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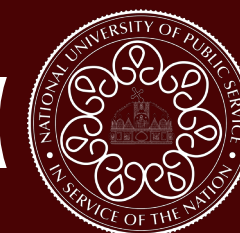
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All correspondence should be addressed to  
Prof. Dr. PADÁNYI József, Chair of Editorial Board  
National University of Public Service  
P. O. Box 15, H-1581 Budapest 146  
Hungary

Phone: +36-1-432-9062

Fax: +36-1-432-9040

[aarms@uni-nke.hu](mailto:aarms@uni-nke.hu)

[www.uni-nke.hu/aarms/index.htm](http://www.uni-nke.hu/aarms/index.htm)

# New possibilities of emergency communication and information in the protection phase of disaster management

TEKNÓS László<sup>1</sup>, ENDRÓDI István<sup>2</sup>

*Today, because of social, technological and climate changes, incidents and disasters have an increasing impact on life and property safety. For this reason, the importance and role of emergency information to the public is becoming more important and vital. Providing real-time information by the authorities, guidelines for the population and rules of conduct increase the individual's ability to survive. The increasingly developed information systems, designed to inform the public and raise the level of safety culture all seek to support the effectiveness of social protection capabilities. In this study, the authors attempt to analyze and evaluate the importance of emergency communication and (public) information in disaster management. They are researching new ways for communication options and methods that promote and support the survival conditions of the population in the protection phase.*

*Keywords: disaster management, emergency, social media, public awareness*

## Introduction

With the development of information and communication technologies, the opportunities for providing public information have widened. With social transformation, the demand for the widest possible access to public information and publicity is playing an increasingly important role. Obtaining information by communities has now become simpler and quicker. While in the past, time and space played an important role in the transmission and reception of information, nowadays, these factors no longer cause problems, because the Internet, overcoming physical boundaries, has dismantled the framework of immobility. Social media has become one of the most relevant elements of this accelerated flow of information.

Due to the large number of users in Hungary, it is essential to consider adapting the possibilities and methods offered by social media in the protection mechanism in Hungary as well, especially in public emergency information. As the March snow situation and the flooding of the Danube in June 2013 also showed, there was a demand by the public that the professional bodies should apply these new information-communication technologies.

The timeliness of the topic is shown in the latter. Incidents in recent years, originating in nature or human activity, all show that society is vulnerable anywhere and at any time at

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1 Doctorandus student, Military Technical Ph.D. School, Faculty of Military Science and Army Officer Training, National University of Public Service, Budapest, Hungary, tekнос.laszlo@uni-nke.hu,

2 Head of Department for Disaster Management Operations, National University of Public Service, Budapest, Hungary, endrodi.istvan@uni-nke.hu

a certain level. The effects of incidents involving strong psychic impact may be mitigated according to the preparedness and the presence of mind of the stakeholders; the number of life-endangering situations may be reduced. These goals can be achieved by raising public awareness and emergency communication.

## 1. Introducing and Interpreting Current Emergency Communication

The security situation in Hungary over the last 20 years has undergone/is undergoing constant changes. The Cold War approach has gradually developed into actions and response activities against the challenges caused by natural disasters. The range of risks and hazards threatening safety and security has grown and become more complex (problems caused by extreme weather, political and climate migration, international terrorism, drug trafficking, illegal arms trafficking, black market penetration, etc.). These challenges have fundamentally changed the protection system in Hungary, thus creating the conditions for effective action against contemporary threats.

The Fundamental Law stipulates, in several points, the safety and protection of its nationals, the best reference of which is paragraph (2) of Section G), according to which “Hungary protects its citizens.” Hungary provides for the protection and defense of its citizens as a state task. [1] One of the important elements of this obligation is the uniform disaster management organization, established in 2012 (hereinafter Disaster Management), whose integrated scope of tasks consists of industrial safety, civil protection and fire safety. The new legal regulation and the Government’s policy have determined to strengthen prevention and authoritative work, to increase response capability and *to protect the life and integrity of the population and to protect its property*. The law in Hungary prescribes the implementation of the successful management of disasters or emergencies, including the strengthening of *emergency communication*.

On the road to an Internet-based society, one can see abroad (e.g. in the case of Hurricane Sandy) that emergency calls by the population, avoiding the overloaded and congested distress call systems were made on the social media sites of the authorities. Non-governmental self-protection efforts have founded the government-level utilization of social media sites in emergency public communication. In Hungary, the snow situation in March and the flood of the Danube in June 2013 were the two incidents that launched the involvement of social media in raising public awareness and informing the organizations participating in the protection efforts. On the Facebook page “Hóhelyzet 2013 március” (Snow situation March 2013), the following initial script was uploaded: “For those stuck in the snow and are in trouble and for those who would like to help or share information. Let’s help if we can.” [2] This page was created on 14 March 2013. The last posts were made on 17 March, but there are still 159 likes this page enjoys (as of 03 February 2014). Mainly the homepage information of the National Police Headquarters, the animated wind maps of “Időkép”, the images taken by the Hungarian Defense Forces and the Hungarian News Agency (Magyar Távirati Iroda — MTI) were shared in the duration of three days. Watching the *organization of non-governmental organizations (NGOs)*, a lesson can be drawn that the population uses a new kind of space to obtain information. Social media is another option for a broad range of emergency information to the public. The snow situation was the first extraordinary situation, where the population

used Facebook to receive help and inform each other. Also in connection with the June 2013 flooding, it can be observed that non-governmental entities used Facebook to organize themselves. The page “Árvíz 2013 Összefogás” (Join Forces, Flood 2013) was created on 02 June. There were 42 512 likes by 17 September 2013. [3] The last post was made on 18 June, which means that the originator of the page did not run it any longer. With such a great number of likes, it is unacceptable. It would be a waste to ignore this crowd, so the next reasonable step for the admin would be to forward them to the information sites of National Directorate General for Disaster Management, Ministry of the Interior (NDGDM). However, it can be seen that in case of an extraordinary incident the number of persons demanding information increases a huge amount. The basis of involving social media in emergency communication and information is triggered by the increasing number of incidents and emergencies in Hungary, and is created by the NGOs of the social media. However, self-organization has its dangers as well, since the large amount of data is not controlled by the authorities in most of the cases, thus the possibility of disinformation is higher. On the official Facebook portal of Disaster Management the information is verified, the communication is authentic. The administrators monitor the responses of the population in the prevention, response and recovery phases.

### ***1.1 The significance of emergency communication in emergencies***

An extraordinary event always gets more attention from the public. Generally speaking, at suddenly occurring incidents affecting larger masses the public frantically search for channels providing information. The more a greater incident escalates in space and time, the more people will come to a close-to-panic situation through their self-organizations, then lose their self-control, to a life-threatening condition or situation. The people in need require quick and authentic information, related to “survival”. It is important that the person communicating information should only concentrate, without revealing their emotions, on emergency tasks, and should accordingly mediate it to the needy.

The response by citizens to an incident depends on the style and comprehensibility of the channel providing the information (media, narrator, and courier). Utmost importance is attached to the onsite reporters in the incident sites, since public media, commercial television channels and radios transmit news and information to a large number of consumers. Generally speaking, it can be witnessed that the reporters do not appropriately use terms related to disaster management; they explain their meaning in a different way. In an emergency or after an incident quick, precise and essential emergency communication and public information have priority. Media people perform their coverage many times in areas that are prone to accidents. Therefore, it is important that they receive labor safety and accident prevention training.

On 29 January 2014, the National Directorate General for Disaster Management held a one-day training for journalists who intend to become emergency correspondents. The goal of this training is that the media informing large masses have adequate quality and quantity of disaster management knowledge. They received information on the vulnerability of Hungary, the classification of Hungarian settlements, recognizing threat factors, the significance of crisis communication, emergency communication, means of alert, the basics of disaster management, hydrological and meteorological forecasting, the basic rules of moving in incident sites, the use of protective equipment, labor safety regulations, rules of conduct in incident sites, flow of information, emergency notification services, etc. [4]

Citizens have the right to learn of incident site information. The media strongly influences public opinion by transferring values and the contents of communication. Authorities and the media are responsible towards the population. [5: 92] In case of the occurrence of an extraordinary event numerous disinformation effects may come to the fore, which must be managed (it would be more purposeful to avoid them, but it is very difficult and complicated in the information society of today). The quality of information is very important. The media is to provide information to the target audience, the aim of the authorities is to achieve safety of life and property through emergency communication and information, to reduce unnecessary conflicts, to prevent the development of panic, etc. The two should converge towards each other, or more precisely, the authorities (mainly professional emergency responders) should prepare the media representatives for emergency correspondence so that the information is more accurate, professional and reliable. Thus, the population will be provided at the adequate time with information of adequate quality, increasing their chances of survival.

As far as the participants in communication, the most authentic sources are the authorities, whose data and information are transmitted to the end users, the population by the media. Through traditional channels (television, radio, written press, etc.), the media have the most opportunities to provide the masses with information. The use of social media and the Internet by the authorities made it possible for the responders to quickly reach the population in a factual and reliable way.

Generally speaking, the damages caused by the devastating effects of disasters and incidents can be mitigated by the preparation of the population and emergency communication. In North America, for example, the financial losses and human tragedies caused by Hurricane Katrina in 2005, on the one hand, can be attributed to the unprepared rescue forces, on the other hand to the unawareness of the public. [6: 5] However, in the case of Hurricane Sandy in 2012, fewer losses occurred in human lives. The reason for this (although it was larger in size than Hurricane Katrina) is to be found in the preventive and operational response measures of governmental bodies and agencies involved in protection. An important factor is that the social networking sites, mobile applications were also used for effective protection. It was proven that massive distress calls during emergencies could not be accepted and processed by the aid reception system of the body in charge. The population, self-organizing, looked for options (such as social media, interactive maps, mobile apps, etc.). At the time of Hurricane Katrina, public emergency information was poorly organized, but during Hurricane Irene in

2011, public information was used properly in time. In the case of Hurricane Sandy, public information was already on an adequate level, emergency communication worked well. Social media was also involved; Hurricane Sandy received an independent page on Facebook, which had nearly two hundred thousand likes (quality indicator). [7: 290]

Emergency communication and information, besides traditional channels, was implemented through the latter. One can make the conclusion that the new opportunities (mobile applications, social networking, and interactive maps) should be used by the authorities during emergency communication and information.

One of the important, widely used possibilities of emergency communication is bilateral communication. Certain elements of social media may make bilateral communication more successful and efficient, which may create the conditions for the population staying alive by providing appropriate information to an individual at a suitable time (for example, appropriate rules of conduct, emergency knowledge, etc.) so they can avoid tragedy or escape from

life endangering situations, quickly and without losses. Interactive communication systems belong to the best means of emergency information in the 21<sup>st</sup> century, which assist disaster management through a rapid provision of information and the reception of verified information from the population. Based on the information from the population, a virtual picture can be compiled of an incident, which may be transmitted to the onsite commander or the person in charge of controlling the response activities. The interactivity of the communications system lies in the fact that the receiving party obtains and collects information from the sender, which is processed by the recipient and it makes decisions based on the knowledge and expertise available, which is fed back to the sender in a utilizable format, orally or in writing. The sender may respond to it once again, thus launching bilateral communication. Interactivity always presumes actions from the user.

## 2. Principles and Methods of Public Information in an Emergency

Population protection is primarily a basic civil protection task, but it includes all principles, strategies, complex protection activities, procedures guaranteeing safety and security, in space and time, which are able to support and ensure the safeguarding of the population and property against a natural and/or man-made hazard or challenge.

Population protection is a partly military (air defense, armed defense, border guarding), and partly a law enforcement (public security, civil protection, etc.) task. In Hungary, the bodies and entities participating in population protection are in close connection with each other, however, population protection is mainly a civil protection “monopoly”, with the provision that civil protection may not support armed actions. Civil protection supports preventive protection measures, the mitigation of the devastating effects of natural or man-made disasters, and following such incidents or disasters, it assists in the creation of the basic life-support conditions for the population, and to safeguard human lives and property.

Experience shows that inhabitants (mainly those in trouble and need), following or during an incident or disaster, are not continuously informed on situations, or they receive false information or useless advice from numerous sources. It must be managed. By making information from a controlled source available to the population negative information can be corrected. By this, the detrimental effect of disinformation may be reduced. With the help of the emergency information having a population protection aspect, provided by social media pages opening towards the population, and other applications, homepages, the sympathy of the population may be guaranteed. Thus, the population will be aware of their susceptibility and possibilities for help in an emergency and the people will know proper conduct.

A dangerous establishment can hold risk for the public therefore it has the right to know the possible dangerous effects, the methods of response to them, the behaviour to be followed after a major industrial accident involving dangerous substances. Depending on the substances and technologies used, the risks may range from health risks, explosion, contamination, etc. The operator of the dangerous establishment is obliged to give correct information about the establishment, hazard sources to be found there and planned measures to prevent and respond to major accidents. The Hungarian regulation on major accident prevention defines the requirements, methods and means of guaranteeing publicity. [8] The means of the information used for the purposes of prevention of major accidents are information materials, open hearings and public information that are provided during the emergency situation. [9]

## 2.1 A short introduction of emergency information

To understand public information, the Act on Disaster Management will be of help. In Act CXXVIII of 2011 [10], public information is part of the tasks of civil protection in relation to disaster management described in Section 52.

The contents of public information should have the following components:

- briefing on the current situation;
- defining and identifying the population and area affected;
- information on the rules to be immediately introduced (rules of proper conduct);
- procedure of providing protective equipment;
- procedure of evacuation, rescue and reception;
- designating assembly points, briefing on the content of the emergency package;
- possibilities of sheltering in a building;
- (bomb) shelter protection (method of access, addresses);
- determining the method and place of individual protection;
- medical rules and support;
- major items of self- and mutual assistance;
- reading public administration decisions (ordering public labor, traffic restrictions, etc.).

Based on paragraph (1) of Section 37 of Government Decree 234/2011. (XI. 10.) [11] on the implementation of Act CXXVIII of 2011 on Disaster Management and on the Amendment of Certain Acts in Relation [10]: the contents of emergency information shall include:

- the danger of disaster, the incident occurred, protection, proper rules of conduct, population protection measures, restrictions ordered and further information possibilities;
- in the recovery phase, the creation of basic accommodation conditions, the possibilities of mitigation on a separate decision and recovery itself.

If law does not provide otherwise, the responsible person for the emergency information of the population is:

- the minister responsible for the protection against disasters;
- the head of the central public administration organ;
- the head of the central and territorial professional disaster management organ;
- the chair of the county and local protection committee;
- the mayor of Budapest, mayor;
- the head of the business unit.

### 2.1.1 Joint rules of emergency information

Paragraph (1) of Section 34 of Government Decree 234/2011. (XI. 10.) [11] on the implementation of Act CXXVIII of 2011 on Disaster Management and on the Amendment of Certain Acts in Relation [10] contains the rules of emergency information, according to which the methods of alarming the population and emergency information are as follows:

- Primarily by *public service announcements*, according to the provisions of the Act on Media Services and Mass Communication. Paragraph (6) of Section 32 of Act CLXXXV of 2010 on Media Services and Mass Communication [12] stipulates, if it is justified based on the decision of the disaster management entity, and the decision has been communicated to the media service provider in time, the public media service



provider is obliged to announce it by breaking its program. The obligation described in the latter paragraph is born by the media service provider of the social media service provider;

- Through the means of the public alarm system, whose definition is stipulated by the Act on Disaster Management “*the entirety of public alarm, warning, storm warning systems and devices and equipment closely related to their functioning operated by the central organ of the professional disaster management organ and the territorial organs of the professional disaster management organs.*” [10];
- In case of the availability of technical conditions, through electronic telecommunication means. Elements of landline telecommunication: T-COM Rt., INVITEL Rt., etc.; fixed line broadcasting: cable television — local service provider; wireless telecommunication: T-Mobile, Telenor, Vodafone; wireless broadcasting: television — local service provider, individual antennas can serve as signal receivers;
- In a way that is customary locally (loudspeakers, courier, posters);
- Through other means locally available for alarming and announcing emergency information, including loudspeakers capable of transmitting live speech belonging to law enforcement and private entities, and hand-held loudspeakers.

Naturally, in order to achieve efficiency, these devices may be used at the same time.

*The textual announcement should contain in particular:*

- the exact location and time of the incident;
- the expected impacts of the incident;
- the extent of the impact;
- the expected duration of the impact;
- the proper rules of conduct;
- the further information possibilities.

*The message should cover:*

- the vulnerable area;
- the nature of the hazard;
- the tasks of protection against the hazard;
- the expected time of the occurrence of the hazard;
- the specificity of the message;
- the consistency of the message;
- its accuracy.

*A message is authentic if:*

- the approach is based on statistics;
- the source is reliable.

*Personal requirements of emergency information:*

- use of more personal and interactive methods of public information;
- the briefers should acquire appropriate behavioral psychological and sociological knowledge;
- it is necessary to assess and be aware of the behavioral psychological, socio-psychological and cultural psychological characteristics of the local inhabitants;
- those organizing and implementing public information should acquire the appropriate knowledge and empathic behavior in order to raise the efficient public awareness of the vulnerable population;

- the operator should be an experienced, suggestive, confident, easy-to-understand and a quiet-spoken person;
- the educational method of the communicators: training, advanced training.

In an emergency, those implementing emergency information cooperate (with law enforcement bodies, non-governmental charitable organizations, etc.) for the sake of authentic, accurate and fast information, during which they harmonize the main areas of the information, the method of coordinated flow of information, the range of the population directly and indirectly affected and the possible international impacts.

*The essence of emergency information:*

- by ensuring immediate information, we have to avoid the spread of rumors and false information;
- the positive feelings (hope, vision) in people should be strengthened.

### *2.1.2 New possibilities in the field of emergency information*

After the occurrence of an incident or a disaster, the number of public distress calls increases. In many cases the distress call systems get overloaded or overflow. Within social media, Facebook for instance, can be used for requesting or offering help or providing information in an emergency.

Abroad, during Hurricane Sandy, the Federal Emergency Management Agency (FEMA), EMS Paramedic and the U.S. Army Corps of Engineers, etc. used social media for the early warning of the population and for emergency information to replace the overloaded public emergency call number 911 (it was activated at a voluntary non-governmental initiative). In Hungary, during the snow situation in March 2013 and the flood in June of the same year, the use of social media became customary in the field of emergency information. In the opinion of the authors, social media not only may but should be used to raise public awareness and for, (emergency) information purposes, because through social media, many people may be accessed. The official Facebook page of the National Directorate General for Disaster Management (hereinafter NDGDM) was visited by several hundreds of thousands for the information on the June flood. In this emergency, Facebook had a significant role, but what is more important is that people were looking for information from the authorities, therefore, the emergency content received an even greater attention.

Generally speaking, through fast and authentic information the population's "faith in governmental competence" grows, because, with the help of new possibilities introduced in the field of emergency communication and information, paragraph (2) of article G) of the Fundamental Law would prevail: "Hungary protects its citizens".

In 2013, the public formation toolbox of professional disaster management was extended. The organization uses, besides traditional methods, social media (Facebook) and an application developed for mobile devices (VÉSZ). Utilizing the advantages lying in mass communication, on 9 June 2013, ÁRVÍZ (FLOOD) FM started its operation for the period of emergency declared due to the flood. The novelty of the radio station was provided by its non-stop possibility to provide information that the population could continuously have access to timely information on the flood situation. The provisional channel of public media, Hungary's first flood protection radio station, due to its national reception possibility, was available to anyone. A great achievement of the radio station was that Hungary's prime min-

ister, the minister responsible for the flood management, the defense minister and the heads of the organizations participating in the response efforts were interviewed several times, which had a psychological impact on the population in such an extraordinary situation. Radio Árvíz FM shared its up-to-date information on social media pages as well, published mainly on the Facebook portal.

In the field of public emergency information, another great achievement was the use of an emergency information application developed for smart phones and tablets, with free access nationwide, which was introduced by NDGDM on 25 November 2013. The application mainly provides meteorological and traffic news to its users, including certain interventions by the fire brigades. [13] The information was highlighted with three different colors: blue for informative, yellow for warning and red for alerts, to which individual sounds could be set. Textual information is also supported by map a display.



Picture 1. Map support of the NDGDM Emergency Notification Service  
(Veszélyhelyzeti Értesítési Szolgáltatás — VÉSZ)  
(Photo by NDGDM [14])

VÉSZ is an option meeting the IT and information requirements of our era, through which emergency information and notification of citizens can be ensured for a wide range of the population, thus the protection of life and property safety is supported by another means.

### 2.1.3 The significance of an interactive map in emergency information

With reference to the snow situation of March 2013, citizens shared a map on Facebook (a type of social media), named social networking map by them. From the 46 shares, it can be seen that the population needs these maps. The 46 shares mean that a minimum of 46 persons saw and (hopefully) used the map. With the miniature spots on the map, different locations (keep-warm shelters, reception sites, etc.) are displayed:



Picture 2. Interactive map during the snow situation of March [2]

A great advantage of interactive maps is that the number and deployment sites of volunteers can also be displayed; thus the heads of the professional disaster management organs and the experts of the protection committees can visually display the situation to help prepare decisions.

The data needed for the maps can be collected, on the one hand, through their own networks (social media, websites, telephony communications, operations duty offices, etc.), on the other hand, through cooperation agreements and by the population.

### 3. Introduction and Significance of the Emergency Information and Communication System when Providing Emergency Information

The above examples are generally used separately when providing information and training. VÉSZ and the interactive map ensures one-way communication, however, social media can provide two-way communication. The main goal is to strengthen two-way communication when providing emergency information and raising public awareness. Social media, the telephony network, the application, the homepage and the emailing system should be “amalgamated” into an IT system.

In the authors’ opinion, conventional methods should be combined with the new possibilities of the 21<sup>st</sup> century. A complex information system should be created, which is dedicated to ensure the survivability of the population through training and briefings *before, during* and *after* the occurrence of a disaster. This would be the Emergency Information and Notification System (hereinafter VITÁR), which would help the operation of the professional disaster management system, cooperating with other non-governmental voluntary organizations established for the protection of the population. The basis for its establishment are the disasters and incidents of recent years, which are emerging in a more and more complex way. With the development of civilization, there is an increasing number of threats in our environment, and global climate change results in more and more localized meteorological anomalies, therefore, in order to facilitate the protection of the population and the work of disaster management, it is necessary to establish a system that is based on two-way and controllable communication, promoting the preparation of the population and raising public awareness.

VITÁR, amongst others, is dedicated to providing information, guidance, advice and knowledge to people and communities in trouble in due time and through appropriate means, thus increasing the individual's and groups' survivability. VITÁR intends to achieve and ensure it through a national *green number telephone connection*, a *homepage* accessible from any part of the world, its own *Facebook* site, a free downloadable *mobile application* and a restricted internal information system (in close cooperation with disaster management).

The following main issues may arise in case a disaster occurs, whose management and solution VITÁR wishes to achieve:

- Managing, analyzing and evaluating increased numbers of distress calls, if necessary, transmitting them to the competent entities. The transmission of possible emergency calls arriving by phone to the 112 emergency call system. Handling emergency calls in their own right, localization of emergencies;
- The inhabitants (people in need), in case of necessity, are not continuously informed of the situation developing, and they receive false information or useless advice from several places. This must be managed. By making the information from a reliable source available to the population, negative information should be rectified and the harmful impacts of disinformation can be decreased. Emergency information in real time. With the exception of the information in connection with telephony, the other information providing methods share the interactive maps of civilian use;
- For local incidents, the population does not receive reassuring information, or no information on the *proper rules of conduct*;
- Communication from and to the population in an interactive way;
- The voluntary rescue organizations may be (are) alerted, however, helpers without a rescue organization (the wide range of the population itself) and donors will only learn later that their assistance is needed (it is possible to overcome with an information module integratable into the system, through which the volunteers can be reached, information may be provided to them). Facilitating the recruitment of and providing dynamic information to voluntary rescue organizations. Registering and controlling the voluntary, map display of their location.

The authors assume that the information published on the website, Facebook and the application will be sufficient to help a person to find safe haven. If the individual does not get into a life threatening situation and the emergency information published on Facebook and the website or the operator's assistance on VITÁR telephone are sufficient, he does not have to use the 112 unified emergency call system (hereinafter Emergency Call System), then no further load from the population is put on the telephone network of Emergency Call System in the period of mass emergency calls. The goal of VITÁR is to ensure the possibility of a public distress call for the population (in cases when there is no imminent danger to life) on its own system through suitable devices (operator controlled telephony system, Facebook, mobile application). It does not have the goal to raise the awareness of the population of launching emergency calls through VITÁR in case of danger to life (to do so they have the more suitable Emergency Call System). The management of situations without the danger to life, involving public information, is the main goal of VITÁR.

Emergency information can also be accessed through the mobile application of VITÁR, thus facilitating the mobilization of the inhabitants to leave their residences more easily (they do not even have to take their laptops with themselves). During an emergency or at the im-

minent threat thereof, VITÁR can send an emergency warning. There is an emergency call shortcut function on the mobile application, which is a GPS-based positioning system with smart phones; with older versions, cellular positioning can send or relay lifesaving emergency information.

Another objective of the non-stop functioning VITÁR is to track the citizens' initiatives in normal times and in classified periods. The aim is to monitor public organizations, interpret and analyze the information posted and shared on the websites, to eliminate disinformation; analyze public reactions, avoid or manage eventual panicking. Where there is a panic-type of mood, VITÁR compiles a so-called "reassuring and calming package" and broadcasts through its application and social media.

Based on public photos, videos and announcements the processes in a given area can be accumulated. For instance, during a flood, through public photos, it is possible to create an overall picture of the status of an area. VITÁR continuously monitors them on the Internet, collects and assesses them, and based on reports, dispatches them to the competent County Disaster Management Directorates (hereinafter Directorate), facilitating the Directorate's decisions on the protection. If the Directorates need it, invitations encouraging voluntary assistance may be sent to VITÁR.

Contacts with the owners and operators (admins) of major portals should be established. If admins ask for information from VITÁR, disinformation can be reduced, since the system ONLY publishes data based on certain authoritative information with the approval of the national civil protection inspector general. Another reason why contacts should be extended to non-governmental initiatives is that they recruit and mobilize a great number of volunteers on their websites, so one should count with this potential.

As a summary, VITÁR is a controlled two-way communications system, composed on the basis of specific protocols, through which society can have access to emergency information. VITÁR provides assistance to professional organs in the management of an emergency (recruiting and coordinating volunteers, raising public awareness, emergency information, receiving and relaying distress calls, receiving donations and offers, continuous collection, analysis and assessment of data on public reactions, feelings, etc.). VITÁR intends to avoid mass hysteria by providing reliable local information. At the same time, provides information on the proper rules of conduct, in a given situation, ensures further information on the management of an emergency.

The Emergency Information and Notification System is NOT meant to organize on its own; the criterion of its functioning is the knowledge of the protection mechanism of professional organs and continuous communication and the authorization of the national inspector general for civil protection. The objective is to help the work of the professional disaster management.

## Summary of the Study

The Cold War approach has gradually developed into actions and response activities against the challenges caused by natural disasters. The range of risks and hazards threatening safety and security has grown and become more complex. Incidents in recent years, originating in nature or humans activity, all show that society is vulnerable anywhere and at any time at a certain level. By raising public awareness and providing emergency information, this vulner-

ability and exposure may be reduced. To this end, continuous research and analyses should be carried out on what means are suitable for communication and are used or kept by the majority of the members of the society. With the development of infocommunication technologies, the possibilities of providing information to the population have increased. Gathering information from the communities has now become simpler and faster. As the snow situation in March 2013 and the flood in June of the same year have shown, the population requires that the professional organs use these new infocommunications technologies. Social media can be used in the phases of prevention, response and recovery as an option to convey information. Amongst the tools of social media Facebook may be the platform, on which a wide range of the population can be reached (of course, besides conventional methods). Facebook can now be accessed on mobile phones. This access makes it possible for people to have access to the necessary emergency information, roadblocks, major data on vulnerable areas, etc. All this contributes to the fact that an inhabitant can receive real-time information. It is important to monitor and analyze the amalgamation of non-governmental initiatives on social media, and to plan the necessary counteractions to eliminate possible disinformation.

When providing emergency information, visualization is more and more a requirement, therefore, the support with interactive maps comes to the fore.

The main goal of emergency information is to ensure the safety of life and property to the greatest extent possible.

## Conclusions

In order to protect Hungary's population and property, and to be able to respond to current challenges in the most efficient way, professional disaster management has been transformed structurally. Within the three main fields, civil protection is one of the most important scopes of tasks to protect the population. The snow situation in March 2013 and the flooding in June of the same year have increased the significance of the role of civil protection by today (mainly emergency information, preparedness, coordinating and controlling volunteers).

Transfer of information through the Internet, compared to the previous conventional methods (television, radio, printed press, etc.), has incredibly changed the notification methods, to which a new language culture should be implemented.

The population (mainly those in trouble and need), following or during an incident or disaster, are not continuously informed of a situation, or they receive false information or useless advice from numerous sources. To provide a remedy, the Emergency Information and Notification System was introduced, which provides year-long public awareness materials for the population (prevention), in an emergency, it sends briefings from verified sources to citizens.

The new kind of public emergency communication possibilities may also be used for preventive purposes. With the help of well-marketed and managed social media, mobile applications, websites, publications, etc. a wide range of the population can be addressed concerning the protection against disasters, and can attract it as a civil protection potential to the disaster management system, in the service of Hungary for safety and security.

## Recommendations of the Study

The most significant factor amongst societal impacts is the change of communication affecting a wide range of the population. Accordingly, the technical advantages of the era should be utilized in the protection against disasters. To illustrate disasters and incidents in a clearer and understandable way geographic information system (GIS) support is needed, through which a higher level of professional public awareness information can be created.

The younger generations use digital devices in a skilled way. These applications have become the integral part of their lives to such an extent that the majority shares all phenomena immediately. The possibilities of social media (not only Facebook) supporting the protection against disasters should be studied in a more profound way; the authors recommend creating a uniform framework, by establishing a strategy, on its joint use (website, Facebook, applications, publications, etc.).

It is important, with regard to the technological and social changes in the 21<sup>st</sup> century that besides the means and devices, (conventional) methods currently used in public emergency information, new opportunities should be put in place and adapted.

It should be considered that when preparing people living in farms and providing them emergency information, a protocol should be compiled, increasing their protection capacities.

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## Western Sahara and Migration

BESENYŐ János<sup>1</sup>

*I have been studying the Western Sahara conflict nearly over 10 years, publishing various articles and giving several presentations. In order to begin to summarize the Western Saharan conflict, some arguments need a reference to Europe, for instance drugs, gun running and legal and illegal migration. In my article I shall examine arguments for the migration taking place in Western Sahara. Western Sahara is an organic part of the Maghreb region, where a considerable portion of African migrants depart to Western Europe. The antecedents of migration to Europe go back in history, since the population living here were in close contact with the early colonial powers, e.g. France and Spain, and with refugees from other African countries, who sought better living conditions (or indeed survival.)*

*Keywords: Western Sahara, migration, Morocco, Sahrawi, conflict, Spain, UN, Africa*

What does migration mean exactly? Migration means a wider population movement or human migration; people change their society and habitation for a longer or shorter period of time. Probably the most typical case of population movement is labour migration, but forced migration emerging from various conflicts is not unknown either.<sup>2</sup> There is also legal and illegal migration, that both occur in Western Sahara. Before addressing the above mentioned topics I shall introduce the region.

Western Sahara is the only colonized region in the African continent that still has not achieved its independence despite 30 years of continuous effort through international diplomacy to find a reassuring solution regarding the settling of the region's status. After the Spanish colonial authority left the region in 1975, it was soon occupied by the two neighbouring countries, Morocco and Mauritania. Notwithstanding, there has been the commitment of the International Court of Justice in The Hague, as well as several UN resolutions about the self-governance of the various indigenous population. [1] The new outburst of conflict turned into a war that has spread to the neighbouring countries, of which the first to exit was Mauritania (1979), following its political, as well as military defeat by the Polisario movement set up by the Sahrawi. [2] Morocco on the other hand did not leave the previously occupied territory, and despite the relevant international laws also built up its own administration and governed it as its own.

Originally, mainly Berber and Arab tribes lived in the scarcely populated independent territory, [3] until the arrival of the first Spanish settlers whom slowly conquered Western Sahara, which did not belong to anyone until that time. [4: 106–107] The borders of the Spanish

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<sup>1</sup> besenyo.janos@gmail.com

<sup>2</sup> In Hungary one of the best known examples of labour migration in our country was the emigration of more than one million Hungarians to the USA at the beginning of the 1900s, and another relatively well documented example of forced emigration was throughout the 150 year long Turkish occupation of our country when the majority part of the population was forced to leave his/her their previous habitation or residence for political, religious or economic reasons.

colony of that period where guaranteed by Treaties (1900, 1904 and 1912), signed by France and Spain, two major colonial powers. [5: 50]

The borders specified in those Treaties are considered, even now, the international borders. The Spanish occupied the territory only at the end of the 1930s (with French assistance). Up to that time the region was ruled by Sahrawi tribes fighting against the colonists. [6: 19] In the 1970s the power of the Spanish was solidified for real, and because of international pressure they started the decolonization of the territory. Following a referendum for self-government they desired to establish an independent state in close alliance with Spain. This was not simple at all, since the Kingdom of Morocco which had been independent from 1956 also claimed the whole territory of Spanish Sahara, invoking the alliance (baaya) pledged over the past centuries by the majority of the Sahrawi tribes to the Moroccan sultans.<sup>3</sup> At the same time locals established their own political organization named Polisario (Frente Popular para la Liberación de Saguia el Hamra y Río de Oro — Popular Front for the Liberation of Saguia el-Hamra and Río de Oro), which fought for the population's right to self-government and independence. [7: 158–159] The organization was also recognized by the international community; moreover all International Forums supported self-government as opposed to Moroccan territorial claims.

But the Spanish were unable to provide the right of self-governance of their previous colony, since their power declined after the death of Franco. The Moroccans, taking advantage of the situation forced the Madrid Agreement through a “peaceful” demonstration (Green March) and some blackmailing, this divided Western Sahara between the neighbouring Morocco and Mauritania. [8] Following the conclusion of the Agreement Spain handed over public administration to the new colonists and left Western Sahara definitively. [7: 215–218] Though the local population tried to resist, they were unable to repel the coordinated attack of the Moroccan and Mauritanian troops and were forced to flee to neighbouring Algeria. There, in one refugee tent they founded the Saharan Arab Democratic Republic (SADR) that was first recognized by Algeria and followed later by other countries.<sup>4</sup>

Following the proclamation of the Sahrawi state a war broke out between the occupying Moroccans and the militants of the Polisario, with various military outcomes it lasted until 1991. By the time of the peace agreement the Polisario achieved certain military and diplomatic advances (e.g. The African Union Organization welcomed it among its members in 1982), but the independence that they hoped for was not obtained. [5: 126] In the meantime Morocco had built a fortification system (Berm) and deployed nearly 200 000 soldiers, which they took over permanently  $\frac{3}{4}$  of the territory, while the Sahrawi controlled the worthless part of the country (huge deserts with some tiny oases).<sup>5</sup> The fortifications, consisting of several wall-systems, forms a border considered final by the Moroccans, and which has torn apart Western Sahara. In the occupied territories Moroccans have introduced a well-functioning

3 In the Arab world oaths pledged by individuals or cities to the ruler, meant the recognition of his superiority as well as the inferiority of the ones taking the oath. Regarding these territories the Moroccan Sultan nominated his own officers (kaid) who controlled the collection of taxes, and guarded the Sultan's rights. In many cases it was impossible for the weak Moroccan state to control certain tribes or to use them for its own purposes though they had taken the oath for certain reasons.

