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# The Execution of the Electronic Data Collection Tasks Made by the UN-classified USAR Teams on Extended Disaster Area Using the International Search and Rescue Advisory Group Coordination and Management System (INSARAG ICMS)

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**Abstract**

The United Nations (UN)-classified urban search and rescue teams are primarily prepared for special tasks to be carried out at the scene of earthquake disasters. Due to the type of the disaster and the strength of the earthquake, this will most often mean an extensive site of damage. In this dilapidated and most often life-threatening arena, missing and trapped people must be found and rescued, often with the help of a dog, an acoustic device or a search camera. A number of international rescue teams may be deployed to strengthen the capabilities of local forces, and national and international intervening personnel must work together to be effective. In the future, these management and coordination tasks can be professionally solved, and the common platform for this will be the ICMS system in many parts of the world.

**Keywords**: search and rescue, electronic data collection, ICMS

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## Introduction

At the scene of an extensive disaster - especially during the rescue period - , many national and international units can carry out tasks at the same time. These may differ depending on the type of event, but in all cases the priority will be to save human lives. Many actors are present during operational tasks and it is very difficult to achieve effective coordination. This is confirmed by many past events and the experience gained from them. For example, the 1985 earthquake in Mexico City[2] and the 1988 earthquake in Armenia[3], which led to the creation of the UN International Search and Rescue Advisory Group (INSARAG).

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[2] David Adler: The Mexico City earthquake, 30 years on: have the lessons been forgotten?. *The Guardian,* 2015.
[3] BBC: *In pictures: 25th anniversary of Armenian earthquake.* BBC News, 2013.

Under the auspices of the UN world organization, more than 90 member states in three main regions (Africa/Europe/Middle East region, American region, Asia/Pacific region) are currently coordinating their urban search and rescue activities against earthquakes. As well as developing their future capabilities in 2020 - with the help of the joint Advancing Flexible Assistance program for the 2025 period[4]. This complicated and complex activity is extremely difficult to implement, but the qualified urban search and rescue teams are able to do it in a modern way due to the processing of continuous experience and professional innovation of the past 30 years. That is why the purpose of the article is to research the electronic systems used by qualified rescue teams from the available documentation, and to examine the efficiency and the possibility of domestic application by analyzing an exercise with large data input. This may be particularly important later on in the liquidation of massive or extensive domestic disaster damage events.

During the activities of the UN INSARAG certified rescue teams, nothing less than the fact: the numerous member countries and organizations should be able to cooperate with each other. They have nearly identical organizational forms and methodologies, in accordance with the INSARAG guidelines. The situation is complicated by the fact that, in order to achieve a common goal, the differences arising from social, cultural, gender and religious situations existing in many countries of the world must be bridged. Management and leadership, as well as coordination, communication and diplomatic tasks must be effectively implemented in secondary roles. Their implementation – due to their difficulty – represents the pinnacle of operational disaster prevention professional activity, especially with regard to the leadership core component of the rescue teams. Here, in addition to physical, mental and health fitness, they must have the ability to apply disaster management professional knowledge at a high level and in a creative, improvisational manner is required. In addition to these, a high level of English is also a requirement, as communication skills with other rescue organizations and the local authorities. Performing operational management is not possible without this. In addition, the team members need IT skills and access to the Virtual On-Site Operations Coordination Center (VOSOCC), knowledge of the applicable guidelines and the ability to apply them, as well as passing an exam on the United Nations Department of Safety & Security – (UNDSS) "Be Safe!" (BSafe) security course.

[4] 3rd INSARAG Global Meeting 2020 Concept Note - INSARAG Session on Strategic Objectives 2020–2025. INSARAG

In order to be able to operate at the highest level and efficiently, the UN INSARAG system continuously develops all its areas of expertise and utilizes the special abilities and strengths of each member country to implement its tasks. From the 1990s until 2015, the use of paper-based forms was primarily during damage site data collection. After that, starting with the suggestion of Peter Wolff[5], the rescue teams switched to using the Kobo Toolbox Data Collection System (KT). The aim was to uniform the electronic data collection[6] so the coordination between the international units could be realized as efficiently as possible. Wolff has been the chairman of the UN INSARAG Information Management Working Group (IMWG) since 2013.

The INSARAG rescue teams must pass an exam[7] for electronic data collection and data processing tasks in the damage area during their classification or reclassification. The units mostly successfully fulfilled this and regularly used the KT during exercises and live situations. KT was an extremely effective tool and proved that the time for electronic data collection and data management started. The use of electronic devices greatly reduced the time for reporting to management bodies compared to the paper basis. Thanks to the accelerated processes, the time available for rescue has significantly increased. This has become particularly important due to the consideration of the "100-hour rule" on the damaged area. This professionally accepted rule of INSARAG means, that, apart from rare exceptions (e.g. a special request of a country in trouble), the rescue teams will search the damaged area only for approximately 100 hours. After that time, - in case of an adult person – there is just an extremely low chance of survival. Unfortunately, in the case of children, old, wounded or sick person this time can be significantly lesser.

But the Development did not stop during the use of KT. At the annual INSARAG Team Leader Meeting (2018) held in Romania, the IMWG already reported that from 2020, KT will be replaced by the International Search and Rescue Advisory Group Coordination and Management System (INSARAG ICMS), which has much more possibilities for coordination and cooperation for urban search and rescue teams. The ICMS system developed by the company Environmental Systems Research Institute (ESRI).

[5] A specialist of the German Federal Technical Assistance Service (Technisches Hilfswerk - THW).
[6] Tamás Hábermayer: Using the Kobo Toolbox program by the UN INSARAG Qualified international teams during widespread quick assessments. *Hadmérnök,* 12. (2017), 2. 127.
[7] „INSARAG External Classification Handbook, Volume II Manual C, Annex A – The IEC/R checklist" – UN INSARAG website, 2019. 47. 11.

***The introduction of ICMS elements***

ICMS is a computerized support system designed for supporting the urban search and rescue tasks. It has been created by computer scientists specializing in data collection and processing as a target tool for INSARAG certified rescue teams. To prepare the ICMS, the experts gathered the experiences of four large user groups, whose work based on INSARAG guidelines. The Reception/Departure Center (RDC), Urban Search and Rescue Coordination Cell (UCC), Exercise Control (EXCON) and Rescue Team (Team) groups were separated. They were given access and software usage options to an appropriate depth. Separate user manuals were prepared for them, addressed to the previously listed groups and compiled according to specific topics[8].

The user manual books present the following main contents relevant to ICMS:

- the operation of the UCC,
- the tasks of the RDC,
- team leadership and EXCON,
- the process of the sessions,
- the operation of the INSARAG ICMS central node,
- the use of the analysis and evaluation board (Dashboard),
- the UCC -applications and the basic functions of ArcGIS Explorer, Survey123 programs.

Essential fact, that due to the compressed use and sharing of damage scene photographs, it is necessary to know and apply the UN's Adaptive System for Image Communication over Global Networks (UN ASIGN) [9]. The previous experience of many rescue teams were, that in an extensive disaster situation - the internet can only be used to a limited extent at the site of damage incidents. Due to the damage, destruction or overload of the communication systems (for example: the rescue teams can only provide the task with satellite access, which is extremely expensive), usually only limited and low bandwidth becomes available. For this reason, the transmission of large files and data is difficult, but at the same time it can be important from the point of view of interventions. With the help of the UN ASIGN program, the file size of photographs can be significantly reduced and for the purpose, they can be quickly shared in professional hands.

[8] INSARAG: *RDC, UCC, EXCON, Team Guide.* INSARAG, 2020.
[9] UN-ASIGN website: https://asign.cern.ch/

It can be seen from the list that the ICMS system does not consist of a single program, instead a set of carefully selected programs. These software can often be used separately to perform some sub-tasks, but with the appropriate professional knowledge, they can be combined into a complex operation control and information analysis-evaluation interface. Through this, the work of international rescue teams can be assigned to each other and can be controlled electronically by the UN specialists with extraordinary efficiency. The received data are immediately processed on the analysis and evaluation board without any special intervention and become directly available to the users of the system. With the appropriate access, any USAR expert - can be anywhere in the world – can get immediate and reliable information about the ongoing tasks and see the realization of the coordination. The testing of the software in a live situation has already taken place during the 2020 Beirut explosion[10]. During the implementation of the operational and coordination tasks of the disaster, the ICMS system brought together the activities of 13 international level rescue teams and local forces, and later the experiences were shared in a publicly available video conference on the INSARAG website[11].

