

**AUTHOR'S PRESENTATION  
OF DOCTORAL (PhD) DISSERTATION**

**UNIVERSITY OF PUBLIC SERVICE  
FACULTY OF MILITARY SCIENCES AND OFFICER TRAINING  
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**Research and development of the technical equipment system for  
industrial safety in disaster management**

**Supervisor:**

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## **THE FORMULATION OF THE SCIENTIFIC PROBLEM**

His scientific research is mainly aimed at defining the technical and applicability requirements for future industrial safety technical device systems, and at developing specific technical solutions. The effective performance of industrial safety tasks requires the procedure for acceptance for service, followed by utilization and application of the tools and systems required to perform industrial safety emergency management, intervention, operations management, remediation and recovery tasks.

Defence and law enforcement organizations, organizations involved in disaster management, as well as economic entities carrying out hazardous activities or operating critical infrastructure have, of course, been using customized technical remediation tools, multifunctional intervention vehicles, installed or mobile deployment management device systems for decades.

Although the tasks show a lot of similarities in each governmental organization, the specialties have chosen different solutions, procedures and methods for implementation due to their different primary professional tasks. However, these systems must be inter-operable. That is why he considers that it is extremely important that the development of emergency management, response and damage control and deployment management systems in the various organizations be well coordinated as much as possible.

The coordinated development of tools and systems described above can guarantee the smooth cooperation of all disaster management, defence and law enforcement agencies and economic entities involved in the same emergency management operation, up to the specified procedural and technical levels. At the same time, the organizations identified above also have unique technical capabilities corresponding to the specificities of the field they represent, ensuring, inter alia, the ability to lead and manage specific operations and operations in the field of industrial safety independently.

In his opinion, the main actuality of the research topic is that due to major industrial and environmental disasters, pandemic crises, intensive technological development and the emphasis on critical infrastructure protection, the development of tools for civilian emergency preparedness has been again on the agenda. The elimination of technical capability gaps and the planning and implementation of development programs have also started in the related safety fields.

It can be stated, therefore, that the development of the industrial safety specialties related to disaster management and the related system of technical equipment is becoming more and more important, and the exploration of development opportunities has become a priority issue today.

### **RESEARCH HYPOTHESES**

1. He assumed that in the event of major disasters or major accidents, the suitability of the current system of industrial safety's technical equipment for command and control, decision support, comprehensive cover and public protection can be assessed in the framework of an impact study, experience can be determined, and development suggestions can be elaborated.
2. In his opinion, in the event of disaster, especially in case of incidents related to industrial safety, the use of event-specific technical means of intervention and damage control is justified; which, in his opinion, can be provided by deployment of a multifunctional vehicle and superstructure system with varied capabilities, among other things.
3. He presumed that the deployment and development of field supporting systems that meet the requirements of modern military camps for emergency management, decision support and comprehensive purposes - which are already used occasionally in disaster protection abroad – are objectively justified.
4. He assumed that the analysis and evaluation of international and domestic good professional practices can provide an appropriate basis for determining the technical requirements of mobile deployment management systems for disaster management in accordance with domestic needs and circumstances.

### **RESEARCH OBJECTIVES**

1. To develop aspects that facilitate the comparative analysis of the technical equipment systems used for the management of industrial safety events and support the adaptation; then, building on this, identify capacity gaps and make suggestions for directions for technical development.
2. To identify the possibilities of utilization of multifunctional vehicle-and superstructure systems for disaster prevention, and, in particular, industrial safety, and to propose directions for their capacity development.

3. To analyse and evaluate the international aspects of the application of field supporting systems for disaster management, the main requirements for their design and the experience of their application. To create opportunities for the development of mobile operations management and command-and-control posts and field decontamination systems.
4. To systematize the development, applicability and conceptual system of command-and-control systems for military and law enforcement (crisis management) purposes in international and domestic relations, and to make a proposal for their technical requirements based on these.