4 By the end of the 1980s 79 states had recognized the Saharan Arab Democratic Republic, this number has now somewhat decreased as a result of Moroccan diplomatic efforts.

5 Every Western Saharan city, the phosphate mines, fishery, and economically utilizable territory is in the hands of the Moroccans.

administrative system, while the political and military leadership of SADR operates from the Algerian city of Rabuni, and not on the “liberated” territories where there is no public administration whatsoever.

The ceasefire coordinated by the UN and concluded in 1991 conserved this situation, and subsequently reconciliation began regarding the future destiny of the territory. [9: 796] [3] At the beginning it was only Western Sahara that became independent, or integrated into Morocco with a high degree of autonomy, but this has changed over the past 20 years. Today only integration is discussed during negotiations. The peacekeeping operation of the UN (*United Nations Mission for the Referendum in Western Sahara*; in French: *Mission des Nations Unies pour l'Organisation d'un Référendum au Sahara Occidental* — MINURSO) created for the implementation of the referendum is only able to keep up the status quo or to control the ceasefire; therefore according to many it has lost justification for its existence.

Though the European Union is not directly involved in the conflict, nevertheless because of the proximity of Western Sahara, economic interests (fishing, exploit of oil– natural gas fields, phosphate etc.) and the common cultural and historical past, several European countries (especially Spain and France) are involved in the conflict one way or another.<sup>6</sup> Due to the aforementioned reasons it is understandable why the number of those involved in migration has increased remarkably over the past few decades. Naturally migration is not the only outcome of the sporadic fighting and economic crisis, but because of the changes regarding social and economic conditions.

The economy of Western Sahara is mainly based on nomadic herding (gradually decreasing), fishing and the extraction of phosphate. It has been well known for some time that Western Sahara and its coastal areas are very rich in petroleum that could be extracted economically, but because of the tense situation, only exploration drillings have been carried out. [10] Though in the past few years in the northern territories agriculture has been undergoing some development, but it is still not significant. Morocco despite the prohibition of related international regulations and the objections of the Polisario, representing the native population, exploits the economic resources of Western Sahara, and most of the vacancies in government employment are filled by Moroccans who have settled down in the country over the past few years, thus locals are gradually being pushed out of the labour market. Naturally Morocco has also carried out some development in the occupied territories, thus creating better living standards there. These are more than the SADR would have ever been able to create in the liberated territories and in the refugee camps.

Because of accelerated urbanization in the occupied territories, 95% of the population has moved to the cities built by the earlier colonists. In hopes of better living conditions more and more nomadic people have moved to the cities and this process has accelerated even more after the Moroccan invasion and the creation of the system of fortifications.<sup>7</sup> The elimination of

6 Spain and France hold contrasting opinions regarding the question of Western Sahara, partly for historical reasons, and also because of Spain trying to redeem the error committed when not providing the right to self–governance to the natives, but giving them up to Morocco. France on the other hand is in close alliance with Morocco, thus is not neutral in the conflict, having even participated in it in some way (transport of arms, programs of military assistance etc.).

7 Since the wall–system closed down the roads used by the tribes, they have been unable to wander with their herds anymore, and have been forced to settle down and to reduce their livestock radically. Thus a considerable part of the nomadic peoples have remained without work and are forced to move into the city in hope of a better life.

a nomadic way of life was also helped by periodically returning drought and rapidly forming floods during the rainy season, resulting in the death of a part of the livestock. Lack of water or the misuse or pollution of water resources also contributes to the acceleration of migration.

The situation of those living in the refugee camps somewhat differs from that of the Sahrawis living in the occupied territories. They theoretically continue the nomadic life-style of their ancestors, but the refugee camps are situated on the most barren areas of Algeria, where the period when livestock grazing is possible lasts for no more than 4–5 months a year. It is clearly understandable that those working in the fields could reach only limited results here. [11]

Many think that refugee camps, because of being very organized, generate a kind of process leading to urbanization, but it is not true. In other places people move to the city to find better living conditions (employment possibilities, higher standards regarding services and better health care etc.) The things missing from the refugee camps are exactly the above mentioned factors, since people are forced to arrive there and they do not desire to stay for a long period of time. Although several researchers concerned with the Western Saharan conflict praise the refugee camps near Tinduf and their perfect organization, it does not mean that a process of urbanization is taking place in the refugee camps. Those staying in the Algerian refugee camps already live in houses built mainly from mud bricks and not in tents, but only basic services are available for them. People living here do not have enough clean water, and water that can be found below the surface is undrinkable because of improper waste-water treatment, thus in many places water is brought by water carrier trucks. Electricity is provided by the Asylum Support Office of the UN in the camps, and only minimum health care is available. [10] In the camps many diseases are present (eye diseases, cholera, asthma etc.) caused by a very hard way of life and unusual weather conditions (frequent sandstorms, significant temperature fluctuations). In general we can say that the inhabitants of the camps live almost exclusively on aid provided by the international community, the decrease or the cessation of which would cause an unforeseeable catastrophe. [12] The only advantage of the refugee camps are better education. Illiteracy has been almost entirely eliminated in the refugee camps, since almost all of those living there have learned to write and to read. We find considerably fewer people among the Sahrawi under Moroccan rule who know how to read and write.

It is very difficult to estimate the exact number of people affected by migration, since we do not even have precise information about the location of the native population. This is partly the result of the fact that over the past few years the problem has become political and not professional, since originally natives could have had the right to vote regarding independence from or integration into Morocco. The fact that the nomadic tribes living on the territory did not settle down permanently, but kept wandering and from time to time left the Western Saharan territory for longer or shorter periods created a problem. The question arose regarding those who were born outside of the Western Saharan territory but were living there, whether to consider them Sahrawi or not, or regarding those who were born in Western Sahara but

were presently living in Southern Morocco or Mauritania.<sup>8</sup> Based on surveys carried out by the staff of the UNHCR there are more than 24 600 Sahrawi living in Mauritania who are originally from Western Sahara. [13] Nevertheless the greatest problem since the outbreak of the conflict is that the larger part of the native population lives in refugee camps. [14]

The last official population census — accepted by everyone — was carried out by the Spanish back in 1975, and recorded not only the natives but every person living on the territory of Spanish Sahara. If we try to subtract from the data provided by the census the number of Europeans and other Africans we get the number regarding Natives living there at the time, it amounts to 73 000 people. Of course the above result is contested by many, referring to the impossibility on the part of the Spanish to calculate the exact number of all the nomads, but no one is able to provide more precise information, and moreover the above data has served as a basis for the preparation of the referendum lists by the UN. The exact number of the people remaining in the territories occupied by the Moroccans and the Mauritians can only be estimated, though all the people dealing with the matter agree that most of the Natives have fled. The number of those remaining was augmented in favour of the referendum by those arriving from other territories of Morocco, and the occupying soldiers and their families.

In September 1982, based on the referendum of the Moroccan authorities, they found 163 838 people in Western Sahara, out of which 96 784 were living in Laayoune. [15] According to the estimations of the FAO the population of Western Sahara is somewhat above 300

000. According to a study of the AFASPA, as a result of “moroccanization” the proportion of natives amounts to only 30% of the total population, but this is contested by the Polisario as well. According to the staff of the Office of Identification of MINURSO, founded by the UN, out of the 86 381 Sahrawi entitled to vote, 48 000 had lived in territories occupied by the Moroccans. A further 120 000 people regarded as Sahrawi by origin, by the Moroccan Authorities, could only be accepted as Moroccan by the World Organization because of their uncertain origin.

Numbers regarding those living in refugee camps also differ greatly. There are certain studies according to which 155 000 Sahrawi refugees presently live in the four refugee camps. According to the official position taken by the UNHCR, there are 165 000 Sahrawi living presently in refugee camps, while the World Food Programme in 2003 provided aid for “only” 158 000 people, and in November 2006 the estimated number of those staying in Tindouf amounted to only 125 000. The reason for these contradictory data can be found partly in the fact that for several years aid organizations had been working with numbers provided by Algeria and the Polisario, and the aid organizations had not been able to provide precise numbers either, because of certain restrictions. The picture becomes unclear also because numerous families moved out into the liberated territories from the refugee camps, where they had more freedom than in the camps. Their number most probably amounts to 20 000 people. [10]

As I have mentioned earlier we can differentiate several types of migration in Western Sahara. The first, may be considered traditional, is internal migration, and within its framework

8 Who counts as a “Sahrawi” is a very delicate question, from a legal as well as a political aspect. In the Arab language Sahrawi stands for the people living in the desert, regardless of their tribe or people of origin. Over the past years international public opinion started to apply this term to the tribes that earlier lived on the territory of Spanish Sahara. The elimination of the tribal system was first started by the Polisario, and that was the time when the term Sahrawi started to be used for all tribes in general to make it possible for the people of the various tribes, previously fighting against each other to be able to view themselves as an independent nation.

livestock herding, nomadic tribes “wander around” the territories of present Morocco, Algeria, Western Sahara and Mauritania, and are greatly influenced by weather conditions. This sort of migration does not exist anymore due to international borders. This is why it could happen, that in Mauritania, that later became independent, a considerable Sahrawi minority living there caused quite a few problems for the Mauritanian government at the outbreak of the conflict. The French as well as the Spanish tried to restrict this type of migration — or at least keep it within certain limits — with more or less success. Finally the coup de grace regarding the wandering of the Sahrawi tribes was the construction of the system of fortifications that made movement between the two opposing parties impossible. On the territories controlled by the Polisario, between Algeria and Mauritania nomads can still move around freely, engaged not only in herding but in the smuggling of various goods. [16]

The second migration directed towards Europe, had already started at the beginning of the 1950s, when the primary destination was still Spain. This caused no considerable problems, since Spanish Sahara was viewed by the colonists as an overseas province of Spain and therefore they considered this type of migration as internal. Decision-making regarding migration was also eased by the fact that the official language of the colony was Spanish, and that every Sahrawi learnt to speak at least at a certain level, thus making settlement easier in other Spanish territories. This can be explained by economic reasons, at the time the political factor did not play a major role regarding migration towards Spain.

The number of migrants increased as a result of the ongoing battles following the Madrid Agreement, and many decided from the refugee camps to migrate to Spain. Since the integration of Western Sahara by Morocco into its public administration, it is very difficult to distinguish among the Moroccan legal and illegal migrants, the number of those of Sahrawi origin. [17]

Since the Spanish Non-profit Organizations are represented in a considerable number in the refugee camps, it is quite logical that migrants turn first to them. A process that can be well observed in the refugee camps is that migrants living and working there move abroad for a few years to support their families from their foreign earnings. Of course migration may also happen related to scholarships, not only related to the seeking of employment, since many students are given the opportunity to study abroad (Spain, Italy, Cuba, Great-Britain etc.), and some of these students do not return to the refugee camps once their studies are completed. According to certain estimates there are supposedly 26 000 Sahrawi migrants in Europe who left the camps this way. Sahrawi migrants also get into Europe through an unusual example of migration, not always voluntarily. A couple of years ago an opportunity was given and taken by nearly 10 000 children between 8 and 12 years of age to spend their summer and winter holidays in the homes of Spanish families (Holidays in Peace Program), providing them with full board, and some aid for their families in the form of presents and some cash sent back with the returning children. Several times the Spanish families did not want to send back the children to the “barren desert”, but kept them in their homes based on the decision of the local courts. Thus these children did not go back to the refugee camps but remained in Spain, though the settling of their status requires a long time (adoption, acquisition of the Spanish citizenship). [10]

The third type of migration, arriving through the Maghreb region, causes the most serious trouble for Western European states. [18] Not only the Moroccan or Sahrawi refugees arrive from here, but refugees from almost every African country. Since Western Sahara is very near

the southern borders of the EU (less than 100 kilometres from the Canary Islands), it became one of the main intersections for international migration directed towards Europe. Migrants arrive following itineraries that have been used as caravan routes over the centuries. One of the main gathering points of Sub-Saharan refugees is Accra, or Bamako from where bigger and smaller groups go to Tamanrasset, located in the Southern part of Algeria. From there they continue towards Morocco (through the city of Oujda), Tunisia and Western Sahara (Mauritania). [16]

The flow of refugees in Western Sahara began in the middle of the 1990s, when migrants trying to make their way across the Mediterranean Sea<sup>9</sup> started to prefer getting to Europe from the various ports of the Atlantic with their dinghies. Since in the territories controlled by the Polisario there is no centralized government, and the Mauritanian border patrol is practically symbolic, more and more refugees depart towards Europe not from the direction of Morocco but from Western Sahara. [19] The Moroccan government has therefore, on several occasions, accused the leadership of the SADR and that of Algeria of supporting actively the entrance of refugees into Morocco, destabilising the country. The parties concerned reject such accusations but they continued not stopping the illegal immigrants. [20] Peacekeepers of MINURSO have often reported that during their patrols they come across more and more Black African refugees — sometimes whole caravans — accompanied by the “usual” smugglers and armed men of the Polisario. The UN warned the leadership of the Polisario several times to stop the flow of illegal migrants. Finally the Sahrawi yielded to pressure and in 2004 in the vicinity of Tifariti they caught a group of refugees from Pakistan and Bangladesh, first putting its members into prison then letting them go near the Mauritanian border. [21]

Of course the flow of refugees did not stop, on the contrary, in 2005–2006 more and more refugees arrived to the territory from Senegal, Gambia, Sierra Leone, Liberia, Mali, Ivory Coast, Ghana, Nigeria, Republic of Democratic Congo, Cameroon, Sudan and even from distant Asian countries. [22] Only between January and September of 2006 did 24 000 illegal immigrants arrived at the Canary Islands, compared to the year before when this number was only 4 472 of. Out of the refugees rejected by the official bodies of the Maghreb countries, many do not go back to their countries but settle down right on the spot (their number is more than one million in Algeria, Mauritania, Morocco, Sudan, Libya and Tunisia), and later they attempt to get to one of the European countries again. According to several Organizations of Human Rights (UNHCR, Amnesty International and a Human Rights Watch) refugees are being abused by the border guards and the policemen of the North African as well as the European states, thus often violating basic human rights standards.<sup>10</sup>

This cannot be mitigated even by the fact that Europe has had enough of the more and more radicalized Muslim masses, that are capable of provoking bloody conflicts from the

9 The principal migrant “route” across the desert led towards the Spanish enclaves (Ceuta and Melilla) located on the territory of Morocco, then from there they tried to get into Europe on small fishing boats or dinghies. The Spanish government in cooperation with the Moroccan authorities and other African countries tried to stop the flow of refugees, often through very harsh methods (construction of a huge radar and fence-system, enforcement of various coercive measures, common patrol with the Moroccan authorities, reinforcement of sea patrol in the Strait of Gibraltar, imprisonment of refugees etc.)

10 In October of 2005 several hundreds of Sub-Saharan refugees broke through the fence-system built by the Spanish authorities. Panic broke out among the Spanish soldiers guarding the border, and they reacted against the migrants more violently than usual, it resulted in several migrants losing their lives. Simultaneously the Moroccan authorities took 1 500 captured migrants to a deserted spot in the desert and left them there to their fate.



police within a second, and that are admittedly hostile towards the states receiving them.<sup>11</sup> Unfortunately the European approach towards the illegals is based on security rather than on a comprehensive policy or economic considerations, and for them it involves more negative than positive aspects. Sahrawi migrants, until now, have not caused any troubles to the states receiving them, but unfortunately they are more and more often considered together with radical Muslim immigrants arriving from various Muslim states.

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# Inspection of the Transportation of Dangerous Goods by Inland Waterways in Hungary

KÁTAI–URBÁN Lajos<sup>1</sup>, KISS Enikő<sup>2</sup>

*It has not even been two years since disaster management took over the enforcement process of the transportation of dangerous goods by inland waterways. The international regulations of the transportation of dangerous goods by inland waterways are recorded in the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN). The most important goal of control and inspection is to get the regulations enforced in order to ensure transportation safety. The main goals of this article are to evaluate the experience, present the achievements and make proposals on how to correct the mistakes and deficiencies.*

## Regulation of the transportation of dangerous goods over inland waterways

The inspection of the transportation of dangerous goods by inland waterways is still a new task for the disaster management authority, as this has been within the competence of the disaster management authority for only the last two years. Because of this we have rather limited information and experience, however this is a very important area and even within such a short time there is a significant improvement in the adherence to the rules related to the transportation of dangerous goods over waterways.

On the Danube River there is almost only international transportation of dangerous goods, and most of the ships arrive from outside of the member states of the European Union at the Hungarian sections of the Danube River. The ships cross the Schengen borders at the Border Port of Mohács both from the Serbian and the Croatian side, with arriving ships entering the area of the European Union. As on public roads, on the water inspectors carry out strict inspections, thus Hungary has a major responsibility for the completion of authority tasks.

There is usually a high quantity of goods transported simultaneously on one ship. As an example shows, only one ship used for the transportation of goods with a capacity of 1500 tons, the transportation of goods is by far more economical compared to rail or road transportation. A train consisting of 38 pieces of 40 ton wagons is easier to imagine than a convoy of 50 pieces of 30 ton trucks transporting the same quantity of goods. From this, one can also conclude that if a ship transports such a high quantity of goods at once, then an anomaly aboard a ship is a high risk. For this reason the inspection of the transportation of dangerous goods over waterways by the disaster management authority is of special importance, as by sorting out anomalies various risks can significantly be reduced. [1]

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1 National University of Public Service; Institute for Disaster Management, Katai.Lajos@uni-nke.hu

2 Central Office for Administrative and Electronic Public Services, Criminal Records Authority

The authors collected experience from the employees of the branch offices of the Disaster Management Directorate of Budapest, of the ship inspection office of the Branch Office in Mohács, of the Dangerous Shipments Chief Inspectorate of the Ministry of the Interior (MI) National Directorate General for Disaster Management (NDGDM) and of Hungária Dangerous Goods Engineering Office (Hungária Veszélyes-áru® Mérnöki Iroda Kft. — HVESZ).

Dangerous goods can be transported on public roads, by rail, over waterways or by air-plane. There are various transportation regulations applying to the various transportation methods: *ADN*, *ADR* (European Agreement Concerning the International Carriage of Dangerous Goods by Road), *IMSBC Code* (International Maritime Solid Bulk Cargoes Code), *ICAO TI* (International Civil Aviation Organization Technical Instructions for the Safe Transport of Dangerous Goods by Air)/*IATA DGR* (International Air Transport Association Dangerous Goods Regulations), *IMDG Code* (International Maritime Dangerous Goods Code) and *RID* (Regulations Concerning the International Carriage of Dangerous Goods by Rail). The tasks of the disaster management authority related to the transportation of dangerous goods are completed in line with the Hungarian and international legal regulations. For the ships transporting dangerous goods over the Hungarian section of the Danube River it is compulsory to know, apply and stick to the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways. The provisions of *ADN*, *ADR* and *RID* are similar and contain cross-references.

In addition to *ADR*, *ADN* and *RID* inspections within the competence of disaster management organizations. [2]

Simultaneously with the changes effected on January 1, 2012 new tasks have been delegated to the disaster management authority as well. As of that time not only the tasks related to the inspection of the road transportation of dangerous goods, but also the inspection of rail and water transport is within the competence of the disaster management authority. Within the frame of the preparation for the implementation of new tasks, since 2011, there have been several training courses related to rail, water and air transportation of dangerous goods. [3]

In order to complete authority inspections, affairs and ad hoc coordination tasks, it is extremely important to cooperate closely with other co-authorities. The Dangerous Shipments Chief Department, starting 2012, participated in the implementation and coordination of a numerous series of actions organized by co-authorities aimed at the inspection of the transport of dangerous goods. On the side of co-authorities the competent organizations of the National Transportation Authority, the National Tax and Excise Bureau, the National Police Office, and the Water Police Office of the Police Office of Budapest participated in the inspections.

According to the declaration of the MI NDGDM the cooperation with the co-authorities was great and efficient in every case, therefore, in coordination with the National Chief Inspectorate for Industrial Safety and the Dangerous Shipments Chief Inspectorate the series of national actions continued in the year 2013 as well. The aim of the actions is to identify dangerous illegal international and national shipments, to unveil hidden or illegitimate shipments of dangerous goods and to follow such shipments up in the individual transportation sectors, paying special attention to the inspection of shipments entering the area of Hungary. [3]

The rules of the standardized procedure applying to the inspection of dangerous goods and to the fines to be imposed in the course of the actions of the professional disaster management organization and the amount of fines that can be imposed in case of the violation of the rules and the general rules of authority tasks related to fines are stipulated in Gov. Decree No. 312/2011. (XII. 23.).

The local organization of the disaster management authority is authorized to carry out the inspection. The local organization of the disaster management authority has the right to carry out inspections within the competence area of other disaster management authorities based on previous approval. The amendment of the Gov. Decree No. 312/2011 (XII. 23.) took effect on July 4, 2013, for this reason, based on previous statistics, reports, in line with the legal regulations then in effect, also the regional organization is mentioned as an inspecting organization.

In case of the violation of rules related to the transportation of dangerous goods, in the first instance the local organization of the disaster management authority carrying out the inspection, in the second instance the regional organization leading the first instance local organization of the disaster management authority has the right to impose fines and to take other actions.<sup>3</sup>

The competent authorities, in terms of being responsible for the location where the shipment crosses the border are: at the time of the announcement of the transportation of dangerous goods, in case of loading in Hungary, the regional organization; in case of loading abroad, the organization of the disaster management authority.

In case of the transportation of dangerous goods over waterways the competence area of the disaster management authority extends until the state border of the adjacent state is located along a common section of the river.

The code of procedure is defined in the order No. 127/2012 of the director-general of MI NDGDM that took effect on January 1, 2013. The effect of the order extends also to the central organization of the professional disaster management organization (MI NDGDM), its regional organizations (directorates), and local organizations (local offices). [5]

## Forwarding over the Hungarian section of the Danube River

With regard to the type of the shipment we differentiate between ships transporting dry goods and liquid cargo. Dry goods can be bulk shipment (transportation of solid materials as bulk loads without packaging), consignment (consisting of packaging units ready for dispatch, large packaging or IBC and its content) and Ro–Ro (Roll–on, Roll–off, combined road and water transport). Liquid goods are transported in various types of tankers. The types of tankers are specified in the ADN rules.

Ships can be divided into further groups according to their propelling force, thus there can be power propelled ships, self-propelled ships, tow boats, track–boats without propelling, and barges. It is important to know the type of the ship at the time of the inspection, because there are different regulations in place for the different types of ships, for example the relevant provisions of the leak alarm plan.

On the Hungarian section of the Danube River the water transportation of dangerous goods takes place almost exclusively in tankers. The reason is that the highest turnover results from the transportation of fuels, mainly fuel oil (UN 1202) and petrol (UN 1203). Occasionally bulk load is transported, this being in most cases fertilizers covered by ADR. Ships transporting dangerous goods as consignment have not been inspected yet in the area of Hungary during the inspection period. [6]

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3 BM OKF Veszélyes Szállítmányok Főosztály adatai alapján

## Regional level of inspection

In Hungary, in the authority inspection of the water transportation of dangerous goods, on the basis of the data of navigability (e.g. riverbed, water level and ship traffic) only the counties along the Danube River are affected. Thus the inspections are within the competence of Győr–Moson–Sopron, Komárom–Esztergom, Pest, Fejér, Bács–Kiskun, Tolna and Baranya County, and of Budapest. Water inspection in Baranya County and in Budapest is of special significance. In Baranya County, in the city of Mohács is located at the crossing point of the border with Serbia, Croatia and Hungary, where, without any exception every ship leaving/arriving is subject to a comprehensive inspection as this is the beginning and the end of the Schengen zone.

Budapest is an area of paramount importance because of its disaster management ranking and due to its special central role. The main reason is that there is a significant concentration of important and protected public institutions (e.g. ministries, bureaus, the Hungarian Parliament), Seveso II. upper tier establishments, residential buildings and public institutions of protected persons, establishments involved in international water transport are present here and the number of inhabitants is very high. Furthermore the inspection shall take place without hindering the transportation and at the present only the Disaster Management Directorate of Budapest has a fireboat. [7]

## National annual inspection statistics

In the course of our research, in addition to the practical parts, MI NDGDM, the Dangerous Shipments Chief Department has made available the national statistics of the year 2012 to us. In the course of 2012 a total of 43 resolutions were adopted: 42 in Baranya County and 1 in Tolna County. From the 43 resolutions only 3 reached the authority of second, most of the other 40 have been acknowledged and paid for. During 2012 there was a total of 315 water inspections. More than 50% of the inspections took place in Baranya County (184 inspections) but there were many inspections (40 inspections) in Budapest as well.<sup>4</sup>

The number of inspections at sites was much lower. The reason is that there are not sites everywhere to inspect, this activity is absolutely unnecessary in certain counties. All over Hungary there was a total of 20 site inspections, 25% in Budapest.

In the course of 2012 all over Hungary the staff of the disaster management authority inspected a total of 1 995 ships and 1 199 of these ships transported dangerous goods. Most ships were inspected in Baranya County (1 479 ships in total), of which 61% transported dangerous goods. In Budapest the ratio was similar, here a total of 139 ships were inspected and 59% of them were subject to ADN.

The extraordinary character of the work of the authority is supported by the fact that only 5% of the ships inspected during 2012 were from Hungary. 33% of the ships arrived from EU member states and 62% from states outside of the EU. The ratio expressed as percentage indicates that inspection in Hungary plays an important role, because most of the ships in transit in Hungary arrive from outside of the European Union and this is also the point of their entrance to the Schengen zone.

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4 BM OKF Veszélyes Szállítmányok Főosztály adatai alapján

On the basis of the statistics around the year 2012 only 3% of the defective transporting units arrived from Hungary, the ratio of defective ships from EU member states is rather high (44%) and 53% come from outside of EU member states.

Based on the experience collected so far it can be stated that a total of 100 million tons of dangerous goods are transported on the Danube River, ships transporting dangerous goods subject to ADN log in via the NAVINFO system. As mentioned earlier, most ships transport fuels, fuel oil, Petrol. As of January 1, 2012 the disaster management authority inspects in the area of eight disaster management county directorates along the Danube River. [5]

## Summary

Fortunately, on the Hungarian section of the Danube River accidents happening in the course of the transportation of dangerous goods are not typical. There were only two accidents because of bedding during the last two years, but there were no dangerous substances released into the environment.

There are similarities between the experiences collected in Budapest and at border ports. Most of the procedures resulted from the shortcomings, full or partial lack of documents or fire extinguishers, and of personal protective equipment, but statistics show improving tendencies.

All in all it can be stated that during the last one and a half years there were major changes in the adherence to the rules pertaining to the water transportation of dangerous goods. The reason is that the disaster management authority, since the take-over of the task, pay special attention to the inspections, making a good use of the experience collected earlier during the inspection of road transports.

Within a short time safety on the ships improved significantly, as the ships of most forwarding companies enter Hungary, and thus the European Union not only once, but every week or every month. In order to avoid sanctions resulting from anomalies identified in the beginning, these companies try to rectify the anomalies and in addition to the remedy of shortcomings to exercise continuous control over the assets and documents, and have them revised as needed, and to extend the expiry date of documents still in due time.

News about inspections are spread also internationally, therefore it happens only rarely today that a ship, needing to be turned back because of its extremely bad condition, tries to enter the territory of Hungary. However we still identify shortcomings in new arrivals or on ships arriving after the swap of captains.

In case continuous control would be terminated, then probably the safety of water transportation would diminish to the level before 2012, as most of the forwarding companies stick to the rules in order to ensure conformity with the rules when inspected and to avoid fines. Of course this does not apply to water transportation only, the same would probably happen to road and rail transportation as well.

Cooperation with co-authorities is excellent, which is very important in this area, as the common actions and in case of the ship inspector's duty and everyday work is performed together with them. Cooperation is excellent both as far as information flow and the completion of tasks is concerned.

In the course of the inspection the lack of the possibility to hold ships back in case of the removal of the addressee is a problem. This could be resolved by the amendment of regulation No. 312/2011 and the fine could most probably be delivered.

The training courses and methodological guides of authority inspectors are extremely useful. The employees of the disaster management spoke out positively on this. Due to changes regarding training courses listed on the National Register of Vocational Qualifications the training course “administrator of dangerous goods” was cancelled from the register. At the present the deficiencies of the training system are not yet remedied, but the necessary knowledge can be acquired at safety consultation courses. A permanent solution should be found as soon as possible, either by introducing new training courses or by reactivating old courses.

The problems resulting from the lack of IMDG and the solution proposed calling for the translation of the IMDG and for the adaptation of the same to the legal regulations is also related to the topic of courses, or alternatively, there should be language courses (English) with professional curriculum organized and the possibility of further education abroad should be ensured. In addition at least one copy of the codex should be available in the language of professional language training at each branch office.

For the improvement of the professional level of inspections in the future the training course specializing in industrial safety at the National University of Public Service is a great basis, and the university notes published by the Disaster Management Institute of the University as gap-filling literature also facilitates the work of industrial safety specialists. [8]

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# Effects of different decorporating agents on the whole–body retention of radioisotopes

GACHÁLYI András, GYULAI Gábor<sup>1</sup>

*Internal contamination of people (persons) working in the nuclear industry and laboratories or living near such establishments may occur as a result of single or repeated exposures to radionuclides. Some of the population that might ingest radionuclides could also be expected to receive substantial doses of external (mainly gamma–rays and/or neutrons) radiation.*

*Among the fission products forming in nuclear reactions are elements such as strontium, niobium, caesium, rare earth elements and plutonium. These play an important role when they are released into the environment and are also the focal point of radiation protection.*

*The authors investigated the effectiveness of some important decorporating compounds in the case of internal contamination with radionuclides (cesium, strontium and cerium) in animal experiments.*

## Introduction

In recent years, as a result of urbanization and the development of the industry there is greater need to be prepared for more severe contamination of the environment. Emerging environmental contaminants (radioactive and/or toxic metals, hazardous waste, etc.), either directly or indirectly (e.g. through the food chain), pose a potential danger to people performing any kinds of tasks in these areas, as well as the local population.

All around the world there is still a large number of nuclear power plants, training and research reactors which can be potential sources of contamination during every day work (i.e. fuel substitution, waste transport and storage, filtration) and/or in case of malfunction such as the failure of the cooling systems or reactor accidents. Thus, the reactor staff and rescue workers are directly exposed to a combined effect of the external radiation (beta–, gamma–), and the internal radionuclide load coming from possible inhalation or swallowing substances containing radionuclides.

In recent years, terrorist acts (e.g. “dirty bombs”) clearly demonstrated that the world should be prepared for unexpected and seemingly unavoidable events.

We have investigated the toxicological properties, deposition and elimination characteristics of these radionuclides (for example: strontium, caesium, cerium) in animal experiments.

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<sup>1</sup> gabor.gy@citromail.hu

## Material and methods

Experiments were performed on white female rats of the strain CFY (origin HRC England Laboratory Animals, bred in Laboratory Animals Institute, Gödöllő, Hungary) weighing  $200 \pm 15$  g. The animals were kept in an air-conditioned room and fed granulated chow and tap water ad libitum.

In experiments with pregnant rats, the time of pregnancy was calculated from the second day of mating and eventually corrected on the basis of fetal gain in weight or the time of birth.

The animals were given intraperitoneally (i.p.) and/or by stomach tube (g.t.) a distilled water solution of isotopes (Sr-85-chloride, Cs-134-chloride and Ce-144-chloride) with an activity of 185 kBq.

As decorporating compounds, *DK-1* (DTPA, Na<sub>2</sub>Ca – diethylenetriaminepenta-acetic acid, MEDITOP, Hungary), *DK-2* (PB, Prussian blue, MEDITOP, Hungary) and *DK-3* (natural high molecular weight polysaccharide, MEDITOP, Hungary) were administered.

The initial body burdens of injected isotopes (IBB) were determined by a whole-body  $\gamma$ -ray counter 30 minutes after isotope administration. Values of daily measurements were compared to a standard solution prepared for the stock solution. Changes in whole-body activity were followed for 20–35 days.

The retention data for each animal were submitted to a computer program. The derived parameters that provided best fit of the data to the curve described by

$$Y = A e^{-0.693 t/T1} + B e^{-0.693 t/T2}$$

equation, where  $t$  is the time in days after exposure, and  $T1$  and  $T2$  are the biological half-times in days. Differences between means were evaluated using Student's  $t$  test and were considered significant when the  $P$  values were less than 0.05.

## Results and Discussion

1.) Mobilization of Cs-134 by *DK-2* (Prussian-blue) in normal (non-pregnant) and pregnant rats:

Radio-caesium isotopes (mainly Cs-134 and Cs-137) are considered a major fission product (approx. 6% are formed) and associated with fallout from nuclear weapons and radioactive waste from nuclear power plants. The absorption from both the GIT (*gastrointestinal* tract) and the lungs are very easy/effective. The cesium compounds can be absorbed into the body within 1 hour after exposition. Caesium — in the living body — behaves similarly to potassium, it is evenly distributing, especially in the muscles build-up. [7]

As the potential risk of exposure exists not only for non-pregnant but pregnant organisms, experiments were initiated to study how pregnancy will influence the retention and transfer of radioactive caesium as well as the efficacy of *DK-2* (the Prussian-blue was administered by gastric tube or mixed with food) treatments in non-pregnant and pregnant rats exposed (single dose or continuously) to Cs-134 as a chloride.

The whole body retention of Cs-134 administered by g.t. (single dose) to non-pregnant and pregnant animals and the efficacy of applied treatments is shown in Figure 1, Figure 2 and Figure 3 shows the Cs-134 intake per body gram of new-born rats. (*The all figures, which are based on their own experiments created by the authors.*)

It can be stated that the feeding of animals with food containing 1% DK-2 and their simultaneous exposition to Cs-134 significantly reduced the body burden by 5–20% of control values both in non-pregnant and pregnant rats.