***The possible use of ICMS HUB and the working process***

When major, high-intensity earthquake disasters occur, the UN's international community of experts can use the VOSOCC interface of the Global Disaster Alerting Coordination System (GDACS) to get information. They selecting the Disasters menu (Figure 1) [12]. After selecting the given disaster event, they can access additional important information. For example:

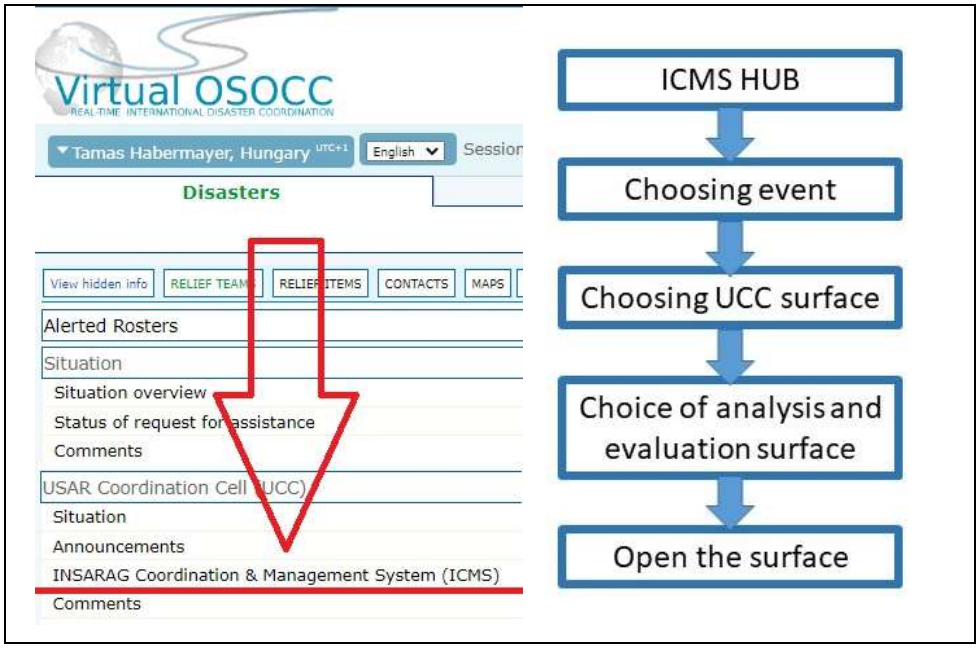
- situation overview,
- status of request of assistance,
- operational environment,
- response coordination.

In this surface, the experts can find the ICMS link linked to the disaster, where they can access the active interface of the system. By selecting the link, they can proceed to the ICMS central node.

[10] Michael Safi et alii: Beirut blast: a night of horror, captured by its victims. *The Guardian,* 2020.
[11] „INSARAG Technical After Action Review following Beirut port explosions 4-5 November 2020" – UN INSARAG website, 2020. [Online]. Elérhető: https://www.insarag.org/technical-reference-library/post-mission/841-information-management-and-technology
[12] Hartner Péter – Hábermayer Tamás – Muhoray Árpád: A Globális Katasztrófa Előrejelző és Koordinációs, valamint a Közösségi Veszélyhelyzeti Kommunikációs és Információs Rendszerek bemutatása. *Hadmérnök,* 13. (2018), 3. 206.

This is a protected and non-public interface, the content can only be used by authorized and trained professionals. This includes the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA), the members of the Information Working Group, as well as the leadership of Very Important Person (VIP) and internationally qualified rescue teams. For them the necessary data will be provided to enter the site. After logging in to the node, they can access the main functions of the program, and the professional tasks can be performed. Qualified rescue teams were given a separate username and corresponding authorizations for the team and UCC unit.

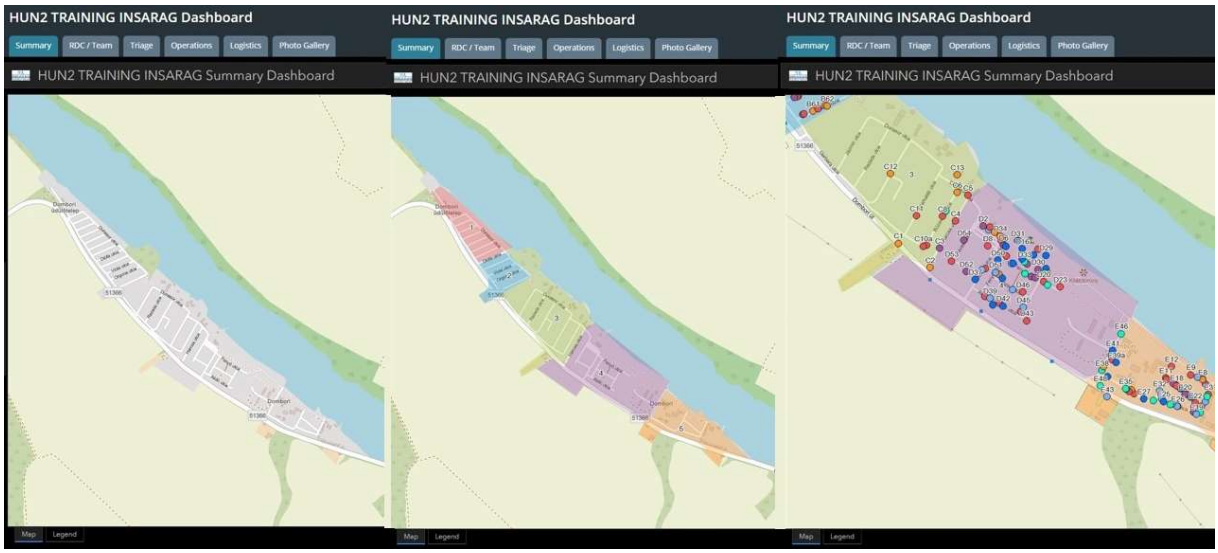
This also shows that the joint coordination unit of the rescue teams is extremely important. That is why the INSARAG guidelines require that all qualified rescue teams must be able to provide expert personnel to the coordination unit at the international level. In the case of medium rescue teams, this means 2, in the case of heavy rescue teams, 4 trained personnel from our own staff. These persons are typically drawn from the highly trained and best-skilled staff of the rescue teams. This step can make the team's basic life and task performance difficult.




1. *Figure: ICMS system Virtual OSOCC access and session flow Source: edited by the author*

The authorizations granted to the team ensure the performance of operational tasks at the damage site (electronic data collection and reporting, coordination tasks) and the possibility of viewing the most important information, primarily with the help of the Summary interface of the analysis-evaluation table and the Survey123, UN Assign and ArcExplorer programs.

The UCC access gives you much more software rights than that. With its help, the designated staff is able to carry out sectorization tasks, which can be used to divide the damage area into parts (Figure 2) [13].

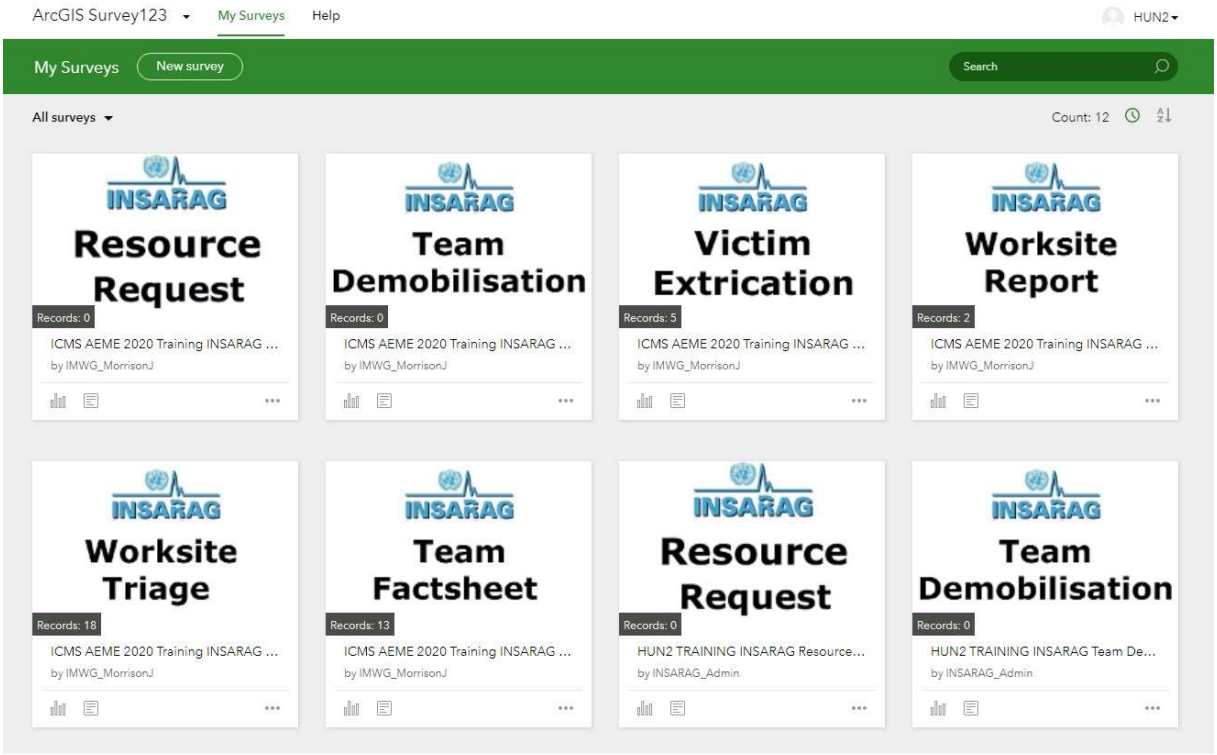



2. *Figure: ICMS sectorization process step by step from left to right Source: edited by the author*

After that, the rescue teams can already see the sub-areas defined for them on an electronic interface, in which they will carry out operative detection and rescue tasks. The UCC application is available from the ICMS central node, which offers many options for recording and displaying data on the operational map interface. With the help of the smart editor (Smart Editor) function, the boundary lines and sectors for the event can be designated, which can be easily updated as needed, and additional data (for example, safety rules for the area) can be attached to them. It is possible to filter the entered data by selecting the Filter options, which will only display the data that we specified as a condition on the work map. This function significantly facilitates, for example, the search for individual damage events, damage locations, or speeds up the display of activity for individual sectors. When using the work map, you can choose from 24 basic maps (for example, satellite, topographic, night, hybrid, nova), which can be adapted to the current task or period. In addition to this, we can add additional data (such as URLs, file attachments) and manage the added layers.