## **RESEARCH METHODS**

In accordance with the research tasks set out in his four-year research plan, he used the following research methods:

1. In accordance with his research objectives, he used the general research methods, which are analysis, synthesis, induction and deduction.
2. In order to establish his research work, he processed the international, European Union and domestic legislative and internal disaster management regulations with due care, and striving for the need for completeness - to the extent appropriate to the research problems. He also paid special attention to the critical examination of foreign and Hungarian literature.
3. He used analytical-logical methods, when the evaluation of the current damage control procedure and methodology formed an integral part, as well as the formulation of proposals based on the conclusions drawn from it.
4. The application of empirical research methods, which is primarily based on his professional experience in the field corresponding to the researched scientific problem.
5. Study of foreign technical solutions and good industrial practices, comparative analysis with domestic technical solutions.
6. Participation in international and domestic professional exhibitions and conferences, where he also collected the data necessary for the preparation of the dissertation.
7. Consultation with recognized foreign and domestic disaster management and operator experts on the research topic.

## **BRIEF DESCRIPTION OF THE STUDY CARRIED OUT BY CHAPTERS**

In the **first chapter**, in the framework of a summary and systematic study, he carried out theoretical foundations related to the system of technical devices used in the field of industrial safety. His scientific systematization and analytic work included processing the historical background of the application of the technical equipment system for the prevention and management of “industrial safety events”, the relevant legislative and internal disaster management regulatory environment, the main characteristics and classification of the applied technical equipment systems and identifying deficiencies and possible technical development opportunities.

In the **second chapter** of the dissertation, he examined in detail the cases, purpose and advantages of the applications of multi-purpose and multifunctional vehicles used in disaster management tasks. He also presented the steps of the development of a base vehicle family made for national defence purposes and the development opportunities inherent in them. He made an overview of the multi-purpose and multifunctional device systems used in disaster management, and based on this, he developed a proposal for the further development of the existing interchangeable superstructure systems and multifunctional special capabilities for industrial safety purposes in Hungary.

In the **third chapter** of the dissertation, his aim was to examine the application and international and domestic experiences of field supporting systems. As part of this, he examined the defence, asylum procedure and disaster management aspects of the design of field supporting systems. He also performed an analysis and evaluation of the means and procedures of decontamination of field supporting systems for disaster management, following the remediation of dangerous substances related to industrial damage. Finally, he made a proposal for the development of the decontamination capability, the key element of which is the elaboration of the technical and procedural requirements for the establishment of mass decontamination capability in disaster management organizations.

In the **fourth chapter** of the dissertation, he analysed the role and main capabilities of mobile command-and-control systems in the framework of disaster management activities as an important element of the research.

He also carried out an examination of the typical disaster management design of mobile command and operation control devices for disaster management, as part of which he examined the capabilities and possible modular units delivered as supplies on the one hand, and the possible technical design of a containerized solution unattached to a moving vehicle chassis.

Based on his research, he developed a proposal for the technical requirements for deployment management capabilities.

## **SUMMARIZED CONCLUSIONS**

### **I. Analysis of the applicability of the technical system of industrial safety technology**

1. The history of technical and organizational development in the field of protection against industrial emergency events have been influenced primarily by the defence and civil protection history of NBC defence activities, which stem from the Cold War period and the fulfilment of post-regime alliance obligations.

2. The professional activity "Protection of industrial safety events" means, in a narrow sense, the performance of dangerous substances remediation tasks related to the control of adverse effects incidents involving dangerous substances originating from a threat to civilization. A special variant of events occurring in the presence of a dangerous substance is the prevention of events occurring in the presence of nuclear or radioactive material, in connection with which nuclear accident prevention appears as a separate field of expertise.

3. Based on the analysis of the legislative and internal disaster management regulatory environment related to the application of the system of technical and technical tools necessary for the prevention and management of industrial safety events, he came to the following conclusion:

a) The quantitative and qualitative requirements for response forces and equipment shall be reflected in the protection plans in proportion to the vulnerability.

b) It is also necessary to ensure that special tasks are performed according to the specific characteristics of the events. The multifunctional and interchangeable design of the remediation devices may be a possible solution for adapting to individual circumstances. Due to the rapid course of industrial safety events, detection, remediation and decontamination tools need to be used on standby and in a quick-install manner.

c) During the response and recovery of major industrial and natural disasters, it is necessary to ensure the accommodation of participating forces and equipment in field conditions.

4. Based on the applicability study of the industrial safety remediation tool system, he concluded that - in addition to the NBC protective detection, reconnaissance and monitoring tool system - it is necessary to develop multifunctional vehicle and superstructure systems supporting, among other things, event-specific use for industrial safety purposes. In addition, camp systems that can be used for emergency management, decision support, and comprehensive support tasks, as well as command-and-control systems for military and law enforcement (crisis management), and field decontamination systems.