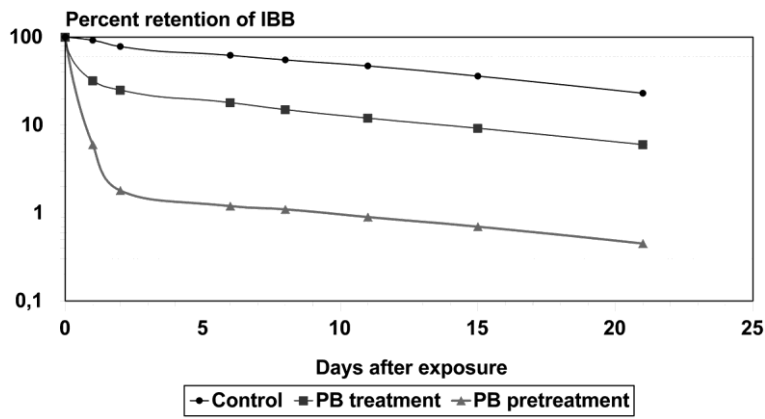


Figure 1. Effect of DK2 on the whole body retention of Cs-134 in non-pregnant rats

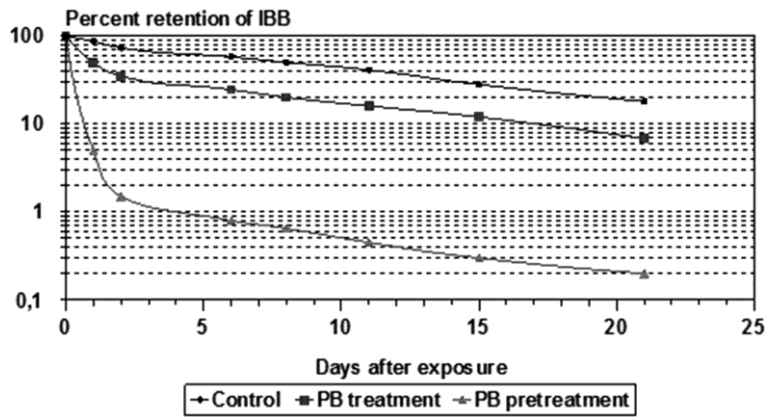


Figure 2. Effect of DK2 on the whole body retention of Cs-134 in pregnant rats

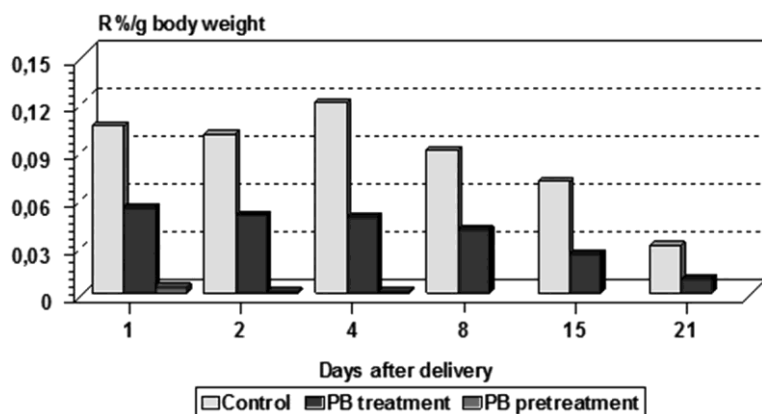


Figure 3. Cs-134 intake/gram body weight of new-born rats as a percent of the mother's initial body burden (IBB)

The efficacy of the whole-body retention of Cs-134 through applied DK-2 treatment on normal rats (exposed to Cs-134 contamination continuously in drinking water) is shown in Figure 4. Figure 5 and respectively Figure 6 show the Cs-134 intake per body gram of new-born rats.

The DK-2 treatment just after exposure (the Cs-134 is administered continuously through giving drinking water to adult rats) reduced the body burden by 50–70% both in non-pregnant and pregnant rats. Three-day pre-treatment eliminated an additional 30% of the caesium contamination. In new-borns with mothers treated with a single dose of DK-2 the content of the body was 50% less than that of the controls. Practically no Cs was found in new-borns when their mothers were pre-treated with food containing DK-2.

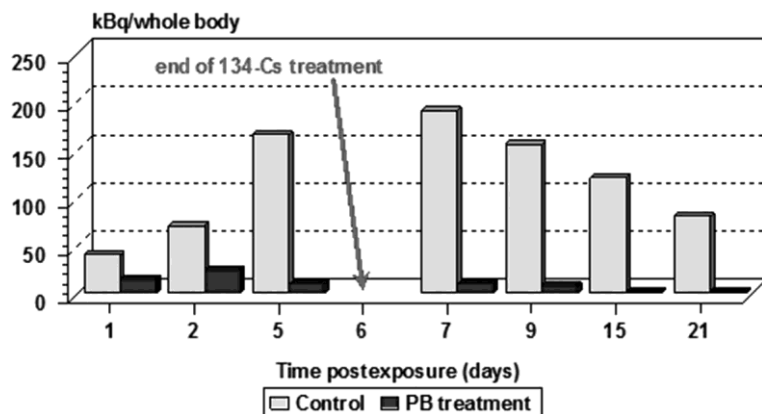


Figure 4. Effect of DK2 on the uptake and whole body retention of Cs in non-pregnant rats exposed to Cs-134 by contaminated drinking water

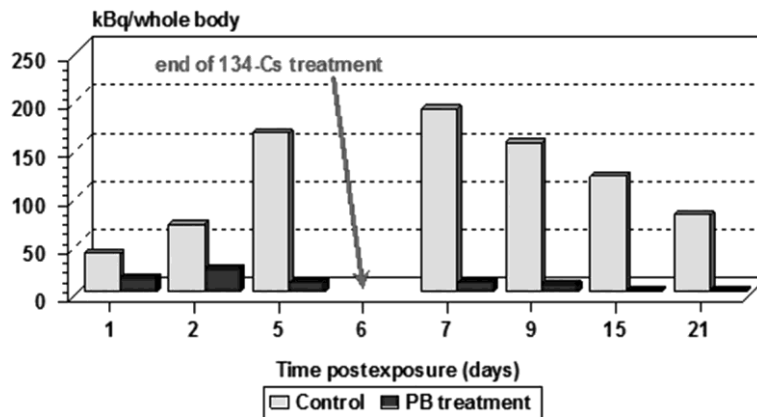


Figure 5. Effect of DK2 on the uptake and whole body retention of Cs in pregnant rats exposed to Cs-134 by contaminated drinking water

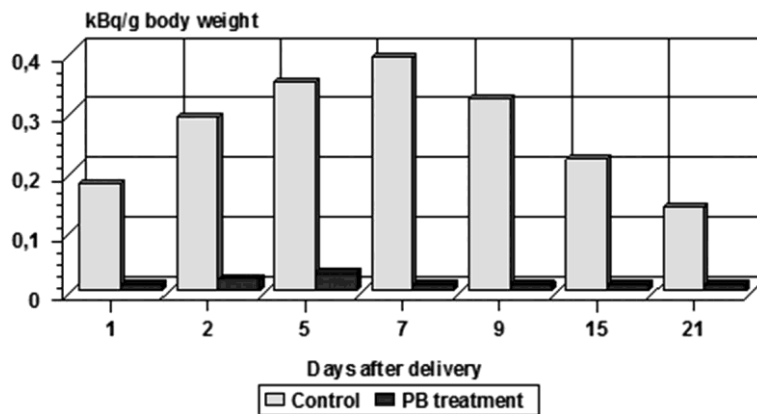


Figure 6. Cs-134 intake of new-born rats

## 2.) Mobilization of Sr-85 by DK-3 in non-pregnant and pregnant rats

Strontium isotopes of fission products are ones of the most dangerous (physiologically) elements because – strontium as a member of alkaline earth metals – can easily substitute calcium in biological systems. During a nuclear explosion many strontium (Sr-85, Sr-89, Sr-90) isotopes are created which are dangerous due to their determined first physical half-life.

[1] [4] [5] These strontium compounds are relatively well soluble in water and body fluids, so that they can easily be absorbed.

The absorbed compounds quickly disappear from the circulation and appear mostly in bones in the form of deposition. These compounds get involved in the metabolic process of the bone, become embedded in the bone matrix, and then very slowly, during almost 20 years of effective half-life the kidneys slowly excrete the wastes through urine.

The mobilization of radioactive strontium has not been properly solved, it seemed of interest to study the efficacy of the DK-3 (natural high molecular weight polysaccharide) compound in strontium decorporation.

The whole-body retention of Sr-85 administered by stomach tube to adult animals and the efficacy of applied treatment are shown in the Figure 7 and Figure 8 respectively. Figure 9 shows the Sr-85 intake in the different stages of pregnancy as well as in new-born rats.

It can be established that Sr-85 can beneficially be mobilised with administration of DK-3. The retained amount of Sr-85 in the animals decreased by about 50–70%. In case of newborn rats the applied treatments reduced the whole body burden of the fetuses in the treated group by 20–40% of control values.

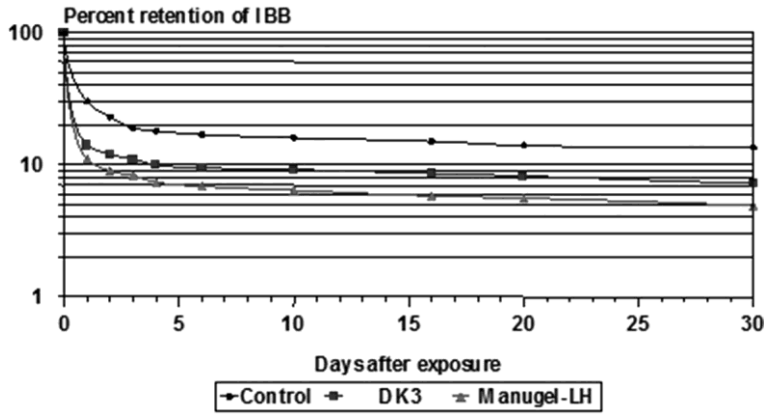


Figure 7. The effect of DK3 and Manugel-LH on the whole body retention of Sr-85 in non-pregnant rats

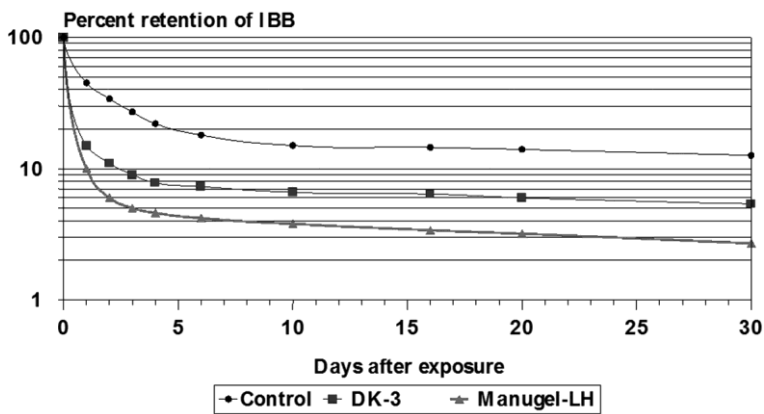


Figure 8. The effect of DK3 and Manugel-LH on the whole body retention of Sr-85 in pregnant rats

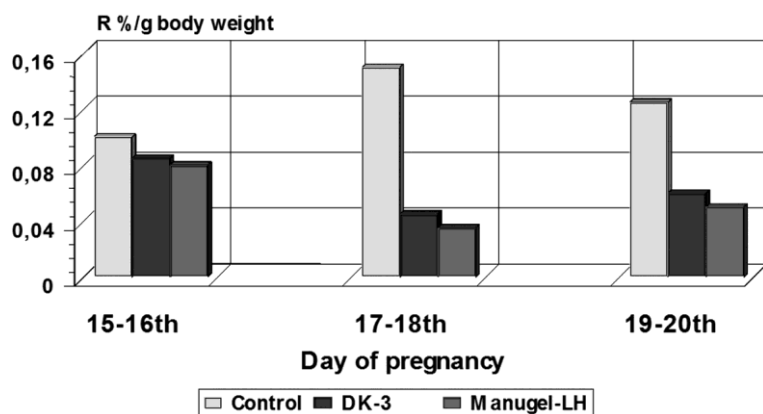


Figure 9. Sr-85 intake/gram body weight of new-born rats as a percentage mother's initial body burden (IBB)

3.) Effect of decorporating agents (DK-1, DTPA) on the whole body retention of Ce-144 in rats:

In nuclear reactions, primarily in fission products occurring during nuclear weapon tests the Ce-144 is present in 4.6–6.2%. This isotope has a significant rate in radiation hygiene, being a potential environmental pollutant as a by-product of nuclear industry/reactions.

The values for whole body retention of the radioisotopes in control and treated rats are shown in the Figure 10.

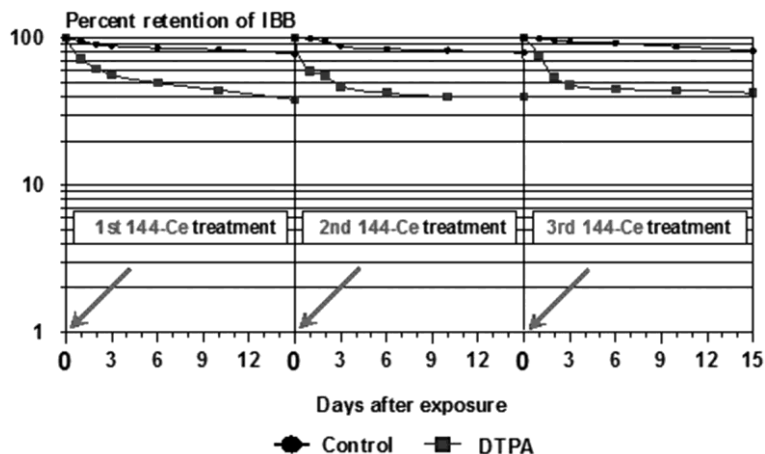


Figure 10. Effect of DTPA (DK-1) treatment on the whole body retention of Ce-144 after repeated exposure

From the results (in control group) it can be stated that the long-life components belonging to the various retention curves indicated an increase (e.g. at the end of 3<sup>rd</sup> period about 1.2–2.5 times) in the deposition of radioisotope after repeated exposures, consequently the rate of elimination decreased. But treatments applied DTPA (DK-1) caused a significant decrease (about 50–80%) in the retained amount of isotope. [2] [3] [6]

## Conclusions and recommendations

The results of our animal experiments clearly show that the radioisotopes which in different ways get into the body and there become deposited do significant damage to the whole organism. The degree of damage depends primarily on the type of the isotope (e.g., alpha-, beta- and gamma-radiation), the amount of the isotope (the delivered dose), the route of ingestion (inhalation, ingestion, damage etc.) and the time spent in the organism.

The radioisotopes which have already deposited, practically, cannot be removed by medication, nor can the emptying of them be accelerated. Consequently, the effectiveness of the different decorporation methods depend on how quickly the mentioned methods are applied after the contamination. The best results can be achieved with preventive application, if it is not possible then at the soonest possible time after the contamination. The shorter the time is between the contamination and the treatment the better the result is. The possibility of immediate or fast treatment can reduce the harmful effects caused by the incorporated isotopes.

Therefore it seems highly recommendable to compile a personal radiological first aid kit, which is necessary for the effective treatment of different exterior and interior contamination caused by the most common fission products, and their mixtures.

For appropriate decorporating (and decontamination) treatments, effective use of a compiled Personal (self-rescue, emergency) Radiotoxicological (First-Aid) Kit (PRK), which is set for the most important fission products respectively, effective (emergency) treatment of radioisotope inside (and outside) with a mixture of dirt they occurred. [8]

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# The Quality of the Defence Administration

NAGY Sándor<sup>1</sup>

*All states have to have and run institutions, which provide services — such as mandatory state functions, which also result in Hungary being treated as an independent, sovereign Country — to each citizen, hopefully in the same way. Public safety, fire department, the armed forces of the country, healthcare and education can be mentioned as examples. The state runs a system to control the connecting directive and coordinating activities, which is called simply “public administration”. Obviously, it is essential to have a cost effective point of view of the manpower and the quality of the service in the administrative institution. Thus, it is needed to study the main purpose of the service given to the citizens to maintain the standard or to develop it, if needed — by public social needs. The main topic of this work is the quality of the administration but it studies only a tiny segment of it and the quality of the defence administration based on it.*

## Introduction

As can be seen in 21<sup>st</sup> century Europe, rebuilt after the financial crisis in 2008, different countries were affected financially in different ways. The countries had different backgrounds of course before the crisis so the result depended on the strength or weakness of their economy, when the first banks started to go bankrupt in the United States.

It is a recognizable tendency that recently the economy has become determinative in our World. It means if a country is rich, it can provide higher level services to its citizens, thus social satisfaction grows concerning the state and the state apparatus. Most of the state income comes from taxes. Of course, as a member of the European Union we can get significant financial support, although, we have to pay in as well. As a result, a democratic country cannot be strong unless its economy works independently and the economy can be competitive if it is able to produce the same or better quality products at a lower price than the competitors abroad. The price–value rate is a question, which cannot be neglected in such a financial situation and simply national awareness based economic–marketing cannot be really successful in the globalizing world.

The state income has been mentioned but we cannot forget expenses either. All states have to have and run institutions, which provide services — like mandatory state functions, which result in Hungary being treated as an independent, sovereign country — to each citizen, hopefully in the same way. Public safety, fire department, the armed forces of the country, healthcare and education can be mentioned as examples. The state runs a system to control the linking directive and coordinating activities, which is called simply “administration”. Obviously, it is essential to have a cost effective point of view of manpower and the quality of

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<sup>1</sup> nagy.sandor1975@gmail.com

the service in the administrative institution. It means even the richest countries cannot afford to have larger administrative institutional systems than is needed without any problems and there is a need to check the mandatory services of the state. Thus, it is needed to study the main purpose of the service given to the citizens, to maintain the standard or to develop it if needed

— by public social needs. The main topic of this work is the quality of the administration but it studies only a tiny segment of it and the quality of the defence administration based on it.

## Quality in General

What is quality? It is an up-to-date and often discussed question with several answers and refutations. People studying it can be divided into two groups, those who think quality as a notion can be described and those who make a question of it.

Searching for the word in an encyclopaedia more descriptions can be found but we shall emphasize only one of them. Quality as a philosophical category means all the features which characterize the essence of things. [1] According to another approach, “quality is the conformance of a product or service (or even a process, system or anything else)”. [2] Both descriptions show that quality is a bunch of properties which describe a given thing and it has to be examined from a given point of view.

Some philosophical trends say there is no substance without quality [3], which means the material described by the features is the material itself. If quality, is some feature that changes we get totally different material.

Quality as a notion appeared in leadership theory education as well. A significant member of the conventional quality-school, Philip Bayard Crosby says [4]:

- Quality means the adequacy to the needs and it is not elegance;
- Adequacy can be provided by prevention, not by assessment;
- Quality means zero fault;
- Quality can be measured by the cost of nonconformity.

Crosby is somewhat contradicted by William Edwards Deming, who said that control itself does not lead to quality, the quality of the product features the worker “who build it”.

According to another conventional definition, by David Garvin, quality has different approaches [5]:

- Transcendent: Quality is what passes the test. It means quality cannot be defined, it can be recognized only when it is seen;
- Product based: Quality is based on the presence or lack of a given feature. If a feature is expected, based on this definition, the more a feature describes the product or service, the more valuable it is;
- Production based: Quality is what the producer can produce with the given tools in the given environment if the product fits the agreed expectations or specifications. If it fails, it means some lack of quality;
- User based: Quality means we are able to satisfy the needs and expectations of our customers;
- Value based: Quality means that we offer products with given features for an acceptable cost and price;
- Standard based: Quality means the feature of the product which makes it adequate for the requirements of the standard.

In brief it can be said that quality means all the features of an examined material, product or service, which make it able to satisfy the needs as expected.

## **Defence Administration as a Service**

Defence administration is a duty and acting system based on public administration. Its only target is to provide the complex defence tasks of the state. There is no doubt, the support of population defence is in close connection with dangers, and our legal system divides dangers into two groups:

- military and disaster management administration.

The Fundamental Law of Hungary mentions five possibilities where the following dangers can happen (These are the special legal orders):

- State of National Crisis;
- State of Emergency;
- State of Preventive Defence;
- Unexpected Attack;
- State of Danger.

These terms are mentioned in the constitution as a special law and the military and defence law describes the special acts in such cases. The constitution before the fundamental law described these situations as qualified situations with more or less the same meaning. Most dangers have similar features because they threaten people, essential properties and created environment, directly or indirectly. Protection against dangers is a national duty and it is controlled by the state. Those who control protective acts save people's lives and properties, such as the integrity of our country. They perform this by doing their duty according to their own responsibilities or according to the special laws of the term, if their peace-time concentrated power is not enough to avert dangers. At a central level, the power centre of defence administration changes according to the given, special laws (Military Council, Parliament, Government), while defence administration is done by county defence committees at a rural level, such as local defence committees on the spot and mayors at municipal level according to their administrative power.

Let us examine the question from the point of view of the citizen itself. A normal citizen pays taxes, repays loans, goes to work, lives in a family and brings up children. In his everyday life, he has the right to expect the state to provide a peaceful life for him without dangers while he does his public burden payments. As for the individual, based on the Maslow pyramid, need of safety and defence have only the second place, which has an effect on the society as well. We cannot forget that the image of the state as provider is deeply ingrained in Hungarian culture, which also fosters this way of thinking. The product of defence administration is not tactile by people, who pay for it in public burdens, which means, in their point of view, it is a service provided by the state.

## **Quality in defence administration**

Let us study the connection between quality and defence administration according to the chapters above. The base of the examination is a previous statement, which says that "quality is a bunch of properties which describe a given thing and it has to be examined from a given

point of view”. The point of view is described usually by a social need, obviously through a political direction. To some extent, of course there are some financial barrier to the system. How should defence administration work? What is expected from it?

- Basically, if we examine why this social and administrative system has been created, we can answer:
  - It has to do its duty, which means it has to provide the complex security of the state.
  - It has to be effective and sustainable.
  - It has to react flexibly in terms of its function.

I asked a few people, not in a representative survey, but with my own questionnaire to describe according to priorities what social needs they can mention and are to be expected from defence administration and to draw up what can be the quality features of defence administration, and what they first thought of when they hear the expression: quality of defence administration.

For the first question, 77% of the people said information is the most important. The second place is shared between efficiency and fast reaction, while in third place prevention stands with 31%. It is clear now that social need of the questioned people are the same as the operational needs of the system itself as it was mentioned above.

It is interesting that information was expected not only for the endangered period but for the defence administration itself so defence administration is not well-known by the usual people.

Provision of the complex state protection, as a principle is reflected in the fact that it was created through a centralized method. There are four categories according to the stages of centralization:

- Central,
- Rural,
- Local,
- Municipal.

The special law periods and its power centres are shown in the chart below:

*Table 1. Special Legal Order Periods*

<b>DESCRIPTION</b>	<b>CONTENT</b>	<b>POWER CENTER</b>
State of National Crisis	War, risk of war	Military Council
State of Emergency	Threat to law and order, takeover of power	Parliament
Unexpected Attack	Risk of an armed attack	Government
State of Preventive Defence	External armed attack or duty to NATO	Government
State of Danger	Natural or industrial disasters	Government

*Source: NAGY S. (Based on the Fundamental Law of Hungary)*

It can be seen on the designation of central levels, which are responsible for the control of acting against real dangers that even if there are some barriers in peace or normal periods, the financial sources have no upper limit in case of real prevention or damage control tasks. The system is based on administration, which means the human parts of the system get their wages by doing other usual, temporary tasks. In my opinion, there cannot be found a better way to efficiency but I have to return to this question when I analyse preventive tasks.

The ability of reaction to emergencies is speeded up by the reorganization of administration and the establishment of government and district offices, although it is important to state that the time factor of reaction ability depends on the possibility to forecast a given danger. It means the system of defence administration has problems with time, which comes from the change-over of the normal period. However if the given danger is not forecasted in time, if the forecast time is longer than the time factor mentioned above, the fact of time will not appear for citizens. This is why we need the action before the reaction time, which can be called prevention. Axioms of prevention are:

- Prevention is based on mostly magisterial work (control);
- The base of magisterial work is careful and designed legislation.

Certainly we have to rely on compliance with law, but authority always has to have doubts, which can be proved or neglected based on inspections. Another question is that excessive control has a negative effect in some cases and official sanctions can make authority a target of political attack in society. This field should be developed in countries formerly known as the Eastern Bloc.

The analysis of answers given to the second question showed a wider picture, 46% of the responders emphasized workmanship, reaction ability and efficiency; 31% of them mentioned information; 23% of them think that the experience in handling real events is the most important.

All of them have been mentioned in my essay, their analysis is not necessary now but I have to mention one thing. Among the quality features of defence administration, the responders mentioned experience in handling real events in the third place. Here we can see again the problem which was mentioned in connection with forecasts. Moreover, the analysis of past disasters shows that the different branches have a lot of experience in handling floods. It is obvious if the event can be forecasted, except the floods of river Tisza at the borders. The river Danube can be forecasted at a really early time. Situations which happen because of the extraordinary weather are different cases. In 2012, when the forecast happened in time, we were able to defend successfully against a heavy snow and terribly cold weather in the Southern Great Plain, but on the next occasions we saw, that people — probably for political reasons — wrongly tried to blame disaster management for the snow situation on 15<sup>th</sup> March in 2013.

## Summary

Above, I have broadly mentioned quality and defence administration, then the definition of quality in the field of defence administration. We could see that quality means a bunch of features in every case, which has to be examined from a given point of view. The most emphasized social need is information, efficiency, ability for fast reaction in case of emergency and prevention.

It was also shown that defence administration is based on administration, which is controlled by effective political power. It means prevention even in official or other fields, like reacting or handling real situations can be a centre of political conflicts.

On the other hand, the Hungarian defence administration meets social expectations but there is no doubt that such statements are temporary in a continuously developing world and the quality of defence administration depends on changing social needs as well as a possible modification in administration.

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# Developmental Trends in the SA–6 (2K12 KUB) Air Defence Missile Systems and the Finalized Developments in the Hungarian Air Force Surface–To–Air Missile System

BOZSÓKI Attila<sup>1</sup>

*Nowadays only a small number of governments can afford to spend money in the billions from their budgets to replace their surface–to–air defence systems. One of the reasons is the financial crises of the last decade that swept the world, but it is not the only one. Many governments decided to operate their outdated systems and try to improve their present capabilities, instead of obtaining newer ones. And to be honest, currently in Europe no countries have to be frightened or threatened by their neighbours. That is why they think it is enough to improve their existing systems — given adequate defence — rather than buying expensive new ones. On the other hand, it is less expensive to utilize soldiers who are currently trained to operate these types of equipment, than to teach them the operation of new types of equipment.*

*Keywords: air defence system, SA–6, Gainful, Strait Flush, missile, development*

## Introduction

The whole SA–6 air defence missile system was improved by Soviet engineers during the Cold War era of the 1960s. The first impressions were given to the world during the Yom Kippur conflict of 1973. Pilots gave it the nickname “three fingers of death” out of respect for the entire system. After that, the SA–6 systems spread within the Warsaw Pact countries, in Africa and in Asia as well. [1] Those countries had some different expectations and that is why so many variants of the original system exist all around the world. The developments of these also tend to vary.

## Developments in Iraq

One of these occurred during Operation Iraqi Freedom in 2003, when a most interesting “*in- digenous hybridisation of the 3M9 SAM<sup>2</sup> round with a seeker section from the Molniya/Vym- pel R–60 / AA–8 Aphid heat seeking air–to–air missile*” [1: 45] was found (see Picture 1).

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<sup>1</sup> bozsoki.attila@gmail.com; Hungarian Air Force, Surface–To–Air Missile Wing 12<sup>th</sup> “Arrabona”, Győr, Hungary

<sup>2</sup> SAM — Surface–to–Air Missile





*Picture 1. A captured Iraqi 3M9/R-60 hybrid heat seeking Gainful round can be seen. Note the Magnesium Fluoride nose window and ad hoc removal of the fixed nose strakes (US DoD image). [1: 46]*

*“While the resulting heat seeking 3M9 round would retain similar susceptibility to flares or more recently, infrared jammers, the missile engagement sequence would be devoid of the CW<sup>3</sup> illumination for the terminal phase of the missile’s flight. As a result, the aircraft under attack would only have the command uplink signals and terminal phase IS91 tracking signals to warn of an approaching missile. Where the defensive countermeasures suite relies on the CW signal to trigger angle/Range jamming, the heat seeking 3M9 could be potentially very effective.” [1: 45]*

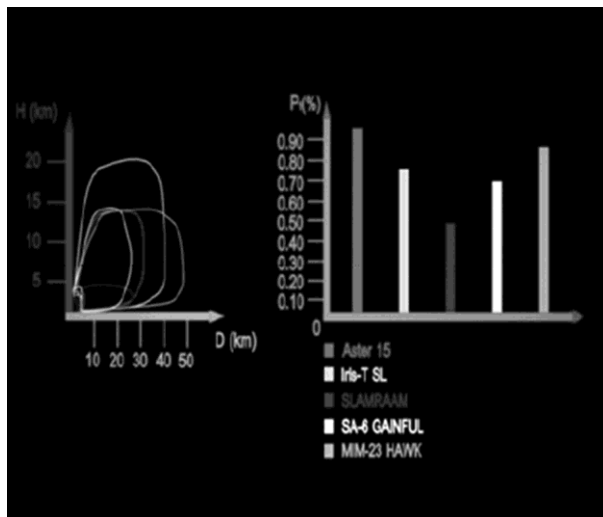
As this attempt shows, engineers in less developed countries were able to rebuild a surface-to-air missile, and mix its capability with another one to create an entirely new capability, which makes it more dangerous, mainly when no one is expecting this type of variant from the original one. We do not know how advanced the missile was or if it was used during Operation Iraqi Freedom. Nor do we know how effective it was, but observations show that air crews, of any type of airplane, will not be as safe anymore. The pilots cannot rely on their aircraft rebuilt equipment, which earlier was suitable against “normal” SA-6 missiles they must now count on new options, as well.

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3 CW — Continuous Wave

## Changes in Romania

Not just in Iraq, but also in Romania, officers and engineers are thinking about the development of SA-6 systems. Romania has many different types of — long, medium, short, very short range — air defence systems. They categorise the SA-6 into the medium range category, and they think it is worth improving its capability along with other ones. “A more efficient option would be the ESSM<sup>4</sup>, a recent development of Kongsberg, which besides its superior performance has an advantage. In fact, the SA-6 system can be modernised at the same time with the same missile (similar project was proposed by the Polish producer WZU and Raytheon)” [2: 110] Picture 2 shows the parameters of different types of air defence systems (distance, altitude, efficiency with one missile).



Picture 2. Capabilities of the Medium Range Air Defence (MRAD) [2: 110]

Three different types of missiles are loaded on an SA-6 2P25 launcher. From left to right in Picture 3 is the ESSM, Spyder-MR, 3M9. These attempts are shown in different countries as engineers try to solve a similar problem. Sometimes solved in similar and sometimes in different ways. They try to reduce the needed budget and get an effective and affordable solution. They emphasize the reliability of the original system and the relatively fast opportunity to rebuild these pieces of equipment.

<sup>4</sup> ESSM — Evolved SeaSparrow Missile, [www.youtube.com/watch?v=pJeXesbbVGg](http://www.youtube.com/watch?v=pJeXesbbVGg), (downloaded: 11 02 2014)



Picture 3. The modernization of the SA-6 system [2: 110]

## Ambitions in the Czech Republic

The Czech Retia Company and the French MBDA<sup>5</sup> Company offer another modernised SA-6 system with renewed Straight Flush radar, in which almost the whole system — the surveillance and fire control radar electronics, target illuminator — have been upgraded and now have a new communication system and new operators' workstations too. Additionally, the whole system is operated with Aspide 2000 missiles (see Picture 4). Unfortunately this improvement is solved with some disadvantages. The intercept coverage is only 23 kilometres while the original was about 27 kilometres in distance. The renewed system is able to track, intercept and engage the target from 25 metres up to 12 kilometres from the original

14 kilometres in altitude. And the main problem with the Aspide 2000 missile is that it is able to fly only at 1.8 Mach while the original 9M9 missile is able to fly at 2.8 Mach. And to be honest there is a very big difference between the two systems, which gives the advantage to the original Soviet made system.



Picture 4. Modernised SA-6 2K12 KUB CZ [3]

5 MBDA — Matra BAE Dynamics Alenia

## Trends in Hungarian Air Defence SA–6 Missile Systems

The modernisation of Hungarian Air Force capabilities started in the middle 1990s. After the collapse of the Warsaw Pact, East European countries tried to solve their military defence problems. Earlier — during the Warsaw Pact era — all countries had their independent and Warsaw Pact integrated air defence systems. As the Cold War situation melted, Hungarian politicians and military experts decided to reduce the Hungarian air defence capabilities. First, they reduced the army organic air defence artillery, secondly, the home air defence missile capabilities were eliminated step-by-step, and later the army organic air defence missile units were integrated into one. So nowadays, only HUAF<sup>6</sup> Surface-To-Air Missile Wing 12<sup>th</sup> “Arrabona” exists in Győr.

The Hungarian SA–6 weapon system modernisation was fulfilled in 2002 in Poland and in 2003 in Hungary [4]. The Polish WZU–2<sup>7</sup> Company [5] renewed the Straight Flush radar stations and the Hungarian ARZENÁL Company [6] renewed 2P25 launchers. The main effects of the modernisation and overhaul of this weapon system are as follows:

- *“Increased resistance to passive and active interference;*
- *Increased detection of low radar cross-section targets;*
- *Passive day and night target acquisition with long range thermo visual and television cameras;*
- *Application of IFF<sup>8</sup> (target identification) system (Mark XII Mode 4) standard);*
- *Use of advanced spare parts allowing the supply of replacement spare parts necessary for normal operations;*
- *Introduction of advanced methods and algorithms for digital data processing,*
- *Enhanced radio electronic camouflage ECCM<sup>9</sup> by application of radar sector blinking system;*
- *Elimination of adjustments and tuning for upgraded systems;*
- *Growth capability to launch state-of-the-art (fire and forget) missiles;*
- *Integration of dehumidification system;*
- *Air conditioned crew cabin.” [4: 643] Visible changes are seen in Pictures 5–8.*

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6 HUAF — Hungarian Air Force

7 WZU — Wojskowe Zakłady Uzbrojenia S. A.

8 IFF — Identification Friend or Foe

9 ECCM — Electronic Counter Countermeasures



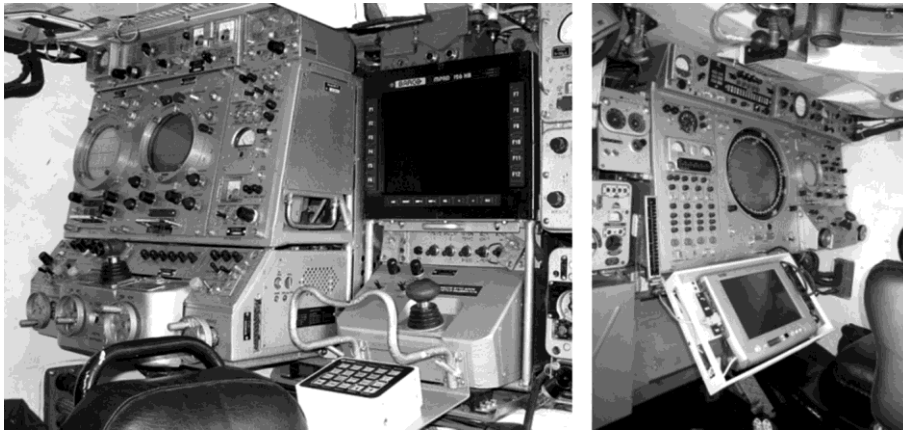
*Picture 5. Hungarian Army IS91 Straight Flush. A Polish built WZU-2 day/night optical tracker has been retrofitted on the RHS of the illuminator antenna (image © Miroslav Gyűrösi). [1: 51]*



*Picture 6. Hungarian Army IS91 Straight Flush. Note the stacked feeds on the search radar (image © Miroslav Gyűrösi). [1: 52]*



Picture 7. Hungarian Army 1S91 Straight Flush illuminator and optical tracker (image © Miroslav Gyűrösi). [1: 53]



Picture 8. Hungarian Army 1S91 Straight Flush operator stations. Note the retrofitted digital flat panel displays provided by Hungarian contractor ARZENAL (image © Miroslav Gyűrösi). [1: 54–55]

After the completion of the fire unit-level modernization, the Hungarian ARZENÁL Company commenced to renew the former Soviet K-1M SAM unit command post to a K-1P digitalized Wing/Group level Fire Distribution Centre. The K-1M was able to receive orders from higher echelon and send them to subunits but it was not able to get RAP<sup>10</sup>. It just used local radar signals as LAP<sup>11</sup>. That is why combat operations were based on local sensors data. [4]

10 RAP — Recognized Air Picture

11 LAP — Local Air Picture

By that time Hungary had become a NATO<sup>12</sup> member country, this development had to be able to solve NATO requirements. All air defence missile action had to be taken according to NATINADS<sup>13</sup> rules and procedures. Thus the new K-1P was designed and built to meet these fire control requirements.