[13] INSARAG External Classification Handbook, Volume II Manual C, Annex A – The IEC/R checklist – UN INSARAG website

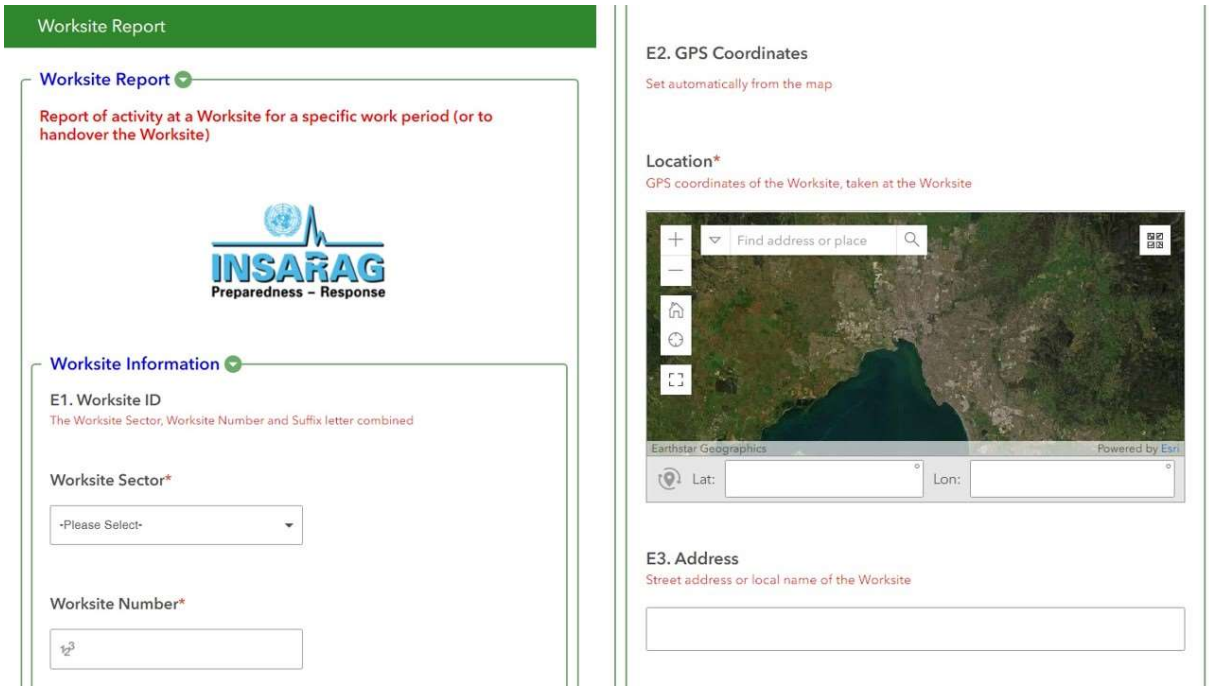
Starting from the ICMS central node, the next program used by the UCC staff is the UCC Quality Assurance (QA) application. This software part was introduced by the IMWG primarily due to the experience of past acute damage events. It has happened on several occasions that the data collected at the damage site were incorrect or uninterpretable. Because of this, professional decision-making encountered difficulties (or it was not possible to make a rational decision from the given data at all). This led to serious problems, since wrong decisions led to conflict situations countless times due to limited logistical and resource capabilities in the damage area. The QA system aims to eliminate these events. With its help, only those electronically collected data can be included in the real operational data that have been checked and approved by name, date and electronic signature of the authorized professional staff (primarily team leader, deputy team leader, UCC staff). This actually emphasizes the responsibility of the management of rescue teams and greatly increases data accuracy and operational efficiency on a global level. If a professionally trained person carries out this check responsibly, there is no or only an extremely small chance of an error occurring in the system.




3. *Figure: ICMS Survey123 program interface with electronic forms Source: edited by the author*

The Survey123 program is the next part of the ICMS central site. This software enables damage site data collection in accordance with INSARAG principles using electronic forms, for example team factsheet, worksite triage form, worksite report form, resource request, team demobilization form

(Figure 3). From the point of view of the ICMS, this part is extremely important for the intervention staff of the qualified rescue teams, who record these scene data in the system. The great advantage of the form-filling application of the ICMS system is that it automatically utilizes the location-determining ability of electronic devices, so that the data recording staff can record their position with sufficient accuracy, depending on the device used, but even within seconds. Based on this, the program can immediately place it in the sectors and, if there is one, also record the street name and address to it (Figure 4).




4. *Figure: ICMS Survey123 program interface with electronic forms Source: edited by the author*

### *The analysis of the test ICMS exercise*

As part of the ICMS system, rescue teams also have an independent training interface, which actually models the operation of the central node. With its help, all the functions required for live application can be tested, and real data can be collected at the damage sites designated for the exercises. Aware of this, many of the INSARAG units have already carried out independent exercises. In the following, we summarize the data and experiences of an exercise - which took place at a training site simulating an extensive damage area - anonymously for data protection reasons.

The internship was held on 04.09.2020. It was carried out by trained and certified rescue teams between 04:00-07.00. According to the assumption, a powerful earthquake occurred in a resort area

next to the river bank. As a result of the disaster, a significant part of the buildings collapsed or deteriorated, so it became necessary to request international help to rescue those in trouble. According to the concept, the units of 8 rescue teams (5 real on-site and 3 virtual) worked together to assess the damaged area. As part of it, the UCC also went into real operation and implemented sectorization. They defined 5 sectors (A, B, C, D, E). The survey was carried out by the assigned forces in 5 pairs, with the participation of 10 people. According to the areas determined for them, and in the course of three hours, a total of 245 individual damage sites were assessed in 30 streets of the 32.69 hectare area. Each INSARAG worksite triage form[14] used for such events contains 29 data fields to be filled in (e.g. damage location identifier, damage area boundaries, photo, safety rules, GPS coordinates, etc.), all of which are contain important information for the implementation of coordination between qualified rescue teams. Summarizing the data in a table, the following results were shown:

1. *Table: ICMS practice experiences, made by the*

| | Sum | Each Rescue Team | 1 team member |
|---|---|---|---|
| Elapsed time (in minutes) | 180 | | |
| Actual number of on-site rescue teams (pcs) | 5 | | |
| Actual number of on-site rescue teams (main) | 10 | | |
| Area size (m2) | 326900 | 65380 | 32690 |
| Street (pcs) | 30 | 6 | 3 |
| Number of damage locations (pcs) | 245 | 49 | 24,5 |
| Damage site triage data field number (pcs) | 29 | | |
| Total number of filled-in data fields (pcs) | 7105 | 1421 | 710,5 |
| Average time spent filling in 1 data field | - | 0,13 min | 0,25 min |
| Data field corrected during execution (pc) | 8 | 4 | 2 |
| Software error occurring during execution (pcs) | 0 | 0 | 0 |
| Hardware error during execution (pcs) | 0 | 0 | 0 |
| The average processing time of 1 damage site triage data sheet electronically | - | 3,67 min | 7,34 min |

[14] Worksite Triage Formp

| | | | |
|---|---|---|---|
| Fill in 1 damage location on paper [15] | - | - | 8,4 min |
| Based on the data, the number of probable damage sites for a 10,000 m2 rural area per rescue team and per person (pcs) | 7,49 | 7,49 | 3,74 |
| Based on the data, detection time of likely damage sites for a 10,000 m2 rural area for 1 rescue team (2 people) | 27,48 min | | |

During the analysis of the data, we can make several conclusions. The first is that only 8 of the all entered data fields (7,105) had to be corrected - typically due to interpretation reasons. Based on this, the error percentages – 99.9% the correct and 0.1% incorrect input. This results provides outstanding accuracy, which is excellent if we take into consideration the fact that the same data is used by the rescue teams and the UCC after the electronic recording.

In addition, efficiency is further increased and intervention time is shortened by the fact that, compared to the paper basis, a single intake is sufficient. After that, the data becomes available in the electronic system for immediate, multi-purpose use. In this way, it is no longer necessary to carry out the previously "used" additional activities (e.g. copying paper data, editing it in tables, sending it in photos, etc.). All of this significantly optimizes the execution of communication and coordination tasks between different organizations and enables higher-quality rescue activities at the site of extensive disaster damage areas.

