flowing and stagnant water.

Furthermore, taking into account the structure of the HDF and the current and expected task system of military organizations, I will not describe the possibilities of detecting explosive devices related to maritime operations, nor the related detection procedures for conventional and unmanned aerial vehicles used by the Air Force. I also do not discuss the detection of explosive devices containing chemical, biological, radiological and nuclear materials, given that their detection can be interpreted as an independent field of expertise or as an independent research topic.

The researched scientific problems, the goals of my research work, and the formulation of the results of my research were motivated and determined by the following research hypotheses:

1. The effort devoted to the fight against explosive devices in the HDF shows serious progress in the last decade, but at the same time, this development only includes some sub-areas, and the detection of traditional and improvised explosive devices is not emphasized. It can be assumed that by studying the construction and application principles of explosive devices, the range of devices that appear as a prominent source of danger during military operations can be determined.
2. In many cases, the tools and procedures used to detect explosive devices are used differently from military applications. For example, during the insurance tasks of commercial airports or major civil events. Therefore, it is particularly important to examine the possible military application of these methods and procedures. I assume that a significant advance can be achieved in this area by collecting detection opportunities and incorporating the applicable methods and procedures into a unified system. Furthermore, with a comprehensive examination of the procedures, the advantages and disadvantages of their application, and an analysis of their military applicability, it can be ensured that the reconnaissance method best suited to the given military operation is used.
3. . In order to detect explosives and explosive devices more effectively - as a result of changes in the security environment - a number of new technical devices have been developed and implemented in recent years. However, the application of the latest tools and methods did not fulfill the expectations in all cases, so in several cases it was necessary to re-introduce previously used tools and procedures. In addition to the continuous development of technical tools, the application of simpler systems and the appropriate level of combination of procedures proved to be appropriate in several cases. I assume that the effectiveness of detecting explosive devices during military operations can be increased by analyzing the results of efficiency tests and comparative tests carried out in order to establish the real effectiveness of certain devices and procedures.
4. 4. Getting to know the basics of activities against improvised explosive devices and preparing for the basic order of activities is a particularly important area

during training. At the same time, during vocational training, sufficient attention is not always paid to the detection of IEDs. Based on experience, it can be concluded that the importance of reconnaissance usually comes to the fore only after the loss has occurred. I assume that personnel losses can be prevented or reduced with training modernization proposals based on the systematization and comprehensive examination of IED detection possibilities.

5. While studying the literature related to my research topic, I found that the related terminology is not uniform in many cases, and the use of the terms used in international regulations in Hungarian, in many cases due to their mirror translation, is somewhat un-Hungarian, or does not accurately express its real content. I assume that the Hungarian military term and vocabulary can be expanded by clarifying technical terms, their uniform application and conceptual and content definition.

By analyzing the methods and procedures for detecting explosives and explosive devices collected during the research, including them in a system and examining their application possibilities, I aimed to create a study that could later help in the preparation of professional manuals, regulations, notes and aids, and also provide a suitable basis for an explosive devices within the framework of the fight against I believe that the reasons explained above sufficiently support why I chose the detection of traditional and improvised explosive devices as the topic of my dissertation, for which I defined the following main research goals:

- I will examine the sources of danger posed by traditional and improvised explosive devices to the soldiers participating in the operations.
- - Research, collect and systematize the most frequently used explosive devices, as well as the principles, innovative methods and tool system of the constantly changing application of improvised explosive devices.
- - I will examine the structure of various explosive devices and the characteristics of their use, with particular regard to those devices that appear as a major source of danger during military operations.
- Research and systematize the possibilities of detection of explosive devices, as well as present explosive and explosive device detection devices and methods in

a unified system, with particular attention to their advantages, disadvantages and military application possibilities.

- - I will examine the application possibilities of the explosives detection dogs and shallow mine detection instruments organized in HDF, and I will also analyze their real applicability with an efficiency and comparative study. Based on my results, I will make a proposal for possible development or synchronization of the tools and methods used.