Functioning as an FDC<sup>14</sup>, K-1P collects all relevant information and orders RAP from higher echelon and LAP from local sensors. The hardware and software correlates RAP and LAP and using its optimized algorithm, gives a recommendation on fire distribution for the authorised person — so called FDO<sup>15</sup> — and the FDC sends information back to CRC<sup>16</sup>, as well. The FDC links up to the higher echelon via NATO standard LINK-11B protocol. It is able to lead subordinated fire units providing them with the RAP and different orders and receives reports using TCP<sup>17</sup>, too. *“A three-workplace computer system has been installed for handling fire distribution algorithm, for sensor management tasks and logistic support necessary for efficient work.”* [4: 639] (In Picture 9 you can see the inside of K-1P.) The orders and reports are delivered and sent via encrypted lines on wire or on radio connection. Additionally it is able to turn Straight Flash targeting radar and launchers towards the target. So fire units are able to lock on their targets without emission with their television or thermal cameras. They just turn on the target illumination radar when they have got an engagement order. The time of switching on depends on the type of missiles<sup>7</sup>. If the fire unit is loaded with less modern ones, they have to turn it on before launching or with the newer type, just after the initial stage detaches from the missile. This can potentially be very dangerous to pilots.



Picture 9. Workplaces of the FDC [7]

The three workplaces are — from left to right in the Picture 9 — as follows: FDOA<sup>18</sup>, FDO and SM<sup>19</sup>. The FDO in the middle is always an officer in charge of the whole fire control activities. On the monitor he/she can see the RAP, integrated with LAP, the targets detected by local radars, the deployment places of subordinated fire units, their engagement footprint,

12 NATO — North Atlantic Treaty Organization

13 NATINADS — NATO Integrated Air Defence System

14 FDC — Fire Distribution Centre

15 FDO — Fire Distribution Officer

16 CRC — Control and Reporting Centre

17 TCP — Tactical Control Panel

18 FDOA — Fire Distribution Officer Assistant

19 SM — Sensor Manager

their RS<sup>20</sup>, ES<sup>21</sup> and so on. He/she has responsibilities listed below:

- *“To identify air targets based on the NATO airspace control orders in force, the RAP, the electronic and visual identification capabilities of the fire units;*
- *To autonomously distribute fire between subordinate fire units in respect to air targets identified unambiguously as hostile, taking into consideration the capabilities of the fire units (the FDO workplace software supports this activity with automatically generated proposals);*
- *To control the fire units’ activities according to NATO FCOs (Fire Control Orders).” [4: 640]*

The right hand side workplace is designed for SM. He/she has responsibilities see below:

- *“To produce and maintain the LAP processing data of operational surveillance and height-finding radars;*
- *To produce the complex up-cleared air picture per correlating LAP and RAP;*
- *To introduce and control jamming and clutter filtering procedures by available primary radar information displayed in digital form;*
- *To determine emission control by effective EMCON<sup>22</sup> status and the available RAP;*
- *To supervise and control the radar crews*
- *To control the tactical relocation of surveillance radars meanwhile continuously maintaining the air picture.” [4: 640]*

The left hand side workplace is designed for FDOA. He/she has responsibilities listed below:

- *“To input the effective ACO<sup>23</sup>;*
- *To handle the deployment positions of fire units;*
- *To receive and input the orders<sup>24</sup> (sending to subordinated fire units);*
- *To receive reports<sup>25</sup> from fire units and to forward those to higher command post;*
- *To attend to objective control, keep the action log;*
- *To input and process the alerts (ARW<sup>26</sup>, NBC<sup>27</sup>) and other messages.” [4: 641]*

At fire unit level the TCO<sup>28</sup> is the counterpart of the FDO in FDC. His/her workplace is in Straight Flush radar in front of the TCP workstation (you can see it in picture 8 right). On TCP *“he/she can keep track of a computer synthetic air picture formed in the FDC, receives orders (SSTO and engagement) and sends reports to the FDC (SSREP and engagement)”*. [4: 641] The main advantages of this situation are that they receive air pictures to monitor the air situation and track targets so that they do not have to switch on their surveillance and target acquisition radars. They do not emit tell-tale radar radiation, as in the past, which improves their efficiency. *“In automatic mode the equipment receives control signals from the universal interface device installed as a replacement of the old one that locks it on the target in elevation and azimuth.”* [4: 641] In this way the crew can start the covering-engagement

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20 RS — Readiness Status

21 ES — Emission Status

22 EMCON — Emission Control

23 ACO — Airspace Control Order

24 SSTO — SAM-SHORAD Tactical Order (SHORAD — Short Range Air Defence)

25 SSREP — SAM Status Report

26 ARW — Air Raid Warning

27 NBC — Nuclear, Biological and Chemical

28 TCO — Tactical Control Officer



using television or thermal cameras which are parallel with target acquisition radar (see Pictures 5–7). Since the modernization of SA–6 Straight Flush radars in Poland, the Hungarian fire units have been disposed of secondary IFF radars, made by Rytheon Company, type AN/TPX–56. This equipment gives the last chance to TCO to identify the flying objects before giving the engagement order. *“The solution guarantees every service necessary for modern high level automation, but needs no such modification in the original systems of the fire control radar that prevents its use in the conventional (before modernization) way.”* [4: 641]

## Conclusion

This article wanted to give the reader a general picture about the development of SA–6 systems in some countries, especially in Hungarian GBAD<sup>29</sup>, which has been performed during the last one and a half decades. Since Hungary joined NATO, it has been always clear to Air Force officers — especially to those who work for air defence — that our systems had to be able to work together in NATINADS/NATINAMDS<sup>30</sup>. At the moment we can say that our modernized system — using the K–IP Fire Distribution Cell with connected Tactical Control Panel that sends different orders, reports and Recognised Air Picture — is able to connect to higher echelon, and it is able to fulfil the requirements of the air defence community.

But now we cannot stop. Unfortunately — in some years — our missile stock is going to reach the end of its lifecycle. Nowadays no countries produce those types of missiles, which originally belonged to the SA–6 system, although, many different missiles with variants were produced. As it has been featured in this article, many attempts have been made in many countries all around the world to change these types of rounds to newer ones so as not to be forced to throw away the whole system and those soldiers who are trained to operate it properly.

So the main question for decision makers is to consider the whole situation. Hungarian Defence Forces has only this type of radar guided GBAD system, which — because of its ageing missiles — in the early 2020s must be pulled out of service, or must be further developed to be able to use another type of missile, which can be bought and operated in a NATO environment. A different decision can be a procurement of an entirely new — at least in Hungary — GBAD system. If policy-makers make this decision, they must do it in a very short time, because those officers, NCOs<sup>31</sup> who are going to operate it must start their studies some years before the new system arrives in Hungary. They must consider if they want to have a conventional GBAD system or the type which has capabilities against ballistic missile threats, too. [8] In our unit we try to do our best to give the most useful pieces of advice to our superiors in accordance with solving the problem.

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29 GBAD — Ground Based Air Defence

30 NATINAMDS — NATO Integrated Air Missile Defence System

31 NCOs — Non-Commissioned Officers

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# Problems and Future Possibilities of Visegrad Cooperation

SZILÁGYI Ilona Mária<sup>1</sup>

“...this regional cooperation is encouraging the hope that it can influence the present and near future of Central Europe in the framework of the European Union. It was the first time for centuries that instead of conquered and defeated state, the participation status and possibility is given to this region. Now it also depends on us what is our present and what will be our near future.” [1:42]

*The Visegrad Cooperation was founded in 1991 by the newly independent three countries: Czechoslovakia (as it was called then, now Czech Republic and Slovak Republic), Hungary, and Poland. The spirit of the 14<sup>th</sup> century arose. Their aim was to promote joining Western integrations by mutual assistance. They had to face several problems during times which obstructed the cooperation for longer or shorter periods, but it has survived and it was able to find new goals for itself. Its 20<sup>th</sup> “birthday” was celebrated in 2011, and nowadays the role of regional integration is larger than ever before. At present there are still interfering factors which cause problems, so I shall examine them in my study and I shall outline the future possibilities of Visegrad Cooperation.*

## Introduction

The history and the results of Visegrad Cooperation are quite big issues that I am not going to discuss in this study, as I have already published regarding these questions. I have also previously introduced the participating four countries (Czech Republic, Hungary, Poland, and Slovakia) in an essay. So I am going to highlight three milestones of the history of Visegrad Cooperation.

The first milestone was the Royal Meeting of Visegrad in 1335, attended by king Charles Robert of Hungary, Czech king, John of Luxemburg, and Casimir III of Poland. In addition to further goals there was the plan for successful Central–European Cooperation, which was forgotten for years, remaining without any results. [2][11]

The second milestone was more than 650 years later. The Visegrad Cooperation was revived in 1991 when the main aim was coordinated Western integration.

The third one was in 2004 when the V4 joined the European Union, which brought it to a crossroads: the objectives had been fulfilled and thus the partnership ended or new goals would be needed to revive the organization. The last prediction was realised partly: regional cooperation, consultation, joint actions in the framework of EU and other international organizations.

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<sup>1</sup> National University of Public Service, The Faculty of Military Sciences and Officer Training, Doctoral School of Military Sciences, Ph.D. student, ilonamaria@freemail.hu

20 years has flown by in the life of Visegrad Cooperation, it has become an adult but it has not reached its final form. Lots of problems, inhibitors, and obstacles are here, which I am going to present first.

In the second part of my essay I will try to deal with the problems mentioned above and I shall outline the future possibilities of the V4.

## The Problems of Visegrad Cooperation

There were many efforts to create regional cooperation in Central Europe in the 20<sup>th</sup> century but these were rather unsuccessful. Although at the end of this century there were some more positive initiatives like the CEI (Central European Initiative)<sup>2</sup> and CEFTA (Central European Free Trade Area)<sup>3</sup>. [3] In this area the cooperation is in initiatory phase because of disadvantageous economic, historical, political, and ethnic conditions. [4] Effective and good cooperation is unknown and it is being learnt, formed at present with more or less success. Thus the lack of the tradition of successful cooperation can be the most important problem.

The Visegrad Cooperation faces external and internal tensions as not all Central European countries are member states of it. The option of enlargement includes the ability of a strong core which attracts the other Central European states as a positive example. For this it must provide stability in the region which also depends on a successful and deep relationship with- in Visegrad Cooperation. [1]

Many criticize this cooperation, stating that it is not efficient, but this means impatience because they misunderstood and made incorrect conclusions many times. So "...we have to consider that it works as a not obligatory interest conciliation forum, a platform of opinions, attitudes, beliefs and interests presentation and consultation forum from its birth." [1: 46] The mechanism of cooperation was laid down in 1999 [8] and 2004 [10]. The organization was founded in 1991, and does not bind the V4 to take a common view of issues, at least at the expense of their own interest. [5]

Historical injuries are determining for the life of a state, they influence its international connections. The states of the Visegrad Cooperation are neighbours and during their history grievances developed against each other. These grievances must learn to be managed, taking steps forward, and rising above them. [6] Sometimes the option of reviving old alliances has arisen, but these are rather fears than real possibilities, for example the extreme nationalists think that former Czechoslovakia can be restored when the Czech Republic and Slovakia work closely with each other.

The actual borders of the region were made in the 20<sup>th</sup> century and they were changed many times during history. [7] There were numerous border disputes again and again that caused mixed ethnic habitants in border areas. The authorities tried to solve this problem by inhabitant exchange, violent colonization, and language laws. But the rules bringing peace and quiet for everyone have not yet been born, and in my opinion you can not create justice in this question, there is no perfect solution, only a mutually acceptable, tolerable situation

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2 It was founded in November 1989, foundation members: Hungary, Italy, Yugoslavia and Austria. It has been extended to 15 members during the following years. [www.cei.int](http://www.cei.int)(downloaded: 10 10 2012)

3 It was founded in 1992 by the Visegrad countries, then other countries joined it. Its importance was temporary because the Central European members exited automatically after they joined the EU, and nowadays it is a Western Balkan organization. [www.ecopedia.hu/cefta](http://www.ecopedia.hu/cefta) (downloaded: 10 10 2012)

which needs empathy, patience and mutual esteem. Decreasing the role of state borders and thinking as one region can minimize extreme and hateful views.

The deepening, strengthening, and enrichment of the relations inside the V4 is very important so it has to be pursued. This has to be seen as the most important task and after it is reached the Eastern Partnership<sup>4</sup> of the EU or the West Balkan could move forward.

Pursuit of dominance stems from the existence of the nature of states and lots of examples can be found during the decades of Visegrad cooperation. For example between 1990–1998 the Slovak strategic position was overestimated by the current government (Vladimir Mečiar) or we can mention the Poles' ambitions for a leading role in the region, which arises at times. But if this cooperation wants to be effective, mutual partnership has to be reached. [8] Although only Slovakia (from among the 4 countries) is a member of the euro zone, they opposed the grant rescue package for troubled states. The Visegrad Identity is still missing because lots of times the single interest of member states are emphasized at the expense of the others.

The size and weight of the 4 Visegrad countries is different, and Poland has emerged because it is bigger than the other 3 countries together. So it is not surprising that Poland is supposed to be the leader of the region by some people, but it would rather be among the great powers of Europe. Germany and France are getting closer to Poland and one reason for it is that they are afraid of a strong regional organization. It is remarkable that in the Council of the EU the votes of the V4 together are almost equal to the votes of Germany and France together. Perhaps not surprisingly Germany is happy to take part in the Visegrad meetings as an observer. [9]

There are only bilateral intergovernmental relations in Central Europe and unfortunately these are often formal. Thus the infrastructural connection of the region has not happened yet, which hampers economic cooperation. The transition to a market economy was a common problem for the V4 at the beginning of the 21<sup>st</sup> century and enforced certain sectors to make structural changes. The developmental differences create difficulties in the cooperation of neighbours even today, so developmental policy gets high priority. [10]

The members of the V4 are similar economically therefore they compete with each other rather than being partners or complementing each other's economies. Their geographical features are also similar and they struggle with the same problems. The development of infrastructure, their consumption structure, and the ability of capital attraction is similar, too. [11:

46–47] There were significant economic declines in the Visegrad countries after the change of regime, and they have not yet been solved. [11: 50] The stable, strong economy definitely strengthens the cooperation among the allies. The commercial stability of the region is inhibited by the Slovak Euro, the high inflation in Hungary. All four countries are reliant on foreign capital and investment, which also makes it difficult to cooperate with each other in this area, and even rivalry has developed in the competition for foreign capital. [3] The level of intra-regional trade is low, the predictable foreign trade regime is missing, and the incentive for trade is poor with each other. Only the trade between the Czechs and Slovaks is lively (but it is because of the former unity, unfortunately, and not the relationships within

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4 This program was started in 2009; its aim is closer political cooperation and facilitates an economic process among the former Soviet Union members (Armenia, Azerbaijan, Belarus, Georgia, Moldova, and Ukraine). [www.ec.europa.eu/dgs/home-affairs/what-we-do/policies/international-affairs/eastern-partnership/index\\_en.htm](http://www.ec.europa.eu/dgs/home-affairs/what-we-do/policies/international-affairs/eastern-partnership/index_en.htm) (downloaded: 01 09 2013)

the region). 90% of services “use” these four countries as a transit country. The Visegrad countries also maintain relations with other states, and these are stronger than those between each other, e.g. Czech–German/Austrian; Polish–Baltic States; Hungarian–Austrian/Slovenian/Croatian/Ukrainian cooperation. [4]

## The Aims of the Visegrad Cooperation

The “New Visegrad Declaration” was accepted in 2004 in Kroměříž [12] and is another milestone in the history of the cooperation. Four areas of cooperation were assigned and the mechanism of the cooperation was also recorded.

Areas of cooperation:

- cooperation within the V4 area;
- cooperation within the EU;
- cooperation with other partners;
- cooperation within NATO and other international organisations. Mechanism of cooperation:
- governmental cooperation;
- meetings of presidents of the V4;
- cooperation of parliaments of the V4 countries.

*First* I shall describe the four areas of cooperation. The first area is the cooperation within the V4 area including culture, education, youth exchange, science, infrastructure, and environment. There is the continuation of the strengthening of the civic dimension of the Visegrad cooperation within the International Visegrad Fund and its structures, cross-border and Schengen cooperation. In addition to the exchange of experience on foreign development assistance policy, and views on possible cooperation in the field of labour and social policy. New areas like the fight against terrorism, organised crime and illegal migration, disaster management, and defence and arms industries.

The second area is cooperation within the EU meaning active contributions to the development of the CFSP, including the “Wider Europe — New Neighbourhood” policy and the EU strategy towards the Western Balkans, and also active participation in the development of the ESDP, as a contribution to the strengthening of relations between the EU and NATO and deepening of substantive dialogue between both organisations. Consultations, co-operation on current issues of common interest, as well as exchange of experience in the area of Justice and Home Affairs, Schengen co-operation, including protection and management of the EU external borders, visa policy. Creating new possibilities and forms of economic co-operation within the European Economic Area, and consultations on national preparations for joining the EMU (European Monetary Union)<sup>5</sup>.

The third area is cooperation with other partners that have an interests in Central European countries. Cooperation with other regional structures, and with EU and NATO candidates and aspiring countries in support of reforms essential for their European and Euro-Atlantic perspective and collaboration in effective implementation of programmes of cooperation of these countries with the EU and NATO. Collaboration with other interested countries and organisations.

5 The agreement among the participating member states of the European Union is to adopt a single hard currency and monetary system. [www.ebook.law.uiowa.edu/ebook/faqs/what-is-the-european-monetary-union](http://www.ebook.law.uiowa.edu/ebook/faqs/what-is-the-european-monetary-union) (downloaded: 07 04 2014)

The fourth area is cooperation within NATO and other international organisations which are the following: the cooperation and consultations in the framework of NATO and in its defence capabilities; strengthening of transatlantic solidarity and cohesion; and cooperation on the basis of the V4 experience to promote a common understanding of security among the countries aspiring to European and Euroatlantic institutions. Enhanced cooperation within the international community in the fields of new security challenges, with a special emphasis on combating international terrorism. Cooperation and consultation in the OSCE on issues of common concern for V4 countries, as well as exchange of information in international organisations (UN, Council of Europe, OECD, etc.) are very important, as are considerations of possible joint initiatives. Possible mutual support of candidacies in international organisations and bodies.

*Secondly* I present the mechanisms of cooperation: governmental cooperation, meetings of Presidents of the V4, and cooperation of Parliaments of V4 countries. Governmental cooperation contains a rotating one-year presidency, each chairmanship prepares its own presidency programme ensuring, among others, continuity of long-term V4 cooperation. There is one official Prime Ministerial summit a year at the end of each presidency, and occasional informal meetings of Prime Ministers and Foreign Ministers before international events. Deputy foreign ministerial meetings precede the PM official summits and meetings of other ministers in V4 and V4+ format. Intensified communication of V4 national coordinators and their key role in internal and inter-state coordination is included. Last but not least consultation and cooperation of Permanent Representations to the EU and NATO in Brussels, as well as in all relevant organisations (OSCE, UN, CoE, OECD, WTO, etc.) are very important as well as the International Visegrad Fund<sup>6</sup> and its structures. [10]

## The Future Possibilities of Visegrad Cooperation

In 2011 the Visegrad cooperation celebrated its 20<sup>th</sup> anniversary with the “Bratislava Declaration”. In the first part of it the results made to date are described and later the future purposes of the V4 are declared. V4 confirm their determination to continue and further develop mutual cooperation aimed at contributing towards a strong, stable and democratic Europe and strengthening its position in the global arena in the interest of peace and sustainable development. They take part actively in the strengthening of Europe by carry out projects which enhance the competitiveness and foster cohesion of the V4 and EU at a global level to solve the economic and financial crises. Energy security is very important for the V4 so the internal energy market is going to be extended and deepened as a regional organisation within the framework of the EU. Routes, sources, diversification of energy suppliers are needed for this, and energy infrastructure, especially implementation of the North–South gas interconnections need to be improved, as well as an oil and electricity network needing to be modernized.

Road, rail, and river transportation infrastructure needs to be improved in a short time for cross border cooperation and cooperation among citizens.

Deeper cooperation must be built within the framework of the EU, especially in the field of common foreign and security policy, to make visible the V4 for other partners. Stability and democracy is fostered in the neighbourhood of the EU, and the Eastern Partnership Program

<sup>6</sup> The International Visegrad Fund is an international organization based in Bratislava founded by the governments of the V4 in Štířín, Czech Republic, on June 9, 2000. [www.visegradfund.org/about/](http://www.visegradfund.org/about/) (downloaded: 07 04 2014)

supports the West Balkans in their integration to the EU and NATO. The V4 fosters development of Euro–Atlantic relations, including NATO–EU strategic supplement, which is key to the long–term security of Visegrad cooperation and the whole of the Euro–Atlantic area.

In the current international environment there are continuously growing complex challenges which cannot be answered by any single country alone, therefore the V4 actively contributes to the war against terrorism, human and drug trafficking, illegal migration, as well as other security threats including cyber threats.

The Visegrad cooperation has become a well–based brand and an appreciated partner. It is going to be opened for cooperation along the lines of common interest with other countries and regional organisations in the framework of V4+. This organisation is led by solidarity and a theory of cooperation, so it is going to continue its important regional role. [7]

The possible areas of cooperation of the V4 can be the following: military, energy security, Eastern–Partnership Program, and cohesion support within the EU. The maintenance of the level of the cohesion support is quite important for every country. The reform of Common Agricultural Policy creates a good opportunity for common activities.

Energy security has come to the fore in recent years which means the risk of the dependence on Russian energy supply for all the four countries. This dependence should be reduced effectively with the creation of a North–South energy corridor. [3] An energy strategy should be developed that ensures energy supply for at least one year in case of any crisis, and the diversification of energy routes is necessary. Energy consumption is increasing with the development of the economy and the growth of population. Renewable energy sources’ efficient usage is necessary because according to a survey until 2030 energy consumption will grow 50%. More than half of the energy resources are made up of oil, gas, and coal. Between 2000 and 2015 the gas need will increase 100% and the oil need will grow 25%. [6: 21–22]

Breakdown of Likely Energy Sources

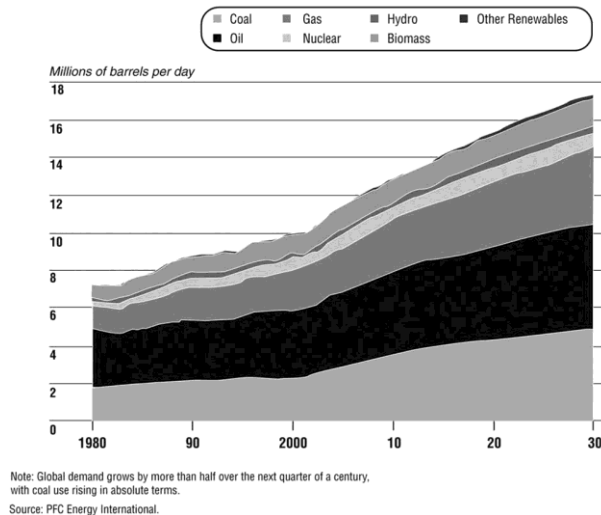


Figure 1. Global Trends 2025: A Transformed world

7 www.dni.gov/nic/PDF\_2025/2025\_Global\_Trends\_Final\_Report.pdf p43 (downloaded: 03 04 2014)



The V4 has successfully collaborated in advancing Western Balkan countries as they also contributed to Albania and Croatia joining NATO, so this line of action should also be continued in the future. The efforts of Montenegro, Bosnia–Herzegovina, Serbia should be supported consistently. [6: 19]

A single position should be advocated in the Eastern Partnership program that could raise the prestige of the organisation. Pushing east the borders of the EU would be very important from security policy view, and it could open a market for investments. We must not forget that these countries have influence on the economy of Europe, and thereby energy security, too. [3] The V4 has already had an effective role in the dialogue with third countries so it cannot be stopped in the future. Visegrad countries have been in contact with Japan, Israel, and the Benelux Union within the framework of V4+. Their experience in security policy has been handed over to other Central European countries since 2009.

The International Visegrad Fund is there to strengthen cooperation between the civilian dimension through scholarship programs, student exchange programs, annual student conferences, and it gives an opportunity to young researchers to exchange ideas. [6: 19–20]

The V4 has to know and discover the other states of the region and this process demands money, time, education, effort, and learning. Successful cooperation is the key to deliberate policy and social intents. Patience and perseverance are needed, Visegrad Cooperation has to move along in small steps, slowly because it is worth it in the long term and it needs constant maintenance and care by its members.

One of the possible roles of the V4 is to organize the Central European countries along the lines of the Benelux Union and Nordic Council<sup>8</sup>, in order to support political cooperation in the region. The Visegrad Cooperation is in a favourable position from the view of regional cooperation because the EU strongly supports this format. And it is not only a framework but also provides protection in the EU implementation of regional cooperation. Therefore the Visegrad Four countries could accomplish regional tasks within the EU, take part actively in shaping local and foreign policy, in addition to strengthening and deepening their mutual relations in the future. Such important areas like transportation, energy, economy have to build common networks to assist each other. Network interconnection in the energy sector is going forward slowly but it has to be continued. [1: 42–48]

Last but not least, another important subject is Roma integration within the V4 countries. “None of the countries facing this problem is able to handle it by itself in the future. It is necessary to initiate and find, within the entire EU, a way or a system of how to communicate with the other side, and how to put them in a position when they will be able to accept the offered assistance as cooperation” as the Slovak President Ivan Gašparovič emphasised in a V4 Summit in Karlovy Vary.<sup>9</sup> He also mentioned another future task, energy security, which has top priority within the Visegrad Cooperation and should be dealt with at a regional level in this area. Vaclav Klaus, Czech president added that a new political dimension has opened before the V4 which makes it possible in the future for the V4 to formulate common interests and priorities, and maintained them at an international level.

8 The Nordic Council was founded in 1952 by Denmark, Sweden, Iceland, Norway, and Finland; its headquarters is in Copenhagen. [www.norden.org/en/nordic-council/the-nordic-council](http://www.norden.org/en/nordic-council/the-nordic-council) (downloaded: 01 04 2014)

9 V4 Presidents end their summit in Karlovy Vary. [www.prezident.sk/?nahlad-foto&gallery\\_id=12086&language=en](http://www.prezident.sk/?nahlad-foto&gallery_id=12086&language=en) (downloaded: 05 04 2014)

A Further future area of cooperation can be environmental protection, and fostering economic growth. The V4 could be the main participant in the fostering of international democracy as it is a success story and an example to follow for the Balkans and the countries in the Eastern Partnership program. NATO and EU are going to provide the necessary tools for this task. [5]

Summarizing this topic I think there is an endless repository for future cooperation, which covers everything. There are some directions for cooperation which have already started, so these need to be broadened and deepened. If I wanted to organise the activities described above, the best would be the areas defined by the V4:

- cooperation within the V4 area;
- cooperation within the EU;
- cooperation with other partners;
- cooperation within NATO and other international organisations.

There is no more or less important area, each has a different dimension. However the most important task might be the coordination of work and the closer integration within the V4, the development the Visegrad identity, a support culture, education, infrastructure, and environmental protection.

A strong, influential regional organisation can be achieved within the framework of the EU, based on the voting rate; if we compare the vote of the V4 and the combined vote of France and Germany. So the V4 has a voice within the EU if all the four member states represent a common position.

Common positions within NATO and other international organisations can also be effective, based on the example of the EU. The Visegrad Cooperation is the centre of Central Europe, and it can be the leader of it, too in the future.

The cooperation of the V4 is a good example in the international scene because it can help other states to develop and protect democracy, joining international organisations through its experience.

## Conclusion

In summary the Visegrad cooperation has to face many problems which are still waiting for a solution.

I outlined many difficulties of cooperation in my essay but these are often the opinion of sceptics. Yet I believe it was a good idea to collect them and analyse their views because I think negative criticism can be constructive and push forward cooperation. The lack of the tradition of good real regional cooperation is highlighted by me, because though there were earlier connections among the four countries, they were forced, not based on equal partnership, and also not represented by their own interests. Cooperation is important but in the meantime we should not forget about ourselves, we must act to advance our own interests, and all participants need to think of the cooperation positively. Therefore it is necessary to create unity among the Visegrad cooperation in which the Czech Republic, Hungary, Poland and Slovakia remain a separate entity; the motto could be: "unity in community".

These four countries have advanced very similarly from historical, political, economic, and cultural points of view, there are elements that connect and separate them. They often compete with each other, and have acted as the oppressor of the other party. The state of eco-

conomic affairs greatly influences the success of cooperation, so they should seek to strengthen each other in this region, the single Visegrad cooperation can be a relevant player in Central Europe.

Last but not least, the sense of the Visegrad identity is highlighted by me because it would be very important if it were born. The four countries should be aware of all the citizens of Visegrad's spirituality to actually be able to work well in the organization.

Unfortunately there are lots of problems facing the Visegrad Cooperation since it was founded, but the lack of the tradition of a successful cooperation can be the most important in my opinion.

Many problems and hindering factors have been identified, some of them may have already been solved, and others should be solved in the future. The barriers to collaboration can inspire the future tasks to be solved. Problems should be recognised, ranked (which I have not done) by the V4, and solutions need to be found.

A wide range of possible future cooperation were mentioned, lots of them are worthy of separate study and need further research. At the end I highlighted the issue of energy security because it has great importance, and I agree with the view that it cannot be solved alone by single states; a regional response must be given for which the cooperation of V4 offers the perfect possibility.

As for the final conclusion I shall return to my starting motto, quoted by Judit Hamberger: "now it is up to us at last, what is our present, and what will be our future". [1: 42]

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# Personal Radiotoxicological (First Aid) Kit

GACHÁLYI András, GYULAI Gábor<sup>1</sup>

*In recent years, with the spread of nuclear industrial activities, and the widespread use of radioactive materials and products the possibility of radionuclide contamination of humans and animals has significantly increased. During nuclear tests or reactor accidents, a large amount of radioactive materials may enter the environment which can contaminate the living environment (air, water, vegetation, soil), for a long period. This contamination may enter living organisms by inhalation, intake and ingestion, causing severe biological damage. As an example the Chernobyl reactor accident can be mentioned, where there was no possibility for the decorporation of isotopes, as there were no products available such as the “RADISTOP”.*

*To achieve appropriate decorporating (and decontaminating) treatment which is effective, it is highly recommendable to use a personal Radiotoxicological First Aid Kit (PRK) within the shortest possible time after internal contamination. This unit provides effective treatment to decorporate the most common incorporated fission products.*

## Introduction

Nuclear testing, nuclear accidents (e.g. Chernobyl) or incidents caused by natural disasters (like Fukushima), as well as terrorist attacks can cause the radioactive contamination of the environment. The living media (air, water, vegetation, soil) can become contaminated for a long period, and serious biological damage can be caused to living organisms. The situation is similar to the threat caused by chemical plants, or the heavy metal pollution caused by increasingly heavy traffic. The whole body is exposed to the contamination caused by toxic heavy metals and radioisotopes, which incorporate into various organs (bone, liver, thyroid, etc.) where they can pose health hazards (e.g. toxic, carcinogenic) long after the incorporation.

For effective treatment and handling of the aforementioned problems there have not been any available products present on the market and as such nor have they been available for the Hungarian Armed Forces.

The authors of this article present a special first aid kit, the Personal Radiotoxicological Kit (PRK) and its compounds.

## The reasons for developing the products

Of late, as a result of urbanization and the development of the industry we need to be prepared for more severe contamination of the environment. Emerging environmental contami-

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<sup>1</sup> gabor.gy@citromail.hu

nants (radioactive and/or toxic metals, hazardous waste, etc.) are either directly or indirectly (e.g. through the food chain) a potential danger to persons executing their work in these areas, as well as the local population.

As regards the polluting effects of the radioactive isotopes generated in nuclear fission, mainly Sr-90, Zr-95, Nb-95, Ru-106, I-131, Cs-137, Ce-144 as well as the U-235 and Pu-239 play an important role during the initial period of the fallout. During the latter period the long-term fallout fission products, such as Sr-90, Cs-137, pose a potential threat.

The Toxicology Research and Radiobiology Research Departments of the Scientific Institute (Health Protection Institute of the Home Defence Forces) in cooperation with the Ministry of Defence Military Technology Institute (respectively its successors), based on international recommendations, and their own research, have developed and compiled a Personal Radiotoxicological Kit, which includes all the drugs and the application methods meeting the requirements of the decontamination procedures.

The components of the kit can not only be used as a personal Radiotoxicological Kit, but they can also be made available on the pharmaceutical market individually.

The Personal Radiotoxicological (First Aid) Kit has been developed for emergency treatment of personnel contamination by inhalation or ingestion of iodine, strontium caesium, rare earths, plutonium, transplutoniums, and a mixture of fission products; as well as for the decontamination of already contaminated wounds with the above mentioned substances.

The Personal Radiotoxicological (First Aid) Kit was given a bronze medal at the Geneva International Innovation Salon, and it was also given the Grand Prize at the International Exhibition of Genius Inventions. (shown in Figure 5 and 6) The Personal Radiotoxicological (First Aid) Kit was put into service for the Hungarian Army in 2011.

The kit contains different types of substances according to the different areas of intended use.

Table 1. The Personal Radiotoxicological (First Aid) Kit should contain the following components

Item	Agents	Quantity	Format and Package	Total (piece)	Expiry date (year)
1. (KI)	<i>Jodecorp</i> Potassium iodide	(100 mg of iodide)	Tablet in foil package	3	2
2. (DK1A)	<i>Radecorp</i> Na-CaDTPA-salt	0,54 g	Inhalation aerosol	2	2
3. (DK1B)	<i>Radecorp</i> Na-CaDTPA-salt	0,50 g	10 ml liquid in plastic bottle (10 ml)	1	5
4. (DK2)	<i>Radistop</i> Prussian-blue	1 g	Paste in Tube (10 g)	1	5
5. (DK3)	<i>Raditox</i> Pectin *	5 g	Powder in foil package	1	5

\* Natural high molecular weight polysaccharide

## 1.) JODECORP — tablet:

Using potassium iodide tablets, taken orally, reduces the accumulation of thyroid iodine isotopes and helps to accelerate excretion of the radioisotope. [1]

## 2.) RADECORP — inhalation aerosol:

Pentasodium hydrogen bis (calcium pentetate) inhalation aerosol as a chelating compound binds and therefore reduces the absorption of consumed rare earth metals (e.g. cerium) and transuranium (e.g. plutonium), and it also increases their excretion. [2]

## 3.) RADECORP — topical solution:

Pentasodium hydrogen bis (calcium pentetate) solution can cleanse isotopically contaminated wounds and their surroundings. As a complexing compound this solution binds and thus reduces the possibility of the absorption of the rare earth metals (e.g. cerium) and transuranium (e.g. plutonium) through the injured skin. [2]

## 4.) RADISTOP — oral suspension:

Prussian blue 10 ml paste (white sealed capped PE tube) taken orally effectively reduces the absorption of radioactive caesium isotopes (e.g., Cs-134, Cs-137) in the body (lessening the amount of deposition) and increases the excretion rate of isotopes. [3]

## 5.) RADITOX — powder taken orally:

A defined composition, special pectin powder product (in alu-alu foil pouch), which dissolved in water turns into gel, should be taken orally. It primarily inhibits the absorption of the radioactive strontium and various radioactive and / or toxic metals (such as cadmium, mercury, lead, etc.) in the body (reducing the deposition rate), and increases the rate of excretion of contaminants. [4]

Table 2. Instruction for the users of the Personal Radiotoxicological (First Aid) Kit

Label	Radionuclide	Type of contamination	
		Wound	Ingestion or inhalation
1.	Iodine	Swallow 1 tablet with a little water (up to 3x1 Jadecorp tablets/day)	
2. 3.	Rare earths Transuranium	Wash the wound Radecorp (3) solution	Inhale Radecorp (2) (if necessary repeated transmission)
4.	Caesium isotopes	1 tube Radistop was (perhaps mixed with a little water) directly into the (up 3x1 tube/ days)	
5.	Strontium isotopes	Swallow 1 bag Raditox mixed with a little water (up to 3x1 bag / day)	
Mixture of fission products		Continue all instructions for 1–5 days depending on the type of contamination	

The body of the Personal Radiotoxicological (First Aid) Kit and the pharmaceutical inventory (medication set) of 1–4. shown in Pictures.