***Conclusions***

Using the collective knowledge and experience gained, UN INSARAG professionals were almost among the first organizations to commit themselves to the use of electronic IT systems. This is indicated by the fact that expertise is a basic, verifiable qualification criterion for all rescue teams. If a team is unable to use it, they cannot qualify. Initially, the specialists used the KT program, which proved to be effective in the short term (2017–2020). With its help, the members of the internationally qualified rescue teams mastered the basic concepts of electronic data collection in the damage area, and with their help, they were able to significantly reduce the time required for the execution of individual disaster management operative operations, as well as for decision-making. The KT

[15] The filling was carried out with the help of 10 experts, measured over time.

program will be replaced by the current ICMS system from 2021. The purpose-built professional software system was able to significantly increase efficiency. The advantages of the analysis and evaluation board, the central node and Survey123, especially the coordinate-based virtual display and the summary interface, are continuously used by international organizations for coordination tasks.

In Hungary, only the members of the HUNOR and HUSZÁR rescue teams know how to use the ICMS system and are able to use it live in an international environment. Extensive and massive catastrophic damage events occur several times a year in Hungary, and their eradication is a difficult and time-consuming task. Seeing the example of the UN INSARAG and the ICMS system, it would be worthwhile to investigate whether a domestically developed system would be able to result in significant energy and asset allocation, time and efficiency savings in a similar way. In addition, it may be subject to further investigation whether the elements of this system could be transferred to military use (for example, artillery data collection tasks - fire observation, fire support).

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(Downloaded: 2022.08.23.)

# Major chemical accidents in the 21st century Europe and its lessons learned in higher education

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**Abstract**

**This article provides an example of how to use case studies in the case of disaster management subjects. The development of the subject's program and content is a continuous activity, actually a consequence of the changing world. Companies carrying out chemical processes, while maintaining their competitiveness, cannot be considered constant in parallel with the constantly evolving technical conditions. Therefore, industrial processes, chemical processes, accident prevention, recovery techniques, presentations in the lectures need to be updated.**

**New methods can be used for computing devices, applications, or their results. In the case of hazard analysis, the software and the presentation of their computational results are, in my experience, effective in the line of teaching methods. Namely, depicting and propagating the propagation of a gaseous material with a dangerous property, the direction and speed of the wind (and other physical chemical parameters) is an effective frontal technique for the students.**

**The chemical processes are based on numerous chemical processes, which are able to operate under constant control of the control parameters. There is a strong professional justification for describing these processes, which is the subject of the Dangerous Technology section of the subject in the field of industrial security.**

**Keywords: chemistry, hazardous chemicals, case study, chemical industry**

## Introduction

Mankind was helped by numerous accidental discoveries and inventions to achieve today's development level. Here are a few seldom heard special discoveries:

Thanks to the development of Sir Humphry Davy in 1815, by replacing the lamp used for lighting in mines with a safety alternative, much fewer accidents occurred in coal mines. Methane was an undesirable by-product in many coal mines, resulting in frequent firedamp explosions. Davy's lamp saved many lives and proved to be a huge opportunity for mining. [1]

In 1839, Charles Goodyear invented a process that made it possible to use rubber extracted from the rubber tree on an industrial scale, thus making rubber one of today's most useful materials. The vulcanization process was accidentally invented. This process is a chemical process which increases the strength and durability of rubber tires. The tire retains its elasticity in a much wider range of temperature, therefore vulcanised rubber can be used for more purposes.

In 1846 nitroglycerin was produced by an Italian scientist, Ascanio Sobero, the first to do so according to the publications. Nitroglycerin is a very explosive liquid, so it was very risky to use.

In 1866, Alfred Nobel, a Swedish inventor, mixed silicon dioxide with liquid nitroglycerin, thus obtaining an extremely explosive paste and patented the process in 1867. Nobel's aim was to place dynamite on the market and use it for larger construction work, such as building roads and tunnels. Unfortunately, however, dynamite has been used by the military as a weapon in numerous battles.

The contradictory story of DDT (dichloro-diphenyl-trichloroethane) is also worth recounting to the readers. DDT was first produced in 1874 by German chemist Othmar Zeidler. Its usefulness was proved by Swiss biochemist Paul Hermann Muller in 1939, discovering its effectiveness as a general insecticide. Muller received a Nobel Prize in 1948. The introduction of DDT reduced the occurrence of malaria, typhoid, yellow fever and bubonic plague, which had killed millions of people. However, it was found that DDT is not selective, its effects are not limited to insects and it is very dangerous to the human body, able to cause many changes in the body.

The first artificially created element was technetium (Tc), created in 1937 by Emilio Segre and Carlo Perrier. Alloys containing technetium oxide reduce corrosion. [1]

**A brief introduction to Europe's chemical industry**

The chemical industry supports virtually all segments of the economy and is closely entwined with its customers downstream. Rubber and plastics, pulp and paper, and the automotive industry are all huge users. Closely two-thirds of EU chemicals are supplied to EU manufacturers or construction. The EU chemical industry distributions technology throughout the region’s economy. The EU chemical industry’s share of world markets has declined in the past two decades. Trading chemicals all over the place prompts competition, provides an incentive to develop different markets through innovation, inspires production efficiency and helps develop the quality of human life. Characteristics of the EU28 chemical industry structure as can be seen in Table 1. [2, 3]

*Table 1. Characteristics of the EU28 chemical industry structure (based on year 2015 data) [2, 3]*

| | |
|---|---|
| Number of companies | 28,221 |
| Turnover | 520.2 billion € |
| Direct Employees | 1,155,000 |

The chemical industry is demand of energy and competes globally. Anything that increases energy costs in Europe relation to our participants has a major impact on competitiveness. EU legislation adds several costs for the European chemical industry, hampering its worldwide competitiveness. [2, 3]

Among others REACH prices will likely decrease after 2018, on the other hand complying with biocidal product and plant protection regulations will become more costly. The aim is to guarantee regulation is achieving its objectives in the most well-organized way, and correct any shortcomings without negotiating health, safety and environmental protection. Europe's chemical industry needs a regulatory framework that is fit for purpose, consistent, cost-effective and which does not negatively impact its competitiveness vs other regions.

Over the last two decades, the European chemical industry, together with pharmaceuticals, has made a huge effort to minimise the environmental impact of its production. The European chemical industry is still a world leader, and a highly inventive sector. Germany and France are the two largest chemicals producers in Europe, followed by Italy and the United Kingdom. [2, 3]

**Characteristics of Hungary chemical industry structure**

The chemical industry plays a large role in Hungary's economy. The chemical and pharmaceutical businesses have a long history in Hungary, as do investigation, improvement and novelty that are mainly essential now to the competitiveness and sustainable development of the country's chemical companies. [4-8]

Manufacturers operate laboratories and research centres. The Chemical Research Centre of the Hungarian National Academy and the technical universities of Budapest, Veszprém, Debrecen and Miskolc participate in both basic and applied research projects in cooperation with companies and/or under EU programmes and projects. Characteristics of Hungary chemical industry structure as can be seen in Table 2.

*Table 2. Characteristics of Hungary chemical industry structure (based on year 2015 data) [4-8]*

| | |
|---|---|
| Turnover | > 16 billion € |
| Direct Employees | 80,305 |

*Table 2. Characteristics of Hungary chemical industry structure (based on year 2015 data) [4-8]*

Strengths of the Hungarian chemical industry:

A robust petrochemical base

Rule economies of scale, up-to-date technologies and sound environment practices

Powerfully presence on the stock exchange

Volume improved by investment to meet demand from electronics and agriculture

Development targets of the Hungarian chemical industry (weaknesses):

Depends heavily on imported raw materials and energy

Great and volatile energy prices weaken competitiveness

The chemical enterprises are trying durable to maintain and develop close relations with vocational training schools, dedicated high-schools and technical universities to attract young, well-trained and greatly educated people to replace an aging employees. This aims to avoid the skill shortages and losing professionals to other developed economies. Chemical industry structure in Hungary (2015), source: Hungarian Chemical Industry Association as can be seen in Figure 1. [4-8]