DESCRIPTION OF RESEARCH METHODS

The detection of traditional military explosive devices and improvised explosive devices is currently a little researched area, only a few domestic literature deals with the topic. It can be stated that the field has not yet been explored, and as a result, extensive research opportunities are available. During my scientific research work and the development of the topic, I used both general and special (partial) research methods. Among the general methods, I also used the historical and comparative methods to determine the system of military, industrial and home-made explosives and explosive devices and their development process. When developing the research methods, in order to accurately understand and apply the meaning of the terms, I considered István GŐCZE's publication: Methods of scientific research as a benchmark.

Among the special (partial) research methods, I used the empirical (experiential) research method when performing a comparative study for the applicability of explosives and explosive device detection devices and service dogs. I used several types of the theoretical-logical research method. I separated the collected technical literature according to the topicality of the topic using an analytical method, and after systematization, I processed it by synthesizing. During the processing of the literature, I used the methods of induction and deduction, mainly in the investigations of the use of improvised explosive devices and in the methods and procedures promoting the effective use of the devices.

In the investigation of technologies suitable for the detection of explosive devices, and in the research of new devices, I supplemented the previously mentioned methods with analysis. In order to achieve my research goals, I studied the relevant domestic and foreign literature, various journal articles, and reports on explosive and terror-type

explosions, and I also conducted a targeted search on the Internet to find non-classified documents and publications related to the topic.

I consulted with specialists from domestic and foreign organizations, as well as fellow soldiers with personal experience in the detection of explosive devices used in operational areas, employees of other law enforcement agencies, and scientific researchers already familiar with the subject, with whom I compared and clarified the partial results of my research.

With my participation in domestic and foreign conferences, symposia and lectures, I also broadened my knowledge regarding the detection of explosive devices. I published partial results of my research in various professional publications for the purpose of introducing them to the professional community, and presented them in the form of presentations at local conferences.

CHAPTER 1
BASIC KNOWLADGES OF EXLOSIVES AND EXPLOSIVED ORDNANCES

During the preparation of the chapter, I collect the most characteristic properties of explosives and explosive devices and try to explain the characteristics of explosions and explosives to the reader who is less experienced in the field, and by analyzing the explosive devices, I present the types of explosive devices that, after analyzing the experiences, are the most dangerous in the operational area the safety of serving soldiers.

My hypothesis regarding the basic principles related to explosives and explosive devices is as follows:

1. Hypothesis: By studying the structure and application principles of explosive devices, the range of devices that appear as a major danger source during military operations can be determined.

PARTIAL CONCLUSIONS

In the chapter, I organized and presented explosives and explosive devices, based on the criteria most closely related to my research topic. In order to provide a uniform interpretation of the terms used in the thesis, I precisely defined the related concepts, explained and interpreted the terminological terms of the field, and also explained and solved the relevant abbreviations. I briefly covered the characteristics of the explosives found in explosive devices and generally explained their properties and the basic principles of their application and use in explosive devices. With a more detailed presentation of mines and improvised explosive devices, I illustrated the most dangerous explosive devices for military ties and the success of operations.

In order to illustrate the danger of the devices, I explained the effects of explosions and explosive devices on the human body. The knowledge I gained during the collection and analysis of the materials necessary to write this part further confirmed in me the paramount importance of the detection of explosive devices.

While developing the research topic, I found that the applied Hungarian terminology does not completely or does not cover the terms related to the field. For the sake of uniform interpretation, I believe that some terms need to be revised and elaborated. therefore, without claiming to be complete, I made a proposal

However, given that the scope of the thesis is limited, the definition of the entire conceptual scope of the field goes beyond the scope of this thesis. Therefore, it is recommended to develop it in the context of an analysis in the context of a comprehensive approach later on.

CHAPTER 2
HISTORY OF THE EXPLOSIVE DETECTION

The history of the detection of explosive devices is practically the same as the history of the use of explosive devices, since the possibility of defense against them was formulated as a legitimate security demand on the part of the people. And reconnaissance proved to be the best form of active defense.

In the chapter, I collected the main stages of the military application of explosive devices from 700 to the present day, although the biggest change and development affecting the field undoubtedly occurred in the 20th century. It is related to the history of the 20th century, since in its stormy decades the number of explosive devices used reached unprecedented levels. The rapid development of the use of war materials and combat methods also brought with it the development of their reconnaissance. More and more new procedures and methods appeared, but in many cases a mixed application of older and new procedures took place.