Picture 1. Personal Radiotoxicological (First Aid) kit external form



Picture 2. Personal Radiotoxicological (First Aid) kits health (medicament) products





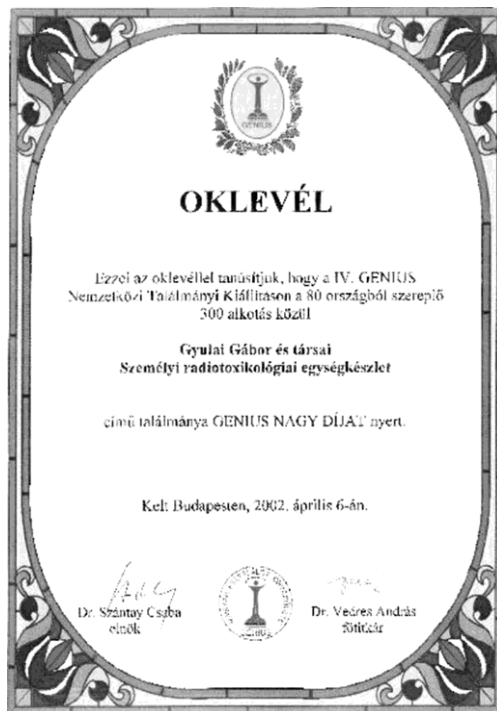
Picture 3. Personal Radiotoxicological (First Aid) kits health (medicament) products



Picture 4. Personal Radiotoxicological (First Aid) kits health (medicament) products



Picture 5. Geneva International Innovation Award



Picture 6. International Exhibition of Inventions Genius Grand Prize

The main application areas of Personal Radiotoxicological (First Aid) Kit

*a) The nuclear power industry*

**Nuclear testing, reactor accidents**

Once radionuclides have entered the body (mainly by inhalation, or digestion or through wounds) they quickly get into the bloodstream reaching their final place of deposition. Consequently for effective treatment it is essential to start the detoxification process as soon as possible. The immediate usage of the Personal Radiotoxicological (First Aid) Kit makes this rapid treatment possible, enhancing the effectiveness of the applied methods.

**Maintenance and rescue operations**

In these cases, the primary task is to prevent any external and internal contamination, aiming to prevent or reduce the contact of the radioactive material with the body or its ingestion.

Maintaining relevant health and technical safety regulations — such as the use of individual and collective protection equipment, instrument control, possibility of immediate decontamination or prophylactic medication is essential. The immediate application of the Personal Radiotoxicological (First Aid) Kit can contribute to the success of this process.

The Personal Radiotoxicological kit contains all the ingredients and treatment methods which are necessary for the prophylactic treatment of the population at risk, as well as the possible therapeutic treatment of post-intoxication.

*b) Research, diagnosis, therapy area*

During the performance of the above mentioned activities one of the most important tasks is to prevent accidental/incidental internal and external contamination. Both the personnel involved and the patients receiving the treatment are to wear the necessary protective equipment and keep the safety regulations. The use of the Personal Radiotoxicological (First Aid) Kit provides both prophylactic and therapeutic drug management options.

*c) Acts of terrorism*

Terrorist acts (e.g. the Tokyo subway gas poisoning, September 11<sup>th</sup> attacks in the US.) clearly demonstrated that the world should be prepared for unexpected events, which are likely to be unavoidable. To prevent or to reduce personal and property damage caused by unavoidable terrorist attacks it is necessary to have a well prepared and competent body of professionals, with adequate financial and technical support. To achieve these goals is both an important national and international interest.

*d) Local wars*

In this case, primarily different terrorist attacks (e.g. anti-government rebellions in Syria or ethnic riots) should be taken into consideration.

*e) Other (e.g. natural disaster) cases*

These events include damage caused by natural disasters (earthquakes, floods, hurricanes, etc.), or accidents (e.g. Fukushima reactor accident). Chemical plants, and the environmental pollution caused by heavy traffic also pose a potential threat.

## Conclusions and recommendations

During the operation of the nuclear energy industry, and nuclear explosions the external and internal radiation exposure (fall-out fission) and the possibility of incorporation is to be reckoned with at all times.

It is advisable, therefore, for all parties potentially involved in possible radioactive contamination to possess or to have access to a Personal Radiotoxicological Kit for self-help. The user of the kit may also be able to provide further help to those exposed to contamination.

In the following years, further research tasks are deemed necessary to develop therapeutic procedures, which ensure higher levels of health care (medical aid facilities, hospitals). This research should enhance the efficacy of decorporation of the radioactive and/or inactive toxic metals, also in the case of mixed metals they should determine the effective and appropriate medical treatment.

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# The National Environmental Protection Programme of Hungary

KIROVNÉ RÁCZ Réka Magdolna<sup>1</sup>

*The statements relating to climate change draw attention to the necessity of the distribution of knowledge relating to climate change among the population and within the education system, starting from elementary school up to higher-level institutions on different levels.*

*Decree OGY Nr 96/2009 (XII.9.) on the National Environmental Protection Programme (hereinafter referred to as: Programme) discusses the necessary steps and tasks in a separate chapter in order to achieve the strengthening of environmental-ly conscious thinking and attitudes.*

*Below I present the findings of the Programme in relation to environmental education and training, which are integrally connected to the role of climate protection education.*

*The draft of the special policy strategy of the 4<sup>th</sup> National Environmental Protection Programme for the period 2014–2019 was made in October 2013.*

## Introduction

The relation between humans and nature and its quality are in the long run influenced by social values and the production and consumer habits deriving from them.

Environmental consciousness has to be made an integral, determining element of social values so that the cause and effect relations are clear to everyone.

The system approach of people in this regard shall be formulated so that the burden on the environment will be the least, with regard to both social and business activities (emissions of hazardous substances, reduction in waste production, and economic utilization of resources).

To be successful in the formulation of an environmental attitude it is essential that everybody sees its necessity and understands the knowledge, and should be ready for changes, through small yet determined steps in the interest of an environmentally conscious lifestyle.

The main goals of the National Environmental Protection Programme are as follows [1]:

- establishment of environment education, attitude formulation in the complete process of lifelong learning;
- sustainable production processes and consumer habits gaining importance;
- development of systems ensuring sustainable production processes, more effective dissemination of information.

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<sup>1</sup> National University of Public Service, Budapest, Hungary, email: raczreka1@gmail.com

## **Programme on Environmental Education, Attitude Formulation**

Environmental education promotes the establishment of an environmentally conscious attitude for all age groups, just as personal role models, its influence on the generations growing up and the gained knowledge will be capable of becoming determining in their lifestyle and decisions.

The values of persons and also of the society are also formulated in case of successful environmental attitude formulation.

The Programme considers it a future goal to create an effective information and cooperation system from the nurseries up to high-level education and adult training through creating an environmental knowledge chain. It is taken as an important token of success that each age group is encouraged to have an environmentally conscious attitude and be interested in the establishment and safeguarding of the appropriate state of the environment, and for the formulation of sustainable consumer habits.

## **Programme in Public Education**

Several positive initiatives could be incorporated into the educational work and syllabus through the legal environment and institutional conditions of public education, for this reason public education can set this as a primary target area.

Pursuant to Act on Public Education it has become compulsory for all schools to establish a local environmental education and health education programme.

Qualification frame systems on a national level to promote the strengthening of environmental consciousness have been established and operated, such as “green kindergartens”, “eco-schools”, and “forest-kindergartens” and “forest-school” programmes.

In such establishments bigger emphasis is placed on environmental education and attitude formulation, and these must also take the environmental aspects into account.

Each establishment has different needs and possibilities to join and be a part of real development work. Due to this, the Programme makes it necessary to establish a support system on a medium level serving the strengthening of environmental consciousness.

The goals are set as follows:

- strengthening an environmentally conscious attitude and practice in the operation of schools;
- extension of educational supplementary materials with knowledge on environmental consciousness and sustainability;
- strengthening the activities in the education process, which establish responsible behaviour towards the environment, strengthening the activities offering practice and knowledge, and improving skills;
- maintaining and extending existing programmes;
- strengthening the cooperation of schools, local communities and parents in order to sustain the results achieved.

## **Programme in Educational Institutions**

The Program draws attention to the fact that schools have to elaborate a concept and enforce it in the field of environmental education, which shall include making the operation environmentally friendly, starting with energy conservation and including the products sold in the snack bars.

E.g. reduction in energy and water use, increase of the products with low waste ratio sold in the snack bar, etc.

## **Program in Vocational Education**

The Program summarizes that module-type education and legal environment created in the field of environmental, nature protection and water vocational education provide an adequate basis so that those experts with such environmental protection vocational qualification enter the labour market, who are precisely aware of the term “sustainability” and have also acquired practice thereof.

*It points out that the improvement of environmental consciousness and the inclusion of sustainability-relevant knowledge in the different points of correlation both in the field of educational, and syllabus-development. Thereby environment conscious thinking can gain importance in the work performance of the different special fields and it can be prevented that environmental protection remain a separate profession.*

## **Programme in Higher Education**

The Program draws attention to the opportunities presented by the Bologna education system and the three-year revision of the training structure. Environmental protection aspects are better enforced, either with regard to the establishment of new faculties, or to the determination and accreditation of educational and graduation requirements.

These goals are set as follows:

- *all students shall receive special knowledge in environment and nature protection, water management — adjusted to the educational line;*
- students attending teacher training and continuing teacher training shall receive training on the significance of environmental consciousness, on the relevant knowledge, assisting in the accomplishment of environmental education;
- to enhance the educational level of specialists in environmental protection, and to train teachers who are capable of additional attitude formation;
- to increase the role of environmental consciousness in institutional performance goals and in contracts with bodies operating it.

## **Programme on the environmental attitude formulation**

The Program points out that the success of environmental protection relevant attitude formulation conducted in educational establishments is greatly promoted if the knowledge learnt in theory appears in the everyday routine as well.

If the players on different levels of society speak up for environmental protection matters, people will have a clear view on the state of their direct and wider environment, on the importance of ecosystem services, on the role of environmental protection, and they will learn the environmental, chemical and biological risks of products used every day, the consequences of their use, and thereafter the possibilities of reducing the risks.

*The Programme highlights that it is important to integrate the environmental aspects into the activities of certain industries and special fields.*

It reminds us that public collections (libraries, museums), public educational institutions and bodies can help, organise and formulate environmental education, attitude formulations in a direct and indirect manner.

It points out that the circle of cooperating partners in the field of environmental education and attitude formulation needs to be extended with the churches and media — beyond the civic bodies.

The Programme sets the goals as follows:

- environmental and nature protection should appear more focused in the lifelong learning process of the society;
- *strengthening of the relation of environmental and nature protection, of the interaction points with other special fields;*
- strengthening of the cooperation among public collections, public educational institutions and bodies, civil bodies, churches and media, helping their active participation in environmental education and attitude formulation.

## **Environmental Education**

Environmental education means education for culture, world-view and lifestyle. [2] It gives means into our hands so that we may protect our natural environment for future generations.

Education on the protection of environmental values contributes to the formulation of students' feeling of responsibility toward environmental problems.

Teachers, educators have the important task, on all levels of the educational system, to introduce the pupils and students to the beauty and variety of nature. Thereby affection, respect and responsibility for environmental values can be deepened in future generations.

## **Programme on the Role of the Media**

It is considered important to strongly show the issue of environmental consciousness in the programme and to present positive local examples and to critically present the environmental polluting and wasting processes.

It stresses the role that the media can improve the communication of the civil environmental protection bodies, can facilitate the flow of their information, and thereby can greatly promote the success of their work.

## **Summary**

I have presented above the most important statements of the National Environmental Protection Programme relating to education and attitude formation.



In summary I point out that the Programme draws attention to the fact that the improvement of environment consciousness and the inclusion of sustainability–relevant knowledge in the different points of correlation both in the field of education and syllabus development are important in cases of all special education. Thereby environmentally conscious thinking can gain importance in the work performance of the different special fields and it can be prevented that environmental protection remains a separate profession.

In the field of higher education it is considered a goal to be attained that all students shall receive special knowledge in environment and nature protection, water management — adjusted to the educational subject. The support of talent care programmes connected to environmental and nature protection, the elaboration and conduct of the award system of the National Scientific Student Conference, special studies and dissertations, and doctoral thesis represent an additional goal.

The Programme points out that it is important to integrate environmental aspects into the activities of certain industries and special fields, and the relations of environmental and nature protection, and points of connections shall be strengthened throughout all special fields. [3]

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# Modification of the Radioactive Wastewater Treatment Technology in the Hungarian Nuclear Power Plant Paks

PÁTZAY György<sup>1</sup>

*This paper describes the results of a joint research program of the Budapest University of Technology and Economics and the Paks Nuclear Power Plant (NPP) to modify the radioactive wastewater treatment technology for the evaporator bottom tanks in the NPP. The main characteristics of the modified technology were that we first removed all the long life radioactive isotopes with an underwater plasma torch reactor (UPTR), micro and ultrafiltration and a cesium selective ion exchanger stable at pH~12–13. After the separation of precipitated borate crystals, the remaining liquid was released as chemical waste.*

## Introduction

There are about 6000 m<sup>3</sup> of concentrated evaporator bottom as liquid radioactive waste in the tanks of the Hungarian NPP Paks. A liquid waste treatment technology was developed for the separation of the long life radioactive isotopes (<sup>134</sup>Cs, <sup>137</sup>Cs, <sup>60</sup>Co etc.) from the inorganic chemicals borates and nitrates. The radioactive liquids contain these radioactive isotopes with 10<sup>4</sup>–10<sup>6</sup> Bq/L activity concentrations, dissolved salts with about 400 g/L and organic complex builders (ethylene–diamine–tertaacetic acid (EDTA), citrate and oxalate). The treatment of this type of wastewater is complicated [1–4]. The original treatment technology starts with the underwater plasma torch reactor (UPTR) destruction of the organic complex builders followed by crystallization of inorganic borates using nitric acid acidification. The resulting liquid is then treated by a cesium selective ion exchanger CsTreat. The separated inorganic precipitation contains (~6–11%) radioactive isotopes and colloid iron from the original waste so unrestricted release of these solids as chemical waste is impossible without further washing.

To solve this problem we have developed a modified technology suitable to produce non-radioactive crystals and liquid for unrestricted release.

## The modified technology

The main characteristics of the modification were, that after the destruction of the organic complex builders using UPTR, we removed all the long life radioactive isotopes from the evaporator bottom using micro and ultrafiltration and then a cesium selective ion exchanger, stable operating at pH~12–13. After these radioactivity separation steps we separated the

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<sup>1</sup> patzay.gyorgy@uni-nke.hu

alkali borates by crystallization using nitric acid acidification. The radioactivity of the separated inorganic borates was at unrestricted release level and the radioactivity of the liquid was lower than 290 Bq/L. We tested the modified technology steps under laboratory conditions using 1 L batches and followed testing at the NPP using 20 L batches. After successful tests the wastewater treatment system was built and started to work in the NPP. [1]

## Laboratory Experiments

In our laboratory experiments we used evaporator bottom samples pre-treated in the NPP by UPTR. After this treatment the cobalt ions bound to EDTA and other organic complex builders were oxidized and the radioactive cobalt content was filtered out.

First we investigated the crystallization parameters of a non-radioactive model solution of the evaporator bottom. The model solution contained sodium borates, nitrate and free sodium hydroxide at a total dissolved solid, TDS~400 g/L. The thermostated crystallizer with stirrer, temperature and pH meter and acid dose system is shown in Picture 1. The thermostat, at 27°C 1 L model solution, was stirred at 300 rpm. After reaching a steady state condition we started the dose of 65 m/m% nitric acid with an average flow rate of 1.247 cm<sup>3</sup>/min and measured continuously the temperature and the pH values in the liquid phase. The acidification was stopped after reaching a pH value of 9.8. The crystallization experiments with simulated solutions were repeated three times. A typical acid volume–pH curve is shown in Figure 1.



a)



b)

Picture 1. The thermostated crystallizer with stirrer, pH-meter and acid dose system  
a) at the starting time, b) at the end of crystallization (source: PÁTZAY Gy.)

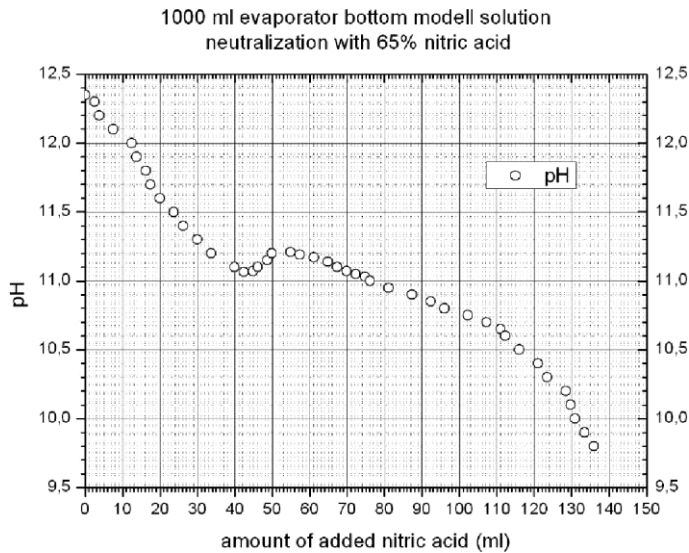
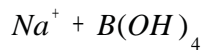


Figure 1. Neutralization of the evaporator bottom model solution  
(source: PÁTZAY Gy.)

At pH=11.3 the colour of the solution changed to yellow, at pH=11.07 the crystallization started and white crystals accumulated at the lower part of the reactor. The pH and the temperature of the solution increased slightly after a 40 cm<sup>3</sup> nitric acid dose, because during the dilution sodium borate dissociated and sodium hydroxide generated [2] according to the following equation:



Finishing the acid dose we stirred the solution and the crystals for an additional 30 minutes. Then we filtered the crystals and dried them at 96°C for 12 hours. According to the material balance we introduced into the reactor 366.1 g dissolved salt and 848.89 g water, then added 121.84 g nitric acid and 65.60 g water (altogether 1402.43 g materials) and separated

206 g dry crystals and 1042.5 g liquid (altogether 1402.3 g materials).

Based on the nonradioactive experiments with simulated solutions, the second step was we investigated the selective separation of cesium radioactive isotopes from the evaporator bottom samples pre-treated in the NPP by underwater plasma torch.

6 L of evaporator bottom solution was treated by 1.5 cm<sup>3</sup> cesium selective ion exchanger with 10 bed volume/hour (BV/hour) fluid flow and the effluent solution was controlled by an ORTEC GMX25P4-76C Gamma-X HPGc coaxial detector with a 25% relative efficiency and an ORTEC DSPEC-jr-2.0 pro and DigiDart MCA (multichannel analyzer). The gamma-spectra were evaluated by a Gamma Vision – 32 software. The measured <sup>137</sup>Cs breakthrough curve is shown in Figure 2 as the breakthrough in percent and as the function of ion exchanged solution in bed volumes unit. The cesium breakthrough (0.1%) is reached after 3800 BV.

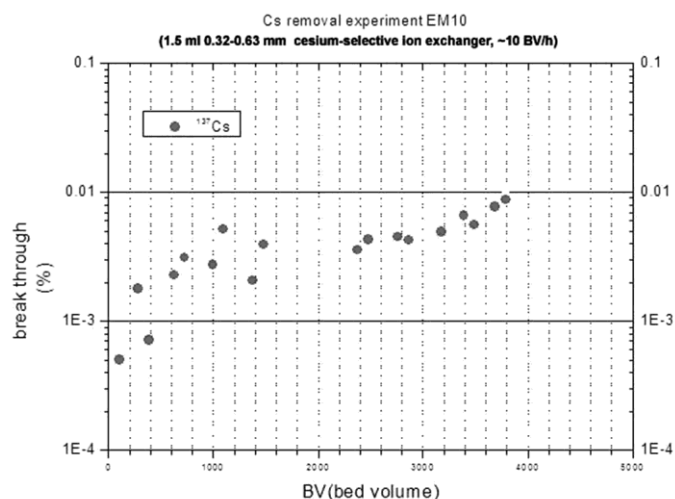


Figure 2. The ion exchange breakthrough curve for the pre-treated evaporator bottom (source: PÁTZAY Gy.)

1 L of ion exchanged solution was then stirred at 300 rpm and thermostated at 27°C. We used this operating temperature, because at the NPP the conditions are similar. After reaching steady state condition we started the dose of 65 m/m% nitric acid with an average flow rate 1.0 cm<sup>3</sup>/min and measured continuously the temperature and the pH values in the liquid phase. The acidification was stopped when a pH value of 9.7 was reached. The crystallization experiments with radioactive evaporator bottom solutions were repeated three times. The measured acid volume–pH curves were similar to Figure 2.

Finishing the acid dose we stirred the solution and the crystals for an additional 30 minutes, then we filtered the crystals and dried them at 96°C for 12 hours. In this experiment we separated as on an average 206 g dry crystals and 1042.5 g of liquid. The radioactivity of the liquid and the dry crystals was at the background level.

We repeated the crystallization with the original technology too, i.e. without preliminary cesium selective separation, but the resulting borate precipitate contained about 6–11% of the original radioactivity (in the case of <sup>137</sup>Cs ~8700–10240 Bq/kg) and the precipitation had a yellowish–brown colour, caused by colloid iron precipitation. Washing the radioactive crystals with ~50% by volume water, the crystals were suitable for unrestricted release.

We also investigated the mass balance of separated crystals at different drying temperatures [3]. Starting with 288 g of wet mass, drying at 35°C for 48 hours we got 194 g dry crystals and part of the crystals were further dried at 65°C, 80°C and 105°C for 48 hours resulting in 126.93 g, 123.319 g and 120.19 g dry crystals respectively. Plotting the mass decrease as a function of temperature together with an exponential curve fit the results and are shown in Figure 3.

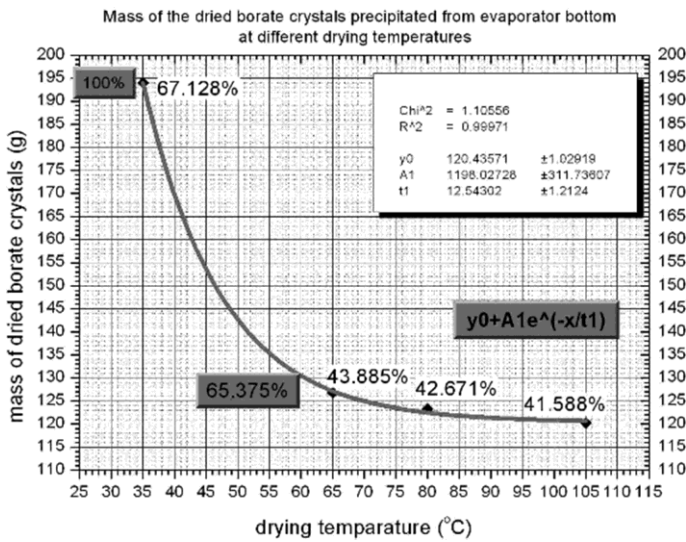


Figure 3. Mass of dried sodium borate crystals as a function of temperature (source: PÁTZAY Gy.)

According to our drying experiments we found that drying at 35°C results in a mass with 67.13% of the original wet precipitation, drying at 65°C the remaining mass is 43.89%. According to the solubility of sodium metaborate ( $\text{NaBO}_2 \cdot 8\text{H}_2\text{O}$ ) as a function of temperature (Figure 4.) above ~55°C  $\text{NaBO}_2 \cdot 8\text{H}_2\text{O}$  releases four water molecules, which results in  $\text{NaBO}_2 \cdot 4\text{H}_2\text{O}$ , whose mass is 65.675% of the octahydrate compound. This mass decrease is in coincidence with the observed value at 65°C. Drying the sodium metaborate crystals below 55°C does not release bounded water [4].

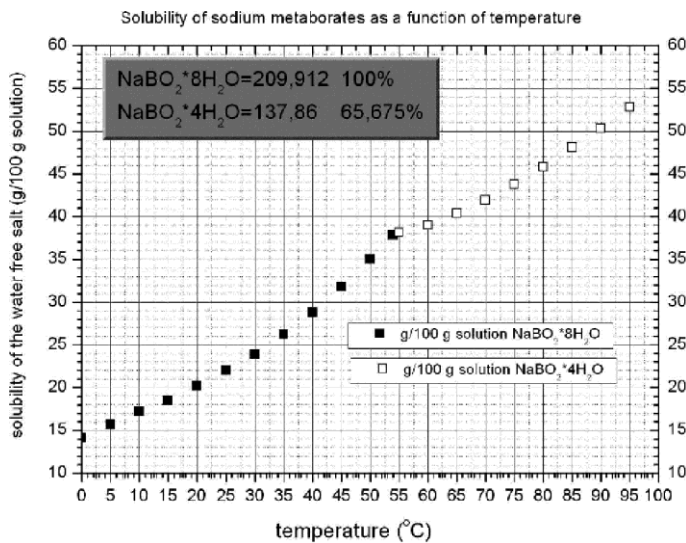


Figure 4. Solubility of sodium metaborates as a function of temperature (source: PÁTZAY Gy.)

## Experiments in the NPP Paks

In the third step we repeated the investigation of the NPP using 20 L batches of evaporator bottom samples pretreated by UPTR. First the solution was microfiltered by 100 mm and 1 mm filters then ultrafiltered by a 20 kDa molecular weight cutoff (MWC) membrane filter with a 50–50 L/h permeate flow rate. According to our gamma spectrometry measurements we found that microfiltration removes only 10–20% of the remaining cobalt content. The results of the ultrafiltration experiment are shown at Table 1.

Table 1. Ultrafiltration of the evaporator bottom pretreated by UPTR and microfiltration (source: PÁTZAY Gy.)

Fluid flow	<sup>60</sup> Co activity concentration (Bq/kg)	%	<sup>134</sup> Cs activity concentration (Bq/kg)	%	<sup>137</sup> Cs activity concentration (Bq/kg)	%
Feed	294*	100	1330	100	180000	100
Permeate	260	88.4	1300	97.7	176000	97.7

Following the ultrafiltration, 60 L ultrafiltered evaporator bottom solution was treated by 60 cm<sup>3</sup> cesium selective ion exchanger, stable at pH>12, with 10 BV/hour fluid flow. The effluent solution was controlled by the same ORTEC GMX25P4–76C Gamma–X HPGe coaxial detector, jr–2.0 pro and DigiDart MCA and the gamma–spectra were evaluated by a Gamma Vision – 32 software too. After passing 1000 bed volume solution we could not reach breakthrough.

Following the cesium separation, 60 L of ion exchanged solution was then stirred at 300 rpm and thermostated at 30°C. After reaching a steady state condition we started the dose of 65 m/m% nitric acid with an average flow rate 21 cm<sup>3</sup>/min and measured continuously the temperature and the pH values in the liquid phase. The acidification was stopped at a pH value 9.0–9.7 adding 1800–2200 cm<sup>3</sup> concentrated nitric acid to the stirred solution. The measured acid volume–pH curves were similar to Figure 2.

Finishing the acid dose we stirred the solution and the crystals for 30 additional minutes, then we filtered the crystals and dried at 96°C for 12 hours. In this experiment we separated on an average 3800 g dry crystals. The radioactivity of the liquid and the dry crystals was at the background level.

We repeated the crystallization in the NPP according to the original technology, with- out preliminary caesium selective separation , but the resulting borate precipitate contained about 6–11% of the original radioactivity (in the case of <sup>137</sup>Cs ~8700–10240 Bq/kg) and the precipitation had yellowish–brown colour, caused by colloid iron precipitation. Washing the radioactive crystals with ~50% volume by water, the crystals were suitable for unrestricted release. In Table 2. we compare the analytical compositions of the liquid after crystallization.

Table 2. Analytical composition of the mother lyes from the original and the modified technology (source: PÁTZAY Gy.)

Parameter	Unit	Liquid modified technology	Liquid original technology	Remark
Boric acid	g/dm <sup>3</sup>	19.5	21.2	Nearly the same
Chloride	mg/dm <sup>3</sup>	67.8	164.2	Original higher
Nitrate	g/dm <sup>3</sup>	86.5	85.9	Nearly the same
pH		9.6	9.9	Nearly the same
ICP <sup>2</sup> -analysis				
Ag	mg/dm <sup>3</sup>	<0.01	<0.01	Nearly the same
Ba	mg/dm <sup>3</sup>	<0.01	<0.01	Nearly the same
Cd	mg/dm <sup>3</sup>	<0.01	<0.01	Nearly the same
Co	mg/dm <sup>3</sup>	3	6.4	Original higher
Cr	mg/dm <sup>3</sup>	32.8	33.7	Nearly the same
Cu	mg/dm <sup>3</sup>	0.5	0.5	Nearly the same
Fe	mg/dm <sup>3</sup>	27.3	0.58	Modified higher
Mn	mg/dm <sup>3</sup>	<0.01	<0.01	Nearly the same
Na	g/dm <sup>3</sup>	27	30	Nearly the same
Ni	mg/dm <sup>3</sup>	5.53	5.68	Nearly the same
Pb	mg/dm <sup>3</sup>	1.05	2.08	Original higher
Zn	mg/dm <sup>3</sup>	0.23	0.11	Modified higher
As	mg/dm <sup>3</sup>	0.10	0.10	Nearly the same
Mo	mg/dm <sup>3</sup>	2.23	2.39	Nearly the same
Sn	mg/dm <sup>3</sup>	0.35	0.08	Modified higher
Hg	mg/dm <sup>3</sup>	0.1	0.08	Nearly the same

It can be seen that the iron content remains in the liquid in the modified technology while precipitates together with the borates in the original technology caused a yellowish–brown colour of the precipitated crystals. The measured average activity concentrations in the liquid and the separated dry crystals are summarized in Table 3.

Table 3. Measured average activity concentrations in the mother lyes and in the separated dry crystals in the original and in the modified technology (source: PÁTZAY Gy.)

Experiment	Activity concentration in the liquid (Bq/g)	Activity concentration in the dry crystals (Bq/g)
1 L original technology	170 000	102 000
1 L modified technology	0.250	~0
20 L original technology	175 000	105 000
20 L modified technology	0.290	~0

2 ICP– inductively coupled plasma



More detailed radioactivity analysis results are seen at Table 4.

*Table 4. The measured activity concentrations in the dry separated crystals in the modified technology (source: PÁTZAY Gy.)*

<b>Radionuclide</b>	<b>Measured specific activity (Bq/g)</b>	<b>Unrestricted re-lease limit (Bq/g)</b>
<sup>51</sup> Cr	1.42E-02	30
<sup>54</sup> Mn	1.19E-03	1
<sup>58</sup> Co	1.01E-03	1
<sup>59</sup> Fe	1.93E-03	0.9
<sup>60</sup> Co	1.17E-03	0.9
<sup>65</sup> Zn	2.66E-03	2
<sup>95</sup> Nb	1.10E-03	0.9
<sup>95</sup> Zr	1.81E-03	3
<sup>106</sup> Ru	1.15E-02	1
<sup>110m</sup> Ag	1.83E-03	0.9
<sup>124</sup> Sb	1.83E-03	0.9
<sup>125</sup> Sb	7.63E-03	1
<sup>134</sup> Cs	1.66E-03	0.9
<sup>137</sup> Cs	1.11E-01	2
<sup>144</sup> Ce	1.02E-02	30
<sup>154</sup> Eu	2.59E-02	0.9
<sup>3</sup> H	2.94E-02	2000
<sup>14</sup> C	1.91E-05	200
<sup>55</sup> Fe	3.01E-05	100
<sup>59</sup> Ni	6.20E-06	800
<sup>63</sup> Ni	2.72E-04	300
<sup>90</sup> Sr	3.19E-02	1
<sup>99</sup> Tc	7.19E-05	1
<sup>129</sup> I	1.24E-09	0.9
<sup>234</sup> U	4.69E-07	0.9
<sup>235</sup> U	1.71E-07	0.9
<sup>238</sup> U	1.09E-07	0.9
<sup>238</sup> Pu	4.83E-07	0.9
<sup>239,240</sup> Pu	3.62E-07	0.9
<sup>241</sup> Am	5.48E-08	0.9
<sup>242</sup> Cm	4.01E-07	0.9
<sup>244</sup> Cm	4.26E-07	0.9

## Summary

Based on our modification of the original wastewater treatment technology in the Hungarian NPP we get beneficial results, summarized as follows:

1. The use of the new cesium selective ion exchanger stable at  $\text{pH} > 12$  eliminates the acidification of the evaporator bottom before the cesium removal by ion exchange.
2. We can thus avoid the formation of borate crystals contaminated with radionuclides of cesium etc. and the additional washing of the separated crystals for the radioactivity removal.
3. According to measured specific activity data we could release the dried solid crystals from the NPP and could be used as non-radioactive borate chemical. For a practical aspect we compared the activity-concentrations of borax with the valid unrestricted release levels of general solid radioactive waste.

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# Large scale diesel oil burns

PIMPER László<sup>1</sup>, MÉSZÁROS Zoltán<sup>2</sup>, KOSEKI Hiroshi<sup>3</sup>

*Diesel oil was burnt in a 41.5 m diameter real oil storage tank. Thermal radiation and IR–image of the flame were obtained. Effects of wind direction for external thermal radiation were studied. Results of thermal radiation and IR–image are in good agreement with our previous results, and justified our previous results in large scale tanks, up to 50 m in diameter which were burnt on the ground.*

*Key words: tank fire, thermal radiation, radiant emittance*

## 1. Introduction

It is very important to understand the characteristics of a large petroleum fire in order to prevent loss caused by fire, explosion and other accidents in petroleum and chemical complexes. [1] Therefore, since Blinov and Khudyakov [2] there have been many studies of this topic. [3] [4] Currently the LASTFIRE project (Large Atmospheric Storage Tank Fires project [3]) concentrates on this topic. After serious fires in a refinery in Hokkaido, Japan in September 2003, we became much more interested in large scale petroleum fire phenomenon.

In order to understand the phenomenon of large scale petroleum burning in a tank, diesel oil was burnt in a real oil storage tank at MOL Plc. Duna Refinery in Hungary, and external thermal radiation was measured to compare our previous results of large petroleum fire tests, especially effects of wind direction and its speed.

