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Security Planning in the Transport of Dangerous Goods by Road

Csaba Almási, University of Public Service, Hungary, <u>almasi.csaba@uni-nke.hu</u> ORCID: 0000-0002-3031-0515

Gyula Vass PhD, University of Public Service, Hungary, <u>vass.gyula@uni-nke.hu</u> ORCID: 0000-0002-1845-2027

Gyula Kóródi PhD, University of Public Service, Hungary, <u>korodi.gyula @uni-nke.hu</u> ORCID: 0000-0003-0227-6695

Lajos Kátai-Urbán PhD, University of Public Service, Hungary, <u>katai.lajos@uni-nke.hu</u> ORCID: 0000-0002-9035-2450

The regulations on the transport of dangerous goods are not only aimed at reducing the risk and frequency of accidents. In 2005, new security provisions were added to the relevant international standards to prevent unauthorized possession of dangerous goods. With the introduction of security provisions, companies handling dangerous goods posing a high risk to public safety were required to draw up a security plan. The strict regulation of the transport of dangerous goods by road is particularly important for a number of reasons: a possible road accident could result in a large contaminated area due to the escape of dangerous goods, but could also be a means of terrorist attacks. The authors present the regulation of protection against the misuse of dangerous goods.

Keywords: ADR, dangerous goods, security plan, transport, road



1. Introduction

The term security is a translation of the Latin word securus, which means a state without fear. Assigning definitions to the concept is rather difficult and, in general terms, almost impossible. The perception of security varies from one historical period, subject and territory to another. Basically, we can distinguish between social, political, economic, military, environmental and information security components, which are in constant interaction with each other. It can be argued that the lack of security can be caused by the scarcity or inadequacy of any of the above factors, through resource constraints. The aim of terrorism is generally to create fear and insecurity by attacking specific security components.

The value of chemicals exports in the EU in 2011 was €266 billion, while imports amounted to €171.8 billion. In 2021, exports were worth €459.1 billion and imports €271.4 billion. [1] It is clear from this that chemical production has been increasing over the past decade and is on a steady upward trend. The increase in chemical production also means an increase in the risk to transport security.

Hungary, due to its geographical position, plays an important role in transport to and from Eastern and Southern countries. Therefore, in addition to domestic shipments, the share of transit shipments is also significant, and our transport infrastructure is therefore of particular importance. [2]

In Hungary, the industrial safety section of the professional disaster management body is responsible for licensing, supervision and management of major accidents involving dangerous substances. In this context, the authors point out that the release of dangerous substances into the environment is not only a careless act. Large quantities of dangerous substances and goods, which are essential to the functioning of the economy, can also be the target of terrorist acts.

2. Security privisions in international recommendations

The system of rules for the transport of dangerous goods by road has been developed by the Economic Commission for Europe, set up by the United Nations Economic and Social Council in 1947, and is constantly adapted to scientific and technical progress. The Convention, entitled the Agreement concerning the International Carriage of Dangerous Goods by Road (hereinafter referred to as ADR), was signed in Geneva on 30 September 1957 and entered into force with its Annexes on 29 January 1968. [3]

The UN ECOSOC Sub-Committee of Experts on the Transport of Dangerous Goods is working on the development of the "UN Recommendations on the Transport of Dangerous Goods, Model Regulations," which will provide a common basis for the structure of all transport sectors. The amendments to the ADR based on these Model Regulations are drafted by the Working Party on the Transport of Dangerous Goods (RID/ADR/ADN Joint Meeting) of the UN Economic Commission for Europe (UNECE) Inland Transport Committee (ITC).

Following the terrorist attacks on the United States on 11 September 2001, the importance of protecting against the misuse of dangerous goods, which are an important part of the flow of goods and the functioning of the economy, was recognised. The UN Economic and Social Council has therefore included provisions in the UN Model Regulations to help prevent terrorist acts. These provisions are uniformly contained in Chapter 1.10 of the Transport of Dangerous Goods Regulations, based on the UN Model Regulations, also known as the "Orange Book".

Security provisions were added to the international regulations on the transport of dangerous goods in 2005. The aim of the new provisions was to prevent unauthorised possession of dangerous goods, in particular their use in terrorist acts. With the inclusion of Chapter 1.10, companies handling dangerous goods presenting a high risk to public safety were required to prepare a security plan. [4]

3. Monitoring the Hungarian disaster management system for the transport of dangerous goods

Incidents involving the transport of dangerous goods pose different types of risks to life and health. However, several types of hazards may occur simultaneously. Basically, physical, fire, heat and toxic effects must be taken into account. [5] There is always a significant risk of dangerous goods being released into the environment during loading and unloading. There is also a risk when the vehicle stops near populated areas or in frequently visited places. Incidents may occur accidentally, but deliberate acts must also be taken into account. [6]

The most important task of disaster management is to prevent disasters. The tools for disaster prevention are state supervision and licensing. Preventive measures are introduced and implemented by the public authorities, local authorities and economic operators carrying out the activities most likely to cause a disaster, which are most concerned with reducing the risk of an incident occurring in the vicinity of the hazard. [7]

With the adoption of Act CXXVIII of 2011 on Disaster Management and the Amendment of Certain Related Acts, the Parliament of Hungary established the system of tasks, organisation and procedures of the industrial safety authorities with effect from 1 January 2012. [8]

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The newly created unified disaster management body now has three pillars: fire protection, civil protection and industrial safety. The national-level coordination of the activities of the professional staff of the industrial safety sector, the provision of technical equipment and the continuous evaluation of the standards system are carried out by the Industrial Safety Inspectorate of the National Directorate General for Disaster Management of the Federal Ministry of the Interior.

The new industrial safety regulation covers the protection against accidents in hazardous industrial plants, the protection of critical infrastructure and the emergency response to the transport of dangerous goods. An important part of the regulations is the investigation of incidents and major fires related to hazardous substances [9].

One of the main tasks of the disaster management industrial safety department is therefore to guarantee the highest possible level of safety in the transport of dangerous goods. [10]

The transport of dangerous goods poses an additional risk in all transport sectors, but an assessment of the statistics and the accident risk of each transport mode leads to the conclusion that road transport poses the greatest risk. [11]

4. History and need for security provisions in the regulation of the transport of dangerous goods by road

The misuse of vehicles carrying dangerous goods can be identified as a relatively new risk. The phenomenon needs to be distinguished from acts of planting explosives in vehicles and then setting off the device, such as that which occurred in the garage of the North Tower of the World Trade Center on 26 February 1993. In the 1993 terrorist attack in New York, the perpetrators concealed and detonated some 600 kilograms of explosives in a rented vehicle, [12] the vehicle was not used for the commercial transport of dangerous goods and was not stolen.

However, on 6 March 2016, in Hilla, Iraq, 47 people were killed, dozens injured and significant property damage was caused in a suicide bomb attack on a fuel truck at a police checkpoint. [13]

It is also important to mention cases where the sheer mass of vehicles carrying non-dangerous goods was used to carry out an act of terrorism. On 16 July 2016, in Nice, France, a man of Tunisian origin killed 84 people when he drove his 19-tonne rented truck into a crowd celebrating on a promenade on the Nice seafront. On 19 December 2016, in Berlin, Germany, 12 people were killed and 48 injured after a Tunisian immigrant killed the driver of a Polish-registered tractor-trailer and drove his truck into a Christmas market.

5. Security provisions in the regulation of the transport of dangerous goods by road

According to the ADR definition, dangerous goods presenting a high risk to public safety are those which could be misused in terrorist acts, which could cause mass casualties or mass destruction, which could cause serious socio-economic disruption. [14]

Chapter 1.10 of the Security provisions chapter of the dangerous goods transport regulations lays down the main rules, necessitating the development of detailed rules. In this context, it can be concluded that the identification of best practices to increase the effectiveness of the implementation of protection against terrorist acts involving dangerous goods requires the development of professional methods and procedures that ensure a high level of resilience. The risk can never be reduced to zero, but by following, examining and discussing these professional guidelines, risk reduction measures can be put in place that can provide an appropriate response to the latest types of challenges.

Guidance on the practical implementation and application of ADR Chapter 1.10 has been developed by a panel of industry experts from eleven organizations. The document is entitled "Industry Guidelines for the Security of the Transport of Dangerous Goods by Road."

The document was first published in April 2005 and last revised in 2016. The Guidelines are not adapted to the changes in the ADR, and the above-mentioned professional body has been working on their update and harmonization since 2013. The document of "Industry Guidelines for the Security of the Transport of Dangerous Goods by Road" consists of the main part and four annexes.

The first annex recommends technical solutions for securing temporary storage sites, the second deals with practices for the management of the undertaking and the reduction of public safety risks. The third annex discusses technical solutions to prevent or deter theft of vehicles or cargo during a transport operation and the fourth is a model security plan.

The security plan is divided into five sections: company information, security management, communication, security measures and other information. It can be seen that the document provides detailed recommendations on the planning process and the preparation of the security plan.

In the public security plan, information on the company should include the name, full correspondence address and contact details (telephone, e-mail) of the company, the name and contact details (telephone, e-mail) of the appointed security manager and a summary statement of the dangerous goods handled which present a high risk to public security.

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The safety management section lists the persons responsible for safety issues and those authorized to handle dangerous goods presenting a high risk to public safety, together with a description of their duties. Procedures for recording safety meetings, receiving and transmitting public safety information to competent personnel, investigating public safety incidents, handling public safety alerts, storing sensitive public safety information and accounting for the movement of dangerous goods involving a high risk to public safety are also described. Also included in this section are details of security equipment, including the maintenance programme and operations to be carried out in the event of equipment failure, and information on the public security awareness training programme.

The communication section of the plan includes sections on site-to-vehicle communication links, site public safety alerting, restricted access area designation and vehicle protection.

The last, fifth section of the security plan contains other information. Appendixes A, B, C and D of the plan contain a list of persons responsible for dealing with public safety issues and their duties, a list of persons authorized to handle dangerous goods involving a high risk to public safety, schematic drawings of restricted areas and a chronological record of amendments to the security plan.

The plan should be based on the general situation, not on individual shipments. It is possible that some of the required elements of the plan may already have been prepared to comply with other legal obligations or quality management systems, and these should be referred to.

There are three steps to developing a security plan. The first step is to identify the threat:

- for news and information on current national and international circumstances or terrorist organizations,
- what the police's position is on the possibility of a terrorist act occurring in the area of operation of the organization,
- whether there could be any attractive targets in the facilities or personnel of an organization,
- could be harmed by an attack on a high-risk neighbor?