PARTIAL CONCLUSIONS

After studying the specialized history described in the chapter, it can be concluded that the detection of explosive devices, after their mass appearance, was a task of great importance.

CHAPTER 3
BASIC PRINCIPLES OF DETECTION OF EXPLOSIVE STRUCTURES, TOOLS AND METHODS FOR DETECTION

While studying the methods used to detect explosive devices, I came across a variety of opinions on the subject. They were different, of opposite value, but I often came across opinions that underestimated or even overestimated the given tool or procedure. Knowing all this, I consider it important to publish the knowledge collected and systematized during my research, as well as the research results, in the form of an objective, factual description. While searching for and analyzing the tools and methods that can be used for the detection of explosive devices, I deliberately did not prioritize the application under actual conditions - since the conditions are usually different - but I examined and organized their general military application possibilities based on the aspects that best fit my research.

The possible methods of detecting explosive devices can be defined in an extremely broad vertical. The method used depends on the nature of the task, the geographical and climatic conditions, as well as the available tools and the level of preparation of the personnel. Taking all of this into account, the tools used and the detection methods and procedures closely related to them can be grouped based on various aspects.

While studying detection methods, I found that the detection of explosive devices is always based on the detection of either the entire explosive device, or one of its components, or the explosive material that evaporates from it. Consequently, the tool and procedure used for detection is basically determined by which component of the tool the research is aimed at.

PARTIAL CONCLUSIONS

In this chapter, I collected the basic principles of detecting explosives and explosive devices and the applicable technical tools and methods. While studying the data, I found that the procedures can be grouped in several ways, so I tried to include them in a unified system in the most comprehensive way and then explained them based on the criteria I set up.

I examined the applicability of various methods and procedures during military operations and analyzed their advantages and disadvantages. I found that the detection of explosive devices is determined by several parameters, which can influence or even hinder the applicability of certain methods in a given situation.

One such parameter is the sensitivity of the given device. Because if the device is too sensitive and often gives a signal in the event of a very low amount of explosive residue, then trust in the device is lost, and such devices are completely useless in military operations, since large amounts of explosives are regularly stored and handled on the battlefield and on military bases, thus, the presence of material residues is continuous. Based on all of this, I believe that explosive material or explosive device detection technologies that are not fully accepted by the personnel of the employing organizations and do not trust their effectiveness cannot be used with complete safety.

The specific environmental parameters can be a factor influencing further detection. Vegetation, soil factors, temperature, precipitation and wind also affect the applicability of a given method or tool, but even atmospheric pressure can affect individual tools.

The next such factor is the parameters related to the society, i.e. the characteristics characteristic of the society, the nature of the society in which the given tool must be used, as this often limits the technologies that can be used in a given situation. For example, some technologies are more accepted in Israel, where attacks with explosive devices are common and therefore a higher tolerance level has developed among the population and some more invasive detection technologies are also considered more acceptable, as in Budapest, for example. In other words, in other words, those devices which, if applied too widely, may violate constitutional or other legal rights, or their use involves serious restrictions, or whose use can have a measurable harmful effect on health and/or the environment, neither conventional nor improvised explosive devices can be used either. for detection. However, I believe that a detailed examination of this area is beyond the scope of this thesis.

After processing the procedures and methods described in the chapter, I believe that the detection of explosive devices should not be examined as an independent field, but should be done in the complete relationship system of defense against explosive devices. Protection against explosive devices is a key area during military operations, as

the security of military units participating in operations can be significantly increased by the effective application of activities related to the field. In my opinion, the options for defense against explosive devices can basically be divided into two categories, which can be passive and active defense options. By the term passive protection, I mean the set of activities and forms of behavior that can be used to reduce the primary, secondary and tertiary harmful effects of the explosion described in Chapter 1 after the operation of the explosive devices. Such passive protection options are different levels of fortifications that provide individual or collective protection of personnel and technical equipment, or protective clothing and armor that provide self-defense for personnel and technical equipment. Furthermore, passive defense options include those procedures that can be used to prevent or reduce the loss of military ties. This includes the procedures that I described at the beginning of this chapter: behavior in a mine-hazardous area, activities against improvised explosive devices and measures to increase safety.