The original aim of the experiments was to test the high–capacity mobile equipment, the latest foam agents and modern firefighting tactics in real conditions. However, taking into consideration the uniqueness of the firefighting experiments, various measurements and data recording were carried out. Related to other research, detailed processing of the measurement results has come to the fore recently, and we shall publish the findings of the analysis in this publication.

## 2. Experiments

Experiments were conducted using Tank No. 20.008 at a tank yard of MOL Duna Refinery in Százhalombatta, Hungary. The size of the burning tank was 41.5 m in diameter and 16.0 m height. Table 1 shows a summary of the test. Brief layouts of the test site are shown in Figure

1. There is 40 m space between the burning and adjacent tanks, No. 20.007 and No. 20.009. Burnings of diesel oil were conducted twice, but thermal radiation and IR–camera measurements were done only at the second run.

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1 FER Fire Brigade, Hungary, lpimper@fer.hu

2 FER Fire Brigade, Hungary, zmeszaros@fer.hu

3 National Research Institute of Fire and Disaster (NRIFD), Japan

The records, photographs and video footage documenting the experiment are available at FER Fire Brigade, Hungary.

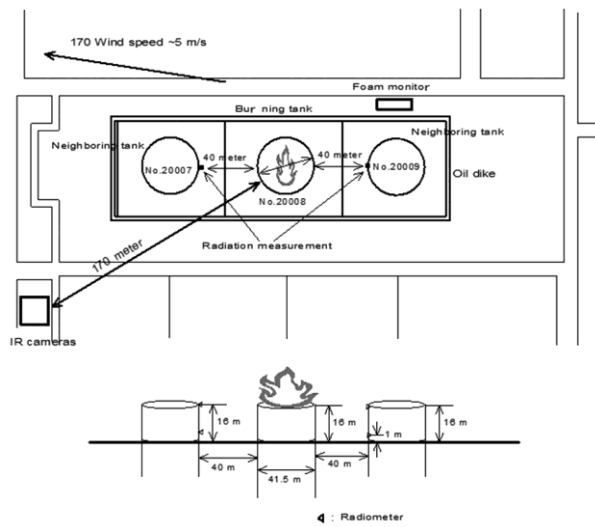


Figure 1. Layouts of burning tank and measurements  
(Created by the authors)

Table 1. Summary of the burnings

	Burn 1	Burn 2
Date	26 April, 2005	19 May, 2005
Fuel	Diesel oil	Diesel oil 42kL
Weather conditions	NA	18°C, WP: <5m/s
Measurements	Picture, Video	Thermal radiation, IR-camera, Picture, Video

WP: wind speed NA: no data

## 2.1 Weather conditions of second run

Burning of diesel oil was conducted under mild weather conditions. There was a slight rain at the ignition of the second run. The ambient temperature was about 18°C at the moment of ignition, and wind speed was 2~5 m/s at the start of burning.

## 2.2 Fuel

Half-refined diesel oil was used for the burning, of which specifications are shown in Table 2. It is slightly heavier than diesel oil for automobiles. In total 42 kL diesel oil (= 34 mm depth in the tank) was used for burning which was floated above the water layer. 2 kL gas-oline was added into the fuel for easy ignition. Free board, which means vertical distance between the tank edge and the fuel surface, was about 0.5 m at the ignition.

Table 2. Fuel specifications

Density	807.3 kg/m <sup>3</sup>
Czetan index	60.4
Flash point	70.0°C by Tag closed cup method
Beginning of boiling	172.2°C
End of boiling	294.7°C

### 2.3 Thermal radiation

Thermal radiation from the fire was measured by four wide-angle radiometers, RE-3 (Tokyo Seiko Co.), specifications are shown in Table 3. Its outputs were calibrated with a black body heat source in NRIFD. They were placed at the top edge and on the dog-run<sup>4</sup> of the adjacent tanks to both leeward and windward directions. Data were taken every five seconds by a data acquisition system, and stored into a computer.

Table 3. Specifications of radiometer, RE-3

Detector	Thermopile coated with platinum black
Solid angle	120°
Heating surface area	100 mm <sup>2</sup>
Time constant	0.30 second

### 2.4 IR-image of the flame

IR-images of the flame were taken by IR-cameras, IWS-100 (Nippon Avionics Co.), of which specifications are shown in Table 4. It gave the apparent temperature in IR-image of objects following Stefan-Boltzmann's Law. Outputs were calibrated with a black-body source. Horizontal distance between the tank and the IR-camera was about 170 m. Ten to fifteen IR-images were taken per second.

Table 4. Specifications of IR-camera, IWS-100

Detector	In-Sb (Indium-Antimonide)
Detector cooling system	Electro-cooling
Time constant	< 0.1 second
Spectral range	3-5.4 μm
Field of view	15° × 20°
Display resolution	120×160
Range of temperature	-30 to 920°C
Minimum detectable temperature	0.2°C

<sup>4</sup> A "dog-run" is a built-up walkway around the perimeter of the tank shell at or near ground level.

## 2.5 Extinguishments

After enough pre-burn for measurements had been conducted, extinguishment was done by a large fire-fighting monitor (capacity: 20 000 L/min). 1% AFFF foam was used. The fire was extinguished in 72 seconds.

## 3. Results and discussion

An example of the pictures of the burning is shown in Picture 1. It was taken just before the extinguishment was started. The flame was tilted by cross-wind and huge smoke was produced.



Picture 1. Picture of the flame (Source: FER Fire Brigade)

### 3.1 Shape of the flame

As shown in Picture 1, the flame was mostly covered with black smoke and was tilted by cross-wind. Based on about 10 pictures of IR-image and normal camera, flame height and its tilt angle was estimated. Flame height,  $H_f$ , was about  $1.5D (\pm 0.2)$ ;  $D$  is the tank diameter. Its tilt angle was  $30^\circ (\pm 5.2)$ . According to Yumoto, tilt angle of the flame,  $\theta$ , can be calculated with wind speed by the following equation [5].

$$\tan \theta = (U^2 / D)^{0.38} \quad (\text{for gasoline fire})$$

Here,  $U$  is the wind speed, and  $U^2/D$  is the Froude number. When  $U=5$  m/s,  $D=41.5$  m,  $\theta$  is calculated to be  $39.5^\circ$ . It is larger than the observed value.

### 3.2 Burning rate (Fuel level regression rate)

It is quite difficult to define the accurate burning rate of diesel oil,  $v$ , because fire-fighting foam was applied onto the tank after about three minutes pre-burn. However, we estimated the burning rate with flame height by the equation of Zukoski [6] that should be applied into such large pool burn. Heat of combustion of diesel is 40 MJ/kg.

$$H_f / D = 3.3 (Q^*)^{2/3}$$

$$Q^* \cong Q / D^{5/2} / 1000$$

Results of calculations;  $Q=3400$  MW,  $Q^*=0.31$ , and  $v=2.9$  mm/min. These numbers are acceptable compared to our previous results [7, 8], where  $v=2.5$  to  $2.9$  for crude oil burns [1].

### 3.3 Thermal radiation from the fire

Thermal radiation from the fire was measured by wide-angle radiometers, RE-3. Results are shown in Figure 2(a) and (b). It needed dozens of seconds for the fire to spread over the fuel surface; even though a small amount of gasoline was added. 150 seconds after ignition, the thermal radiation reached its maximum value, and extinguishment was started after around 170 seconds. Thermal radiation at the top of the adjacent tank was about three times as much as thermal radiation at the dog-run of the same tank. To explain these results angle factor was very useful, which was used to estimate thermal radiation with the solid flame model. [1][4][6] This model explains radiant emittance of the flame time's angle factor for thermal radiation to any place from the flame. Angle factors between the flame and radiometers are 0.15 for top of the adjacent tank, and 0.05 for the dog-run of the neighbouring tank; respectively when there was no wind effect. So this difference of angle factors can explain the results of thermal radiation.

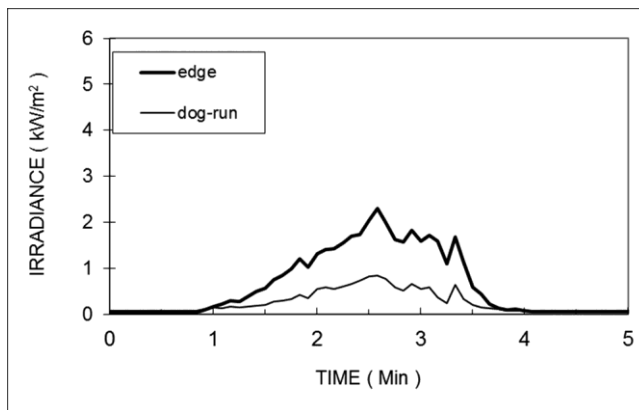


Figure 2(a). Thermal radiation from the flame towards windward direction  
(Created by the authors)

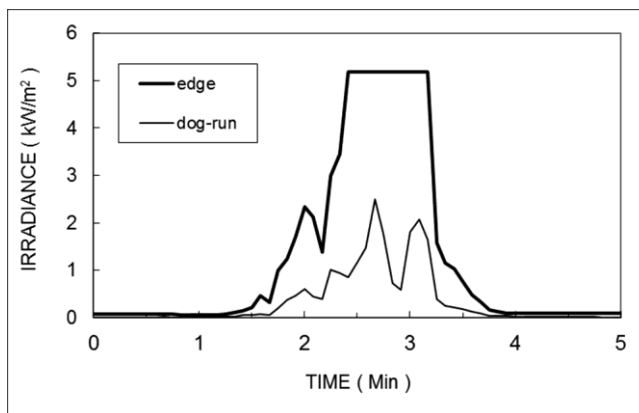


Figure 2(b). Thermal radiation from the flame towards leeward direction  
(Created by the authors)

On the other hand, thermal radiation towards the wind was smaller than that of leeward because the flame was tilted in windward direction. Based on data of thermal radiation from the flame, effect of wind direction was studied. Table 5 shows the results. At t=105 seconds, thermal radiation windward was slightly larger than that leeward. This reason might be that ignition and fire-fighting were done from windward for safety reason. After full burning (t=135 second), thermal radiation leeward was twice as much as that in a windward direction. And for both directions thermal radiation at the top of the tanks were about three times as that at the dog-run.

Table 5. Thermal radiation from the flame (Unit: kW/m<sup>2</sup>)

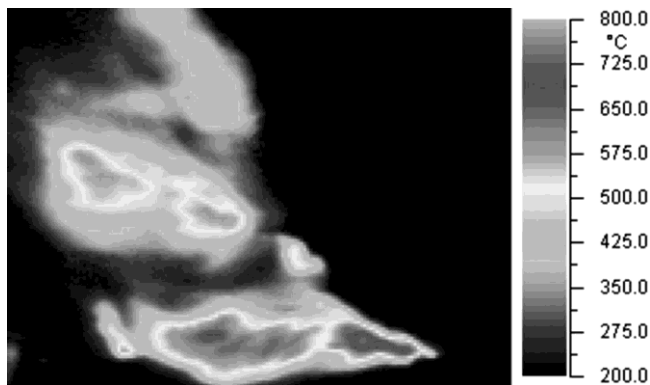
Time from start (s)		t= 105 (s)	t= 135 (s)
Windward direction	Top of tank	1.0	1.56
	Dog-run	0.34	0.61
Leeward direction	Top of tank	1.1	3.1
	Dog-run	0.24	1.1

### 3.4 IR-image of the flame

IR-images of the flame were obtained by IR-cameras. It shows the profile of radiant emittance of the flame. Here we assumed that emissivity of the flame was equal to 1 because flame size was large enough. [2]

An example of IR-images is shown in Picture 2. The maximum temperature of the flame obtained by IR-camera was about 900°C, which was equal to 107.4 kW/m<sup>2</sup> (or 8.5 kW/m<sup>2</sup>sr) of radiant emittance of the flame. This is slightly lower than our previous data in 20 m crude oil fires, where the maximum emittance was about 120 kW/m<sup>2</sup>. [5]

There was a strong, steady radiant emittance zone at the flame base, and occasionally a strong fire ball shape emittance zone existed at the middle of the flame. Based on normal video tapes, it appeared every 2.5 seconds. Others of the flame were mostly covered with a thick smoke layer, of which radiant emittance was 5–20 kW/m<sup>2</sup>, compared between normal video and IR-image.



Picture 2. Example of IR image of the flame (Source: FER Fire Brigade)



Figure 3 shows relationship between the average radiant emittance of the centreline of the flame and the dimensionless height ( $H_f / D$ ). Height of the strong, steady radiation zone near the flame base was about 5 meters ( $= 0.12 D$ ,  $D$ ; tank diameter). About 20–30 % of the total thermal radiation from the flame was emitted from this zone. The highest radiant emittance zone, except for the flame base zone, was about 20–30 m ( $= 0.5 \sim 0.75 D$ ,  $D$ ; tank diameter) high from the flame base.

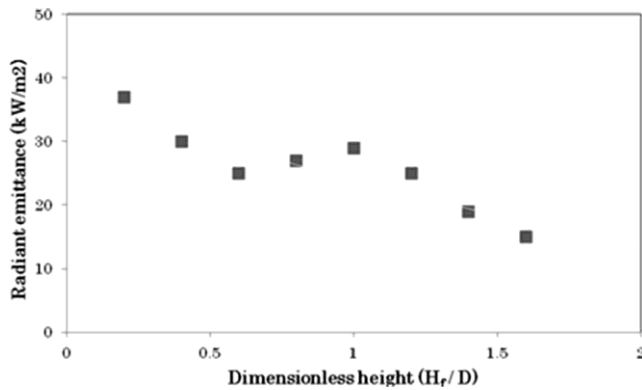


Figure 3. Relationship between radiant emittance of the centreline of the flame and dimensionless height ( $H/D$ ) (Created by the authors)

Average surface emissive power of the flame was calculated with these data. Though, from previous kerosene fires (Tank diameter  $D=30$  m and 50 m [6]) we had data of 20–30  $\text{kW/m}^2$ , this time our data gave 20~30  $\text{kW/m}^2$  in average.

#### 4. Conclusions

Diesel oil was burnt in a 41.5 m diameter tank, which might be one of the first trials when a real oil tank facility was used. Based on the data, we obtained the following results:

- a. Thermal radiation leeward was much larger than that windward, even though huge smoke existed around the flame leeward.
- b. Thermal radiation at the top of the tank wall of the adjacent tank was much larger than that of the dog-run of the same tank.
- c. A strong radiant emittance zone existed at the flame base, and sometimes a kind of fire ball appeared through the thick smoke layer.

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# The Modernization of the Armored Combat Vehicle Fleet of the Hungarian Defense Forces in Terms of Mobility

KOVÁCSHÁZY Miklós<sup>1</sup>

*The Hungarian Defence Forces (Magyar Honvédség) have several off-road combat vehicles of different ages and condition. One can find tracked- and wheeled equipment, such as battle tanks, armored infantry fighting vehicles, armored personnel carriers, special purpose vehicles, and engineering machinery among them. Some of these devices are now obsolete, the exchange of the rest is becoming due. This study looks at the armored combat vehicle portfolio of the Hungarian Defence Forces, seeking an answer to the question what the role of the mobility of armed forces is; are only wheeled or tracked equipment needed, or both. I am going to re-view, on the basis of the main sources of literature, what results have been achieved in national military-technical life, in the field of mobility, by comparison and an examination of a selection of military use off-road vehicles.*

*Keywords: armored fighting vehicles, combat vehicle, armored infantry, off road mobility, cross country mobility, selection, comparison, exchange*

## The modernization of the Hungarian Defense Forces, the condition of the armored fighting vehicle fleet

With Hungary's NATO accession the Hungarian Defence Forces targeted the creation of a smaller but more efficient army which can facilitate the avoidance of armed conflicts, and which is able to protect the country and fulfill its international obligations independently or in alliance. As a result of the 23<sup>rd</sup> July 1999 decree of the government, a strategic review of the Army has been completed. A development program started based on this, during which the flexible development of the existing assets was the essence of modernization. [1] Today, the Hungarian military armament, the vehicle fleet and the equipment need renewal again. [2] Development of the land forces almost completely stopped in the '80s. The maintenance activities, as well as industrial-maintenance background have narrowed down, depletion of reserves was forced, which together led to the stop of inefficient operating techniques. [1] It can be stated as a general characteristics that the military utility of means is low. A significant number of them are obsolete, maintenance becomes more difficult to ensure, their operation is so uneconomical. Therefore it means the replacement definitely needs to be solved. [3]

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<sup>1</sup> M.Sc. mechanical engineer, National University of Public Service, Doctoral School of Military Engineering, denkmeyer79@gmail.com

Table 1. Armored off-road devices of the Hungarian Defense Forces [4] [17]

	Tank	Wheeled AVF						
Type	T-72M1	BTR-80	BTR-80A	BRDM-1, BRDM-2	Cougar	HMMWV M1151A1	MaxxPro MRAP	Rába H14
Amount [pcs.]	15 (43 con- served)	413 (100 in stock)	178	341	13	41	12	7

The operating time of T-72 type tanks expired in 2010 although many are in fairly good technical condition. Their present amount — including preserved reserve — is not sufficient for the execution of combined arms training and for particular bond practice. As a result, the Army would find itself without the support of heavy weapons in case of traditional deployment.

There is a somewhat more favorable picture of the armored fighting vehicles being investigated. The wheeled combat vehicles BTR-80 and BTR-80A are of the appropriate standard but do not supply the long term armored fighting vehicle needs of the Hungarian Defence Forces. Between 2006 and 2010 a significant part of the fleet was modernized and rebuilt in order to support a variety of tasks. The BRDM vehicles according to their design can provide anti-armor and chemical protection functions. [5]

Because of the Hungarian participation in the mission in Afghanistan there was a need for armored vehicles that can provide appropriate fire support during patrol and transport duties. Therefore, the Hungarian Defense Forces started to use a small number of armored wheeled vehicles of Western European and American origin, such as the Mercedes-Benz G 270 CDI, Toyota Land Cruiser, the Cougar, the HMMWV (High Mobility Multipurpose Wheeled Vehicle), M1151A1 and the MaxxPro MRAP ( Mine resistant Ambush Protected ). In addition to this, the Hungarian Provincial Reconstruction Team (PRT) in Afghanistan received 7 pieces of Hungarian-made armored H14 RÁBAs with increased protection.

According to the security predictions projected to 2030, a conventional armed force attack against Hungary is not likely. However, Hungary is located in the buffer zones of countries of different cultures, languages and religions and undertakes foreign military missions. Therefore, the armed forces of the Hungarian Defense Forces may be needed — in the home environment, or in mission areas — in traditional and non-war military operations alike. As a result of the more frequent and unpredictable weather the disaster management tasks — in the absence of others — require special off-road vehicles in the Army. So the army should be characterized by flexibility, multitasking and it should be installed easily. [6]

The armored combat vehicle fleet of the Hungarian Defense Forces mainly involves wheeled devices these days, among which the modern types can be found. However, the number of the types originating from many different manufacturers is low, which can cause maintenance difficulties. The number of tracked devices is small and they are obsolete. For further development of this field the outcome of the issue of “wheeled or tracked” is determining. [1]

## The role of mobility in the armed forces

One of the distinguishing features of military science is the importance of mobility. The need for freedom of movement in the 20th century was called for increased mechanization. It requires a sufficient number of good off-road capabilities and advanced machinery stock. The future's operations may be characterized and may contribute to "full-spectrum superiority" precision commanding, the full dimension protection and logistical capabilities in addition to the dominance of the maneuver. The actual tactical, operational and strategic significance of mobility is the reason that in the twentieth century mechanization of armies has so far grown explosively. [7]

Strategic mobility means the ground, naval and air transportability of military vehicles, tactical mobility means the locomotor ability of the vehicle in the terrain. The mobility of technical insurance is determined by the quality and timing of spare parts supply, the standardized measure of structure and operation of materials, the repairability, service interoperability between field conditions. Mobility has a lot of components resulting from the above, thus ways of increase may be quite varied and complex. [8]

The tracked and wheeled military combat vehicles of good off-road ability are suitable for controlling land and water obstacles, in any climate and terrain conditions. In addition, they ensure the performance of equipment, they provide increased protection for the operating personnel and the cargo against the various devastating battle factors. The off-road vehicles should be able to act off-road, in the support of combat troops, to solve tasks of transport, supply and security in the field of combat material, supply food, delivery of maintenance materials, supply health insurance and logistics. The off-road vehicle is to overcome any obstacles where continuous and combined movement of groups of people is still possible.

In the terrain the proper mobility of wheeled vehicles is achieved mainly by the provision of all-wheel drive. The all-wheel drive allows the vehicle to effectively perform military transport duties in war conditions on needed roads, in difficult terrain and in bad weather conditions. [8]

Today, in all modern armies of the world, land troops have different armaments and additional units of special teams. Separately examining the place and importance of these it is commonly accepted that the main role is played by mechanized infantry and tank troops, which are the most suitable for a fight in the circumstances of both conventional and mass destruction weapons. It should be noted, that the hostilities of the past decades does not verify definitely this statement. Tank troops are able to provide combat activity of high level and independence, the coup, the offensive combat and operational activities, a high degree of dynamism of adversity momentum, strength, depth, security conditions and a high level of endurance, flexibility and strength of the defense. Tank troops with these abilities provide an explanation to the fact that tank technology occupies a prominent place in military equipment development these days. [7] From the experience of wars, military activities, peace support, peace keeping and enforcement these days, military experts have no doubt that tanks are needed in order to fight battles. The main issue is not the quantity but the quality. The modern tank really fills its role, if the planned and executed content embodies the most modern achievements. Therefore, reducing the number of models, the concept of development and production, the economy, efficiency and quality improvement will be highlighted. [9] It is

very likely that in the first half of the next century that tanks will still retain an important role in the waging of war. It is also true that the development of anti-tank devices, the use of mines against tanks further increases expected battle losses, but — with armor protection against a variety of targets and from the exchange opportunities effective fire opening through to a high degree of mobility — it remains indisputable: the tank remains one of the principal players of land battles. [10]

## The development of the theory of cross country mobility and tracked cross country mobility

The main issues of the theory of military off road mobility already occurred in the 18<sup>th</sup> century and the traction resistance was defined in the 19<sup>th</sup> century. Between 1900 and 1910 instruments were made to measure features of soil, then, in the 1920s motility studies were conducted in sandy soil. Before World War II uneven road surface was measured by instruments and effects were evaluated and the relationship of tank and soil was tested. In the 1950s mathematical description of certain field effects (motion on loose ground, crossing obstacles) and mechanical analysis were carried out. In 1961 the international organization of terrain walking sciences was formed (International Society for Terrain–Vehicle Systems, ISTVS). The related technical achievements such as the design of the lunar rover contributed to the rapid development of this field of science. In the 1960s motility models were developed in the United States regarding the complexity of the issues, that is technical characteristics needed to evaluate terrain walking were summed up. The use of terrain models helped the planning and resulted in economic savings and helped the assessment of the expected results in tactical exercises. In 1971, the first generation of computer motility models (AMC–71) was created. [11] In Hungary in the field of testing off-road vehicles first place goes to Antal Nowody (M.Sc. mechanical engineer), who published the study series called *Wormdrawing (A hernyóvontatás)* [18] in 1925 in the journal of *Műszaki Szemle*. After World War II, in the studies of Kovácsházy Ernő<sup>2</sup> — the tank constructor of the former Weiss Manfred factory — and Clementis Gyula<sup>3</sup>, written for the postgraduate engineering and military engineering students of the Technical University of Budapest (Budapesti Műszaki Egyetem — BME), the structural characteristics and the use of tracked and wheeled vehicles are sharply differentiated. In 1981, the staff of the Military Technical Institute (Haditechnikai Intézet — HTI) prepared a summary on the technical characteristics of the evaluation of terrain walking in the article *Technical Study of the Terrain Walking of Military Vehicles* (number 81–9090) [19], and presented motility models and studies on kinetic models of NATO experimental institutes. In the 1980s attempts were made to establish a domestic mathematical model for cross country mobility. The environment and vehicle characterizing matrices were created. The modeling of time — measuring instruments and demands exceeded the options, and finally the tests were terminated by the Military Technical Institute. HTI compared 25 types of armored fighting vehicles in the March of 1987 with special regard for the connection between

2 Lánctalpas járművek hajtóműve, 1951. (Engines of Tracked Vehicles), A gépjárműtervezés és méretezés elvei, 1952. (The Principles of Vehicles Design and Scaling), Lánctalpas és kerekes terepjáró gépjárművek tervezése, 1952. (Design of Tracked and Wheeled Off-Road Vehicles)

3 A terepjárás elméleti és gyakorlati vonatkozásai, 1953. (The Theoretical and Practical Implications of cross road mobility, 1953), Lánctalpas járművek vonóerő kérdései, 1955. (Traction Issues of Tracked Vehicles)

motility and protection and survivability. In the 1980s a cooperation emerged between HTI and the University of Agricultural Sciences in Gödöllő (Gödöllői Agrártudományi Egyetem — GATE) in the field of cross country mobility. About the results Lajos Laib provided information in the article *The cross-country running of military vehicles, Determination of motility model accuracy (Katonai járművek terepjárása, Mozgékonyági modellpontosságának meghatározása)*. [20], [11] Later history and soil mechanical and vehicle dynamical theory of cross country mobility was overviewed in his book *Cross country moving vehicles (Terepen mozgó járművek)*. [21]. In the international literature of cross country driving J. Y. Wong (*Theory of Ground Vehicles*). [22] and M. G. Bekker (*Theory of Land Locomotion: the mechanics of vehicle mobility*) [23] are worth mentioning.

## Wheeled or tracked device?

Examining the mechanized formation of the world's armies, it can be concluded that there is no significant military force which is equipped with either wheeled or tracked equipments alone. In the neighbouring armies both types of devices can be found in large numbers, although in different proportions. The responsibilities of wheeled or armored off-road vehicles with track chassis are significantly different. Because of the different tasks the Defense Forces cannot be equipped with only tracked or wheeled off-road vehicles. The question is to be approached from the direction what proportion is required in the operation of wheeled or tracked vehicles, that is when and for what tasks are wheeled or tracked vehicles needed. So the question above should be changed to “when is wheeled and when is tracked chassis needed”.

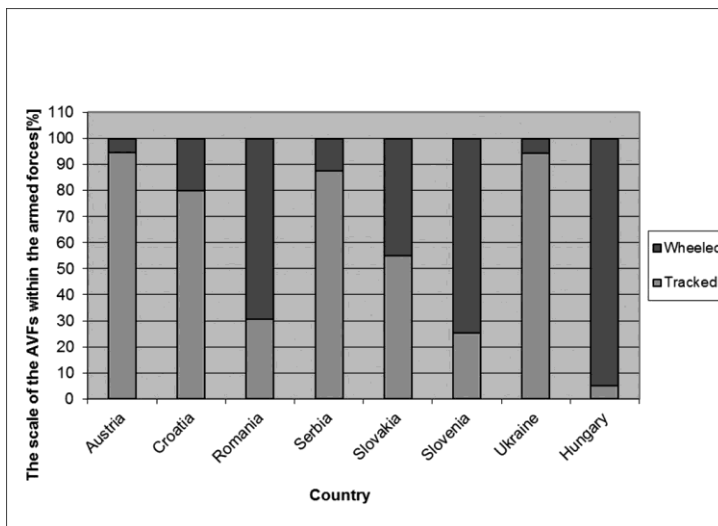


Figure 1. Distribution of wheeled and tracked combat vehicles in Hungary and the neighbouring countries within the armed forces [4] [17]





Engineering Ltd. for the plans of RDO-3221 ABV Komondor “Development of NBV Reconnaissance Vehicle Provided with Terrain, Modular, Ballistic Protection”. This was the design of a Hungarian produced armored off-road vehicle. This is a so-called MRAP vehicle, protected against IED (Improvised Explosive Devices) widely used in asymmetric warfare. Komondor is organized according to MRAP ideas and has a V-shaped bottom, which can divert the blast of a possible explosion aside. It should be noted, that the Hungarian Defence Forces has not done — yet — any military tests (for example ballistic defense) on it.



Picture 1. RDO-3221 ABV KOMONDOR [13]

The project is suitable for other purposes apart from the prototype (nuclear, bio, chemical, locator) like armored troop carrier, command vehicle, armored rescue vehicle or even self-propelled (off-road) chassis. It can be stated that the Hungarian-designed and produced device carries the following benefits:

- includes additional national mental and physical value;
- generates a Hungarian supplier circle;
- new workplaces are created;
- a Hungarian engineering/industrial standard is created;
- Hungarian engineering activity is extended;
- Hungarian professional requirements can be met flexibly, even in small series or in case of an individual item, or foreign interests can be attracted.
- and disadvantages:

(because of the degradation of Hungarian light- and heavy industry after the 80's)

- roundabout, full of pitfalls for development;
- certain raw materials, components, or parts purchasing needed from foreign import, dependence on foreign suppliers.

Of course, there are a number of possible system MATERIALS and foreign-made equipment with the following disadvantages.

Naturally there are a number of options to purchase foreign-made, related devices, which have “comfortable” supply, but then again it results in the following disadvantages:

- it does not specifically tend to support the development of national industry;
- expectedly, it will hardly have additional national mental and physical value;
- it is surrounded by very strong information defence which makes it impossible to execute changes satisfying Hungarian needs and makes the maintenance and repair slow and difficult, even impossible in certain cases;

- it is disadvantageous to take them to the logistic system since it is not guaranteed that the manufacturing process would create the technical service skills at the same time;
- a significant part of the repair material — in case of resupply — would only be delivered for Hungarian demands which would increase the costs;
- finally (generally regarding the interests of all member nations in the case of industrial activities) in the period of peace and war the manufacturers' capacity cannot be mobilized in favour of the Hungarian State and Hungarian Armed Forces.

The *raison d'être* of partially Hungarian made combat vehicles is supported by international examples regarding the provision of national defense tasks. A number of nations attempt to rely primarily on their own industry within the framework of their alliance obligations. Additional benefits would be caused if the significant additional part of defense expenses could be spent in the Hungarian manufacturing and service industry, therefore they would return to the Hungarian state budget. The Hungarian (military) industry still has the capability required for development and production, long-term maintenance and later modernization of a vehicle fleet. [14]

## Comparison and selection of military equipment

Methods commonly used so far for selection of military equipment — which were based on the examination of tactical and technical parameters and so-called professional experience — need to change with new methods. Qualification, comparative analysis and the examination of technical standards with scientific methods should be focused on. [3]

Gyarmati József described it in his study *Comparison of Military Equipment (Haditechnikai eszközök összehasonlítása)* [16] that acquisition and comparison of weapons and weapon-systems is also a Multi-Criteria problem, in which methods of decision making theory, matching and ranking methods based on experts included in the field of economics need to be used. However, in the process of comparison it is not the question that out of two military devices which one is the better, but which of the two is more suitable to fulfill the intended task. The intended use for the battle circuit devices are not necessarily known since it cannot be estimated exactly in advance in what kind of combat situation, in what geographical conditions and which enemy combat devices they will fight. A military device will be applied opposing other enemy devices following its nature, consequently, information is needed about the parameters and capabilities of the enemy assets. The Multi-Criteria making model ranks according to test criteria. Evaluation according to criteria and summary of the obtained values can be done in several ways on the basis of Multi-Criteria, making theory methods such as AHP [15], PROMETHEE and SMART procedures. [16] A military device is used for a significant period — even decades — and its costs of acquisition are also high, so the responsibility of people preparing and making the decisions is very high. In certain situations when adequate numbers of competent experts and data necessary for the previous methods are not available — such as comparing tanks — matching may lead to incorrect results. Several military off-road vehicles are offered by military industry worldwide. Hungary and the Hungarian Defense Forces cannot purchase all the available and suitable types, so their comparison on the test track cannot be carried out. Various vendors do not provide detailed information and measurement results for their products. These technical devices are results of military industry research including technical solutions developed by long and expensive procedures

in order to protect “know–how” and to increase their own military potential. Opinions can only be formed through the limited catalogue data or the physical appearance, even in the case of serious requests. In addition there are very few experienced armored vehicle officers

— who have been to war — whose opinion could be relied on in the tests to correctly select and match an off–road device adequate for our purposes. Though it is not necessary to know all the details of the research and development, and it is not necessary either to have a large number of experienced experts if another method is used.

In this case it can be more appropriate to rank on the basis of “tangible” and expansive technical data, in the book *Heavy tanks (Nehéz harckocsik)* by Turcsányi Károly [24] the comparison of World War II tanks was carried out by the method and complex system of KESSELRING’s. The applicability of the method for armored devices was proved by setting up a sequence generation rank–correct according to other approaches. Possessing an adequate knowledge of vehicle dynamics, terrain mechanics and users’ needs and requirements collecting the aspects defining cross country mobility and considering the designated area of use, the required device can be selected by the adequate comparison method with a good approximation through little but informative data.

## Summary

It can be stated on the basis of directives and objectives determined by Hungarian military strategy that the Hungarian Defense Forces will need armored off–road vehicles in the future. The Hungarian Army should be equipped with a sufficient number of tracked and wheeled off–road vehicles in accordance with national and international duties and commitments. It is to decide that the deployment of new devices can be carried out by modernizing a part of the existing vehicles and/or by purchasing new devices in a satisfactory way. It is also to examine the possibility of the wider involvement in connection with this activity requiring large financial resources. The application of suitable methods of decision making theory can succeed in fast and accurate results in selection and matching combat vehicles for the same role.