In the second step, it is necessary to identify the points to be protected and how they are vulnerable to a terrorist attack. The third step is to take measures to reduce the risk to an acceptable level. It is essential that planning and associated responsibilities are the full responsibility of a single person with appropriate authority. The actors in the supply chain should cooperate with each other and with the authorities in the exchange of information on threats, public security measures and response to public security incidents. The main problem for the transport of dangerous goods is the known or predictable movement of vehicles. A particular problem is fuel transport vehicles, which



and importance:

have little separation from public traffic and unauthorized access when discharging fuel. Typically, four types of sites and cargoes can be distinguished on the basis of risk, based on volume, occurrence

- low-volume or infrequently used, low-priority goods,
- low-priority goods used in large quantities or more frequently,
- small quantities of high-priority goods used in small quantities,
- high volume, high importance goods. [15]

Security planning based on hazard analysis can reduce the consequences of incidents. Safety planning must define the measures to be taken in the event of an accident involving hazardous materials, as well as the human and material resources required to implement them. Special training for personnel involved in security interventions should be part of security planning and tested through practical exercises. Safety plans should be managed as part of the management system and the results incorporated into internal rules. Considering the characteristics of combined terminals, i.e. the fact that the current types and quantities of hazardous materials are constantly changing, the following three effective technical solutions have been proposed for security planning:

- Water shield: The device is a special push nozzle with a standard Storz clip, usually made of aluminium. A vertical metal plate is connected to the horizontal adjustment tube with a special gap between the metal plate and the tube.
- 2. Mobile safety bund: The incidence of accidents involving hazardous fuel and the extent of fluid leakage can be reduced by using a safety guard. The material entering the tank can be extracted into an empty tank either by gravity or by a pump.
- 3. Safety bund connected to an underground collecting system: Hazardous materials can be stored in a separate area, which can also be used as a safety bundle. The concrete base of the storage area is covered with an acid-resistant, chemical-resistant plastic layer. The slope prevents the ingress of potentially hazardous materials and rainwater. enters the drainage opening of the metal grid. [16]

The application of public safety rules in the case of premises is implemented on the basis of similar regulatory and technical principles, such as the handling of security issues of sports facilities [17].

Compliance with fire protection requirements is an important part of public safety planning, which requires the cooperation of professional and volunteer organizations involved in emergency fire protection [18, 19].

5. Summary

The regulation of the transport of dangerous goods must protect both the material and the environment. In planning the delivery of goods to their intended destination in a timely and safe manner, the risk of accidents must be considered as well as the possibility of misuse, and the transport of dangerous goods is coded into the execution of terrorist acts.

It should be borne in mind that the practical application of the law and the necessary partial regulation need to be assessed in the light of the challenges of the security environment. Together, the safety audits of the dangerous goods safety adviser, the safety of the operation of the means of transport, the content of the security plan and risk analysis are the basis for preventing the misuse of dangerous goods.

According to EU statistics, chemical production has increased over the past decade and is still rising. This upward trend also means an increase in the risk to transport security.

The regulation of the transport of dangerous goods must protect both the material and the environment. When planning the safe and timely delivery of goods to their intended destination, the risk of misuse must be considered as a realistic threat, alongside the risk of accidents. The transport of dangerous goods is encoded in the execution of terrorist acts. Dangerous goods for civilian use in road transport may be optimal for the execution of a terrorist act because of the very favourable ratio between the destruction that can be caused by the material and the overcoming of the obstacle to obtaining the vehicle.

In the article, the authors have presented the tasks of the professional disaster management service in the field of industrial safety, licensing, supervision and management of major accidents related to the transport of dangerous goods, and have provided a comprehensive description of the current legal framework.

It can be seen that the regulations on the transport of dangerous goods are no longer aimed solely at reducing the risk and frequency of accidents. The terrorist attacks in the United States on 11 September 2001 radically changed global security culture and thinking. This led to the development and subsequent introduction of regulations to prevent the deliberate release of dangerous goods during transport.

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Chapter 1.10 of the public safety chapter of the dangerous goods transport regulations lays down the main rules, necessitating the development of detailed rules. In this context, it can be concluded that the identification of best practices to increase the effectiveness of the implementation of protection against terrorist acts involving dangerous goods requires the development of professional methods and procedures that ensure a high level of resilience. The risk can never be reduced to zero, but by following, examining and discussing these professional guidelines, risk reduction measures can be put in place that can provide an appropriate response to the latest types of challenges.

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Evalutation of word fire protection performance data

Galina Horváth PhD, University of Public Service, Hungary, <u>horvath.galina@uni-nke.hu</u>, 0000-0002-5134-3607

János Bleszity CSc. University of Public Service, Hungary., <u>bleszity.janos@uni-nke.hu</u>, 0000-0002-6803-3154

One of the characteristic aspirations of developed societies is the creation of safety. Within this, ensuring an adequate level of fire protection is of high importance. Fire protection varies greatly from country to country and depends on many factors and is implemented in different ways. Below, the fire protection of some countries selected on the basis of individual characteristics is briefly presented.

Keywords: fire protection, professional fire brigade, voluntary fire brigade, private fire brigade

1. Introduction

The organizational structure and operating principles, for their part, influence the preparation, training and education of firefighters. Below - without claiming to be complete - fire protection in some countries, as well as certain trends that can be considered general, will be briefly presented.

The purpose of this article is not to provide a detailed analysis of the organizational structure and operational characteristics of the fire departments of different countries, as this is very different from country to country and depends on many factors (for example, the country's social structure, level of economic, industrial and technical development, historical traditions).

2. Overview of the results of international statistical surveys

The Center of Fire Statistics (hereinafter: CFS) of the International Association of Fire abd Rescue Service (CTIF) has been recording and analyzing data related to firefighting interventions since 1995.Az elmúlt évtizedek alatt összegyűjtött információk egyértelműen alátámasztják azt az állítást, hogy a tűz- és káresetek egyre nagyobb veszteséget okoznak az ipari országok gazdaságának: a kár nagyságát a GDP 1 % -a körüli értékre becsülik [1].

CFS CTIF collects statistical data annually from 27 to 57 countries of the world, in which 0.9 to 3.8 billion people live [2].



Between 1995 and 2021, 2.5 to 4.5 million fires were registered annually in the examined countries. These fires lead to the death of 17,000 to 62,000 people every year. In just the last 28 years, more than 1.1 million people died in 104 million fires [2].

In addition, the nature and composition of incidents requiring firefighting intervention is constantly changing: there is a visible trend that, in addition to the decrease in the number of fire incidents, the proportion of technical rescues is constantly increasing.

According to the 2004 data, 9.3% of the alarms were fire incidents, 5.1% un. dangerous accident, 5.3% - technical rescue call. 58.1% of the cases were medical emergency calls (this is a feature of German, French, American, Irish and Finnish fire departments), 9.0% were false reports and 13.2% were other calls [3]. In 2010, based on the analysis of 37 million alarms, the above data were already as follows: the proportion of fire incidents - 7% (that is, a decrease of more than two percent), while the proportion of accidents reached 15% (in six years - an almost threefold increase). Technical rescue was 3.6%, medical emergency calls (typically in the United States and Portugal) – 53.1%, false reporting – 7.2, and other cases 14.1%. Based on the analysis of 45 million alarms in 26 countries in 2012, I conclude that the share of fire incidents continued to decrease and amounted to 6.1%, while the share of accidents and technical emergency calls was 3.3% and 3.7% respectively was, that is, it continued to grow [1]. In 2013, a further decrease in the proportion of fire incidents can be observed from 7% to 5 and a half %, technical rescue was 1.5%, medical emergency calls – 66.8% (mainly in the United States, France and Japan).

The amount of false reports decreased slightly (from 7.4% to 7.3%), other cases approached 19%. In 2021, 60 million alarms were registered in 38 surveyed countries, where 1.2 billion people lived then (1/6 of the world's population), of which 3.1 million (only 5.2% of all alarms) were fire incidents. During these, 16.9 thousand people died and 62.1 thousand were injured. In these countries, there were an average of 47 events requiring the intervention of firefighters per thousand inhabitants, of which only 2.5 were fires. At the same time, the number of fatal cases per 100,000 inhabitants in one year was 1.3, and the number of injured cases was 4.9. On average, 0.5 people died and 2.0 people were injured in every 100 fires. Note that this shows a slight downward trend: in 2012, these figures were 0.8 and 2.3 per 100 fires, respectively [1].

Based on the analysis of the composition and operating principles of the fire departments of a few selected countries, we have come to the conclusion that in the majority of Western countries, the operating costs of the professional fire departments are covered by the local governments from their

According to our studies, in almost all countries of the world volunteer fire brigades operate in addition to professional fire brigades. The organizational structure, management and financing of the latter, the motivation of the workers, and the system of discounts depend on the given regional, national, economic and cultural factors. In addition to firefighting, local government fire departments (both professionals and volunteers) also deal with technical rescue and the elimination of accidents and other emergency situations.

In many European countries (e.g. Germany, France, Austria) the number of volunteer firefighters is several times greater than that of professional firefighters. In some countries (e.g. Denmark, Finland, Ireland, Luxembourg, Sweden) the fire department is organized almost entirely or entirely (e.g. Liechtenstein) on a voluntary basis.

So it can be said that in several European countries, fire protection is largely based on the principle of volunteerism. For example, in Ireland only the capital of the country, Dublin, has a professional fire department. In all other cities and towns, the tasks related to fire protection are performed by fire brigades with a mixed (standby) composition. They are staffed by volunteers and the required minimum number of professional firefighters.

Fire departments are responsible for the training and further training of firefighters. The central Fire Council supplements local training with special programs every year, and also contributes to the organization of central further training for officers. In Sweden, more than 80% of firefighters are volunteers.

he training and preparation of firefighters is significantly supported by the development of firefighting sports at the international level, in connection with which it can be said that it carries within itself the general trends of sports organization [4].

As a general experience, it can be said that local governments are responsible for the organization and operation of volunteer fire brigades [5]. In addition to firefighting, municipal fire departments (both professionals and volunteers) deal with technical rescue, as well as the elimination of accidents and other emergency situations [6].

Of course, there are exceptions: e.g., Albania, Andorra, Bangladesh, Bulgaria, Brunei, Barbados, Georgia, Iran, Israel, Kuwait, Laos, Latvia, Mongolia, Serbia, Singapore, and the Philippines, where there is no volunteer fire department. However, most of these are not European countries [2].

In addition to the organizational structure, the professional training of volunteer firefighters plays an extremely important role. The training basically uses two types of methods. One is the transfer of theoretical knowledge, the other - practical education. During the latter method, after conducting various types of firefighting and technical rescue exercises, a detailed analysis of the acquired experience follows.