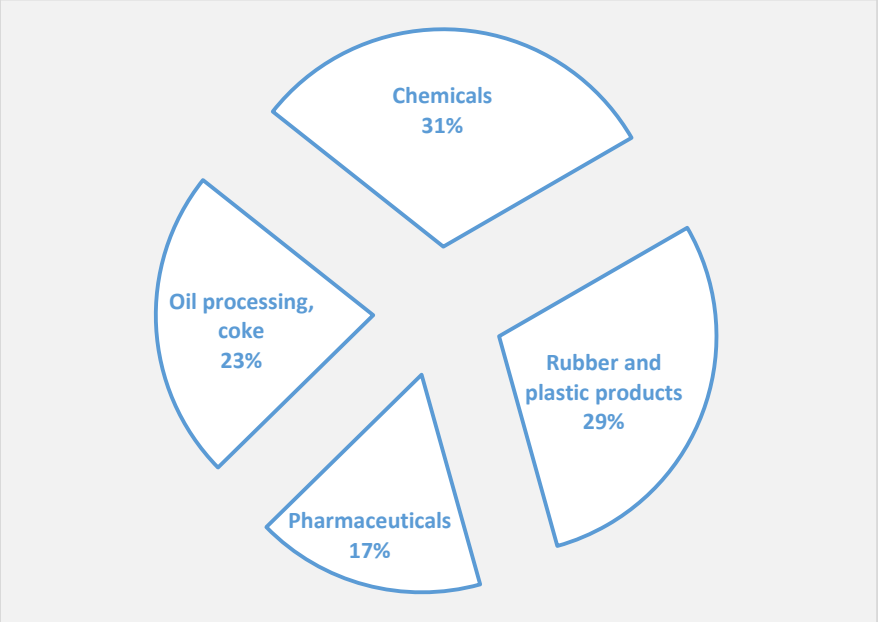


*Figure 1. Chemical industry structure in Hungary (2015), source: Hungarian Chemical Industry Association [4-8]*

The business is a giant employer, with more than 80,000 workers, including 14,000 in chemicals and 17,000 pharmaceuticals. With gross wages above the national average, the chemical segment is a valued employer. Full time employment in the Hungarian chemical industry (2008-2015) source: Hungarian Chemical Industry Association as can be seen in Figure 2. [4-8]

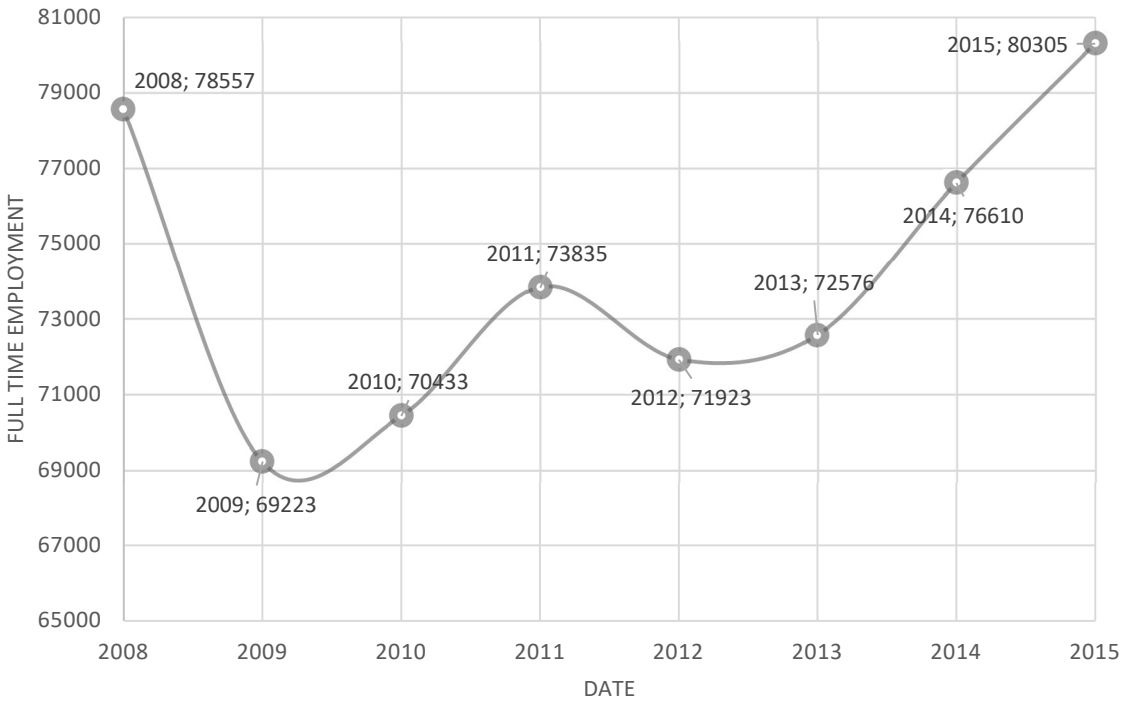

*Figure 2. Full time employment in the Hungarian chemical industry (2008-2015) source: Hungarian Chemical Industry Association [4-8]*

**Toxic leakage in a frozen food storehouse in France**

On the premises of a company operating hundreds of frozen food storehouses located in the village of Nemours, near the A6 motorway in Seine-et-Marne, France, packaging, distribution and storage of food products take place. The company employed 236 employees in 2005, consisted of two buildings separated by a passageway. The logistics warehouse contains a laboratory and a refrigerated storage room with the refrigerator containing ammonia. This technology line is capable of storing up to 2 tonnes of ammonia. [9]

As regards the pressure vessel containing ammonia, it is important to note that it was only equipped with filling and fluid drainage valves, but did not have various pressure accessories, such as pressure gauges or safety valves.

Between April 20 and 26, 2005, safety improvements were planned for the refrigeration equipment used by the company to replace the condenser and other accessories (including, for example, the valves) of the cooling system circulating ammonia under pressure. Prior to the development work, part of the ammonia had to be removed from the system. As noted in subsequent studies, during this process, it escaped the attention of the maintenance workers that 500 kg of the 2 tonnes of liquid ammonia in the cooling circuit remained in the evaporator. 1500 kg of ammonia was transferred into four 450 kg tanks rented by a subcontractor specializing in the maintenance of refrigeration equipment, which were placed outside the storehouse and stored under guard. On April 23, 2005, one 450 kg ammonia tank began to leak.

The toxic cloud affected a total of 100 people in the plant site, including 21 warehouse workers and people who were parking 200 meters from the tank at the rest area on the A6 motorway.

Following this incident, the authorities required the operators to prepare and fully comply with a so-called internal emergency plan.

During the response, significant protection resources were used with substantial efforts and professional supervision. About 100 firefighters, 40 vehicles, and 2 helicopters were needed to manage the incident.

Local ambulance units reported approximately 50 people injured, 28 of them were examined and five injured were hospitalized for a severe asthma attack. Due to the internal emergency plan, a 150-meter radius security perimeter was set up by local professionals.

At the incident, the primary interveners diluted the ammonia gas leaking from the ruptured tank with the help of a water curtain, thus preventing the ammonia cloud from spreading to the nearby rest area. [9]

The waste water generated during the intervention was collected in a 300-m3 basin, and after a laboratory inspection, it was released into the communal drainage system.

The major problem identified as the reason of the accident was the rupture of the pressure vessel, caused by the overpressure in the tank, which can be traced back to overfilling during the transfer. Vessels used for the transfer were originally designed to store liquefied gases and liquids with a filling rate of 85-100%. As a further problem, post-accident analyses revealed that the tanks in which the ammonia was transferred were not suitable for filling above 430 kg, which was very close to the container's storage capacity.

A further complication that also contributed to the damage incident was that the transfer method applied was not suitable for the tank model used by the operator and the company did not have documents or instruction manuals which could have explained the markings used on the tank. [9]

After the investigation of the accident, the following measures were required from the company by the competent French authority [9]:

preparation of a training material for the employees, which includes the events that happened before, simulations, presentation of consequences and analysis of the event;

the company should take measures that are capable of preventing or minimizing leakage of a similar dangerous material;

clarifying, continuous updating and practicing the internal emergency plan;

the instructions of the tank filling processes need to be revised;

installation of devices for the measurement of the concentration of ammonia and their mobile use if the dangerous material is transferred in an open space;

defining the responsibility of the actors involved in the event in legal proceedings.

Measures taken by the dangerous establishment following the accident [9]:

replacement of some of the equipment in the technological line with more suitable ones that fit the parameters more accurately, e.g. tubular heat exchangers were replaced with plate heat exchangers;

the maximum amount of ammonia present at the site was reduced to 600 kg;

building well-designed loading stations, which greatly facilitates the process, and in the event of a possible ammonia leak, the toxic gas clouds automatically flow to the chimney due to a ventilation system, thereby reducing the harmful effects on workers.

As regards the equipment used by the operators, concerns were raised about the use of simple, multi-function tanks that did not have safety valves, pressure and overcharge accessories.

**Ammonia leakage in a facility of Zalahús Rt. in Nagykanizsa**

On January 3, 2003, the service staff of Zalahús Rt., Nagykanizsa, performed the scheduled replacement of one of the pumps responsible for cooling the plant. According to the maintenance workers' narrative, prior to performing the operation, they were planning to separate the sections of the pipelines as prescribed in the operational instructions. Meanwhile, in order to remove the small amount of gaseous ammonia remaining in the pump, they opened the air valves and the gas was released at full pressure through an opening of approximately 16 mm diameter. The maintenance workers immediately alerted the employees in the factory who then left the danger zone and gathered in a safe place. [10, 11]

Following the incident, the relevant units of disaster management were immediately alerted and squads from the Nagykanizsa Fire Department arrived at the scene, who reported the incident to the Zala County Disaster Management Directorate, the Nagykanizsa Civil Protection Branch Office and the Nagykanizsa Police Department. Soon the Emergency Reconnaissance Team was also alerted

and the West-Transdanubian Inspectorate for Environmental Protection was informed about the events in addition to other establishments in the vicinity of the establishment. [11]

Primary interveners dressed in fully protective clothing, equipped with breathing apparatus disconnected the power in the plant. Then during the reconnaissance, it was revealed that the air in the room containing the pump became saturated with ammonia and thus it was leaking through the doors into the plant.