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# On the Genetics of Military Operations: A Powerful Metaphor

JOBÁGY Zoltán<sup>1</sup>

*Military operations are complex adaptive systems in which the means applied must be regarded as important as the ends sought. Complex adaptive systems work in an everything–affects–everything mode with various levels of interrelatedness. Conceptualizing military operations as a complex adaptive system allows biological evolution to be used as point of departure. Thus military operations are seen as a process that rests on adaptation and mutation in which the challenge is to offset changing conditions coming both from the environment and interaction with the enemy. The effects landscape as proposed metaphor makes clear that evolution by natural selection and the conduct of war are intimately related. Both reflect conflict, survival, and conquest in a very similar and fundamental way. The proposed metaphor helps think about military operations differently by also offering some advantages.*

Modern military operations are non–linear and context–dependent. They are complex adaptive systems in which the whole is always more than the sum of the parts. [1] In such a system comprehending all relationships between causes and effects exceeds anything predictable. The same phenomenon understood in a given context can often become obscure in another. Even if laws are applicable at one level, they might become entirely upset at another. Any attempt to address causality must shift from end–states towards transitional states in which the means applied must be regarded as important as the ends sought. Whatever the effects achieved they reflect combinations that come as much from trial–and–error mechanisms as from careful processes of optimizing. [2]

## Military Operations and Scientific Thinking

The theory of complex adaptive systems indicates that assumptions on clear causality in military operations display major conceptual and methodological weaknesses, and are dangerously disconnected from war’s true nature. Although the search for causal relationships has always been fashionable, a causal focus often lacks both substance and meaningful content. It is empty, occasionally harmful and never takes war’s proverbial friction fully into account. [3] Focusing on causality in military operations reflects an equilibrium–oriented thinking. It assumes that it is possible to predict end–states based on analytical rationality. However, military operations display dynamic equilibrium or far from equilibrium conditions. Causality oriented thinking addresses military operations in scientific terms, but analytical skills based on direct causality are valid only within a limited range. Beyond that they are not able to de-

<sup>1</sup> National University of Public Service, Budapest, Hungary, The Faculty of Military Sciences and Officer Training, Jobbagy.Zoltan@uni-nke.hu

liver satisfactory explanations. [4] The causal focus of common science emphasises actions *on* the environment by promising better ways to organise and exploit the world. However, scientific homogeneity exploiting causal relationships cannot get entirely rid of instability. Even abstract mathematical precision and rigour are approximate descriptions of imprecise processes displaying multi-layered problems. [5]

Common science and its supporting paradigms ignore most human attributes that constitute a very important part of military operations. Clausewitz was not short in emphasising that apprehensions, sensations, perceptions, impulses, and emotions are essential ingredients of war. The theory of complex adaptive systems demands thinking holistically. It is important to consider opposites, as one side (*chaos*) cannot be right at the expense of the other (*stasis*): military operations often allow for polarities to manage rather than problems to solve. [6] To comprehend the dynamics of military operations an approach is needed that is less rigid and more flexible, less artificial and more natural, less mechanistic and more organic; one that emphasises actions *in* the environment. [7]

## Domains of Military Operations

Military operations consist of so many factors that it is impossible to include all applicable forces and the complexity of their interactions. Clausewitz stated that war is an activity in which both the enemy's physical and psychic forces have to be destroyed. Whereas the destruction of the former can be seen as the means of war, the latter is its objective. Clausewitz advocated that efforts had to be aimed at the enemy's power of resistance, which was "the total means at his disposal and the strength of his will". Thus war can end only if the enemy's will is broken through a "gradual exhaustion of his physical and moral resistance." [8] A complex adaptive system works in an everything-affects-everything mode with various levels of interrelatedness. According to Clausewitz it is possible to discern two different, but interrelated domains of war such as the *material* and the *non-material*. These domains display military operations as an "extreme trial of moral and physical strength and stamina" in which the actions of the belligerents aim at the "gradual exhaustion of the [enemy's] physical and moral resistance." [9]

The material domain represents categories such as physical strengths and stamina. It describes the space the military tries to influence through combat and manoeuvre. Consequently, the material domain deals with tangible items the enemy usually needs to wage war. It includes assets such as physical platforms and communications networks. This domain is the traditional basis for measuring combat power, which has to be rendered inoperable. The material domain can also be described as *reality proper*. Attempts to achieve effects in this domain must aim at physical ability and as a consequence serve the purpose of *changing functions*. The non-material domain on the other hand, is characterised by psychological factors such as moral strength and stamina. It represents the mind and attributes that generally influence the will in the form of perception, awareness, understanding, belief, and values. Effects in this domain stand for influencing intangibles the enemy needs to wage war. Consequently, effects in this domain serve to *change behaviour*. [10]

When compared to the material domain, the non-material domain is at first appearance non-existent. However, by holding things together it permeates all human endeavours. It is the medium in which act and will merge, and points towards the ability and movement to act.

Despite the difference regarding the two domains there is a strong correlation between them as physical and psychological factors form an organic whole. [11] Clausewitz regarded two domains standing for moral and physical elements both inseparable and interacting. The only difference he saw between the two is that the moral element is the “most fluid element of all”. [12] Clausewitz also emphasised that war is “a trial of moral and physical forces through the medium of the latter” in which “psychological forces exert a decisive influence on the elements involved”. [13] Whereas Clausewitz regarded the physical as the “wooden hilt,” the psychological was for him “the real weapon, the finely honed blade.” [14]

## Holistic Approach by Using Metaphor

A holistic approach to military operations means less certainty, and challenges the human preference for clear boundaries with distinct and potentially solvable problems. Simply put, focusing on certainty is analogous with a life spent in the box. It excludes the different and includes the similar without questioning the latter. An exclusive focus on certainty means that nothing is tolerated beyond its contours. In contrast, military operations are full of evidence that certainty and uncertainty always mix and are separated only by boundaries in human thinking. [15]

Complex adaptive systems are composed of waxing and waning structures that constantly emerge and change. In the course of military operations it is not difficult to detect qualitatively different occurrences composed of *emergent* and *self-organising* attributes. The result is changing and evolving boundaries that depend on the level of aggregation chosen, reflect the limitations of human cognitive resources, and the inherent human need to reduce complexity. [16]

In a holistic approach boundaries are not there to separate but to connect. Managing boundaries stand for the fact that in complex adaptive systems coping is often possible, but control is more often not. Human actions only disturb the dynamic equilibrium of complex adaptive systems, as solving problems in a given area can cause new and unexpected problems elsewhere. Conceptualising military operations as a complex adaptive system means to appreciate it as an organic whole and not as something composed of dissected entities. The term *war-fighting ecosystem* as coined in some military publications very well reflects this approach. [17] A holistic description of military operations however, requires the application of *metaphors* in order to comprehend the complex relationship of the many constituents. [18] A metaphor is an implied comparison or a figure of speech in which a word denoting a certain object or action is used for another in order to suggest an analogy. The very strength of metaphors is that they involve both sources and targets surrounded by an aura of meanings and associations. Metaphors enlarge perceptions by producing insightful connections and interpretations. They offer a conjunction by activating a train of associations. Metaphors place the target in a new light, which might lead to a profound re-conception. Powerful metaphors offer more than a list of associations by emphasising some aspects whilst diminishing others. They enable the individual to see and experience new connections.

Thus metaphors are “comparisons that help give shape and form to abstractions through images that are not dependent on the weaker “like” or “as” foundations of the simile.” [19]

Metaphors are figurative expressions in which a word or phrase designating one thing is used to designate another in the form of an implicit comparison. Metaphors make a qualitative leap from a reasonable, prosaic comparison to identification or fusion of two objects

as the resulting new entity possesses the characteristics of both. Traditionally, the military has loved metaphors and military writings are full of them acting as frames of reference for facilitating discussion and developing ideas. [20]

Metaphors can also be extremely powerful and are much more significant than normally considered. Although metaphors are usually paradoxical statements, they can be very robust. They are literally false according to abstract rationality, but true according to imaginative rationality. Metaphors form essential *as-gates* in the human cognitive process as they enable the understanding of one thing in terms of another. Metaphors are indicators of a network of meanings that affect the processes of perception and conception. As evolving things, they are open to novelty, even mutation. They are able to capture the underlying processes of other evolving entities surprisingly well. Metaphors can help explore an interesting possibility space characterised by contingency and feedback. Metaphors can also be superior to analytical models when the phenomena of interest are impossible to control or the necessary assumptions unsure. [21]

Metaphors appear to be helpful aids when dealing with a complex adaptive system such as war. Four general levels of metaphors can be differentiated:

- *Transfer* — level one means the transfer of a single term into another context in order to create new meaning;
- *Construction* — level two is the construction of analogies as part of a specific theory or a general and systematic inquiry to elucidate phenomena;
- *Unification* — level three stands for a unifying view often symbolised by a specific term that refers to the whole frame of understanding under a given paradigm;
- *Merger* — level four can be seen as the most comprehensive in which science itself is understood as an irreducible metaphor. [22]

## Military Operations as Effects Landscape

Conceptualising military operations as a complex adaptive system allows *biological evolution* to be used as point of departure. The emergent and self-organising attributes of both come from non-linear processes that can be characterised as much by stasis as by chaos. Whereas the former stands for equilibrium and represents spontaneous crystallisation with a high degree of order, the latter is a randomising force that points towards a disordered state. [23]

Both in military operations and biological evolution minor changes can sometimes cause catastrophic outcomes. They contain unpredictable processes and display spontaneous order that can best be described by two interrelated attributes such as *fitness* and *co-evolution*, both standing for simultaneous adaptation and change. [24] Fitness originally described the relative success of a species in relation to others in its environment. No fitness is ever fixed, but changes in response to the actions of other species with which it *co-evolves*. In the process of co-evolution a species tries to optimise its fitness in order to gain a *relative competitive advantage*. Similar to the unpredictable character of war, biological evolution happens in a constantly changing environment in which a species' suitability to the circumstances often alters in a subtle and dramatic way. [25]

Biological evolution can be depicted in the form of an imaginary landscape, called the *fitness landscape*. Its surface is continually evolving and changing due to the action/reaction



cycles of the belligerent. There is no guarantee that current locations of high fitness symbol- ized by high peaks remain unchanged over time as they can alter significantly. The challenge of moving about in such a landscape is to strike an appropriate balance between *exploiting* locations of high fitness and constantly *exploring* new locations that might also have a high value. [26] The inherent relationship between the military and landscapes supports such an approach in many respects:

- *Literal interpretation* — understands landscape as terrain with its geographical features that have always been influential for the conduct of war and warfare;
- *First level of abstraction* — is embodied by the topographical map that directly refers to geography since it depicts the physical landscape in standard symbols;
- *Second level of abstraction* — is representation by metaphor and indicates political, economic, and cultural landscapes that have no physical basis;
- *Third level of abstraction* — allows understanding of landscapes as tools for analysing and modelling complex problems. [27]

The proposed metaphor is on the second level of abstraction as it indicates an *effects landscape* that has no physical basis. The various effects achieved in military operations allows for this notion in which peaks stand for effects. Also effects landscapes show a number of regular properties and structures. In most cases heights of different peaks are correlated in such a way that peaks differing slightly are near each other. As the environment and the enemy change, the value attributable to any given effect will also change. Consequently, the heights of the peaks in the landscape move constantly up and down over time indicating that one effect regarded as valuable today might probably be of little help tomorrow. [28]

By better understanding the underlying properties of such an imaginary landscape it becomes possible to think of military operations as a search process to find high peaks. Thus similar to biological evolution of species there is also a path or trajectory representing the evolution of military operations over time. An effect (E) can be seen as the *function* (*f*) of an *action* (*a*) on an *object* (*o*) and depicted in the form of an equation

$$E = f(a, o)$$

The first part of the equation refers to actions. Well-known terms such as *delay*, *disrupt*, *destroy*, *demoralize*, *deter*, *disrupt*, *degrade*, *decapitate*, *divert*, *dislocate*, *deny*, *deceive* and *defend* can describe actions needed to achieve effects. [29] However, for the effects landscape a simplification is needed. Thus an action is limited to two alternative states such as *action taken* standing for 1 or *action not taken* standing for 0. The second part of the equation refers to object and is equivalent to the number of genes N. In military operations, similar to living organisms the number of objects that must be considered is normally very large. An organism such as the *eukaryote*<sup>2</sup> has 20 000–100 000 structural genes and a variety of other control points. In order to interdict enemy ground units the Air Campaign during Operation Iraqi Freedom identified and struck approximately 19 900 objects called *aim points*. [30]

This way it becomes possible to conceptualise effects in terms of *genotypes*, which in the case of military operations, is defined as the specific makeup of an effect that refers to certain composition of objects. For this reason an object is understood as the focus of an action that sets the boundaries between phenomena. [31] Each effect has genes represented by bits

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2 An organism with cells containing nucleus and other structures enclosed within membranes (*valódi sejtmaggal rendelkező élőlény, akinél a mag anyagát a citoplazmától maghártya választja el*).

composed of binary numbers. Pairing objects with actions means that an object can either be *taken into consideration* in the form of action taken or *left out* in the form of action not taken. Consequently, the effect-genotype represents a given combination of effects and takes the simple form of a binary string with  $2^N$  possibilities. [32]

In the case of ten objects ( $N=10$ ) and the two sorts of actions the effect-genotypes can have  $2^{10}$  or 1024 various possible states ranging from 0000000000 to 1111111111. These possibilities can be depicted in the form of a landscape that contains various peaks representing the different values of the effect-genotypes. The value of any combination can be defined as the average of the contribution of the individual objects, each in its own context and the  $K$  other objects in the form of *functional couplings* or *epistatic interactions*. [33] Thus the effects landscape is defined by effect-genotypes consisting of a given number ( $N$ ) of objects ( $o$ ) with two possible states at each object ( $o_i$ ) and can be expressed as follows

$$F(o) = \frac{1}{n}$$

Whereas for  $K=0$  each object is independent of all other objects, for  $K=N-1$  each object depends upon itself and all other objects. Thus each object's fitness contribution depends on the choice between the two different binary states at each of the  $K$  other objects that impinge upon it. [34]

## Consideration and Discussion

According to the effects landscape effects are highly complex phenomena. There is no single dimension along which it becomes possible to search and find combinations that possess good or high value. Hence predefining desired effects often do not make sense. Military operations represent a high-dimensional search process with the aim to find an optimum combination of effects. The goal is to occupy high spots on the landscape in which a given combination of effects influences battlefield performance. [35]

However, also some limitations must be acknowledged. Despite the mathematical foundation the effects landscape is understood in heuristic terms and the search process is not quantified more precisely. Consequently, it might not always be possible to find a search process that guarantees a good optimum, and often sub-optimal solutions must be accepted. Whereas in theory the search process is driven by an *algorithm* that always chooses the fittest option, it is not always possible to do that in reality. Military operations represent real-life problems that are *NP complete* and intractable to analytical solutions in the form of algorithms. [36]

A further limitation is due to the fact that cultural imprints and past experience always distort perception. Reality is not directly comprehensible and the effects landscape represents a specific mapping of reality. Identity can limit the search process by excluding certain areas that may contain good peaks, but cannot be explored or climbed. Due to these blinders, the effects landscape is always a compressed and distorted form of reality that puts limitation on the search potential. A further reason why the search process is suboptimal comes from the fact that it is not the peaks sought, but the landscape's ruggedness that determines the success of any given search. The effects landscape exists only as a representation, which means that the search process is typically constrained and appears mostly in the form of a biased

$$\sum_{i=1}^n$$

walk. The effects landscape has no objective reality separable from the autonomous agents inhabiting it. Although this sort of bias sometimes eases the search process, it always limits the search potential. Thus any problem decomposition in the form of an effects landscape only coincides with the reality as it “may or may not correspond to the ‘true’ decomposition structure.” [37]

An utterly false representation can induce additional and lasting interactions, which influence the way alternatives are generated and evaluated. Consequently, effects landscapes refer to unique and private mappings of the actors involved. [38] This however, indicates that there will never be perfect battle-space knowledge or transparent battlefield available, only approximations with a certain error value. Due to such less-than-perfect descriptions generating wrong predictions, as time passes the desired peaks on the landscape might differ from the expected peaks, which again might differ from the actual peaks found. Thus very good strategies might often become hidden for long periods of time, but can also emerge occasionally. [39]

Whereas military operations exist in a high-dimensional space, the effects landscape can only provide a certain statistical characterizations of the space of possibilities. Thus the search space is explored in one particular direction, which always implies biased characterisation of the landscape. The way effects are constructed also does not provide clear and attainable information on the *genotype/phenotype mapping*. The way effects are generated and perceived can differ significantly. Despite its power to deliver helpful and valid statistical insights regarding the possibility space, the predictive power of the effects landscape is limited. In other words the effect-genotype has more to do with landscape statistics than landscape reality. It allows for analysing the search space only along a single fitness function and if the problem is multi-objective it cannot provide for further and broader generalizations. Despite all its utility, even the effects landscape is unable to capture the true nature of emergence with all its self-organizing attributes. [40]

The metaphor makes clear that any combination of effects reflects a distribution of potential outcomes rather than a unique outcome. Moreover, distributions overlap so that approaches attempting to optimise make more sense than those attempting to maximise. Thus success and victory in military operations can be seen as a realised positive outcome rather than a maximum one. The greater the uncertainty the greater the possibility, that victory is a combination of relative superiority and fortuitous circumstances. Chance in the form of trial-and-error limits the selection of any meaningful criteria for achieving maximum effects. In military operations there is no guarantee that a particular outcome in the form of desired effects is really the best one. Once chance forces the selection of a particular path and it often locks in regardless of the quality of other possibilities. Consequently, there are many possible solutions to the same problem and sometimes small, fortuitous, and trivial events determine the one event that becomes dominant. [41]

## Darwin, Clausewitz, and Boyd

Darwin recognised in his book *On the Origins of Species* that genetic usurpation and endemic warfare share similarities as both are important forces in evolution and human history. In chapter three he drew an analogy between war, battle and natural selection and saw evolution as a “[b]attle within battle [that] must ever be recurring with varying success.” This analogy

made him conclude that “from the war of nature, from famine and death, the most exalted object which we are capable of conceiving, namely, the production of the higher animals, directly follows.” Thus evolution was for him a “great and complex battle of life”, which together with the *Law of Battle* for survival formed a recurrent pattern also in his second epic work *The Decent of Man*. [42]

In the framework of the proposed metaphor war is conceptualised as a complex adaptive system in which military operations represent a search process with the aim to find an appropriate combination of effects. Effects form a large pool of possibilities and the combination of effects achieved decides over victory and defeat. As the actions of the belligerents develop, high value effects can become obsolete and effects with originally low significance can turn increasingly powerful. As the military operations shuffle back and forth between orderly and chaotic states they validate the Clausewitzian observation that every “action in war is not continuous, but spasmodic. Violent clashes are interrupted by periods of observation, during which both sides are on the defensive.” [43]

He defined this attribute in the *Dynamic Law in War*. Clausewitz stated that in military operations periods of inaction and response change with periods of action as “periods of active warfare [would] always be interspersed with greater or smaller periods of rest”. [44] The period of rest meant for him stability and equilibrium including phenomena such as physical and psychological forces, circumstances and motives. Although this continuous cycle defined war fully, Clausewitz emphasised that the “state of crisis is the real war; the equilibrium is nothing, but its reflex.” [45]

The metaphor makes clear that soldiers might share similar problems with ecologists as both try to find a function that matches the crude reality of life. Boyd also advocated that evolution by natural selection and the conduct of war are intimately related. Both reflect conflict, survival, and conquest in a very similar and fundamental way. Stability and chaos mark the two end-poles of war in which the degree of non-linearity defines both the quantity and quality of the outcome. By finding small areas of order sometimes it is possible to achieve equilibrium, but occasionally no equilibrium can be reached at all. When one understands military operations as a process that includes a trial-and-error mechanism, insights coming from evolutionary biology are very helpful as even a modest pool of effects can show an enormous amount of possible combinations. Clausewitz also pointed out that “the vast, the almost infinite distance ... between cause and its effect, and the countless ways in which these elements can be combined” demand things to be seen in a *comprehensive*, hence holistic fashion. [46]

## Conclusion

When biologist Sewall Wright wanted to understand the properties of gene mutation he concluded that under biparental reproduction even a limited number of mutations can result in an almost infinite field of variants. In order to handle this problem he introduced the idea of fitness landscape, which is a less rigorous and strict theory, but a more picturesque metaphor. [47]

In a similar fashion the effects landscape is a powerful aid to conceptualize war in a novel way. Military operations are seen as a process that rests on *adaptation* and *mutation* in which the challenge is to offset changing conditions coming both from the environment and inter-

action with the enemy. Conceptualizing military operations this way also has the advantage that the emerging search process can be defined by a given network of effects and not exclusively by desired effects. Regardless of the approach and methodology chosen it will never be possible to explore the vast space of possibilities. However, the effects landscape can help understand the complexity of military operations. It can frame it as a complex optimization problem that includes approximations and estimations regarding optimal values. The effects landscape can also give the chance to assess the benefits of further optimization or define termination criteria. [48]

The idea of the effects landscape resembles clear similarities with the idea of *network–centric warfare/network enabled operations* found in military writings that are characterised by the following factors:

- the re–focus from the sum of individual platforms to the network of possibilities they provide for, and the gains that can be exploited;
- the re–focus from mostly isolated and homogenous actors to the various interdependencies smaller and more specified players stand for;
- the re–focus from strategy development in traditional terms to issues such as adaptation, learning and coping under continuously changing conditions. [49]

Some critics question the meaningfulness of fitness as a unit of measure and regard the theory a crude metaphor. However, even they cannot deny that the idea is a fascinating approach towards visualising real–world problems by means of statistical features. In fact, even critics acknowledge that despite objections, problems and limitations, a discussion of biological evolution based on the idea of fitness can be helpful. Fitness can reveal insightful guidelines that may be generalizable to more intricate relations of evolutionary mechanisms. [50] In sum, the effects landscape as metaphor helps one think about military operations differently by offering the following advantages as it:

- helps conceptualise military operations as an emergent and self–organising process;
- forces us to differentiate better between two basic aspects of adaptation such as efficiency and effectiveness;
- gives impetus for a different and more sophisticated understanding of course of action development in a constantly changing and dynamic environment;
- contributes to a meaningful discussion regarding issues such as command and control, and military effectiveness.

Conceptualising military operations as a complex adaptive system indicates an inherent difficulty when attempting to turn the insights gained into actual policies, programs and strategies. It does not offer clear and simple answers to the way armed forces should train soldiers, write doctrines and develop leaders in the future. The 21<sup>st</sup> century has started and as one contemporary scholar emphasised “it is time to let a hundred schools of thought bloom.” [51] It is the author’s hope that expanding on the analogy between war and biological evolution will be one.

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# Non–Destructive Material Testing (Ndt) Techniques Applied for the Life Extension Program of the Aircraft in the Hungarian Defence Forces

BOZÓKI János<sup>1</sup>

*Most aircraft in the Hungarian Defence Forces (HDF) were planned back in the 1960s and 70s. Accordingly, strategies of operating and maintaining these aircraft reflect the level of engineering, technology and diagnostics of that era. However, since the mid 1990s until today a new generation of modern aircraft (JAS–39 EBS HU Gripen, MiG–29 tactical fighter aircraft) have been used in the Hungarian Defence Forces. By using these third and fourth generation fighters, new, modern operating and maintenance environment and systems have also been introduced. This publication is aimed at providing a short overview of Non–Destructive Material Testing; a very special segment of the many diagnostic testing methods used during life extension programs.*

*Keywords: Non Destructive Material Testing, life extension program, maintenance, tactical fighter aircraft*

## 1. Introduction

In accordance with the recent changes in international security policies the Hungarian Defence Forces are also going through dramatic and constant changes. That is, the Hungarian Defence Forces have changed profile from the ‘good old’ ‘mass’ army to a modern, ever prepared force, ready to be deployed at once. In line with the above statement is a relatively new but widespread approach where not only the quality of deployment, but related operational costs are equally important. Transport and combat helicopters in the HDF have either reached or exceeded their time limitations or are awaiting overhauls to extend their airworthiness in the following one or two decades. In addition no new (transport) aircraft have been procured or purchased since 2004. The end of airworthiness of these aircraft is due now. When manufactured these aircraft were planned to be in service up to 30 years and no longer. However, based on the present condition of these aircraft the manufacturer extended their life span another 10 years, coming to a total of 40 years now. Thus AN–26 transport aircraft will presumably be in service till 2015.

Currently the Hungarian Defence Forces have JAS–39 EBS HU Gripen fighter aircraft in service. These fourth generation aircraft and all their systems have been manufactured to meet the requirements demanded by ‘on–condition’ operation. That is, all major parameters and performance of the aircraft are constantly monitored either by built–in or onboard instruments. Built–in warning and diagnostic systems and computer based ground support systems

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<sup>1</sup> Engineer colonel, Commander of HDF Aircraft Repair Plant, leju.pk@mil.hu

enable enhanced and increased efficiency operation. In case of operation, as for technical condition, classical preset life span cannot be defined as such thus this paper does not deal with non-destructive material testing techniques used for this type of aircraft. After joining NATO<sup>2</sup> in 1999 and due to the new requirements and as the result of strategic and defence inspections Hungary introduced changes in the fleet of combat aircraft in the Hungarian Defence Forces between the years of 1998 and 2012 as shown in Table 1. [6]

Table 1. Number of aircraft in the Hungarian Defence Forces between 1998 and 2012. [6]

Aircraft type	pieces as in 1998	pieces as in February 2012
MiG-29B	22	0
MiG-21BiSz	12	0
MiG-29UB	6	0
MiG-21UM	10	0
JAS-39 GRIPEN	0	14
An-26	4	5
Z-43	4	0
L-39ZO	19	0
JAK-52	12	8
Mi-24V, D, P	32	12
Mi-17P	2	0
Mi-17	5	7
Mi-8	35	10
Mi-2	20	0
Mi-9	1	0
<b>Total</b>	<b>176</b>	<b>56</b>

In the following chapters non-destructive material testing techniques used during life extension programs of the previous aircraft types will be introduced.

## 2. Airframe Damages

### 2.1 Surface, material flaws occurring during “Normal” operation

The manufacturer sets techniques of NDT<sup>3</sup> (crash test, fatigue test etc.) to be followed as part of other diagnostics. This information is available for the maintenance staff in the aircraft’s service manual.

<sup>2</sup> NATO — North Atlantic Treaty Organization

<sup>3</sup> Non Destructive Testing

## ***2.2 Surface, material flaws occurring during “Extreme” operation***

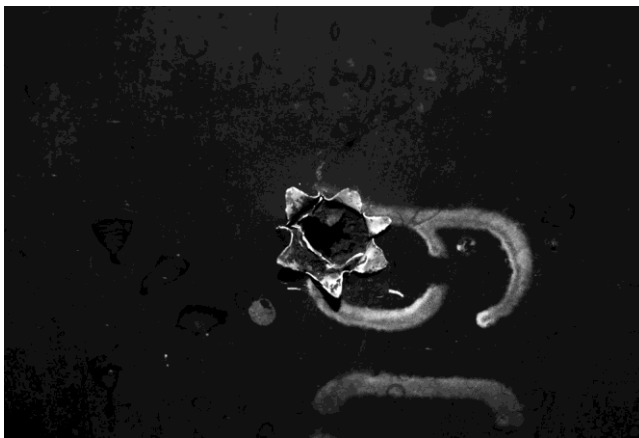
An aircraft may be deployed in extreme conditions several times during its life time. Aircraft manufacturers provide for end users the necessary procedures for these conditions which maintenance specialists may obtain during special courses. However extreme conditions certainly do not merely root from extreme or higher than normal climatic or weather related issues but include any more severe than normal operating circumstances. These may be as follows:

- flaws caused by short interval but severe events (such as momentary overload, foreign object, projectile impact etc.)
- flaws caused by long interval impacts (such as material fatigue, corrosion etc.)

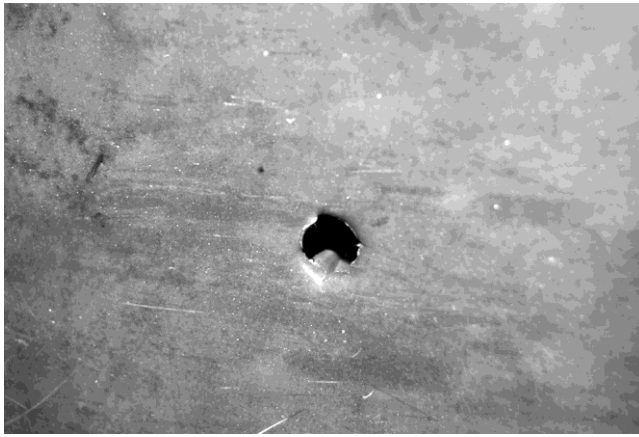
### ***2.2.1 Surface, material flaws caused by short interval impacts***

During short and intense events the aircraft is affected by extreme impacts leading to sudden and severe damage. In case of a projectile impact in metal structures “exit effect” — when the type of damage on the leading in and exiting sides is different and can be well separated

— is clearly visible. (See Picture 1 and 2) This feature of metal structures and components, detailed above, determines the technique of repair and testing to define the damaged area on the aircraft.

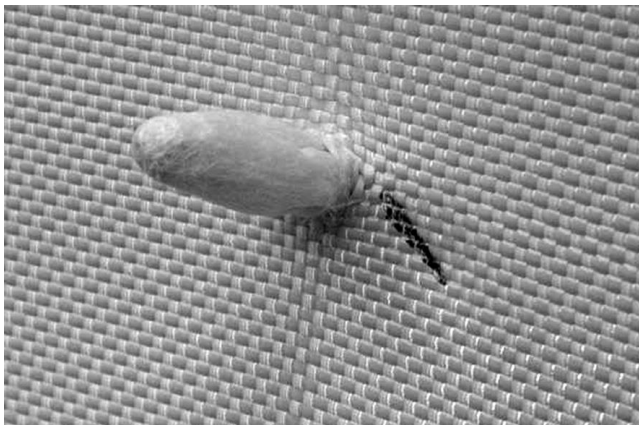


*Picture 1. “Exit” effect after projectile impact [7]*



*Picture 2. Entry damage after projectile impact [7]*

Composite components due to their structural design and mechanical characteristics have a completely different response to loads. The diameter of a projectile impact to a composite component coincides with the cross-sectional diameter and the shape of the bullet itself. In one word there is no “exit” effect when composite components are hit. (Picture 3) The place of the impact regardless of its size may influence the aircraft’s airworthiness (in case an attachment gets hit, the aircraft has to delete its sortie). Energy affecting composite structures of an aircraft get transferred by fibres and absorbed by the matrix material. In case of impact, layers made up from fibres get segregated from one another and in extreme conditions may get broken apart, thus causing damage or flaws in the composite material. (Figure 2) Generally, it is not that easy to classify damage types because delamination and fibre abruption may occur at the same time. But in many cases it is more typical to find broken layers and delamination around and in the vicinity of affected areas. We may find areas of damage as shown in Picture 4.



*Picture 3. Fibre abruption upon impact [4]*

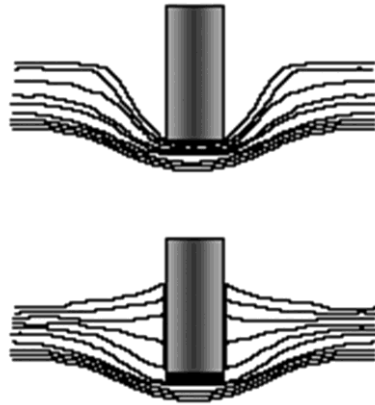


Figure 1. Projectile penetration through woven material [4]

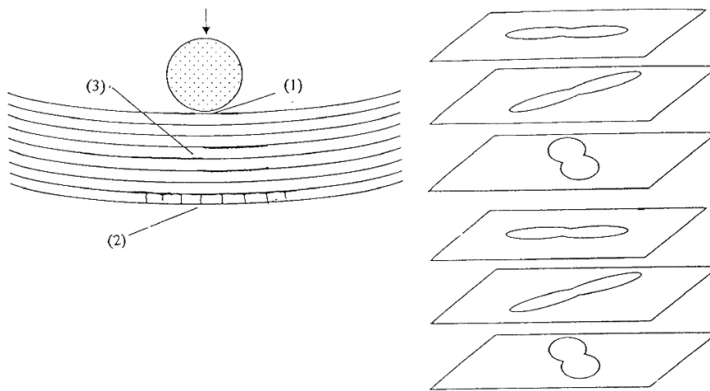
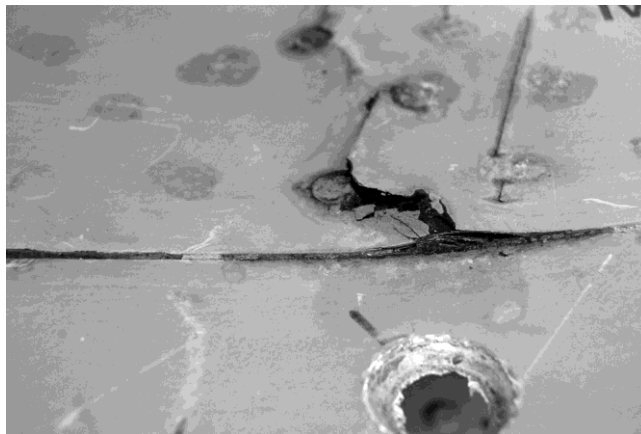


Figure 2. Layer delamination due to foreign material impact [2] (Legend for Figure 2.<sup>4</sup>)



Picture 4. Damage to composite structures [7]

4 1— indent; 2 — fault caused by drag; 3 — delamination in adjacent layers due to shearing forces

### 2.2.2 Surface, flaws caused by long interval impacts

Airframe life span is mainly determined by the amount of random damage and wear due to short interval loads and corrosion. Maintenance and operational handbooks aim to reach maximum life span. However engineers take several extreme operating and maintenance factors into consideration while designing an aircraft. Unfavorable operating and storing factors and their disadvantageous effects are to be considered as higher than normal or planned aircraft usage. Open air storage in unfavorable weather or climatic conditions may cause the aircraft airframe to suffer corrosion. [5] It is almost inevitable for metal structures to be in physical contact with composite components conducting electric currents and causing severe corrosion to metal parts, components and structures. This kind of corrosion is called Galvan corrosion or contact corrosion.

## 3. Contact Corrosion

Metal surface contact corrosion is a process of deterioration starting off from the surface of a metal surface based on oxidation. This process requires the presence of another conductor with higher positive potential than the previous material. Galvanic corrosion takes place on the anode of an electrochemical corrosion cell (a corrosion cell and a local cell) in case of the presence of certain electrolytes. The rank of metal voltage ranges from Cesium with the highest negative charge until the element with the highest positive charge. Table 2 illustrates the list of materials by their potential used for aircraft manufacturing. [1]

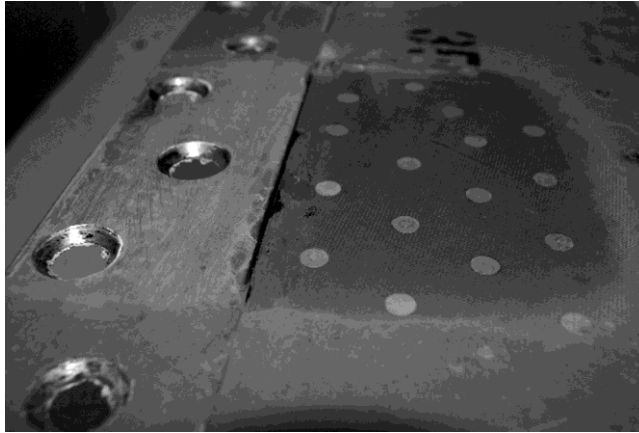
Table 2. Materials used in aircraft manufacturing [1]

ANODE
Magnesium Alloys
Aluminum Alloys
Aluminum
Cadmium
Steel and Iron
Brass, Copper and Bronze Alloys
Stainless and heat resisting steel
Titan
Nickel and Nickel Alloys
Graphite composites
CATHODE

Electrically conductive graphite fibres contacting metal will cause the metal part to corrode hard. The main reason is the significant potential difference of graphite, aluminum and cadmic steel. In the vicinity of composite component contacting metal structures, metal structures lose strength and wear down. [1]

Therefore contact corrosion can be prevented with selecting the right material and using proper insulation. For the same reason only corrosion-proof bonding units — made from materials like corrosion-proof Titan and stainless steel — can be used for graphite woven material.[2]

Picture 5 illustrates carbon fibre composite and aluminum made structures.



*Picture 5. Carbon fibre composite and aluminum made structures [7]*

#### **4. Non-Destructive (Material) Testing**

The operative management and effective planning of aircraft life extension works are impossible without up-to-date diagnostic systems. One special element of this diagnostic system is Non-Destructive Material Testing.

Below is a list of main non-destructive material testing methods, mainly the ones used for aircraft life extension programs:

- Visual Test (VT);
- Magnetic Particle Test (MT);
- Liquid Penetration Test (PT);
- Ultrasonic Test (UT);
- Eddy Current Test (ET);
- X-ray Test (RT).