## **II. In the field of the development of a multifunctional vehicle and superstructure system for disaster management**

1. The heavy-duty base vehicles, used in most technical and technological developments for disaster management, are mainly the results of defence-related developments in the past. In general, disaster management agencies and hazardous plants, usually do not have special vehicles to deal with special, relatively rare but catastrophic events, with the exception of heavy-duty tracked vehicles (e. g. PTSZ, Big Wind) and KOMONDORs.

Due to the cost-demand of technical developments, it is recommended to prioritize the development of multifunctional and interchangeable superstructure disaster management solutions.

2. As a general practice, foreign disaster management bodies shall give priority to the use of swap bodies with hook lifts. The practice of developing heavy-field firefighting and technical rescue capabilities, which allows special industrial safety tasks to be performed, was also a useful experience.

3. The development of multifunctional vehicles in the Hungarian defence industry - also based on developments for national defence purposes - resulted in the unification of the equipment system, mainly with the use of hook lift superstructures and the development of vehicles for special industrial safety tasks.

4. With the further development of the KOMONDOR family of light armoured base vehicles developed and manufactured by Gamma Technical Corporation, for defence purposes, multi-purpose, multifunctional and interchangeable superstructure systems can be developed. In addition to heavy-duty multi-purpose vehicles already regularized and utilized by the disaster management, it is possible to propose the development of additional interchangeable superstructures for special purposes, such as heavy-field water transporter, disinfection, technical intervention for operation in case of major road accidents firefighting, other logistic tasks, personnel or casualties carrier or deployment as mission command post.

5. A universal, closed superstructure establishes a base for all capabilities, where the protection of lives and creation of proper working condition and accommodation is required not just for the personnel of six in the vehicle, but more human lives. A multi-purpose heavy-duty trailer is also suitable for off-road use with a multi-purpose vehicle. The developed equipment can be used for disaster management tasks, among others, in the system of the Hungarian Defence Forces and law enforcement organizations.

### **III. In the field of R&D related to the application of field supporting systems in disaster management applications**

1. In the event of a disaster at international level or in case of a humanitarian emergency, international and regional disaster relief organizations shall cooperate with each other and with the coordination bodies of the EU Member States involved in the protective activities. The provision of camp accommodation and logistics of organizations involved in humanitarian aid and disaster relief is one of the basic conditions for the long-term and effective operation of the units.

2. With regards to the system components to be established in the military/ defence and disaster management camps, we find similar accommodation and service elements and functions in terms of specific design. However, differences in the performance of special disaster management tasks can also be identified.

3. At present, there is no clear and standardized position on the definition of scaling units, but the numbers of intervention units and civilian protection organizations are known.

4. The selection criteria applied for the technical equipment system to be utilized in camp systems can be chosen and used depending on the design of the camp services and accommodation elements. Determining capacity and technical levels can be important to consider in the process of selecting technical equipment. In addition, however, efforts should be made to ensure that the tools used by defence and law enforcement agencies are as uniformized as possible, so that those may supplement each other's capability needs and capacity gaps if necessary.

5. Field supporting capabilities may be provided through the involvement of external service providers, for example by imposing fixed industrial capacity or setting up economic and material service obligations for civilian protection. The establishment of emergency stocks in disaster management organizations must also be implemented in order to ensure full and safe availability of supplies. The capabilities of the disaster management camp are provided for the self-sufficiency

of its own organizations that can also be used for international assistance, as well as for the prevention of rapid events. The current field camp capabilities of the Hungarian national disaster management system are not sufficient for the protracted disasters with significant recovery activity, also reaching up to the emergency level, which currently missing capability must be ensured by setting up at least sample systems. Here, in accordance to the Disaster Management Plan of the Hungarian Defence Forces, national defence systems and capabilities can be used within the framework of the national defence disaster management system.

6. The forces of the Ministry of Defence/ Hungarian Defence Forces and Ministry of Interior National Directorate General for Disaster Management play a complementary role in the response to an NBC-related disaster. The solutions for the special decontamination tasks are available for personnel, casualties, vehicle, road (terrain) and sensitive devices decontamination. The equipment used by the law enforcement agencies is up-to-date and compatible with each other, however it would be necessary to increase the quantitative capacity primarily. In the event of an incident involving dangerous substance damage, immediate mass decontamination capabilities should be established within the disaster management organizations.