For the sake of the operations, they designated the intervention zones according to the hazard. The primary zone was a circle of 10-meter radius around the leakage and it was the one with the strictest personal protection requirements (full respiratory and chemical protection equipment) were put in place to protect the primary interveners. The second zone was a circle of 50-meter radius, in which the incident commander required interveners to wear firefighting protective clothing together with the accompanying respiratory protection equipment. [11]

Subsequently, under the professional guidance of the specialists of the plant arriving on site in the meantime, valves were closed in the pump room and with further operations, ammonia leakage was completely stopped. During the described operations, the chemical reconnaissance units continuously monitored the concentration of ammonia in the air (with the help of detection tubes and measuring instruments).

Subsequently, the plant gradually channelled the ammonia contaminated water into the communal wastewater system, bearing in mind the sustainable capacity of the residential network. In the coming days, all the facilities in the factory were ventilated and inspected. The ammonia accumulated in the pump rooms of the facility was removed with vaporised water.

Reconnaissance findings and the accident analysis later revealed that approximately 300 litres (about 200 kg) was leaked out of 3 tonnes of ammonia and due to the effective intervention, there was no injury or permanent damage to the environment. Based on the continuous reconnaissance, it was stated that the concentration of ammonia did not reach the life-threatening value, but its level was repeatedly found in the range “harmful to health”. The loss of working hours resulted in a significant economic damage in the operation of the plant. [11]

**Accident of a fuel tank in Hungary**

On March 25, 2010, at the Csepel Base Depot of MOL Group, an explosion occurred during the cleaning of a tank of 5,000 cubic meter originally used for storing petrol and then the hydrocarbon compound residues caught fire in the empty uncleaned tank. As a result, the top of the tank collapsed and the subcontractor worker performing maintenance inside the tank lost his life. The dead body of the man burned beyond recognition could be pulled out through a crack at the bottom of the tank formed as a result of the explosion. At the site, the cleaning work was carried out by a subcontractor company, which claimed to have provided the workers with appropriate personal protective equipment, namely respiratory protection (breathing apparatus), protective clothing and the necessary external professional supervisors were also present. The rather robust tank of 5,000 cubic meters cracked open as a result of the physical consequences of the explosion and the roof structure of the tank collapsed. It is assumed that the industrial incident occurred when the hydrocarbon residues were removed and an explosive mixture of petrol vapour and water was formed and an adverse event resulted in a spark. The cleaning worker probably had taken a non-explosion proof hand-held radio with himself, while other case studies claim that his clothing was not entirely suitable and became charged with static electricity due to friction. The author of this article, as a member of the primary mission unit on the day indicated, was on site and conducted a chemical investigation. [12-13]

**Educational methods and their development opportunities in education in disaster management**

The causes of industrial and chemical hazards and their disasters are failures, unanticipated side effects of technical systems. However, this is a misleading over-simplification and many other factors are involved. The calculus of industrial hazard is a blend of industrial structures, people and environments that contain atmospheric, ecological, psychological and social components.

The object of the disaster management main specialisation is to update the knowledge and skills of the college students on multi-dimensional aspects of chemical catastrophe risk management and emergency incident-response, effective planning, integration and organization. [14-18]

In case study materials at time of course registration itself so that participant have a hint at scope of course, general question answer based on perceptions and knowledges, and familiarity with the participants will help in reducing and handling the troubles of heterogeneity of entry behaviour of participants.

The objectives of the disaster management specialization planned for the present is to enable the students to assess and deliver their respective aspects and roles in relation to chemical disasters

management and delineate strategies for risks mitigation and implementation of effective response in case of emergencies.

The education aims of the subject program (elective course-unit, joint training, credit-based education) to allow the students [14-18]:

identify the scenario and challenges associated with chemical disaster risks and consequences;

explain described observations about chemical disaster risks, mitigation methods and response mechanism;

define preparedness for chemical emergencies and response of various services in chemical disasters;

integrate environmental planning with disaster management in siting of Industries and Industrial estates.

Educational methods shall be chosen for teaching a particular aspect of chemical disaster, from a range of following:

• presentation (slides) and discussion,

• group work / project/ dialogue – exercise,

• film, simulation show followed by question-answer, discussion,

• lecture followed by query-answers,

• demonstration /hands on exposure (computer based).

At the end of this educational unit, the participants will be able to [14-18]:

- define and separate between chemical and industrial hazards,

- label their causes and impacts,

- comment the global, national and regional scenario.

To conclude, case studies of chemical disasters give the opportunity:

• Define the on-site hazards and risks of accident that can lead to disaster within premises and out-side,

• State the industrial siting aspects of off-site emergencies in case of a chemical disasters,

• Analysis the vulnerability of the off-site population, property and environment to the risk of a chemical disaster,

• Calculate the risk perception level, mitigation and preparedness including response measures, planning, coordination and command system onsite and off-site for handling emergencies.

A nation's legislative and institutional systems provide the basis for plans and administration in all areas of disaster risk reduction and emergency response. Then strong engagement exit between environmental degradation and disaster risks, environmental legislations and their implementation is a central criterion for disaster risk management. Conversely, the role of legal provisions on environment and natural resources can play significant role in addressing hazards and reducing vulnerability of natural disasters, and in handling after a disaster relief and recovery challenges, are seldom recognized. [14-18]

**Conclusions**

In the recent past, there has been a large number of industrial accidents in Hungary and neighbouring countries as well as in distant countries, some of which occurred during activities involving dangerous substances. For our daily activities, it is inevitable to come into contact with large quantities of dangerous chemicals. The life cycle of chemicals is so closely related to our everyday lives that it can be definitely stated that each and every person performs some kind of activity involving chemicals on a daily basis.

Using detergents, heating or cooking with gas-fired appliances, fuelling a car, a car engine running inside a garage, a poorly functioning combustion equipment, improperly installed and operated ventilation equipment, spraying in a kitchen garden or in a huge agricultural area are all just a few examples that can happen in our everyday lives in a household. The activities mentioned above are carried out on a thousand- or even on hundreds of thousands-fold scale in industry, agriculture, and of course with many different chemicals in the lead.

Statistics reveal that for most of the damage incidents people are to blame, mostly because of the following reasons: non-observance of operation rules, inattention and professional incompetence can all lead to accidents with serious consequences. It is of utmost importance for students studying in any of the three specialties of the disaster management course to master the basics and application of physics and chemistry. During their studies, students take part in both theoretical and practical training, through which they get into contact with the subfield of natural sciences connected to industry. After obtaining a degree, they should possess professional skills in incidents involving dangerous substances that allow them to make high quality decisions. For a disaster management specialist, in addition to legislation, the knowledge and the sensible, conscious use of natural sciences is crucial for decision-making.

Chemicals and related activities can create increased emergencies and pose a risk of malfunctioning or accident. The main purpose of my paper was to present the importance of education through case studies. Ultimately, disaster management students are familiarised with various dangers that may occur during industrial activities, their occurrence characteristics and the methods of identifying the hazards.

In a dangerous establishment with an advanced safety management system, the main guidelines relevant to the employees are discussed at least on a monthly basis in the form of further training and professional discussions.

Conclusions from the case studies are compatible with the curriculum of the disaster management course, and in addition, there are numerous other professional points for continuous improvement of the course syllabuses.

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# Economic and infrastructural evaluation of rail transport of dangerous goods in Hungary

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**Abstract**

The transportation of dangerous goods by rail involves considerable risks of accidents, yet it can represent significant economic interests. All accidents that somehow reduce the competitiveness of railways might have major impact not only on the railway companies and operators but also on all fields of the national economy. Besides the economic approach, the goal is to assess the infrastructure condition of railway stations, which greatly influences the prevention of the accidental release of dangerous substances and potential mitigation and recovery tasks. After studying the related national legislation and laws of the member states, the author attempts to classify the establishments dealing with rail transport of dangerous goods and to analyse the economic aspects and infrastructure of rail transport of dangerous goods.

**Keywords**: rail, dangerous goods, transportation, industrial safety, economy, infrastructure

## Introduction

One of the most important milestones in the history of transport was the invention of the railway, whose development has been closely linked to the progress of industry, economy and society from the very beginning. Following the system change, Hungary created transport, including the possibility of railway development, by joining the North Atlantic Treaty Organization and the European Union EU). In addition to the development of the infrastructure - which is of paramount importance to the national economy - we undertake international transport obligations in this area. The experience of the last twenty-five years shows that both expressways and a high-performance railway network are one of the most important basic conditions for industrial, commercial and logistics sites. However, this decisive role requires the construction and maintenance of a railway network of adequate capacity and quality. As a result of global warming, sustainable development and environmental protection expectations, the development of railways has again come to the fore in our country. As we can see, many large-scale projects are underway (renovations, modernization of security equipment, station reconstructions, renewal of the machine fleet) or are currently being planned, the implementation of which is mostly made possible by EU funds.