In my opinion, the detection methods described in this chapter are the most decisive element of active protection against explosive devices. After all, by using the appropriate tool and method, the intended use of explosive devices, i.e. their explosion, can be prevented. Thereby increasing the safety of those serving in military operations.

CHAPTER 4
COMPARATIVE AND EFFECTIVENESS STUDY OF THE SHALLOW DEPTH MINE SEARCH INSTRUMENTS AND EXPLOSIVE DETECTING DOGS REGISTERED IN THE HUNGARIAN DEFENCE FORCES

My first research idea was to make a comparative study and analysis based on detection efficiency with the involvement of different explosive detection devices and dogs, but this could not be carried out due to reasons beyond my control. While I was working out the tasks necessary to carry out the tests, I found that there had never been an independent test of the effectiveness of explosive detection dogs. I believe that such a capability test is more than timely, since 15 years have passed since the capability was established. Knowing all of this, as part of the research related to my doctoral dissertation, I set out to conduct an investigation based on detection efficiency, as a result of which the real effectiveness of explosive detection dogs can be established. After the evaluation of the test results, it is expected that the real possibility of using dogs in anti-explosive devices activities in the operational environment can be formulated as a new scientific result, with particular regard to their independent or combined application procedures. While studying the performance evaluation system adopted for the qualification of dogs, I found that it does not include the search for explosive devices placed below ground level. Previously, during my years in various positions in the field, we carried out field research tasks on a practice basis, where we placed the odor sample explosives below ground level. At that time, the results of the exercises showed a rather mixed picture, and the exercises were not carried out based on uniform criteria. That's how I got the idea for a further investigation. According to which, based on uniform measurement criteria, in a controlled environment, while searching for explosive devices placed below ground level, I will compare the effectiveness of the shallow mine detection instruments and the explosive detection dogs organized in MH. During the planning of the comparative and efficiency studies, based on my decades of professional experience and in accordance with the battlefield reports I read, I developed tasks that are most likely to occur during the execution of military operations. Consequently, after evaluating the results of the tests, the MH will have useful information about the effectiveness of the devices and the use of

the dogs. In order to provide an objective evaluation, I performed all planned tests with the largest possible number of measurements using all possible tools.

PARTIAL CONCLUSIONS

In the chapter, I presented the tasks planned for the purpose of testing the effectiveness of explosives detection dogs, as well as the comparative testing of dogs and shallow mine detection instruments, and the order of their execution. I explained the results of the measurements, analyzed and summarized them. I evaluated the aggregated results and drew conclusions, as well as formulated suggestions, and also represented them on graphs for better illustration.

The combined 90% result of the examination of the effectiveness of explosive detection dogs according to various aspects confirmed in me the opinion from my many years of professional experience and other studies, that despite the specific circumstances of the use of dogs, they are considered one of the most effective methods for detecting explosives.

I believe that the comparative study of dogs and shallow mine detection instruments is completely new, since during the tests I compared "devices" with different operating principles. Based on all of this, the tests provide new results for the military units that use them.

The tests were carried out in summer, in dry heat, and in such conditions, with a few exceptions, chemically derived odors (see explosives) usually spread intensively upwards. Therefore, I believe that it would be worthwhile to repeat the tests in other weather conditions in the future.

Standard explosives and military explosive devices filled with them were used for the tests, however, as I have already pointed out, in addition to explosive devices hidden below ground level, IEDs pose the greatest threat to military units. Knowing this, I believe that search dogs should not only be taught knowledge of standard explosives, but also HME, which is the main charge of the IED. However, this is by no means an easy task. Taking into account their properties, HME samples cannot be handled in the same way as traditional explosive odor samples - so they cannot be used in their original state during dog training - as their use would involve too much safety risk. At first, it may seem like an obvious solution to teach the dogs the components of HME during training, but this

would not ensure the desired result, because the dogs are not able to produce a complex odor image from the precursors, since the dog learns an odor complex during the learning process. These basic principles have been proven by numerous experiments. In my opinion, the solution to this problem is the use of substitute materials that have the same smell but do not contain real explosives. Such materials are commercially available and their effectiveness during dog training has already been proven by numerous tests. In my opinion, the domestic application of these materials is an area that has not been researched at all, so in the future it may be advisable to broaden dog training and related research in this direction.