One of the specific characteristics of the European volunteer firefighting movement is the tendency of volunteers to join civil organizations (associations, associations, etc.) [7]. The same applies to professional fire brigades, as well as professional scientific and technical institutes that deal with the development and production of technical firefighting tools and equipment.

Presentation of the fire departments of some selected countries

In the following, we briefly present, without claiming to be complete, the characteristics of the fire departments of some of the countries we selected. Despite their many, significant differences, these are good examples of general trends and the organizational characteristics of the given countries.

We consider it important to present Austria because it is adjacent to our country and its population is comparable to that of Hungary, however, the Austrian fire department system is significantly different from the Hungarian one. Denmark has unique experience in the field of private firefighting. In Finland, the cooperation between the civilian population and the fire department is remarkable, one of the most important objectives of which is to increase the common safety of the individual and society. Despite their many, significant differences, the territorial extent of the United States and Germany, as well as their economic and technical development, justify the analysis of the fire departments of these countries. Germany and France are the leading economies of the European Union. The remarkable organizational structure of Russia's fire service, as well as the level and traditions of its professional education. In addition, in the previous years, the state fire departments in the countries belonging to the Soviet bloc were based on the Soviet model, and the higher-level training of the specialists took place in the Soviet Union.

Austria

By the beginning of 2023, the population of Austria exceeded 9.1 million people. The number of firefighters according to 2021 data - 301,107 people [2]. Only six cities in the country have professional fire departments. Their area of operation only covers the given city. The fire protection of other cities and towns is provided by volunteer fire brigades, the organization, supply and financing of which are the responsibility of the provincial and local governments.

Volunteer fire departments operate on the same principles as professional fire departments, but only a very limited number of personnel are paid for the work they do voluntarily. In Austria, a great emphasis is placed on the training of volunteer firefighters, which is the same as that of professionals, and includes both courses and annual exercises. Training takes place in special firefighting schools. These schools can be found in all Austrian provinces. The main method of preparation is practical training, which takes place at well-equipped bases with all the necessary equipment and highly qualified, experienced teachers and instructors.

One of the characteristics of the Austrian volunteer fire department is the large number of reservists who participated in basic training and have basic fire fighting skills and abilities.

The number of volunteers is constantly increasing and exceeds the number of professionals by an order of magnitude: according to the 2021 data, the former numbered 298,972, while the latter numbered 2,135 [2].

Volunteer fire departments are extremely well organized and equipped with the most modern equipment. The fire department must arrive at the scene of the damage within ten minutes after the notification. In addition to firefighting and technical rescue work, Austrian volunteers also carry out active fire prevention duties and educational work among the population.

Denmark

The population of the country: 5,848,188 (2023), the number of firefighters: 5,784 [2]. Fire protection in Denmark is provided by the professional fire brigade, which is operated by the municipalities. The latter have the right to decide whether to maintain their own fire department or not, and they can even enter into a contract with a private company or another volunteer fire department. An important condition is that you must go to the scene of the damage 5 minutes after the alarm. The number of volunteer firefighters is not significant. The facility fire brigade is responsible for the safety of industrial objects.

A characteristic of Denmark is that the private fire department also operates successfully. The organization of the latter is exemplary, as the first Danish rescue organization, Falck Rescue Corps (Falck), was established in 1906 in Copenhagen. In the beginning, the main task of the company was to put out fires in villages and towns, later this operation extended to cities as well. In 1926, local governments received from the state the opportunity to decide independently whether to use the services of traditional or private fire departments. That's when Falck's success story began: currently, the company provides fire protection in 68 out of 98 Danish municipalities and extinguishes nearly 12,000 fires every year.

The company's clients include both state bodies and industrial facilities. Since 2006, thanks to its implemented innovations, Falck has been playing the role of a world-leading fire protection service, primarily in high-risk industrial facilities (oil industry, nuclear energy, metallurgy, machinery industry) and airports.

In Denmark, Falck's emergency services are covered by the local governments from their own funds, so those who use the company's services do not pay the costs of fire fighting, emergency medical rescue or transport to the hospital.

Falck plays a major role in firefighter training and also has special training programs in the field of safety technology. Specialists are trained in well-equipped training centers. Their educational programs consist of a theoretical and a practical part. The preparation programs are developed based on the needs and wishes of the customers.

Falck continues to act as a consultant in more than 70 countries, primarily in the field of critical infrastructure protection, fire protection, prevention and elimination of fires and explosions [8].

In case of major disasters, terrorist attacks and other extraordinary situations, when it is necessary to involve large forces and special equipment, the Danish Emergency Management Agency (DEMA) can be contacted for central assistance (through state regional emergency response centers).

Finland

Population: 5,560,000 (2022), number of firefighters: 18,767 [2].

In Finland, the Ministry of the Interior and the administrative bodies of the governorate are responsible for the operation of the rescue units, including the firefighters. 22 regional rescue organizations fall under their control. At the regional level, rescue is organized by local governments. Regions are classified into risk districts based on risk factors.

In the most dangerous zones, the rescue teams must arrive at the scene of damage within 6 minutes from the alarm, 10 minutes for those classified as second, and 20 minutes for those classified as third. The youth associations (nearly 500 organizations with 10,000 people) are responsible for supplying the volunteers. Women also actively participate in the work of volunteer firefighters, their number is close to 4.5 thousand.

The Finnish National Rescue Association (Suomen Pelastusulan Keskusjäjestö, SPEK) plays a major role in the country's fire protection. In 1993, three traditional firefighter areas of responsibility were consolidated into a central nonprofit association: rescue fire protection, prevention and civil protection. One of the organization's most important objectives is to increase the safety of individuals and society.

SPEK also carries out educational and training activities for a wide range of the population, as well as scientific, educational and publishing work, and also keeps firefighting statistics. The organization unites the 13 Finnish regional rescue associations and cooperates with the 22 regional rescue organizations.

The fire brigade is mainly staffed by volunteer firefighters. Voluntary units operate both in cities and in village communities. The number of volunteer firefighters is close to 12,000 [2]. The training of professional firefighters takes place in the vocational school operating next to the Ministry of the Interior. Volunteers also participate in special preparation, which includes professional education (including medical rescue) and physical training. The training consists of three stages: basic training, development of professional skills, and practice of extended professional skills.

The fire department is financed centrally and from the budgets of local governments. The fire protection of industrial objects is ensured by the facility fire brigades, whose staff consists of professional firefighters (approx. 150 people). The number of professional firefighters does not reach 4,000. In addition to firefighting, Finnish firefighters also carry out prevention, technical rescue and public protection activities, as well as provide emergency and other medical rescue.

France

Population: 67,749,632 (2021), number of firefighters: 251,898 [2].

Firefighting and technical rescue units operate in 90 of France's 92 counties, which organizationally belong to the Ministry of the Interior through the General Directorate for Civil Protection and Crisis Management (Derection générale de la securité civile et de la gestion des crises, abbreviated, DGSCGC). The only exceptions to this are Marseille, where the firefighters belong to the navy, and Paris, where they belong to the army.

The county firefighters are subordinate to the state bodies, the Fire and Rescue Departmental Services (Service départemental d'incendie et de secours, SDIS). It is financed from the local government budget. The structure of the fire department includes the following levels:

- local (city, village),
- county,
- nationwide.

79% of the staff of the fire department is made up of volunteer firefighters, who undertake firefighting duties in addition to their work or studies. The French volunteers, men and women, not

only carry out firefighting and technical rescue duties, but also participate in the elimination of natural and industrial disasters, as well as provide medical rescue, so they are able to perform all professional tasks. This is also important because in France, fire fighting accounts for only 7% of all alarms. Volunteer training consists of professional modules (administrative, legal, firefighting, rescue, medical aid).

Regular exercises are carried out together with professional firefighters. There is also a salary and bonus for volunteer work (after 20 years of service).

In addition to the listed modules, professional firefighters also complete professional integration and adaptation modules. The training of assigned firefighters (both basic training and continuous training) is carried out in the counties. Basic courses are held in local schools for subordinate firefighters and service commanders.

French firefighters take part in continuous training and further training, and all newly acquired professional qualifications are included in their so-called further training book.

The supply is provided by the Association of Young Firefighters, which has 1,590 sections across the country. The members of the organization are children between the ages of 11 and 18, who twice a week have the opportunity to learn the tricks of firefighting and rescue, to learn civic cooperation and discipline, as well as to play sports and participate in professional practices [9].

Germany

According to data from the Federal Statistical Office (Statistisches Bundesamt), in 2022 Germany's population will rise to over 84 million. The number of firefighters reached 1,038 in 2021. 448 people [2].

The peculiarity of fire protection in Germany is that there is practically no unified federal fire brigade. Of course, you can also dial the emergency number "112" there, but there is no such thing as "national fire service". Within its own territory, the given province is responsible for fire and industrial safety, both in terms of legislation and enforcement. For this reason, the financing of the operation of the fire department is solved in several ways, despite this, the applied organizational and operational principles are almost identical everywhere. After that, the firefighting units must arrive at the scene of the damage within eight minutes uniformly everywhere in the country.

Rescue fire protection is dealt with by various firefighting organizations, associations and other associations. All organizations operating in the country and dealing with fire protection are members of the German Fire Protection Association (Deutscher Feuerwehrverband, DFV). German firefighters also belong to two main groups: volunteer and professional.

In some residential communities, the fire service has been made mandatory, although in practice this can only happen in exceptional cases, if there are not enough volunteer applicants.

According to the law, state fire departments (in addition to volunteer fire departments) must only be organized in larger cities with more than 90,000 inhabitants, but smaller settlements can also employ full-time firefighters. In settlements with less than 90,000 inhabitants, fire protection is usually provided by volunteers. In this case, the main-occupation firefighters will only be on duty at the central duty station, and in the event of an alarm, they will ensure that the first ambulance goes to the scene of damage. 80% of volunteer firefighters live in small villages. Volunteer firefighting units usually consist of 100 people. In addition, facility fire departments operate in large factories and other industrial facilities, as well as at airports.

A close cooperation developed between the professionals and the volunteers. Anyone who meets the health and professional requirements can be a volunteer firefighter. In the event of an alarm, he immediately goes to the scene of damage and regularly performs on-call duty. Currently, more than one million volunteers are registered in Germany (not including members of youth organizations), in addition to nearly 35,000 professional firefighters. It is interesting that 30% of the volunteers who participate in both firefighting and technical rescue are women. The number of members of the youth volunteer movement exceeds 250,000 people and their number shows a constantly increasing trend. The latter fact is also interesting because, on the contrary, the membership of other civil organizations is decreasing. So this also proves the high social esteem of the firefighting profession.