He determined the technical and procedural requirements based on the decades-long domestic practice and experience.

#### **IV. Development of operations management and command-and-control systems for disaster management**

1. Operations control or deployment control units shall carry out their activities through permanent or mobile command centres. During the period of industrial safety events, the coordination of the activities of the primary intervening units and those cooperating organizations involved in the defence, which are located close to the scene of the incident, is of paramount importance.

A mobile command centre has a significant role to play in the management of demand involving a large number of personnel and a significant volume of technical equipment.

2. Almost any computer workstation with access to the Shield Mini or other disaster management network may be suitable for operation under the mobile command centre for disaster management purposes. Special purpose industrial safety vehicles can also be deployed. The disaster response telecommunication centre, a mobile communications centre can also serve as a basis for such capabilities.

3. In addition to the temporary mobile command centre capabilities, protracted defence and restoration works after significant damages require the development of a mobile command centre capability suitable for this task, for which he made a specific technical proposal in the appendix of the dissertation.

### **NEW SCIENTIFIC FINDINGS**

1. Building on the regulatory, conceptual, procedural and technical capability studies related to the applicability of the technical tool system for industrial safety in disaster management

a) he identified the grouping aspects of the industrial safety technical equipment system, after which

b) he identified the capacity gaps and the specific development opportunities for each asset group.

2. After a comprehensive analysis of the foreign practical experience of application of multi-purpose, multifunctional systems and vehicles with interchangeable superstructures in disaster protection, as well as the development results of the multifunctional equipment system for defence and disaster management purposes in the Hungarian defence industry, he determined

(a) the technical criteria for the development of a family of emergency vehicles based on a multifunctional and replacement base vehicle; and

(b) the universal capability development possibilities of the double-cab and multi-purpose swap bodywork for emergency, operational, industrial safety and fire safety purposes.

3. After examining the international, European Union and regional military cooperation regulators of the establishment and use of camp support systems, the experience of their use in defence, humanitarian aid, asylum and disaster management, he developed the technical and procedural requirements for establishing mass field decontamination capability in disaster management organizations. On the basis of an extensive foreign and domestic survey of command-and-control systems for military and law enforcement crisis management, he elaborated technical requirements for the application of criteria related to the technical design of mobile command-and-control points for disaster management, which facilitate their practical application.

## **RECOMMENDATIONS**

1. He propose to use the study on the technical equipment system of industrial safety to work out the development possibilities of the equipment system for disaster management.
2. The results of his research on multi-purpose, multifunctional and replacement vehicle systems are excellent for the development of technical requirements for relevant state and operator entities involved in dangerous substance remediation.
3. The experience gained during his analytical and evaluation work on disaster management camp systems can be widely applied in international disaster and humanitarian assistance, in the planning and implementation of domestic disaster management operations, and in the specialized technical support activities of economic organizations.
4. The new knowledge of mobile disaster management command centres and field deployed dangerous substance decontamination systems can be used in an appropriate way in the procedures and technical capacity building of both national and disaster management organizations.

## **THE PRACTICAL APPLICABILITY OF RESEARCH RESULTS**

1. The analyses and evaluations prepared for his dissertation on disaster management, including industrial safety legislation and dangerous substances damage control can be used to improve the implementation of state, municipal and operator professional tasks, as well as to provide a scientific basis for further professional and technical research.
2. The results of his research on the technical equipment system for disaster management and industrial safety can be used for the preparation of technical specifications, procedure for acceptance for service, implementation and system setup plans necessary for the creation of specific technical capabilities, and for the development of application possibilities.
3. His dissertation can be used as an educational aid in the disaster management and technical training of higher education institutions, in the vocational training provided by law enforcement and disaster management training institutions, as well as in the training of economic entities.