Furthermore, in my opinion, it may be necessary to include field research tasks in the EDD training program and in the performance test system, thus and with regular exercises in this direction, the effectiveness of searching for explosive devices placed below ground level can be increased. After all, in the case of trained mine detection dogs, practical experience proves that under favorable weather and soil moisture conditions, they are able to accurately indicate the position of almost 95% of mines placed below ground level. Based on all this, I developed a professional training program in order to increase the field research efficiency of dogs.

SUMMARY

In the first chapter of the thesis, I explain the concepts used in the thesis for the sake of uniform interpretation, and I organized explosives and explosive devices based on the aspects that best fit my research topic. I presented the main characteristics of the explosive devices most related to the topic of the research and the specifics of their application, and examined the explosive devices that most threaten the security of military formations.

In the second chapter, I review the development of explosives and explosive devices, as well as the history of their detection from 700 to the present day. While processing the literature related to the development, I found that the demand for the detectability of explosive devices goes back to the same time as the use of explosive devices. In other words, during the military actions of the past centuries, the detection of explosive devices has always been an important area.

In the third chapter, I explained the basic principles of the detection of explosive devices. I presented the tools and methods that can be used to detect explosive devices, as well as their main characteristics based on the system of criteria that I set up. While writing the chapter, I established that the most important basic requirement of explosive device and explosive detection methods used in military practice is real-time, that is, the presence of explosives must be able to be detected at the moment of the investigation. Therefore, not all processes meet the military application requirements. Although there are procedures that can be used with very high reliability in a laboratory environment, they do not meet the requirements of military application. In the chapter, I defined the parameters that influence or prevent the use of certain procedures and devices, and I also defined the advantages and disadvantages associated with their use, as well as the possible military applicability.

In the fourth chapter, I described my tests carried out in order to compare the shallow mine detection devices and explosives detection dogs organized in the HDF, and I also described my research results carried out in order to establish the effectiveness of the dogs. Analyzing the results of the comparative tests, I found that it may be necessary to include field research tasks in the EDD training program.

NOVEL SCIENTIFIC FINDINGS

1. I examined the sources of danger posed by traditional and improvised explosive devices to the soldiers participating in the operations. I researched, collected and organized the most frequently used explosive devices. I examined the structure of various explosive devices and the characteristics of their application. I defined the group of devices that appear as a priority source of danger during military operations.
2. I researched, systematized and identified the possibilities of detection of explosive devices by exploring the connections. I conducted a comparative analysis and, according to the system of criteria I set up, included the explosives and explosive device detection tools and methods in a unified framework. Based on my analyzes and conclusions, I pointed out their advantages and disadvantages, based on which I determined the military application possibilities of the methods and tools.
3. I was the first in the Hungarian Armed Forces to develop and design the methods of testing the real effectiveness of explosive detection dogs. Based on my tests, I verified and proved the dogs' high level of reliability during detection tasks. Within the framework of a comparative study, I analyzed the effectiveness of the explosive detection dogs and shallow mine detection instruments organized in the MH during the search for explosive devices placed below ground level. Based on my analyzes and conclusions, I pointed out the possible development or synchronization possibilities of the tools and methods used, and made a proposal to change the related training topics.
4. I collected, analyzed and evaluated the principles, innovative methods and tool system of the constantly changing use of improvised explosive devices. Examining the IED detection possibilities, I proved the methods that are best used in military operations.
5. I examined the Hungarian military terminology related to the field of research and determined the range of terms belonging to the field that, in my opinion, need to be elaborated or revised. I made a proposal to clarify some terms and to introduce new terms and expressions.