Of course, the system of requirements for professional and volunteer firefighters is the same in both cases. The same health, psychological, professional and preparation aspects are taken as a basis. One of the most important training methods is the organization of exercises. Professional and volunteer firefighters are usually trained at the same training base. The preparation time for volunteers is 10 weeks, while that of professionals is 40 weeks. The bases are equipped with the most modern technical tools and equipment, and they have different practice fields.

It can also be said that the technical equipment of the German volunteer fire department is one of the most modern in Europe. In addition to firefighting, German firefighters also deal with technical rescue and the elimination of emergency situations [2].

United States of America

The country's population is close to 342 million (2023), number of firefighters: 1,041,200. The active participation of volunteers in rescue fire protection cannot be called an exclusively



European characteristic. For example, in the United States of America, the number of volunteer firefighters (676,900) is more than twice that of professional firefighters [2] and the above trend seems to be strengthening.

Professional firefighters mainly serve in cities with more than 50,000 people, while volunteers - in smaller settlements, whose population does not exceed 10,000 people in 87% of cases. In addition, there are large differences between the voluntary units in terms of both the number of personnel and funding, and also according to the size of the operational area. It may happen that a volunteer firefighting unit with a larger number of staff and a better equipped budget operates in a smaller settlement and vice versa.

According to theoretical and practical aspects, the requirements imposed on volunteers are uniform at the state level.

The financing of the necessary tools and technical equipment is covered by tax revenues and/or donations. In addition, the federal government supports the operation of professional and volunteer fire departments, the acquisition of the necessary technical equipment, and the preparation and training of firefighters from the central budget.

In the United States, there is a national association of volunteer firefighters, the National Volunteer Fire Council (NVFC). The organization works actively to ensure that the technical equipment and training level of the volunteers approaches that of professional firefighters. A campaign related to fire safety and fire prevention is being carried out among the population, within the framework of which extensive public information is provided. One of the main goals of this is the further development and expansion of the national volunteer system, the task of educating the population and raising the professional training and technical equipment of the volunteers to the same level as that of professional firefighters.

The number of facility firefighters also shows an increasing trend, since in this case the maintenance costs are significantly lower than those of professional fire departments, with a higher standard. One explanation for this is that the main activity of the facility fire department is not extinguishing, but fire prevention, which allows for cost savings.

In addition to the facilities, there is also a private fire department, which also aims at prevention and quick response. In addition to fire protection and technical rescue, private fire departments also provide medical rescue. Nearly 150 private companies are involved in extinguishing forest fires, which are members of the professional association against national forest fires.

Russian Federation

problem considering the large area of the country.

Population: according to the data of the Federal State Statistics Service, 146,447,424 people (Pocctar, 2023), number of firefighters: 1,227,600 people. In Russia, the backbone of the fire service is still the state fire service. The inadequate level of infrastructure and technical equipment is a serious

I would like to note that the experience in Russia is also interesting because, as I have already mentioned, in previous years the state fire departments in the countries belonging to the Soviet bloc were based on the Soviet model, and the higher level training of the specialists was also carried out in the Soviet Union.

On January 1, 2002, the fire department was transferred from the Ministry of Civil Defence, Emergencies and Disaster Relief (MChS) (Министерство Российской Федерация по делам гражданской обороны, презвычайным систуациям и ликудации последствий стихийных бесдтсвий, МЧС), where it still belongs.

The main goal of the reorganization and organizational transformation was to strengthen the state management of fire protection, and to be able to concentrate the unification of forces and resources during firefighting and technical rescue.

In addition to firefighting, one of the most important tasks of the fire department in Russia is fire prevention. Within the framework of the reform of the state administration, the tasks of fire protection were divided between the fire protection services of the members of the Russian State Fire Service. The latter is responsible for the protection of certain administrative-territorial units of the country, facilities belonging to critical infrastructure of national importance, and objects that are part of the highly important cultural heritage, and not for the fire safety of the entire territory of the country.

Currently, the fire service in Russia is divided into the following types:

• State fire protection service, including the State Fire Service Chief Inspectorate, as well as the sector's scientific research institute, five educational institutes and 94 experimental laboratories;

• Municipal fire department, which carries out fire prevention, fire fighting and technical rescue duties in cities, villages and facilities belonging to the given municipality;

• Branch fire department, whose operation is determined by the relevant regulations, in consultation with the state fire protection service. Typical sectoral fire brigades include, for example, railway or forestry fire brigades;

• Private fire department, which provides its services on a contractual basis. According to the current law, this type of forced labor requires a permit.

• Voluntary fire department, which, as a civil association and on a voluntary basis, carries out fire prevention and/or fire fighting duties, primarily in settlements where there are no other fire departments. [10]

In Russia, between 2017 and 2021, the number of fatalities per 100,000 inhabitants was an average of 5.60 per year, or 2.55 people per 100 fire incidents [2]. It can be stated that after the disintegration of the Soviet Union, the volunteer fire department in Russia practically ceased to exist.

The professional fire department is only able to protect less than 50% of the settlements. The population of the other settlements exceeds 34 million inhabitants (27% of the country's population). Almost half of all fires occur here (and it's a shame too). More than 60% of all deaths caused by fires also occur in these settlements [11].

Since the volunteer fire department is able to significantly raise the level of fire protection in cities, smaller settlements, industrial and infrastructure facilities, as well as in Russia, taking into account domestic and foreign experiences, the federal law on the volunteer fire department was adopted in 2011. This law prescribes the necessary moral and financial motivation for volunteer firefighting.

The history of organized firefighting training and education in Russia began already in the early 1900s. The current education system includes the following elements:

- explaining the basics of fire safety,
- secondary vocational training,
- higher vocational training.

In Russia, as in many other countries of the world, the organization and conduct of exercises is one of the most important methods of professional training. The practical training of firefighters and technical rescuers is carried out at several bases, primarily at the central base located near the city of Noginsk near Moscow. Professionals have the opportunity to learn water and underwater rescue, alpine techniques, elimination of natural and technological disasters, use of rescue dogs, and medical rescue. In addition to practical training, the training center also offers theoretical education and further training, as well as the psychological preparation of professionals.

Summary of general experiences

The analysis of multi-year statistical data supports the fact that fire and damage cases cause more and more losses to the economies of industrialized countries. The size of the damage can be estimated at around 1% of GDP. In addition, the nature and composition of incidents requiring firefighting intervention are constantly changing in the majority of developed countries: in addition to the decrease in the number of fire incidents, an increase in the number of technical rescues is also visible.

Based on international experience, it can be said that the fire protection system varies greatly from country to country and depends on many factors. These include the organization of the country's territorial and state administration system, the level of its economic, industrial, and technical development, as well as its historical traditions, as well as the culture of the society.

The organizational structure and operating principles of the fire department also influence the training and education of firefighters. However, despite the many differences, certain general trends can be observed. In the course of my research, I found that the training system includes basic, intermediate and advanced level preparation, as well as further training and various special courses, but sometimes education is also done in a modular system.

Vocational education in every country consists of elements that build on each other, taking into account local needs. Higher degrees can be obtained in law enforcement and civil higher education institutions. The German, French, American, Irish and Finnish fire departments are unique in that, in addition to fire fighting and technical rescue, the firefighters also provide medical rescue. This kind of camel training requires additional special preparation.

It can be concluded that the degree of support for the firefighting sport varies from country to country, which significantly supports the quality of the training system, and in several countries, the marks typical of professional athletes are also published [12].

An important part of the fire protection activity is the conduct of fire investigation procedures, the results of which and especially the international experience contribute to the development of preventive and rescue fire protection by country [13, 14].

In addition to the professional and facility and/or private fire brigades, there are volunteer fire brigades almost everywhere, the number of which in certain Western countries (e.g., Austria, Belgium, France, Germany, Sweden, United States) exceeds that of professionals by several times. In these countries, the quality of the training of the volunteers is close to that of the professionals, with a shorter duration at most. The need for the establishment of higher education disaster prevention training is also typical of some of the examined countries, in which process the most important similarities can be seen in the field of fire protection engineering education [15].

It can be observed that in many countries (e.g. Finland, France, Germany) women also actively participate in the work of volunteer firefighters. Youth groups are responsible for supplying volunteers [16].

The quality composition of the fire department's staff affects the level of fire protection (and safety in general) of the given country, therefore everywhere in the world special attention is paid to increasing the standard of vocational education, modernizing the equipment of the training bases, and raising the professional preparation of the teaching staff.

Between 2017 and 2021, the death statistics of firefighters show a decreasing trend in the majority of the country. In the majority of the examined countries, fire protection - with some simplification - is structured in two ways: primarily based on professionals and volunteers. Of course, both systems have advantages and disadvantages. However, based on the comparison of the numbers, I think it is justified to prefer protection based on professionals, since in the countries where this has been implemented, fewer deaths and injuries occur during interventions.

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Evaluation of Rail Transportation Safety of Dangerous Goods in Hungary

Hermina Horváth, University of Public Service, Hungary, <u>horvath.hermina@uni-nke.hu</u> ORCID: 0000-0002-8050-8925

Gyula Vass PhD, University of Public Service, Hungary, <u>vass.gyula@uni-nke.hu</u> ORCID: 0000-0002-1845-2027

Lajos Kátai-Urbán PhD, University of Public Service, Hungary, <u>katai.lajos@uni-nke.hu</u> ORCID: 0000-0002-9035-2450

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 transportation, dangerous goods, 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. [1]

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. [2]

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. [3]



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 4-th 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. [4]

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. [5]

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%. [6]

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. [7]

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. [7]

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. [7]



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. [8]

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. [9]

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. [3]

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. [10][11]



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. [11]

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

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. [11]

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. [10][11]



3. Figure: Railway map in Hungary (source: Hungary Train Map <u>https://www.acprail.com/maps/hungary-</u> <u>train-map/</u>)

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. [11]

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. [12]

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. [13]



1. Picture: Ferencváros Marshalling Yard (Tamás Rizsvai)[14]


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. [12][15]

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. [16]

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. [17]

The application of public safety rules in the case of premises is implemented on the basis of similar regulatory and technical principles, such as the handling of security issues of sports facilities [18]. Compliance with fire protection requirements is an important part of public safety planning, which requires the cooperation of professional and volunteer organizations involved in emergency fire protection [19, 20].