In addition to taking advantage of these opportunities, the railway also continuously applies the latest, most modern technologies, so it can be rightly assumed that a boom in the transport of goods by rail is expected in the future. As an additional advantage, it can be mentioned that railways play an outstanding role in the transportation of goods that are the subject of international trade, since due to their high performance, they are able to transport bulky goods relatively quickly and safely, at relatively favorable freight rates. Based on all of this, we can conclude that one of the most prominent and important key areas of Hungary's economic development and competitiveness is the transport of goods by rail. The transport of dangerous goods by rail also plays an important role in the activity of rail freight transport, which shows a quantitative increase based on the previously mentioned factors.

The purpose of writing my paper is to analyze and evaluate the economic aspects and infrastructure of dangerous goods transport by rail. For this, it is essential that I present the industrial facilities for the transport of dangerous goods by rail, which are not yet fully clarified by law, with an approach from an industrial safety point of view.

**Economic aspects of the transport of dangerous goods by rail**

As a member of the European Union, Hungary has undertaken to fulfill certain obligations, therefore it is advisable that the Hungarian development goals are in line with the goals of the relevant EU recommendations, directives and strategies. The primary goal of European transport policy is to facilitate the creation of a transport system that contributes to economic development, increases competitiveness, provides high-quality mobility services and uses resources more efficiently. According to the European Green Agreement, the goal of the EU, including Hungary, is for Europe to become climate neutral through an economic and social transformation. According to the Sustainable and Intelligent Mobility Strategy, revitalizing the railway sector and making it more competitive compared to other modes of transport is of prime importance in the EU, as well as the 4th Railway Package, which aimed to fully establish a unified European railway area, European competitiveness and to promote growth. According to the EU commitments, Hungary also accepts the expectations formulated by the EU, which appear on the one hand through various domestic legal regulations, or in the National Transport Infrastructure Development Strategy or the Green Paper 2030.

We cannot forget the European Commission's White Book, which was adopted in 2011 (amended in 2017) and can be considered as the foundation for the future development objectives of European transport policy, which, as part of the National Transport Strategy (Strategy), contains both social and horizontal in order to achieve the goals, the goal is to increase the share of rail transport and transport. According to the White Paper, 30% of road freight transport by 2030 and 50% by 2050 should be taken over by rail or water transport.

Industrial production and export play an important role in Hungary's economy, therefore one of the conditions for economic growth is to improve the condition of the transport network and the quality of services. According to the EU2020 industrial policy communication, the competitiveness of industry depends to a large extent on the quality and efficiency of transport infrastructure services. That is why it can be said that railway activities represent an important economic value, any activity that reduces the competitive position of the railway can have a significant impact not only on the railway companies or track maintainers, but also on the wide economic interests of the region or country. Since Hungary's accession to the EU, the share of rail freight was 33.3%, while in the EU it was 27.3%.

***Improving the accessibility of the international (TEN-T) railway network***

Strengthening interoperability is an important aspect in the development of trans-European corridors, which are of outstanding importance from the point of view of the transport of dangerous goods by rail. Trains traveling across borders without stopping and without restrictions can mean competitive rail transport (changing locomotives at borders or border inspections significantly worsen travel times and competitiveness). Due to the territorial extent of the European Union, the transport of bulky goods, including dangerous goods, plays an extremely important role in the field of transport. For this reason, the EU has defined several shipping corridors that are advantageous from a logistical point of view. It is most advantageous to transport large goods over long distances by rail. However, for this it is necessary that the countries connected by the railway line can be traversed by even one train. In order to achieve this, it is essential to check whether the subsystems are interoperable and whether the sections of the member countries meet the EU requirements. The railway developments carried out so far made it possible for the number of vehicles carrying dangerous goods to increase to such an extent in recent times. The economic aspects of freight transport are equally valid and apply to railway transport tasks related to dangerous goods in the same way. At the same time, it can also be stated that safety and environmental protection are fundamental requirements in the management of railways. The economic advantage and improvements must be implemented within a reasonable framework and must not be achieved at the expense of safety or inadequate preparation for accidents that may occur.

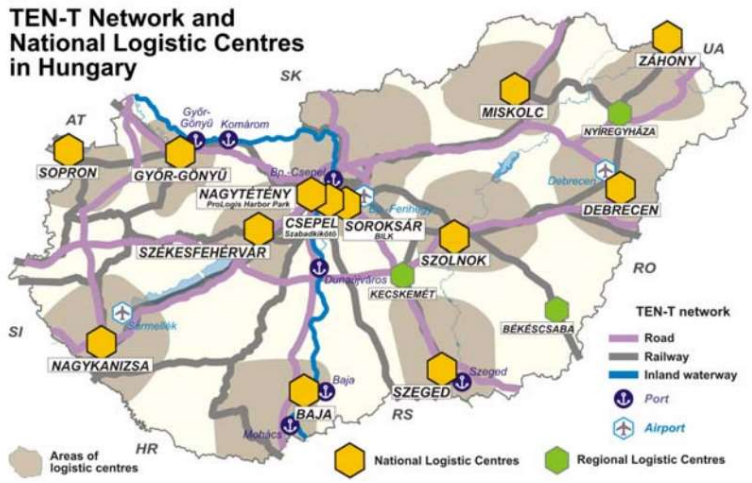
**Infrastructural analysis of dangerous goods transport by rail**

Due to the geographical location of the country, the Hungarian railway plays an important role in the European railway network, and we must use this advantage as successfully as possible. If we compare the role of railways to the European Union average, it can be said that our country is above the EU average both in terms of the density of the railway network and passenger and goods traffic. Significant progress has been made in the development of the main railway network in recent decades. However, the modernization of the branch lines has not been completed and most of the railway bridges also need to be renovated.

***Hungarian sections of the Trans-European Transport Network (TEN-T)***

The Trans-European Networks (TEN) includes the development program of the networks in the EU, as well as the uniform design of national networks with a systemic and community approach,

taking into account the optimal division of labor between different modes of transport and the technical harmonization that ensures interoperability between national networks. The European Council and the Parliament adopted the transport TEN plans in 1996, which aimed to establish a unified land, sea and air transport infrastructure network in the EU. The following diagram shows the Hungarian railway elements of this network.




*1. Figure: TEN-T Networks and National Logistic Centres in Hungary (source: KTI – Institute for Transport Sciences)*

Based on the Integrated Transport Operative Program 2014-2020, the EU-wide, operational TEN-T core network must be created by 2030, and a high-quality, high-capacity network with related information services must be created by 2050.

They are not able to provide a speed of 100-120 km/h everywhere. In order to define the railway as a form of transport, it is essential to know the concept of "solid track". In transport, we can speak of this type of transport if the vehicle travels on a predetermined route, so the freedom of movement of the vehicle can be limited and it cannot - normally - leave the fixed route.

The main advantages of the railway are that, compared to the road, it can transport a huge amount of goods from one place to another in a relatively fast and relatively environmentally friendly way, and weather conditions and traffic risks play less of a role in this transport sector than on the road. It travels in a closed system, so it has an advantage in traffic, and its types and characteristics allow it to be suitable for transporting any kind of goods. One of the cornerstones of the EU's railway policy is that in the coming years, the traffic of dangerous goods must be diverted from the public road to the railway.

One of the problematic areas of rail freight transport, but which seems to be resolved, is that the gauge width of the railway tracks is not the same everywhere in Europe (Finland, Portugal, the territory of the former Soviet Union), therefore the goods coming from or to be forwarded from these countries need at least two transshipments, thereby increasing the damage to goods and the risk of release of the dangerous substance. As an example, the difference in railway gauges on the Hungarian-Ukrainian border (1435 mm in Europe, 1520 mm in the countries of the former Soviet Union) and the resulting waiting time of several hours and the consequent increase in the probability of accidents can be mentioned. The creation of unobstructed cross-border traffic is also an increasingly urgent task in rail connections, both in connection with the transfer of goods and passenger transport. To eliminate this, an automatic gauge changing device was used, so the goods are not damaged and at the same time loading and unloading is much faster.

2. *Figure: Gauge changer rail section*

The automatic gauge changer named SUW 2000 enables passage at a speed of 30 km/h, so as a result of the application of the gauge technology, the time spent at the border can be reduced from several hours to fifteen minutes, thus Considering both the advantages and disadvantages, it can be concluded that the efficiency of the railway in terms of domestic and international freight transport can be said to be very good.

***The operation of companies with a national railway freight forwarding license, the elements of the railway infrastructure***

In Hungary, only companies with a license issued by the Transport Authority (KH) can carry out freight forwarding activities on open access railway lines. In our country, we currently know one hundred and eight such registered companies, whose goods can be forwarded for their own purposes (transportation) or carried out on order by others. Most of the licensed companies do not carry out real transport activities, NKH's freight forwarding license was obtained only for the purpose of transporting building materials to the work site in the course of its activities for the maintenance of railway facilities and their construction. These companies are not railway companies in the traditional sense of the word, only the terms of their railway-related activities are the same as those of companies that actually carry out goods forwarding and transport activities. Railway infrastructure is a collective term that includes all buildings and equipment that are necessary for the operation of railway transport. We distinguish two main parts of the railway infrastructure, on the one hand, the track network itself, and on the other hand, the railway mechanical equipment.