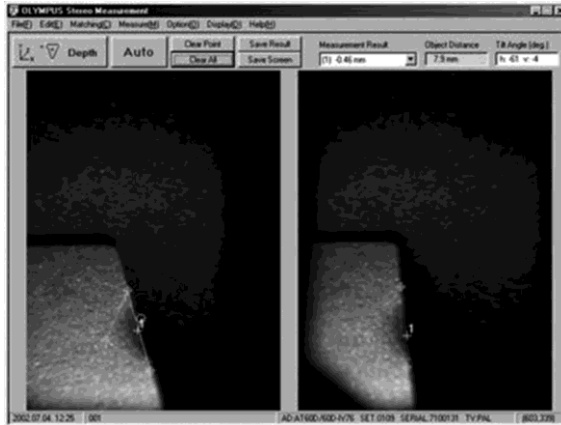
The wide range of repairs and the limitation of each testing method require the usage of multiple testing methods. There are loads of testing methods with different efficiency to detect failures. Their applicability greatly depends on the characteristics such as the size of the object, the time available for the test and environmental conditions. Therefore comparing the result of each testing method will not provide an exact answer. The first step to take before performing a test is to clarify the task and to choose the most suitable testing method or a set of different methods that fit the task. Non used destructive testing methods used largely depend on the type, size, direction, position, depth of damages to be detected in aircraft parts.



## 4.1 Visual Testing

This kind of testing is mainly used for detecting mechanical wear, surface corrosion and damages, chip-offs, tears, permanent deformations, plating material damages, deposits, contamination and leakages. To observe and test elements and parts of an aircraft not accessible to the naked eye (combustion chamber turbine etc.) endoscopes are used.

Picture 6 illustrates an image taken for determining the size of damage to a turbine blade with an endoscope.



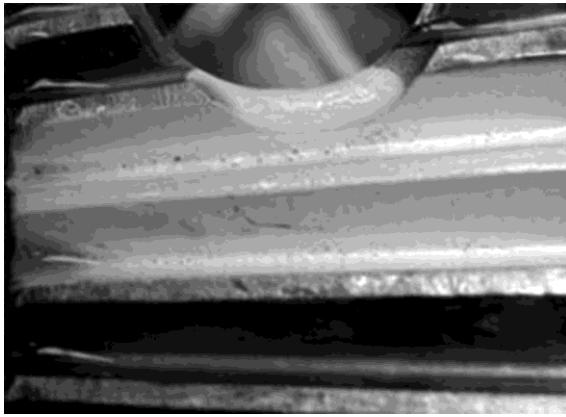
Picture 6. An endoscopic image [7]

## 4.2 Magnetic Particle Test

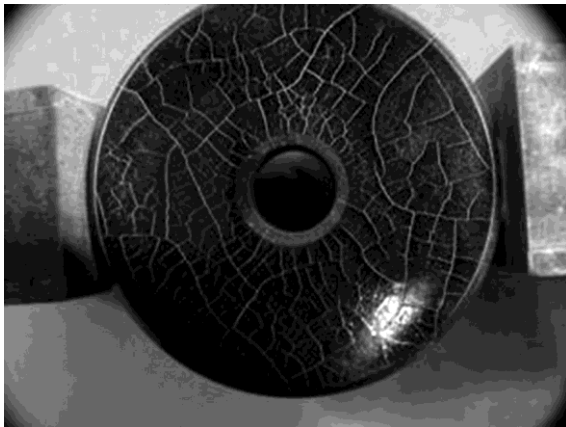
Magnetic particle material testing is used to detect flaws in near surface regions in ferromagnetic parts of an aircraft. [11] The main point of this testing is that the testing material (magnetic particles) accumulates over the damaged surface revealing the magnetic field and thus the flaws. This testing method is very sensitive and reliable. With this method it is relatively easy to detect the location and the size of the damage. However there are some drawbacks to this testing method:

- thicker protective layers must be removed before testing;
- magnetic particles may get into joints and fill them up;
- special attention must be paid to demagnetize parts around joints.

However, magnetizable powders are more sensitive thus giving higher reliability in detecting flaws than other dry powders. At the same time fluorescent magnetic testing materials have higher sensitivity than color contrast ones. In a case where background light cannot be dimmed properly, higher accuracy testing results can be gained using a balancing contrast agent along with colored testing agent. [12] Test output sensitivity in certain environmental circumstances can be established using test samples (standards) as seen in Picture 8 and 9. Picture 7 shows a crack on an annular gear detected with non-destructive testing.



*Picture 7. Crack NDT detected on an annular gear [7]*



*Picture 8. Testing standards to set magnetic particle testing sensitivity [7]*



*Picture 9. Testing standards to set magnetic particle testing sensitivity [7]*

### 4.3 Liquid Penetration Test

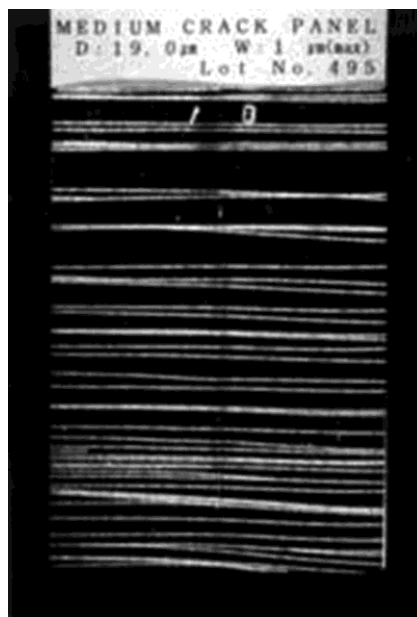
Liquid penetration tests are used to detect flaws open for liquid to enter. [9] Liquid penetration tests enable testing the whole of the surface of irregular shaped objects at the same time. This test comes with high resolution and sensitivity and detects the size and location of possible flaws.

Disadvantages:

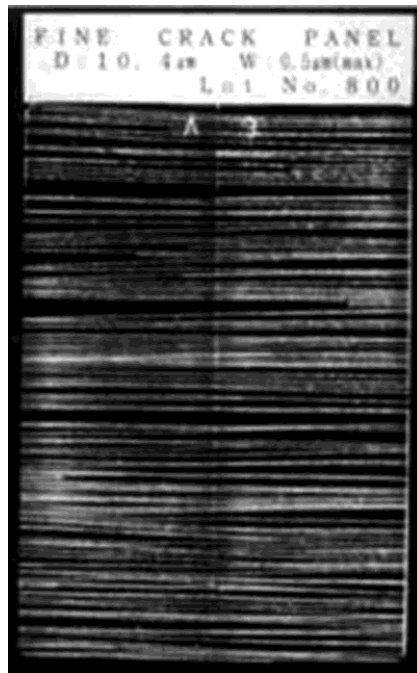
- Contamination and protective layer(s) are to be removed before testing. Preparing the surface for the test is a time consuming task. For instance, during the test of a magnesium component it is vital to take care of corrosion protection, which is almost impossible on the battlefield.
- The testing takes between 2–4 hours so it is rather lengthy. Below freezing point the possibility of false test results gets higher (due to condensation and the resulting liquid — mainly water — fills up flaws and cracks preventing testing liquid penetration).
- Does not tolerate inaccurate testing and is sensitive to environmental conditions (illumination, temperature).

Picture 12 — a crack on an annular gear detected liquid penetration test.

The sensitivity level of testing agents can be established using test samples [10] where the resulting reading is compared with the standard/sample photo. Using this technique we can get information on the level of sensitivity in different conditions as seen in Picture 10 and 11.



Picture 10. Test sample number 2 [7]



*Picture 11. Test sample number 3 [7]*



*Picture 12. Crack on an annular gear detected liquid penetration test [7]*

#### 4.4 Eddy Current Test

Eddy current tests are used to detect flaws on and under the surface. The principle of the test is as follows: eddy current in a tested material is compared with another eddy current of a sample. [13]

This is a fast testing method because the layer covering an aircraft component does not need to be removed beforehand.

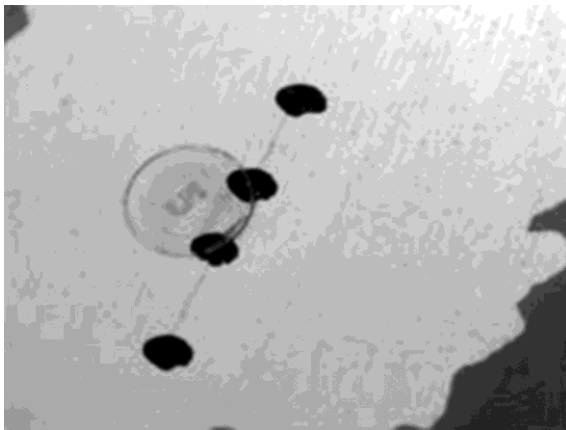
However, this method has disadvantages too. See below:

- Sensitivity, thus test data are largely affected by the fact that a probe (optimized for a single test needs to be used. Depending on the size and shape of the object to be tested different probes need to be used;
- Testing large areas is demanding;
- Special attention must be paid when testing magnetizable components since heterogeneity of the tested material affects test results;
- In case of eddy current tests of ferromagnetic materials, fault signals are hard to separate from the local fluctuation of permeability. However, magnetic saturation of the tested material, and as a result effective permeability drops to 1.0, is a solution to the above problem.[8]

Eddy current testing is an indirect method though. Calibration standards/samples need to be used to determine the size of the flaw due to the difference of size and chemical composition of the tested material and the variable parameters of the numerous search coils plus the sensitivity depending on the testing frequency.

Testing samples/standards as seen in Picture 14 help determine flaw size of different materials.

Picture 15 shows probes used for testing different materials. Picture 13 reveals cracks under painted areas caused by overloads.



Picture 13. Cracks between rivets [7]



Picture 14. Testing samples/standards to determine flaw size of different materials [7]



Picture 15. Probes to test different materials [7]

#### 4.5 X-ray Test

Even in normal operating conditions using X-ray testing requires major infrastructure and safety investments. X-ray testing is more effective and necessary than rewarding. Testing machinery, designing and manufacturing companies pay great attention to provide the high- est level of reliability using the fewest possible resources. Components for aircraft sub- and main systems are manufactured to meet strict quality assurance principles. Based on my pre- vious experience I would say during a normal aircraft life extension program it is not typical to perform X-ray testing as a means of non- destructive testing.

#### 4.6 Ultrasonic Test

The principle of ultrasonic testing is to transmit high frequency audio impulses into the component to be tested and the back echoed signals reveal flaws inside (under the surface of) the material. [14] This testing provides high level accuracy to detect flaws on the surface and under the surface defects. Probes and testing standards are a must for successful ultrasonic testing.

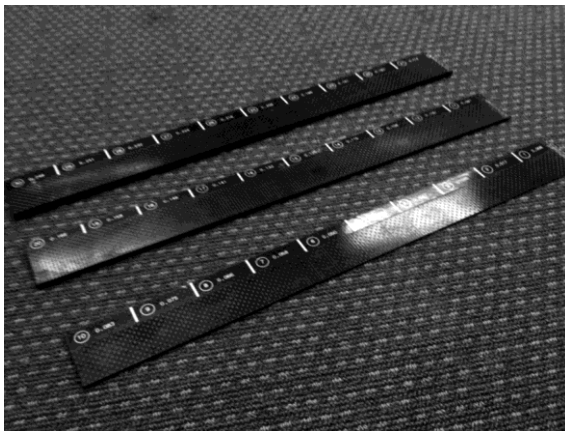
Picture 16 shows probes used for ultrasonic tests.



Picture 16. Ultrasonic test probes [7]

To perform ultrasonic testing the right thickness is to be selected on the testing standard as per the geometrical parameters of the aircraft structure to be tested.

Geometrical and sensitivity parameters of the probe are set by using a testing sample as seen in Picture 17.



Picture 17. Composite test samples [7]

As soon as the right calibrations are completed the testing is rather fast and accurate. Test data are displayed and stored (for further reference) on the testing equipment.

Picture 18 shows back echo signal on the display of USM-25 ultrasonic testing equipment.



Picture 18. USM-25 ultrasonic testing equipment [7]

#### 4.6.1 Ultrasonic testing of fibrous composite structures

To avoid inaccurate test results a technology is to be developed before testing accidental failures and complex components. Un- and remounting a component to be tested from an air- craft takes a long time but a carefully prepared testing method can save lots of precious time.

To detect, locate and verify repaired damage caused by foreign objects or projectile im- pacts (alternately broken and delaminated layers) there are a variety of testing methods with different feasibility and efficiency levels.

Figure 3 — composite component delamination detection chart. Figure 4 — composite component fracture detection chart.

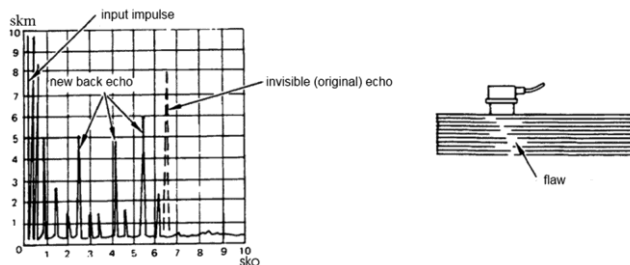


Figure 3. Fracture detection chart [2] (Legend for Figure 3<sup>5</sup>)

5 skm — scale height, sko — scale



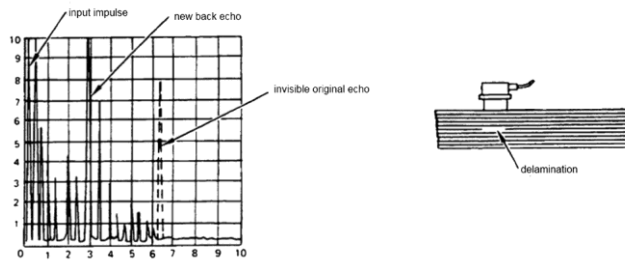


Figure 4. Delamination detection chart [2]

Based on my previous experience and benchmark technical literature ultrasonic testing methods are highly suitable to detect flaws resulting from short and long time impact to an aircraft structure.



Picture 19. Aluminum and carbon fibre assembly [7]

Picture 19 illustrates contact corrosion at the assembly point of aluminum and carbon fibre structures. This kind of flaw of a composite structure cannot be detected with ultrasonic testing. The only suitable solution here is to ultrasonic test the aluminum component. A test like this can be performed with the technologies and equipment available in the Hungarian Defence Forces.

## Summary

In my paper I wished to introduce non-destructive testing methods used for aircraft life extension programs. Certainly it is a really hard and challenging professional job to provide technical support to any equipment used in the Hungarian Defence Forces. Maintaining and operating aircraft in the Hungarian Defence Forces requires the presence of specialists whom on a daily basis face the challenges posed by new technologies, systems and materials. Developing new technologies and training specialists to match the given tasks are inevitable to provide constant, professional support to aircraft maintenance. The necessary certifications and licenses are ensured through special courses organized and authorized by the manufac-

turer. However, simply increasing the number of employees does not certainly mean they can match any situation. The key to success is to establish complex work teams with all the necessary knowledge, expertise and equipment.

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## **The characteristics of women soldiers' profession socialization, integration, adaptation and their emphasized fields of manifestation in the different types of corps**

GYÖRFFY Ágnes<sup>1</sup> , BOLGÁR Judit<sup>2</sup>

*The acceptance of women soldiers still poses questions in the organization of Hungarian Defence Forces although they are more than a countable amount of active members in the last decade. Besides this, their professional socialization in military jobs could be problematic in some ways. Professional socialization is highly influenced by the type of corps (fighting; fight-supporting; serving-supporting) where the woman soldier fulfils her duty, because henceforth she will adapt herself to the requirements and expectations of the corps in question. In order to map the differences of the corps from this aspect we have organized focus groups and by doing this our "hidden aim" was to promote the acceptance of women soldiers and facilitate them in their socialization. As a result we have gained information on the problematic points of adaptation, also the specification of the different types of corps from this point of view. These data will be shown and interpreted in this article.*

*Keywords: women soldiers, socialization, characteristics of corps, gender role, stereotypes*

Women soldiers take a more and more active part in growing proportion in different tasks in different armed and defence forces all around the world, among their male colleagues. [1] The US Army gave its licence to women soldiers to take part in active fighting operations from January of 2013. [2] In the case of Hungarian Defence Forces (HDF) woman soldiers are active participants in all types of corps where the characteristics of the tasks of the corps highly influences the strategy (process) of adaptation that also involves the transformation of their well-built female functioning.

In order to map the process of accommodation, professional socialization and their main focus points, we organized focus groups for woman soldiers from every types of corps of the Hungarian Defence Forces. Besides this we made a mixed group from leaders where all types of corps were included (how the leaders see their woman soldier subordinates) and a group of male soldiers mixed from all types of corps.

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<sup>1</sup> Head of mental health subdivision at the Central Military Hospital; National University of Public Service, Budapest, Hungary Ph.D. student

<sup>2</sup> National University of Public Service, Budapest, Hungary, Professor, Bolgar.Judit@uni-nke.hu

So the groups were the following: Group of leaders;

1. Group of male soldiers;
2. Women soldier — serving supporting group;
3. Women soldier — fight supporting group;
4. Women soldier — fighting group;

In the focus groups — with two group leaders we discussed the question — in their type of corps what are the main problems, questions that are especially connected to women soldiers or representing the differences in some ways in functioning between male and female soldiers in the military organization. Groups were representative from the aspect of corps types of the HDF and each of them consisted of a maximum of 20 members in order to keep the emotional depth of the topic — altogether 98 persons were included in the groups. The collected data have been overviewed by the group members at the end of the group-work, in order to finalize what to include, what is really representative to the state of women soldiers and what shows only individual cases or tendencies. After doing this a group of psychologists considered the pre-collected data and analysed them both quantitatively and qualitatively. In this analysis process the frequency, the importance to the representative group and the military organization have been taken into consideration too. With the help of the focus groups the process of profession socialization could be traced, especially the phase that follows the centralized military basic training and carried out by the different types of corps, so their system of expectation — according to the tasks fulfilled by the corps — for the soldiers and the accommodation to it could be followed. In the group of leaders (where the group members were chosen from all types of corps of the HDF, the criteria were to have women soldier subordinates, colleagues in order to have their personal experience) we have the following results: [3]

*Strongly emphasized:* (presented in many answers)

- The rules of civilian relationships (for example, being polite with a lady) between females and males is often contradictory to the rules of military relationships;
- The lack of standardized expectancies at the level of different corps (different corps – different rules and expectancies);
- The different extent of deployability in the case of the two genders;
- Using and abusing gender/sex;
- Different workload based on gender;
- The chances of career and promotions are different for the two sexes.

*Emphasized:* (It was important in several answers)

- Female colleagues, subordinates as a mode of deriving tension or can easily be blamed;
- The different style of communication of the two sexes can easily lead to conflicts, misunderstanding;
- It is hard to maintain the different roles in the life of a woman especially the soldier — family member — woman/wife roles;
- Being female in a masculine organization — you get too many and intensive reactions to your femininity;
- Making generalizations from one single example;
- Different work performance evaluation by the two sexes;
- Prejudication;
- The expectance of functioning in a masculine way.

*Other important content:*

- The differences in the extent and method of punishments/evaluation when responsibility is questioned between the two sexes;
- The different relation to systematic work;
- Reinforcement in traditional female gender roles (that can be contradictory to the military role);
- Putting on the military uniform that is inevitably masculine wear (it is uncomfortable because it does not follow the anatomy of the female body);
- Parallel execution of tasks (females are better in doing that);
- Males usually overestimate the friendly gestures of their female colleagues
- The different relation to authority in the case of the two sexes;
- Being a female leader in a masculine organization is a hard position.

This group can be considered as a kind of pre-phase of the research, where the contents, problems, attitudes connected to woman soldiers could be overviewed. The most emphasized content that is a surface for presentation of different functioning of the two sexes is the content: "The rules of civilian relationships (for ex. being polite with a lady) between females and males are often contradictory to the rules of military relationships." This could be also a sign that in the process of professional socialization for the military role the general socialization of gender role must be overwritten in some ways. This can lead to behavioural disturbances, because gender role begins to develop right after birth and is also coded before that, while professional socialization to the military role usually starts in the early years of adulthood. [4] So in case of male and female soldiers it is very hard to build a sensitive balance where both socialization processes are presented at the same time. Moreover it could be shifted and influenced when one of the individuals is attracted to the other in the situation or trying to hide or avoid the perceived attraction. This cannot always be made better by strict rules, sometimes it makes it even worse because the situation becomes inflexible. The basis for misunderstanding is usually formed by the non-verbal communication shown in an embrace, that can influence further communication both long-term and short-term. These communication disturbances can lead to other elements of this group of content, where the most powerful disturbance is presented in the content: "Using and abusing gender/sex." This shows some overlapping with the elements of the other emphasized group of content: "Being female in a masculine organization — you get too many and intensive reactions to your femininity" where the reactions show some shift towards gender role socialization. In addition, some overlapping could be observed with the content: "The expectance of functioning in a masculine way" where the reactions shifted towards the military role socialization. The base elements of military professional socialization are mainly closer to the masculine gender role socialization so they could be integrated more easily into personality in case of men than women.

From the strongly emphasized elements the content: "The lack of standardized expectancies at the level of different corps (different corps – different rules and expectancies)" also deserves special attention. The different types of corps expecting different behavioural patterns both from their male and female members based on the different tasks and missions they are fulfilling. This can lead to communication disturbances when the different types of corps are working together; in extreme situations it can even lead to revulsion. In cases like this the process of reasoning are mainly connected to gender and not to altering the social-

ization processes in the corps. Besides this basic military training could be also problematic from this aspect, because the instructors have to take into consideration what type of corps is waiting for the soldier. These differences also can be found in the operational theatre or when changing corps.

Another strongly emphasized element was "The different extent of deployability in the case of the two genders", this content occurs several times different parts and forms of appearance in the other contents. From one side it appears in the content: "It's hard to maintain the different roles in the life of a woman especially the soldier — family member — woman/ wife roles". It also effects promotion and the evaluation of performance as the following content shows: "The differences in the extent and method of punishments/evaluation when responsibility is questioned in the two sexes" or "The chances of career and promotions are different in the two sexes" and influences the daily workload: "Different workload based on the gender." In extreme cases both positive and negative discrimination can occur.

Contents of the emphasized group show more personal situations, with more tension. Some contents, as mentioned before, are details or parts of former contents, showing one of their especially emphasized parts. Firstly in this group the content: "Female colleagues, sub-ordinates as a tool of deriving tension or can easily be blamed" is very illustrious. In a strongly masculine area a woman-soldier with her pure physical presence could be interpreted as provocation. In most languages the word soldier connects strongly to males, so for female soldiers the word needs some kind of extra expressions. So in a situation full of tension their simple presence can evoke former undefined personal emotions.

Also an important and emphasized content: "The different style of communication of the two sexes can easily lead to conflicts, misunderstanding." The members of the military organization experience the communication disturbances between the two sexes in their everyday life and relationships, but in the organization where the precise and aim orientated communication is essential these disturbances can be presented even harder.

Because male proportion in military organizations are usually higher than females, so the presence of a woman soldier could be a curiosum for her social surroundings. From these situations sometimes the conclusion can be drawn that the woman soldier as an individual could be forced into the background and for the community she will be "the woman soldier" both positively and negatively. This is shown by the content: "Making generalizations from one single example." From this on the attitudes and expectations connected to her will influence the relationships to all the other woman soldiers who enter the military organization after her. Prejudice can also occur before or after her integration in the organization ("prejudice" as content) that the woman soldiers have to cope with as a member of her smaller and bigger community, usually independent of her functioning and attitudes. [5]

Into the "other important contents" group, those contents have been included, that showed a rare presence but have high importance in women soldiers functioning and life. From one of these contents, that cannot be found in the other groups, even overlappingly, is the topic of the uniform: "Putting on the military uniform, which is inevitably masculine wear (it is uncomfortable because it does not follow the anatomy of the female body)" the other important content is the special cases of the female leaders in the masculine organization: "Being a female leader in a masculine organization is a hard position" and last but not at least the differences in the relationship to authority: "The different relation to authority in the case of the two sexes."

With wearing the uniform, especially true for the field uniform, women soldiers live their military being on the physical level based on experience and this is enforced by the reactions from the outside. The field uniform that is standardized in the HDF definitely follows and fits male anatomy. So wearing this for a female individual leads to ambivalence because it changes the movements, body image and based on these, behaviour. Some woman soldiers talked about their experience that while wearing this uniform they behaved and moved in a more masculine way than in other types of uniform or in a civilian dress.

The position of female leaders in a basically masculine organization is very special. [6] The expectations and their behaviour reactions usually become masculine. Prejudice and negative stereotypes on women can be highly present, that is especially true for female leaders with male subordinates. Women's different kind of communication and usually sensitive attitude is more emotional than males and are hardly tolerated and handled by the military organization, in some cases these differences could be overestimated based on their alterations.

The relation to authority is a question of high importance in a highly structured organization, this relation also alters connections to gender and socialization. [7] A manifestation form for this could be when woman-soldiers usually relate in a different way to their leader than their male colleagues. Experience from the early childhood, relation to the father or father figure in the gender role socialization gives a good basis for that and will form the relation to authority for the individual's lifetime. Naturally the basic elements of this process also form in early childhood by males too. This relationship is shaded by the different communication and the reaction given to it by the two sexes.

These contents in the case of the other groups or some elements of them will be presented with the following emphasis and quality. According to this in the tables some examples have been included in order to help to understand them more precisely:

Table 1. The result of the male group

Rank	Contents, aspects	Frequency
1.	Physical <i>suitability</i> , differences in performance (different expectations) — lack of <i>suitability</i>	9
	<i>Using and abusing femininity</i> (promotion facilities in the organization, <i>positive discrimination</i> against women : training, better network of relationships) <i>Discrimination in the commander's attitude</i> (performance evaluation)	9
2.	<i>Mood changes/swings</i> ; High sensitivity (more expressed emotions)	8
3.	The use of <i>clothing</i> elements that are not in harmony with the military organization: clothes, jewellery, feminine wear vs. military uniform (bound police, pre-paid female underwear for woman-soldiers as discrimination)	7
	<i>Female/maternal role vs. military role</i> (tasks connected to children, roles in personal life vs. roles in the organization) — Expectations from the organization and commitment as an expectation from the side of the organization	7

4.	<i>Communication disturbances</i> (paying attention to each other) Curiosity, inquiry (the Why question) — Altered Focus of problems, alternative solutions (simplifications or overestimation)	6
5.	Women soldiers' <i>role and place</i> is not clear in the military organization	4
	<i>Tension and conflicts between women</i> (the role of balance in the male — female ratio; the difference in conflict handling)	4
6.	<i>Having your mate/husband/boyfriend at your workplace</i> (How to handle the new relationship, advantages and disadvantages of having it inside the organization)	3

According to the first comprehensive table in the male group the most emphasized contents are communication disturbances between the two sexes and expressed emotions. Connected to this is that males usually give higher importance to these phenomena and differences than females. So in a group or community that consisted only of men the altering behaviour based on the gender role socialization, and its contradiction to the military role socialization; behaviour based on female gender role socialization (for ex.: decorating your office as if it was your home and castle) are the scenes where the conflicts are mainly manifest.

An interesting item in this group is the mention of positive discrimination in case of women soldiers, although to build discrimination you need both sides to be involved actively.

Also a surprising motive is the resentment of the different standards for physical suitability – although they are strictly ruled by regulations – because in sports we also have these differences, based on the different anatomical characteristics of the two sexes.

Table 2. Results of women soldiers' group from serving – supporting corps type

Rank	Content	Frequency
1.	<i>Women are hardly accepted as soldiers and their chances of promotion is also limited — women are forced back to their gender role: Higher education — lower rank; same rank — different position (hard to accept a woman as leader in a profession for a man); Lower chances to get into training for woman-soldiers; Some positions are “protected” from women (creating situations where the woman soldier simply cannot get the training needed), Expectations based on the traditional female roles, for ex.: making coffee; Greeting between man and woman — less respect for the female in lower rank.</i>	16
2.	<i>Female/Maternal role — professional role: Coordinating Tasks connected to children with professional tasks—restrictions in the maternal role (the weekend must be enough for your child to recover from illness); having children vs. preserving your status (the distance from the family members, lack of grandparental help, taking family into consideration in organizing duty, extra work)</i>	9
3.	<i>Creating types, stereotyping</i>	5
4.	<i>Boundaries of physical performance</i>	4
5.	<i>Female leader with male subordinates (daily fights), Female leader's harder position to awake respect than males</i>	2



In this type of corps we could see, that the content that appears could be grouped in two main topics, but it is reasonable to show their subcategories or overlapping either because they can represent the shifts of emphasis. The two main categories are: “education — position — rank” and the differences based on them between males and females and the other is: “roles — role expectations” connected to women soldiers. In the case of the latter, the group members also presented that this could affect not only the acceptance of females as soldiers, but the undifferentiated and hardly catchable picture of the stereotypical woman soldier. This stereotypic picture could be seen by its indistinctiveness on the theoretic level and thoughts. The gaps that could be seen on its indistinctiveness mainly field out with the stereotypical characteristics of the male soldier as an expectation which cannot be fulfilled even with the disclaimer of some parts of the female role.

Table 3. Results of woman soldier's group from fight supporting type of corps

Rank	Content	Frequency
1.	<i>Chances of career – acceptance in the military role</i> (“she has been promoted only for the reason that she had sex with the right man”) choosing your boyfriend/husband from your own – more acceptance (protection); professional role vs. military role (contempt in military topics for woman soldiers — prejudice: “She doesn’t know it...”) The task fulfilled by a woman soldier considered of lower value (differences in evaluation); For the same level of acceptance the woman soldier has to struggle, Self-confidence in military space: not as an equivalent partner, shown in hand-shaking	17
2.	<i>The coordination of the family (female/maternal) role and the professional role:</i> Having your career and children; Gender role — military role; Tasks connected to children, having children — the expectations from the organization	10
3.	<i>Suitability (lower expectations) — differences in physical suitability</i>	8
4.	<i>Workload (women can bear a greater workload simultaneously than men because of their skill at divided attention</i>	2
5.	<i>The influence of wearing a uniform versus civilian clothing (wearing field uniform — practical wear) — the masculine cut of the uniform</i>	2
6.	<i>Stereotypes – One single example of a certain woman soldier creates a type (generalization from one negative example)</i>	1
7.	<i>Camaraderie</i>	1

From this table we could see that the emphasis shift to another direction in this type of corps. One sign of this are the contents with more tension connected to career and their mixture with female gender role and dating. Besides this we can observe that from the groups we could see first here the inevitable importance of the uniform that has its role in civilian life too. It builds in a disturbing way on the personal level that evokes the thought of over – accommodation to the military role that involves the repression of female gender role. [8] Besides these we also could see the phenomena of Camaraderie that has a very special role

in the male soldiers presented and stereotyped by novels and movies in a very positive way. This can foster adaptation, acceptance both on an individual and group level and could enforce the development of a stable picture of the woman – soldier in the long-run.

Table 4. Results of woman soldier's group from fighting type of corps

Rank	Content	Frequency
1.	<i>Chances for a career — acceptance in the military role</i> Expectancies are different and appreciation is lower; In a masculine position a male can have a better, faster career; at the same level of knowledge the male soldier is chosen; more struggle for higher positions (leader), no acceptance even for higher performance; From the family side: the woman has her place at home and not as a soldier: male — female roles; Respect, tone, behaviour (soft — rough); Struggle for acceptance or just spending time — not adapting yourself to the organization at all; “the men must also prove their positions to me!” — Gender roles in the foreground — You are the “new trend”; generalization — prejudice; In the evaluation of performance stress-tolerance considered lower than male, prejudice: “Women shouldn't go on missions!” — You have to pay more attention to them while you are over there.	22
2.	<i>The coordination of the family (female/maternal) role and the professional role</i> children — organization of duty + both parents are soldiers?; being away from your family: taking part in manoeuvres or missions — getting less information about what it takes to live this way; the conflicts of the family (female/maternal) role and the professional role	15
3.	<i>Preserving your femininity “signal” — “I'm behaving like a man, but I'm a woman”</i> Femininity is lost somewhere: “I'm the terminator both mentally and physically”. First you have to make it clear in yourself how to relate, what is in the foreground and after doing this you can communicate it to the outside. Gender-role socialization overwrites the learned rules (for ex.: problems with hygiene at the operational theatre)	7
4.	<i>Suitability: facing the un-acceptance of being female (preparedness; anatomy; drill, etc.); anatomy – different by the two sexes; women's physical burden also different (where men walk — women run) — “You can't do it, lift it, etc.” — spoken who can't do it, you can't stay behind males and can't beat them, because of their vanity.</i>	5
5.	<i>Uniforms are cut for male anatomy, hygienic circumstances too</i>	2
6.	<i>Mood swings</i> It can be interpreted as a histrionic reaction when a woman complains about a serious injury — normal emotional reactions handled as if they were mood swings.	2

The strongest difference between male and female behaviour is presented in this group. The formerly mentioned contents get other colours, shades, the other side is in the fore-ground, besides these the formerly mentioned contents' other sides highlighted that can form another category. From the examples we could see, that the group members mention deeper, personal experiences with more tension connected to body level than in the former (fight– supporting) group. We could see a stronger frustration at the content: “Chances of career — acceptance in the military role” and some kind of challenge with the men in the question of physical suitability, where “you can’t stay behind males and can’t beat them, because of their vanity”, it contains a lot of tension.

The most powerful content that is shown only in this group is: “Preserving your femininity “signal” — “I’m behaving like a man, but I’m a woman.” The members of this group fear losing the feminine side partly or completely is manifested, besides this it also shows that they have to face that even they don’t want it. Also unique content is the mention that this type of corps is barely prepared for working with woman soldiers (toilets, showers, bounds, etc.) that can lead to problems with personal hygiene and as a results to different illnesses based on female anatomy.

The summarized results of the groups (from Table 1–4.) can be seen in the following table:

Table 5. Summarized results of the groups

	Male group	Female groups		
		Serving — supporting	Fighting — supporting	Fighting
Chances of carrier — acceptance in the military role	9	16	17	22
The coordination of the family (female/maternal) role and the professional role	7	9	10	15
Suitability — differences in physical suitability	9	4	8	5
Creating types, stereotyping from single examples	not presented as individual content	5	1	not presented as individual content
Wear — Uniform	7	not presented as individual content	2	2
Conflicts between women	4	not presented as individual content	not presented as individual content	not presented as individual content
Having your boyfriend/husband from the workplace	3	not presented as individual content	not presented as individual content	not presented as individual content
Mood changes/swings — communication disturbances	8	not presented as individual content	not presented as individual content	2

As we could see from the summarized table that in the women soldier's group from fighting type of corps the members show more similarity to the male group than their colleagues from other groups. The contents will be the most emotional in their group. Their accommodation pattern is closer to the masculine expectations of the military organization, from this aspect they are followed by the fight-supporting group of woman soldiers and the serving-supporting group is at the other end of the scale. In the case of the last group their profession also requires a civilian education in the military role and forms some kind of balance in their life. The most emphasized content where the tension and alterations connected to women soldiers can appear is shown in the content: "Chances of career — acceptance in the military role". This content having its importance by every group that shows that the place and role of women soldiers are still not clear enough in the military organization. On a personal level the content "The coordination of the family (female/maternal) role and the professional role" have priority. The family and social surroundings of the women soldier can also have the experience of how different is the military and civilian world and how the adaptation process changes the behavioural repertoire.

*Summarizing* the results, the presence of woman-soldiers in the HDF in a greater amount poses a lot of questions, because based on their gender-role socialization and physiology they have different attitudes, building an altered behavioural repertoire than males that can result in a challenge for women soldiers and male soldiers either in the field of acceptance and adaptation concluding from the traditionally masculine functioning of the military organization. Moreover we could observe alterations in this question at the level of the different types of corps, where the shifts of emphasis could be seen on those fields where the adaptation process of women soldiers becomes harder. So we could draw the conclusion that it is extremely important to take these aspects also into consideration when facilitating and building the military professional socialization in order to facilitate women soldiers socialization and acceptance.

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