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



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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The possibilities of 6G mobile communication

Dr. habil. NÉGYESI Imre PhD. egyetemi docens¹

Abstract:

The 5th generation mobile network or 5th generation wireless network (abbreviated to 5G after its the English name) is a technological standard representing the 5th generation of telecommunications systems. The information and communication industry is a fundamental component of national IT services. As the most active, most widely used and most influential technology field in the world, it serves as an important foundation and support for economic and social development from a strategic perspective. The next step in this development could be the use of 6G technology, which was the purpose of this article.

Keywords:

ARTIFICIAL INTELLIGENCE, 5G TECHNOLOGY, 6G TECHNOLOGY, COMMUNICATION

Introduction

Its rapid development, driven by the Internet, the Internet of Things (IoT), cloud services, big data, artificial intelligence and other technologies, is continuously expanding the scope of the information and communication sector. It is moving away from traditional telecommunications and Internet services to new forms of technical solutions, such as IoT. Today, everything is connected and the exchange of information is constant and continuous. The use of the Internet has become part of the average person's daily routine, influencing various aspects of their lives, including shopping, controlling smart home devices, reading or watching entertainment or educational content, and more.

Today, a new wireless network is spreading rapidly, accompanied by new wireless services. Although this new IT network is more complex, heterogeneous and dynamic than any of its predecessors, it is also branching out and becoming more personalised based on users' needs. The aim of 5G is to satisfy the IT needs of individual users while playing a role in various industrial and social sectors, thus moving mobile telecommunications from consumer use to industrial applications. At the same time, 6G was introduced, so it is worth comparing the technologies to see where they are heading.

¹ ORCID: 0000-0003-1144-1912

The history of the development of the 6G mobile communications system

Despite the growing popularity of 5G, some of its technical specifications are still not mature enough to meet people's initial expectations and needs. There are issues such as limited range, coverage and inadequate performance metrics in terms of information exchange. For example, in terms of coverage, 5G still focuses primarily on base stations, creating blind spots in the communications network or areas where it is difficult or impossible to deploy base stations. These areas, such as deserts, oceans or other regions (such as the Himalayas), can be considered coverage gaps in the communications network. It is estimated that more than 80% of the land and 95% of the oceans on the planet are not covered by mobile communications.

In terms of network performance metrics such as high bandwidth, low latency and ubiquitous connectivity, 5G has obvious advantages over 4G for industrial applications. However, it does not meet the demanding requirements for intelligent communication in real-world applications such as virtual reality (VR/AR), autonomous driving, telemedicine or the Internet of Things (IoT). Further latency reduction is required for the deployment of VR/AR applications. Optimal operation of telepresence (virtual meeting) and holographic (spatial image) display and communication also requires enhanced performance: data transmission speeds of Tbps (TeraBits per second) and latency in the millisecond range are required for proper usability, which 5G cannot achieve. With the projected increase in the number of users, it is expected that around 125 billion devices will be connected to the Internet, which equates to approximately 1 million connections per square kilometre, a capacity that 5G will not be able to serve.

This will stimulate research and development for a more seamless, advanced information and communication network that meets the needs of autonomous driving and virtual reality. This envisaged network would be the 6th generation network, or 6G for short. Given that there has been a generational shift in mobile communications roughly every decade since the 1980s, and that it takes about 5-10 years from research to market introduction for any general communications system, it is necessary to proactively begin research and development of the next generation of mobile communications systems and networks that anticipate future IT needs.

History of development of 6G

In early 2018, officials from the Federal Communications Commission (FCC) in the United States outlined the 6G system. In September 2018, the FCC identified the terahertz frequency range as the foundation of the 6G network, providing base station capacity thousands of times greater than that of 5G. In 2019, the United States partially opened up the terahertz spectrum to encourage



technology research for 6G. In the same year, President Donald Trump publicly supported accelerating the development of 6G research. In March 2019, the FCC opened the 95GHz-3THz frequency range, which will be used for future 6G services, for experimental purposes. The U.S. government is providing financial support primarily to university research. For example, the NYU Wireless Centre at New York University is conducting significant research into 6G technologies. Another notable university research laboratory, the Integrated Nanoscale Communication, Sensing, and Information Systems (INCSIS) Laboratory at the University of California, has developed a wireless chip that operates between 115 GHz and 135 GHz and is capable of transmitting data at a speed of 36 Gbps over a distance of 30 cm.²

Other leading countries in 6G research and development include:

- Japan: Japan is a clear global leader in terahertz and other electronic communications materials, providing valuable support for the development of 6G. Its goal is to have a 6G network in place by 2030, as announced in Vision 2030.³

- South Korea: As the first country to commercially deploy 5G technology, South Korea is at the forefront of 6G development. With the involvement of technology giants such as Samsung and LG, they are among the pioneers in the field. The South Korean government has announced its intention to be the first to launch 6G, with a planned release by 2028. To achieve this, the Korean government and companies are jointly investing \$481 million (equivalent to more than 165 billion Hungarian forints at the current exchange rate) in the R&D programme. According to the plans, pre-6G technologies are expected to be demonstrated as early as 2026. The development of 6G is an integral part of South Korea's K-Network 2030 strategy. South Korea has set an ambitious target to own approximately 30% of the 6G st⁴

² https://www.eetimes.com/100-ghz-wireless-transceiver-takes-chip-into-realms-of-6g/

³ https://www.free6gtraining.com/2022/11/beyond-5g6g-white-paper-by-nict-japan.html

⁴ Aim for 30% share of 6G patents" Ministry of Science and Technology announces 'K-Network 2030' : Seoul Economic Daily https://www.newsdirectory3.com/aim-for-30-share-of-6g-patents-ministry-of-science-and-technology-announces-k-network-2030-seoul-economic-daily/



- China: On 9 November 2019, China established the National 6G Technology Research and Development Promotion Group and the General Expert Group. Numerous companies and universities are involved in the research, with Huawei standing out as a prominent player developing 6G technology alongside 5G.

- Although not widely recognised as a technological powerhouse, Finland is notable for being the first country to host a 6G summit, with 287 participants from 28 countries around the world. As a result of the summit, the University of Oulu published the world's first 6G white paper in October 2019. According to the executive summary, the global rollout of 6G is expected around 2030, and the services provided by 6G will cover the entire world. Artificial intelligence will be an integral part of the 6G network, and key indicators such as transmission speed, frequency range, latency and connection density will dominate.

6G vision and its key performance indicators

6G combines and evolves the key application technologies of 5G, moving towards enhanced mobile broadband (eMBB) services and industrial applications (mMTC, uRLLC). It will continue to increase performance, optimise through technological innovation, and expand from the physical to the virtual world. The key features of 6G services are low latency (MBRLLC), high reliability (mURLLC) of communications, as well as human-centric services (HCS) and multi-purpose applications (MPS).

The 6G communication network will be integrated with cloud services, big data and artificial intelligence. To meet the expectations of the future information society, the bandwidth of the 6G mobile network will increase significantly. Coverage will extend from the ground to the sky and even across oceans, supporting various scenarios such as ultra-high-speed video transmission and ultra-low-latency industrial IoT. As the performance and capacity of the network increases, cost and energy consumption metrics will be efficiently improved, with energy efficiency improving tenfold or even a hundredfold, contributing to green and sustainable development. From physical design, architectural planning and protocol design to new technological developments and innovations such as blockchain and quantum computing, network security, communication reliability and information security will be ensured.

Characteristics	6G	5G	Efficiency
Peak Data Rate	1	10-	100x
	Tbps	20 Gbps	

User Experience Data Rate	1	0,1-	10x
	Gbps	1 Gbps	
Latency	0,1ms	1ms	10x
Connection Density	100	1	100x
(connections/km ²)	millió	millió	
Mobility (km/h)	>1000	>500	2x
Spectrum Efficiency (bps/Hz)	200-	100	2-3x
	300		
Energy Efficiency (bits/J)	200	100	2x

Traditional wireless networks (below 5GHz) and even the recently explored millimetre-wave bands (30-300GHz) are unable to achieve these goals, making the development of new wireless and networking technologies critical. This is necessary to overcome the limitations of existing networks with limited bandwidth and the high bandwidth requirements of future industrial applications.

Possibilities of using 6G technology

• 6G technology seems to offer countless possibilities that can be used in different areas of life. These may include, but are not limited to:

• The human body: Accurate real-time data on vital organs, the nervous system, the respiratory system and emotional state can be extracted through a large number of smart sensors placed on the human body. This enables the extraction of personalised health data packages that can be used by healthcare professionals for diagnosis and future treatments and interventions.

• Internet access on board: With its completely new communications technology and architecture, 6G will be able to provide high-speed internet access on board aircraft, unlike traditional cellular networks. This advancement will bring significant benefits to passengers, flight crews and other stakeholders in the aviation industry.

• Global emergency communications: In theory, 6G's new integrated network is expected to provide complete coverage of every point on the planet, including currently inaccessible areas such as deserts and oceans. This will enable emergency signalling and facilitate search and rescue operations.

• Smart factories: Based on advanced technologies such as artificial intelligence, networked intelligent devices involved in manufacturing help to continuously monitor production and enable real-time intervention in the manufacturing process if necessary.

• Networked robots, autonomous systems: The 6G system will enable fast transmission and sharing of data provided by sensors for autonomous vehicles and autonomous systems, both with the environment and with the supervisory server.

• Virtual reality: 6G will enable seamless, real-time connectivity with no latency, enabling procedures such as remote surgery and new social platforms in the entertainment industry, similar to Facebook and Twitter, but now in virtual reality.

Potential key technologies

As 6G is the advanced, enhanced generation of mobile communications beyond 5G, the following are brief descriptions of the three main operating principles of 5G:

1. Enhanced Mobile Broadband (eMBB): This principle focuses on providing significantly higher data rates and increased network capacity to meet the growing demand for high-speed Internet connectivity. It enables faster downloads, seamless streaming of high-definition content, and support for bandwidth-intensive applications.

2. Ultra Reliable and Low Latency Communications (URLLC): This principle aims to ensure highly reliable and low-latency communications, making it suitable for mission-critical applications such as autonomous vehicles, industrial automation, and remote surgery. URLLC guarantees minimal latency and high reliability, enabling real-time interactions with ultra-responsive systems.

3. Massive Machine-Type Communications (MMTC): This principle is designed to handle the massive connectivity requirements of the Internet of Things (IoT) devices. mMTC enables the simultaneous connection and efficient communication of a large number of IoT devices, supporting various applications such as smart cities, smart grids, and industrial IoT.





1. It demonstrates the interconnection of the 3 main function⁵

Enhanced Mobile Broadband (EMMB)

It is the natural evolution of the existing 4G LTE network, offering higher transmission speeds

for a better user experience.