RECOMMENDATIONS AND APPLICATION OPPORTUNITIES OF RESEARCH FINDINGS

My recommendations regarding the theoretical and practical usability of my dissertation:

1. By analyzing and systematizing the methods and procedures for detecting explosives and explosive devices collected during the research, and examining their military application possibilities, a study was completed that could later help in the preparation of professional manuals, regulations, notes and aids.
2. The thesis provides a suitable basis for preparing for the tasks of combating explosive devices, and also provides a basis for the preparation of some parts of a commander's manual on the same topic.
3. The results of the efficiency tests carried out contribute to the strengthening of confidence in explosive detection dogs, and the results of the comparative test facilitate specialist decision-making regarding the detection method best suited to the given circumstances, thereby speeding up the process of commander's decision-making. The experience of the investigations pointed to the necessity of changing the existing systems, thereby implementing new training methods and training materials in the field of training soldiers performing detection of explosive devices.
4. The thesis systematically presents one of the most important methods of protection against explosive devices, the possibilities of detecting the devices, thereby promoting user decision-making related to the field, thus increasing the security of bonds serving in military operations.
5. By pointing out the terminological deficiencies, it contributes to the expansion of the Hungarian military vocabulary, as well as to the translation of terms according to the applied NATO terminology into the Hungarian language, thus the correct and uniform use of terms can increase the accurate use of terms relating to the field of expertise and reduce professional misunderstandings.

SUGGEST FOR FURTHER RESEARCH DIRECTIONS

After processing the specialist materials related to my research and the experiences of the research, I formulated the following possible research directions:

1. The test of the effectiveness of explosive detection dogs was carried out in relatively optimal weather conditions, in moderately warm temperature conditions. Therefore, I think it is advisable to carry out the tests in bad weather conditions, in cold weather as well, and if possible in other climatic conditions.
2. As a new area of research, it is recommended to carry out a comparative study of explosive detection dogs and explosive detection detectors, in order to verify the same operating principle, i.e. the detection of particles absorbed by air through the evaporation of the explosive, a technical device and a biological detection method applicability indicators.
3. Repeated performance of efficiency tests, in addition to the use of standard explosives and explosive devices, using HME and IED.
4. Carrying out a comparative analysis of conventional and improvised explosive devices containing CBRN charges. Examination of their detectability and examination of the possible military applicability of the methods and procedures.
5. Carrying out detectability effectiveness tests by hiding real traditional and home-made explosives, using an explosives detection dog that did not encounter any sharp material during its training, but only pseudo-odorous material was used during its preparation.
6. Examination of the detectability of explosive devices not only in connection with land operations, but also in the case of water and air sources of danger posing a threat to military ties.

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AURHOR'S PROFFESIONAL BIOGRAPHY

Lieutenant-Colonel József Zsolt Szatai was born on June 3, 1976 in Debrecen and grew up there in the Hajdú-Bihar county, in the village of Földes. He is married and lives in Dunakeszin with his wife and daughter.

The military profession piqued his interest at a very young age, as he enjoyed participating in the work of the national defense specialist group organized in elementary school. He further strengthened his commitment to this when he was admitted to the Technical and Technical Honvéd Vocational High School in Orosháza, where he successfully graduated in 1994 and received his first service assignment at the 31st János Hunyadi Mechanized Infantry Brigade in Rétság, with the rank of sergeant. During the time he spent here, he further developed the knowledge of explosions he had learned in high school and obtained a qualification as engineer NCO.

After one year of service, he was successfully admitted to the technical and civil engineering course at the Lajos Kossuth Military College, where he was promoted to lieutenant in 1999 after passing the state exam. His first officer assignment called him to Várpalota, where he got to know the duties of a EO clerence on the firing range and training ground, as a result of which, at his own request, he was transferred to Budapest to the MH 1st Honvéd EOD and Minesweeper Battalion, to the position of platoon commander. During the 16 years he spent with the military organization, he was fire engineer platoon commander and company commander, then he served in the headquarters of the corps as scout chief, operations chief, training chief, led the dog training chief and was also the chief of staff of the regiment for a year. During this period, he is also credited with the creation of the special arsonist ability and the independent explosives detection dog training. For the latter, he was awarded the silver grade of the service merit badge. He participated hundreds of times in the execution of public service EOD tasks as a 2nd class of EOD officer.

He has continuously developed his professional knowledge, so he has qualifications as an EOD and as a dog handler for explosives detection. He has completed several professional courses in counter-Improvised Explosive Devices (C-IED) at home and on abroad, and also holds a senior pyrotechnic qualification.He started his studies at the Military Doctoral School in 2017.

He is a member of the technical division of the Hungarian Military Science Society. As a result of his scientific work, 14 items can be found in the Library of Hungarian Scientific Works.

He has advanced English and intermediate Russian language skills.