The track networks forming part of the infrastructure can be divided into three further subgroups. Hungary's national railway track network is 7,869.972 km long, which accounts for a quarter of the national road network and, similarly, is part of the national wealth. The national network also includes the 2,830 km of railway lines defined in the law on railway transport, operating as part of the trans-European rail freight network, as well as other national core network tracks and standard gauge secondary lines. The Hungarian rail freight network was established in the 2nd no. is illustrated by the picture, during the study of which it can be established that the Hungarian railway track network has a central, radial layout.

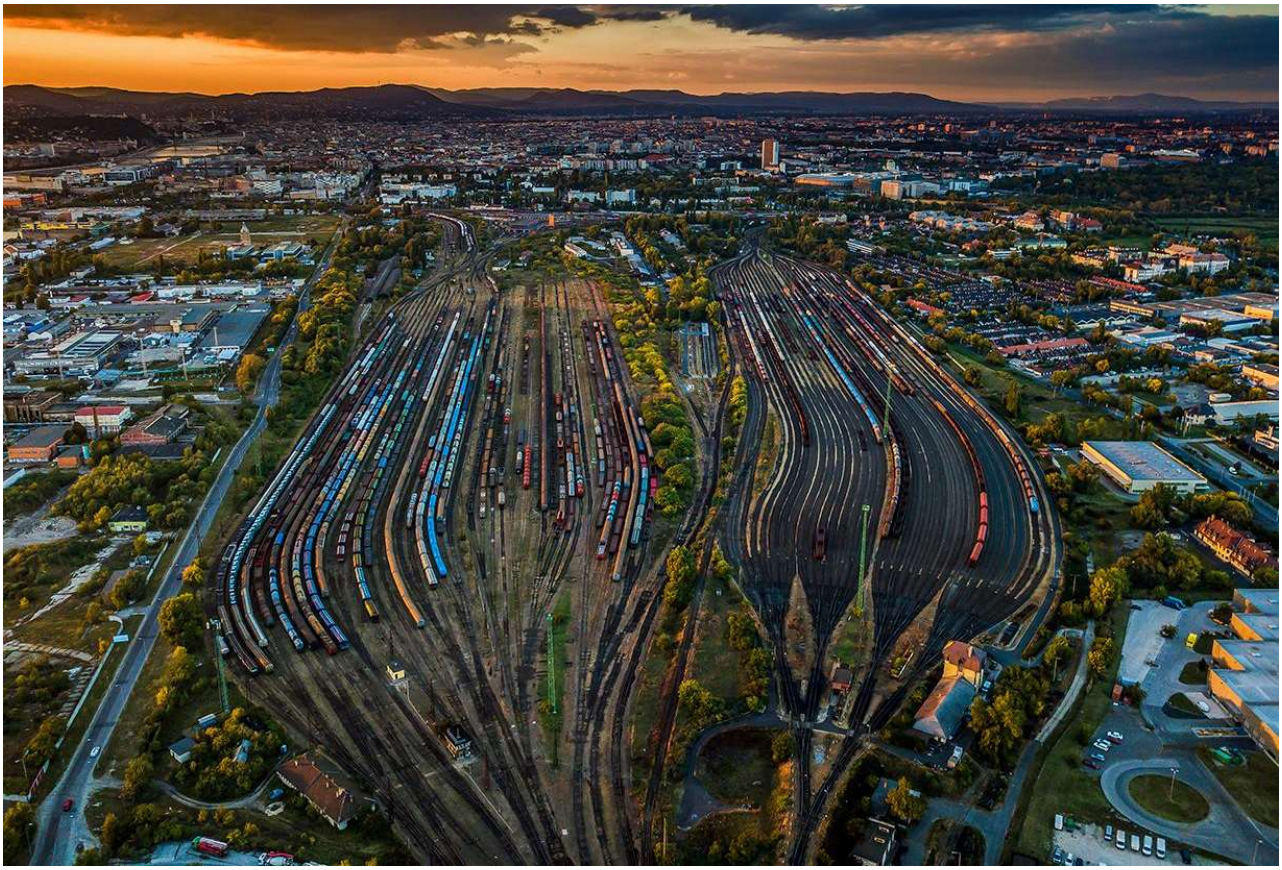
*3. Figure: Rail transport in Hungary*

Pursuant to the Act on Railway Transport, the operation of non-national regional railways, also known as regional railways, is also permitted. These operate on track networks that touch at least three counties and whose length does not exceed 400 km. Regional railway companies, even national railway companies, can carry out freight forwarding activities. Regional railways are characterized by a simplified railway service adapted to a simpler technical design compared to national railway networks, and a smaller capacity fleet. Regional railways operate in sparsely populated areas where there is no significant transport demand from industry. The local railway track network is the railway track network necessary for the performance of local public railway services, which does not have a specific role in the transport of goods by rail.

The operational facilities for the transport of dangerous goods can be grouped by transport chain. The grouping shown below only includes the operational facilities of the railway sector. SEVESO III. According to the Directive, transport means the change of location of dangerous goods, including the necessary stations during the transport process and all the time that dangerous goods spend in wagons, tanks and containers, the time imposed by the transport conditions before, during and after the change of position.

In relation to the railway, it can be said that these operational facilities primarily mean railway marshalling yards. According to National Directorate General for Disaster Management, Ministry of

the Interior (NDGDM) data, MÁV Group has identified 16 railway stations in Hungary, the most significant of which are the freight stations in Ferencváros, Miskolc, Szolnok and Záhony. The following picture shows the Ferencvárosi railway marshalling station, which can be considered the largest station in Hungary based on both railway traffic and occupied area. Its central role is indisputable and it was formed during the construction of the Connection Rail Bridge, because about 90% of the railway traffic between the eastern and western parts of Hungary passes through this bridge. Due to its role as a staging station, it handles significant freight traffic day and night, at all times of the year, as an average of 300-400 freight trains pass through it every day.



*1. Picture: Ferecváros Marshalling Yard (Tamás Rizsvai)*

Pursuant to point 1.11 of the Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) regulation, these facilities are required to prepare an internal hazard prevention plan, which applies the prevention and consequence reduction rules of the SEVESO Directive.

Another important group of industrial facilities for the transport of dangerous goods by rail is the railway marshalling yards of plants producing, processing and storing hazardous materials, or industrial tracks closely connected to the site. A plant handling a hazardous substance or a plant

marshaling station located in the area of a plant below the threshold can pose a serious risk, both in terms of the environment and the population. The industrial tracks connected to the site can cause danger, as there are a significant number of railway cars loaded with dangerous goods, without industrial safety operators and official supervision.

As a third group, we can name plants of railway transshipment terminals dealing with hazardous materials or unclassified plants. The BILK Logisztikai Zrt. operating in Budapest can be considered one of the most important such facilities. During the transfer of containers on the premises of the plant, it is a common problem that the safety of the containers arriving at the terminal depends to a large extent on the changing quality of the domestic or foreign shipping activity, as well as on the technical condition of the railway cars.

**Summary**

About twenty percent of the goods passing through the Hungarian railway network each year are classified as dangerous cargo. Summarizing the above, it can be concluded that the railroad, as one of the sub-sectors of the transport of dangerous goods, organizes the railway stations, Seveso III. directive excludes it from its scope of application, but intermediate temporary storage on them as a "station necessary during the transport process" is still an existing activity. In order to avoid accidents, it would be important to expand the legal regulations.

The domestic disaster prevention legislation follows this trend, so in law enforcement practice, railway marshalling yards are considered to be part of the transport activity, and not as operational facilities dealing with hazardous materials. In my opinion, it would be advisable to treat railway marshalling yards as operational facilities, since the storage, loading and unloading of dangerous goods can involve serious public safety risks, which should be subject to stricter regulatory standards.

From an economic point of view, it can be said that the transport of goods is of essential importance from the point of view of development. Since Hungary is considered a transit country, the cessation of passing traffic is inevitable. In relation to the transport of dangerous goods, we must therefore strive to implement technical and infrastructural developments and modernizations, taking into account the aspects of economic security - by using the resources provided by EU projects. In terms of the infrastructural characteristics of the transport of dangerous goods by rail, it has a relatively high-density (main) line infrastructure that fits into the international backbone network, and in connection with the connection to the TEN-T network, it also has significant international logistics

hubs and rail connections. The over-centralized network (lack of lines bypassing the capital and connecting the east-west parts of the country, the capacity limit of the Danube bridges), the track infrastructure in need of renovation, as well as quality indicators that fall short of the EU average (electrification, ratio of two-track sections) still hide further development opportunities, which EU resources can provide a solution. In my view, the development and modernization of the railway infrastructure could be solved by developing a complex network that increases the level of service, by prioritizing sustainability aspects and even by involving private capital.

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