- Peak data speed: 10-20 Gbps;
- Average speed: 100 Mbps;
- Minimum speed: 50 Mbps;
- Supports servicing 10,000 times more users than 4G;
- Supports transportation up to 500 km/h (high-speed trains, maglev trains);
- Energy efficiency can be up to 100 times higher than 4G;
- Supports serving densely populated areas (hotspots);
- Advanced multimedia support (high-resolution video streaming, mobile TV, video conferencing);
- Real-time connectivity;
- Wide coverage.

Ultra Reliable and Low Latency Communications (URLLC)

Transmits data with high reliability and low latency.

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⁵ https://commsbrief.com/what-do-embb-mmtc-and-urllc-mean-in-5g



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Characteristics:

- Latency: 1ms
- Reliability and availability: 99.9999%
- Medium transmission speed (50 Kbit/s 10 Mbit/s)
- Provides high-speed mobility Application areas:
- Smart factories
- Telemedicine
- Online sports
- Smart electrical networks
- Intelligent transportation

Massive Machine-Type Communications (MMTC)

Designed to power a wide range of low-power IoT devices.

Characteristics:

- High device density support (2 x 105 to 106/Km2)
- Long-range coverage
- Low data rate (<100 Kbit/s)
- Cost-effective
- Promises 10-year battery life (energy efficiency)
- Asynchronous access

Used in scenarios where a network of connected sensors is required, with a large number of low cost, low power, time sensitive, low data rate sensors.

Disadvantages of 6G communication

1. Infrastructure upgrades: The deployment of 6G networks would require significant infrastructure upgrades, including the installation of new base stations, antennas, and network equipment. This can be a costly and time-consuming process.

2. Compatibility issues: The introduction of a new communications standard may cause compatibility issues with existing devices and networks. Older devices may not be able to connect or take full advantage of the 6G network capabilities.

3. Spectrum availability: The availability of suitable spectrum for 6G networks may be limited. Acquiring and allocating the necessary spectrum for widespread 6G deployment may be challenging, particularly in densely populated areas.



4. Technical complexity: 6G technology is expected to be highly complex, incorporating advanced features such as terahertz frequencies, advanced beamforming and massive multiple-input multiple-output (MIMO) systems. Designing, deploying and managing such complex systems can be technically challenging. Cellular networks rely on a cell-less architecture and multiple links between different communication channels (THz, VLC, mmWave, sub-6GHz), requiring precise programming. As the user device connects directly to the network (RAN) and not to a cell station, a completely new network architecture has to be designed. Both VLC and THz data transmission have drawbacks that need to be considered in the communications network. In the THz range, one of these disadvantages is humidity, as the absorption of water molecules often makes signal transmission impossible. The field of plasmonics is concerned with the use of the THz frequency range, exploring the overlap between radio frequency (electronics) and photonics.

5. Security concerns: As with any new communications technology, there will be security concerns associated with 6G networks. Ensuring the privacy and security of user data, protecting against cyber-attacks, and addressing potential vulnerabilities will be critical to a successful and trusted 6G ecosystem.

6. Adoption and transition: The transition from current networks to 6G will require coordination and cooperation between different stakeholders, including telecom operators, equipment manufacturers, regulators and consumers. The pace of deployment and the seamless integration of 6G into existing infrastructure and services may be challenging.

Conclusion

Given the rapid deployment of 5G compared to the time it took for 4G to take off, it is highly likely that 6G technology will take off if the necessary technologies are researched and developed. This mainly refers to communication and network equipment, standards, chips and theoretical research. Given that the telecommunications industry undergoes a generational change approximately every ten years, and that 5G is currently being rolled out, with experts predicting the expansion of 6G by 2030, it is already possible to consider the user, business and industrial needs that will shape 7G mobile communications.

6G offers many opportunities that need to be explored from a military and defence perspective. Taking into account the operational principles mentioned above, there are several potential applications, such as the establishment of sensor networks for border security, support for search and rescue and disaster management operations in the event of catastrophes, the deployment and operation of autonomous weapon systems, and the tracking of logistics and transport tasks. The initial deployment of these systems will require significant investment, but I believe that the return on investment, taking into account cost effectiveness and efficiency indicators, justifies the investment, especially in terms of human resource management.

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Mónika, Balogh

ORCID ID: 0009-0005-7701-3277

Human resource management aspects of the disaster management duty service

Abstract

Human resources are the most important factor in the success and development of any organisation. The development of the training of the emergency services' duty staff is particularly important, as they are the link between the state and the population, actively involved in the prevention of emergencies and the rapid response to incidents, by taking the decision to take the next step after the transmission of calls from the Call Centre. In this paper, I have highlighted the main elements of human resource management closely related to this topic, using a content analysis methodology. Subsequently, I will present some thoughts on training and training development in the law enforcement organisation, drawing attention to thefact that the training of the emergency response personnel is a true legal requirement, and that within this, increased attention should be paid to the training of various non-professional competences.

Keywords: disaster management duty service, human resources, training, employability

Absztrakt

Az emberi erőforrások minden szervezet sikerének és fejlődésének a legfontosabb tényezője. A katasztrófavédelem ügyeleti állományának képzésfejlesztése különösen fontos, hiszen az állam és a lakosság között összekötő



kapocsként veszélyhelyzetek megelőzésében, bekövetkezett káresemények mihamarabbi felszámolásában vesznek aktívan részt azzal, hogy a Hívásfogadó Központból érkező hívások továbbítását követően a következő lépés megtétele ezen állománytagok döntése alapján indul el. Jelen tanulmányban a témához szorosan kapcsolódó humán erőforrásmenedzsment fontosabb elemeit emeltem ki, tartalomelemzés módszertanát alkalmazva. Ezt követően a rendvédelmi szervezetben zajló képzési, képzésfejlesztési gondolatokat fogalmazok meg a tanulmányban, felhívva a figyelmet arra, hogy a katasztrófavédelem ügyeleti állományának a továbbképzése igaz jogszabályban előírt, és ezen belül a különböző nem szakmai kompetenciák képzésére fokozott figyelmet lenne érdemes fordítani.

Kulcsszavak: katasztrófavédelem ügyeleti szolgálat, humán erőforrás, továbbképzés, foglalkoztathatóság

Human resources are the most important factor in the success and development of anyorganisation, especially in the globalised and technologically advanced 21st century. In recentyears, the digital revolution and technological changes have challenged many organisations and the role and importance of human resources in the effective functioning and operation of organisations has become even more important. Organisations in both the public and corporate sectors are affected by the impact of these changes, but the response to the impact has varied. In a rapidly changing economic, political and technological environment, organisations need to adapt to change, and the effectiveness of this adaptation lies in answering the "when-what-how" questions.

In Chikán's formulation, human resources are "the structured set of people involved in the activities of organisations according to their skills, knowledge and position in the division of labour" (Chikán, 2021, p. 319). The worker undertakes work to meet his own needs, which willserve the goals of the organisation he has chosen. Hence, it should be the goal of theorganization to help its employee to achieve its goals, thereby creating the fulfilment of the organization's mission. Human

resources are the value represented by people who contribute to the functioning of an organization through their various skills, experiences and abilities (Noe et al., 2022)

Human resource management (HRM) covers aspects related to the day-today employment of people, such as recruitment and selection, organisational development, knowledge management, talent management, performance and reward management, and social responsibility. Based on Walton - Lawrence (1985) and Pride et al. (2016), we distinguish five functions of human resource management:

- general tasks identifying labour needs and demand, identifying potential sources, attracting, recruiting, retaining and developing the workforce, and creating the financial basis;
- 2. motivation and incentive schemes designing and delivering cash and nonmonetaryschemes, salary and income management;
- work organisation creating an efficient and humane workplace through controlled workprocesses;
- 4. managing and organising training and further training providing formal education and opportunities for self-development;
- 5. managing industrial relations building good relations between employees and stakeholders in the organisation, ensuring ongoing communication.

Human resource management is a part of strategic management, whose role has increased in importance in recent decades. Management needs to be able to develop plans and structures, to evaluate and reassess strategies, new economic situations and technologies. As a result of strategic management, organisations learn to make timely and appropriate decisions and to manage an increasingly uncertain future (Elbanna, Katheeri, Colak, 2020). A vital issue in the life of an organisation is that the management must have a clear vision of the strategic existence of the organisation. Strategy has many dimensions, which are closely interrelated, causally linked and affect the day-today life of the organisation. As a leader of any company or organisation, it is necessary to constantly analyse the world around us, lookingfor cause and effect, for both good and better solutions. In order to stay afloat in this rapidly evolving world, self-development is essential, as is the development of employee skills (e.g. problem recognition, efficiency, time management, stress tolerance, etc.), which should be partof strategic management.

Management must take into account all the environmental factors that characterise an organisation, such as its culture, values, interests and power relations, in order to ensure that the strategic direction and the internal characteristics of the organisation are in harmony. (Balaton et al., 2017) Strategic management is a series of steps towards the future, in which theorganisation seeks not only to maintain but also to gain an advantage. This requires a kind of strategic foresight, which can be understood as an ability to predict the manager's position in the strategic environment and to interpret and synthesize what has already happened and what has happened in the past. The determinants of this strategic foresight are individual cognition and organizational structure (Petersen, Wu, 2021).

Human resources are fundamentally different from all other resources in terms of their characteristics. Human resources are durable, they do not wear out during use, they retain the knowledge and experience already acquired. It is neither storable nor imitable. If an organisation does not use the knowledge that its employees have, it is lost. Human resources have the capacity to innovate, create value, make decisions and it is important to stress that they are not the property of the organisation. Consequently, if the employee is not satisfied, he or she will leave the job, which in the case of an employee with a high level of work experience



and workforce, may cause difficulties for the organisation. Last but not least, human resourcesalso have knowledge capital, intellectual, practical, emotional intelligence, competence sets, which can also contribute to the effectiveness of the company (Elbert et al., 2001).

A constant concern for every HR professional is how to retain employees and keep the people who work there. Understanding the importance of training development as part of human resources is key for organisations to deliver a high quality level of service, both at public and enterprise level. Organisations must be committed to human resources and training development and provide people with the right opportunities for both development and career progression.

Training development is aimed at increasing the skills of the employees working in the organisation, expanding them and improving their existing competences. One of the basic tasks of human resources management is to ensure that the company has the right number of employees with the right skills to keep pace with the changes of the times. The right knowledgecan only be ensured if the issues of training, education and development are dealt with with sufficient emphasis and expertise within the company. Proper management of training development in the public sector is particularly important, as public organisations need not onlyto develop the skills of their employees, but also to improve the quality and efficiency of public services. In this context, training development must be consistent with public policy objectives and priorities and take into account budgetary constraints and the regulatory environment.