## LIST OF PUBLICATIONS PREPARED BY THE DOCTORAL CANDIDATE

### ARTICLES REVIEWED AND SELECTED FROM PROFESSIONAL PERIODICALS (ONLINE AS WELL)

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- [1] Petrányi, János; Kátai-Urbán, Lajos; Zsitnyányi, Attila: Investigation of the architecture of early warning radiation monitoring systems. POZHARY I CHREZVYCHAJNYE SITUACII: PREDOTVRASHENIE LIKVIDACIA 2020: 4 pp. 66-72. (2020)
- [2] Cimer, Zsolt; Vass, Gyula; Zsitnyányi, Attila; Kátai-Urbán, Lajos: Application of Chemical Monitoring and Public Alarm Systems to Reduce Public Vulnerability to Major Accidents Involving Dangerous Substances. SYMMETRY 13: 8 pp. 1-16. Paper: 1528, 16 p. (2021)

#### In periodicals published in foreign language

- [3] Zsitnyányi Attila: Development of a light-armoured vehicle family in Hungary HADMÉRNÖK XVI: 4 pp. 41-53., (2022)

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- [4] Zsitnyányi Attila: Egy „bennfentes” álláspontja a magyar védelmi ipar helyzetéről. KATONAI LOGISZTIKA 24: 2016/1 pp. 7-53., 47 p. (2016)
- [5] Zsitnyányi Attila; Vass Gyula: Multifunkcionális járművek alkalmazása a katasztrófavédelemben HADMÉRNÖK XIV: 2 pp. 44-55., 12 p. (2019)
- [6] Petrányi János; Zsitnyányi Attila; Vass Gyula: Gyalogos sugárforrás keresési módszerek és mérési összeállítások vizsgálata. VÉDELEM TUDOMÁNY: KATASZTRÓFAVÉDELMI ONLINE TUDOMÁNYOS FOLYÓIRAT IV. évfolyam: 3. szám pp. 83-95., 13 p. (2019)
- [7] Zsitnyányi Attila: KOMONDOR - könnyű páncélvédett bázisjármű család fejlesztése Magyarországon I. rész HADITECHNIKA 53: 6 pp. 44-50., 7 p. (2019)
- [8] Zsitnyányi Attila: KOMONDOR – könnyű páncélvédett bázisjármű család fejlesztése Magyarországon. II. rész HADITECHNIKA 54: 1 pp. 35-42., 8 p. (2020)
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- [10] Zsitnyányi Attila: Mentésítő rendszerek fejlesztése Magyarországon a NATO-csatlakozást követően I. rész. HADITECHNIKA 54: 5 pp. 49-55., 7 p. (2020)
- [11] Zsitnyányi Attila: Mentésítő rendszerek fejlesztése Magyarországon a NATO-csatlakozást követően II. rész. HADITECHNIKA 54: 6 pp. 43-47., 5 p. (2020)
- [12] Zsitnyányi Attila: Mentésítő rendszerek fejlesztése Magyarországon a NATO-csatlakozást követően III. rész. HADITECHNIKA 55: 1 pp. 52-56., 5 p. (2021)
- [13] Ocskay Gábor; Zsitnyányi Attila: Különleges megoldások az S3 kategóriájú Komondor járművekben. VÉDELEM KATASZTRÓFAVÉDELMI SZEMLE 28: (4) pp. 52-54. (2021)

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## **THE DOCTORAL CANDIDATE'S PROFESSIONAL AND ACADEMIC BIOGRAPHY**

**Name:** Attila Zsitnyányi

**Place and date of birth:** Budapest III., 27<sup>th</sup> April 1972.

### **Studies:**

In 1996, he obtained a degree in safety engineering at Kandó Kálmán Technical College. Following his MBA, he graduated with a master's degree in disaster management from the University of Public Service (NKE) in 2018. In addition to his studies at the Doctoral School of Military Engineering of NKE, he also conducts doctoral studies at the Doctoral School of Clinical Medicine of the University of Pécs.

### **Professional career:**

He has more than 28 years of experience as an owner, CEO, investor in various companies in the defence and safety industry. Since 1998 he has been the CEO of Gamma Technical Corporation.

### **Public activity:**

President of the Defence Industry Association of Hungary since 2012. Between 2010 and 2021, he was a member of the Technical Advisory Board of the Ministry of Interior. He is a member of the Hungarian Military Science Society and the Hungarian Law Enforcement Society.

### **Scientific activity:**

He has been conducting professional and scientific research for more than 24 years in the development of safety equipment for the defence sector, disaster management and industrial safety. His main areas of research are the development of early warning systems, mobile laboratories, special field supporting systems, multi-purpose vehicles and superstructure systems.

**Budapest, 15<sup>th</sup> June, 2022.**



**Attila Zsitnyányi,**