The above is no different in the case of the disaster management as an internal affairs agency. Due to its hierarchical structure, the organisation is highly centralised in its day-to-dayoperations, which is reflected in the allocation of tasks to be carried out and in the number of tasks to be performed, as well as in the routing of services. As Bakacsi puts it, "if individuals join the organisation of their own



free will, leadership based solely on power leads in the vast majority of cases to withdrawal." (Bakacsi, 2010, p. 160) The present study does not aim at examining staff turnover, but in general, the trends in the labour market (resignations, career drop-outs) do not leave this organisation untouched.

Every employer tries to select the most suitable employee from the labour supply. What constitutes the best employee for each employer and what they expect from their workforce varies from organisation to organisation. At its core, the mission, purpose, strategy and mission of the organisation are determinants, as are the organisation's leadership (the identity of its managers), values and culture. At the same time, it is important to stress that the individual and the organisation's purpose need to meet in order for the employee to stay with the organisation in the long term.

In contrast to the duty staff of the emergency services, who receive emergency calls to the Call Centre in 19 counties and the capital, there are similarities with the workforce expectations of market-based organisations in many respects, but also marked differences due to the law enforcement nature of the organisation. According to Martina Noel, the dream employee should strive to continuously optimise his or her work performance, should want to shape his or her own career, should be able to cope with the challenges that arise during his or her career, and should also care about his or her employability (Martina Nohl, 2020, pp. 59-61).

Law enforcement is a specific segment of the world of work. In my view, as the number of years spent in law enforcement increases, workers become increasingly distanced from the reallabour market around them, which significantly reduces their employability. Employability is understood as the ability of a person to enter into an employment relationship, to work in it as a professionally and socially competent worker and to seek new employment independently if necessary. (Martina Nohl, 2020) From the employee's point of view, the loss of this ability can be seen as a negative change, but from the organisational point of view, from a human resourcemanagement perspective, the loss of employability can result in a long-term commitment to theorganisation. Recognising this context, the challenge for the organisation is to find competent employees with professional, social and personal competences and to train them continuously in order to ensure that their attachment to the organisation is strong enough to keep them frombecoming the focus of the labour market.

Duty staff receive different numbers of hours of on-the-job training for their duties, depending on their prior training. During this training, they acquire (and pass an examination in) the theoretical and related practical knowledge required to carry out their duties (e.g. fire- fighting, rules and organisation of technical rescue, industrial safety and civil protection, disaster prevention, etc.). The task of human resources management does not end when the staffhave attended this training and successfully completed the requirements. The real challenge and task for a human resources professional start at this level, as the staff member has arrived professionally prepared for his/her duties, works on a rotational basis, is on duty and performshis/her duties on a regular basis. The duty staff, by virtue of their specific work, have, compared to the average worker, a number of factors over which they have no control or influence, which they have to face during a shift: they are constantly working on a computer; they have to be on constant standby to receive phone calls; it is unknown to them whether the incoming call will be a true call or a deliberately false call; the content of the incoming call is also unknown to them; there are human lives behind each call; they have to make decisions to take further action, decisions that carry weight. They must learn to deal with these situations and circumstances, and apply what they have learned effectively in their daily practice. Basic competences such as assertive communication, decision-making, conflict management, stress management, aggression management, effective cooperation, etc. are necessary and could of course be extended.

These competences can be developed by the 2/2013 (I. 30.) BM Decree on the system of further training and leadership training of professional staff members of bodies under the control of the Minister of the Interior and on the law enforcement supply and leadership database (hereinafter: 2/2013 (I. 30.) BM Decree), which prescribes further training obligations for law enforcement personnel. Pursuant to Article 3 (1) of the Decree, further training may take place

- centralised training programmes;

:

- law enforcement training programmes, management and leadership training programmes organised and run by the Ministry's training departments;
- internal professional training programmes organised by the Home Office for its own staff;
- qualified training programmes organised by registered training institutions or the Parliamentary Guard.

Continuing education programmes may be as listed in § 1 of BM Decree 2/2013 (I. 30.):

- centralised training: a law enforcement training programme ordered by the Minister which provides uniform training for the professional staff of one or more home affairs bodies or for members of a specific rank group at the same time;
- certified continuing training programme: a quality-certified training or competence development programme which meets the requirements of the certification procedure, which is designed to provide training or competence development with a continuing training credit, which consists of units of independent learning or units of course content and which enables the acquisition of the knowledge and practice needed to meet the training outcome requirement;
- law enforcement continuing training programme: a notifiable continuing training programme developed and run by a department of the Ministry

responsible for continuing training, which imparts a wide range of professional knowledge and which may be ordered as central continuing training if the Minister so decides;

 internal professional training programme: a notifiable training programme developed and delivered by the home affairs body, which includes professional knowledge or competencedevelopment, and which is relevant to the tasks of the home affairs body.

In the framework of training, the organisation has the opportunity to develop the competences of its staff by assessing the real training needs of the staff and developing a training matrix. The purpose, methodology and tools developed for training development should be essential for lawenforcement, as it will facilitate the professional development of the personnel and thus improve the performance of the organisation. The aim of training development is to continually improve the knowledge, skills and abilities of the personnel, thereby adapting the organisation's adaptability to the changing social circumstances around it.

I am convinced that the importance of this topic will continue to grow in the 21st century and that it will play a key role in the success of organisations and employee satisfaction. Organizations need to find innovative and effective solutions in human resources and training development to meet the changing challenges and opportunities in an era of digitalization and globalization, both in the public and corporate sector. Investment in human resources and training development is the way forward.

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COMPARATIVE ANALYSIS OF SLIDING FORMWORK SYSTEMS AND SELF CLIMBING FORMWORK SYSTEMS AND THEIR WORK AND ACCIDENT PROTECTION

Zsolt Huszár; huszarzs470@gmail.com

Abstract

One of the key auxiliary elements of structural construction is the lifting machine, that is, the crane. Reinforced concrete structure construction consists of three basic activities: formwork, iron installation and concreting. In the case of tall buildings, the stationary tower crane is an indispensable auxiliary structure for all three activities. The three construction activities often take place simultaneously in time. Therefore, the possible relief of the crane is a very important factor in shortening the export time. Rebar can only be brought up to the construction level by crane, while the transport of concrete largely depends on what kind of structure needs to be concreted. Large slabs are usually concreted with a concrete pump, while vertical structures such as walls and pillars are concreted using containerized concrete technology that is lifted using a crane. [7] Thus, the only activity is the production of formwork, where it is possible to move formwork without the help of a crane. The method of this is to use the self-propelled type of climbing formwork or to use the sliding formwork technique developed earlier. Both methods have their advantages and disadvantages, and, of course, it is worth examining the work and accident protection systems of these structures.

Keywords: accident, occupational safety, sliding formwork, climbing formwork, crane, speed

Author:

Huszár Zsolt, master teacher, Department of Construction technology and Management, University of Technology and Economics, H-1111 Budapest, Hungary

1. Introduction

The aim of the following comparative analysis is to examine the principle of operation and the usability of sliding formwork against self-propelled climbing formwork. Neither process is a new technology, as the sliding formwork system was patented in the USA at the beginning of the century, in 1913, while creeping formwork developed with the development of large-panel formwork in the mid-60s. The interesting thing about the two systems is that while sliding systems have not fundamentally evolved much in recent decades, the creeping system has undergone revolutionary changes.

Of course, the development and development of formwork cannot be compared with the almost daily changing innovations of computer technology, or even with the pace of developments in the automotive industry, since the construction industry, following its thousand-year-old traditions, takes steps only slowly during developments, but these changes occurring every five to ten years should not be ignored either.

2. The sliding formwork

The commonly used area of sliding formwork is relatively high village structures, silos, cooling towers, factory chimneys, where monolithic concrete or reinforced concrete structures are made without working gaps at the entire height of the wall. The principle of operation of the system is known to everyone, since structures were made with this technology already at the beginning of the century, before the First World War, in America.[2] During the use of sliding formwork, formwork 1.0-2.0 m high is made according to the layout of the structure to be built. In terms of formwork, it is identical in material to the material of wall formwork of general use. Due to the low height, robust frame formwork is not typically used, but rather timber formwork. The concrete surface of the formwork is made up of wooden formwork boards with a three-layer glued pine design, but phenol-coated plywood is also commonly used. Three-layer pine boards are cheaper than plywood, but their service life is shorter. Their surface is damaged sooner, they



cannot be repaired, they are more sensitive to moisture, so after 15-20 uses and they no longer give a plaster-free surface. In contrast, the phenolic coating of plywood boards protects the sheet from strong sunlight and frost, prevents water from entering the wood layers, and in case of damage it can be well puttyed. The rigidity of the formwork shell is ensured by wooden supports appearing on the back in case of straight walls. Wooden supports are generally glued I supports 16 or 20 cm high with a belt width of 8 cm, or wooden supports with a truss ridge 24 cm high, regardless of manufacturing companies. Previously, the ridge design was only conceivable from glued pine, but nowadays it is not uncommon to have wooden supports with pressed ridges or double ridges for telescopic splicing. The layout geometry of buildings made with sliding formwork technology, such as silos and cooling towers, is usually arched. In such cases, instead of module wooden supports, factory-made arched wooden planks adapted to the given geometry form the supporting frame.



Figure 1: Sliding formwork system [8]

At the same time as concreting and iron installation, the formwork moves upwards in a continuous vertical direction. The structure moves at such a speed that the concrete coming out of the formwork is already strong enough to stand without formwork.

The formwork and the loads of the related work levels are carried and moved by the buttresses embedded in the concrete and the lifting machine moving on it. (Figure 1) The most striking innovation was the continuity of concreting, which means that the formwork rises by 15-20 cm per hour, thus achieving a daily average lift of 3.00 m. The continuous movement of formwork in the same direction is well mechanized. Initially, the first screw lifting devices were still manually driven, then they were gradually replaced by pneumatic and hydraulic lifting devices. It is almost compelling that with formwork that is motionless for a long time, the structure sticks. An important aspect of sizing is that the side pressure of the concrete left by the formwork is eliminated, while at the same time the surface (height) of the very smooth formwork jacket in contact with the concrete should not be large, because then a very large force is required for movement. [3]

The advantages of sliding formwork are usually manifested when building walls with high, intermediate slabs, not interrupted by other structures, most often with a constant cross section. Since the height of the formwork ranges from 1.0 to 2.00 m, so its material requirements are small, but at the same time this small amount of material is enough for the construction of large heights. The considerable work involved in the construction, demolition and conversion of formwork is cancelled. The scaffolding supporting the sample decking is omitted, and even a concrete scaffolding is not required. The concrete coming out of the formwork is usually of good quality, as excess water is pushed out of the concrete due to the load above it, and the solidification conditions are also more favorable due to the compressive stress. The post-treatment of concrete can be carried out with water introduced into a perforated pipe running around the outer and inner surface connected to the sliding formwork. The surface coming out of the formwork is smooth, attractive, plaster-free, and any surface imbalances that may appear in places can be

The disadvantage is that the assembly and operation of formwork requires well-experienced personnel with extensive experience. The formwork requires constant inspection, if, for example, the deviation of the position of the formwork from the vertical plane is noticed late, this can cause the whole structure to be warped. Inadequate adjustment of the speed of progress of the formwork or prolonged downtime may result in cracking of the concrete of the structure.

From an industrial safety point of view, that formwork system is one of the safest structural systems. It is thanks to the fact that the entire working platform is assembled on the ground floor, and after that, during the whole process of slipping, people already work in the inner closed ring under the protection of the formwork. Full surface protection of the finished lower working levels

3. Climbing formwork systems

Formwork designed in such a way that linear concrete structures can be constructed. These include, for example, bridge piers, reinforced concrete silos, reinforced concrete dams, but also the façade walls of high-rise buildings. The essence of the technology is that the formwork is pushed forward in stages and attached to the concrete structure prepared in the previous work phase. [1] Once the work phase has been concreted, once solidified, the formwork creeps up and is attached to the newly solidified structure. The advantage of the technology is that the formwork does not need to be built as a separate supporting structure, this task is performed by the structure under construction. Basically, looking at the movement of formwork, we can distinguish two main types. One is when the formwork is moved with the help of a crane, in the other case the entire structure is self-propelled, its movement is carried out without the use of a crane. What both systems have in common is that the formwork itself as a formwork system can be any modern formwork, whether framed or timber-durable. In terms of structural principle, the wood-durable large-panel formwork rather evokes the past, in a modern guise. This



means that instead of the classic wall supports, modern glued I section wooden supports take up the load and transfer it to modern double U profile crossbars. Its shell is glued plywood board, coated with phenol, but with free edges. Framed formwork systems: typically enclosed in a steel support frame with plywood formlining. From a wide variety of board widths to elements one storey high or half a floor high, systems can be fitted with quick-clamping clips. Formwork is a structure that can be moved by crane or by hand.

4. Crane-movable climbing formwork

The key question is on which working platform the formwork will be built and how this working platform is attached to the already finished reinforced concrete wall structure. The simplest version, the work platform has a carpentry wooden structure manufactured on site, which is fixed with connecting irons to the already existing reinforced concrete wall one level below. A more modern version is the finished front-mounted work platform, which is foldable and thus easy to transport and deposit in the construction area. Finished working platforms are usually manufactured in lengths from 3 to 5 meters, so their linear placement is very fast and efficient. The most industrialized version of the product is a working platform designed to fix the formwork. The advantage of this is that after formwork of the reinforced concrete structure, the entire unit, together with the working platform and formwork, can be raised one level with the help of a crane.





Figure 2: Climbing formwork system [9]

From the work platform iron installation, formwork, concreting can be carried out, but it can also be used for masonry. The scaffolding, for the necessary work, is installed on a receiving structure fixed in a reinforced concrete wall or reinforced concrete slab. The hanging structure is usually concreted into the slab structure, this solution can also be applied to masonry structures. At the edge of the slab, in the fields between the rack brackets, the hanging cone, anchor sleeve or suspension loop must be placed and fixed between the slab reinforcements. In the event that no slab structure is attached to the wall structure, e.g. in the case of elevator shafts, vertical formwork of high-height walls in several stages, the hanging cone must be cemented into the wall structure. In the case of end walls, where the stand is placed only on the outer side, it is enough to mount the cone on the outer surface. When constructing silos, where scaffolding must be installed inside and out to receive the formwork, the cones must be installed on both sides. Hanging structures placed in reinforced concrete façade walls or on the edges of slabs play a major role in the fact that, taking into account the scaffolding load, the scaffolding can be used as a protective scaffolding, roof protector, protective roof or work platform.



One of the most critical parts of work and accident protection is working at height. [6] To protect and secure this, a multi-level work scaffolding was developed. The top level ensures safe concreting, the middle level allows the formwork to be assembled and dismantled, while the lowest level unscrewes the cemented hanging cone and repairs the concrete surface.



Figure 3: Operating principle of climbing formwork system [9]

4. Self climbing formwork

The development engineers of formwork systems have long been interested in the question of how to formwork taller than average, tower-like buildings and pillars in such a way that it can be solved without the use of cranes, but at the same time any modern formwork system can be used with low material and labor requirements.

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The solution was a so-called self-propelled climbing formwork, which is moved by a special hydraulics. The whole structure moves at once, which consists of: the formwork, the concrete scaffolding of the formwork, the working rack on which the formwork rests, a two-level suspension rack from which the climbing slippers necessary for transitions can be handled, and the vertical steel rails on which the whole system "climbs" up and down. The basic principle of the newly developed process is the same as that of climbing formwork, which is as follows: When formwork is installed on the starting level, so-called recoverable cones are connected to the iron installation, the outer plane of which is the same as the plane of the formwork. After concreting or formwork, special slippers are screwed onto these concreted conical nuts, on which the work platform is hung with the help of a crane and the formwork is placed on it. Then the whole process begins again, that is, setting the formwork on one side, installing iron, laying cones, closing the formwork on the other side, concreting.

Simpler climbing formwork systems can be modified in three crane phases. First, the formwork boards are lifted off the work platform and placed on one of the slab levels or on the ground temporarily, then the working platform is raised one level higher on the cones cemented in the previous cycle, and as a third stage, the formwork is raised back to the working level. In the case of modern climbing formwork, the formwork can be craned together with the work scaffolding, thus reducing crane time.





Fig. 4: Operating principle of self climbing formwork system [9]

A revolutionized change in the self climbing system is that vertical steel rails are attached to the conical slippers, and the entire scaffolding climbs these rails one level higher with the help of hydraulics during transition. After the next level has been cemented, first the rail climbs up to the next cemented cone, and then the whole process begins again.

The result of such a self climbing formwork system is that any tall building can be built without the use of a crane. Even above 100 m altitude, the consumption of materials and labour is significantly lower than with traditional construction methods. The formwork rises at a speed of 12 m/h without vibration, and the system moves smoothly downwards just as smoothly as it goes up. It can "climb" down from a great height without the help of a crane and thus dismantle at ground level, saving time



and effort. During ascent, all work and walking levels remain in a horizontal position, because the hydraulic system of the formwork operates with height tolerances of up to 1% of the cylinder stroke, even with up to 16 brackets operated simultaneously. It is operated by a single person. The operational safety of the system is ensured by the hinged bearing of the climbing head.

The self climbing formwork can absorb and discharge all forces up to a vertical load of 150 kN per bracket. Brackets allow formwork with a height of 5.50 m and a width of 17 m. As a result, the use of brackets will be minimized and less material will be required for suspension points. The system can move not only on a vertical plane, but also 25 °It can fit both positive and negative tilts and shifts of up to 15 cm, so-called stepping. This is especially important in road construction, where the pillars of bridges and viaducts are often inclined or broken in shape. The number of brackets relative to the formwork surface can be adjusted precisely to the shape of the structure.

It is important that the hydraulic self-propelled system is independent of the type of formwork working with it, i.e. the formwork giving the surface itself can be framed metal formwork, but it can also be a large-panel formwork with a timber support system, which is mostly determined by the geometry of the building. In both cases, it is true that the formwork can be pulled back 90 cm on the work platform during formwork, which helps to clean the formwork surface, prepare it for the next concreting and provide space for iron installation after the changeover. In contrast to traditional climbing systems, where only the boards can be tilted backwards during formwork, here a lightweight scaffolding can also be erected on the 90 cm free strip due to pulling back, in case of high formwork, to facilitate reinforcement. This formwork method was also used to create the ensemble of four pillars on the valley side of the "Viaduc des Vaux" built between Geneva and St. Margrethen in Switzerland, with a height of around 97 m and an area of 4.00 x 2.80 m. The pillars were connected at about half height by a horizontal vb. frame, which was formwork from the working platform of the climbing formwork reaching this level. An interesting feature of the formwork is that only four brackets were used per pillar, two facing
each other on the 4.00 m sides, while a novel wing formwork was used on the shorter sides of the pillars, which was connected to the two self-propelled formwork units. While the lattice timber formwork was formwork on the longitudinal side of the pillars by tilting backwards or pulling the formwork back 90 cm, on the shorter sides the formwork boards suspended by the hinged system could be opened as a double-leaf door. With this procedure, 6 concreting phases per week could be achieved.

Climbing formwork work and accident risk: One of the most dangerous areas of construction within building construction is structural construction, where most fatal or seriously injured work accidents occur. [4] The reasons for this are:

Outdoor working, which means workers are out of the air for all the vagaries of the weather,

work with or in the vicinity of cranes,

working at high altitude,

work culture in the construction industry often falls short of expectations,

work often carried out at an unreasonably high pace,

There are many unskilled workers.

Since creeping and sliding formwork are only built at high altitude and are economical to use in the construction of structures, their technology means that one of the greatest hazards is working at high altitude. To protect against this, formwork companies have developed very serious safety systems to protect against falls. One of the latest developments in recent years is the safesreen [5], which can provide fall protection through several levels.

From the point of view of this article, special attention must be paid to the fire protection of built-in building structures and structures used during construction [10], and in the case of chemical industry or logistics investments, to protection planning and industrial safety issues [11, 12].





Figure 5: Safescreen [5]

5. Summary

Comparing the two formwork systems, we can make the following statements. In terms of modernity, self-propelled climbing systems rank higher in terms of ranking, as state-of-the-art wall formwork systems, from garden to wood-durable, and their modern additional elements can be used here. At the same time, this also means that the formwork company does not need to specialize, but can carry out this type of formwork with its existing set, of course with the accessories of the self-propelled climbing formwork. It is not necessary for the contractor to have more expertise than formwork professionals in general, and still spectacular results can be achieved. Despite all this, sliding formwork technology has not been pushed out of the market either, as with its low material requirements it still represents a competitive technology in the formwork palette, but its scope of application has become narrower. Rather, in residential and public building construction, there is a greater demand for the construction of such fast, pre-slab stiffening cores, elevator shafts and sliding formwork, while in the case of industrial structures, modern, self-propelled climbing formwork is preferred by today's construction industry.

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