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Innovative technologies supporting the safety of the transport of dangerous goods

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Abstract

The article presents solutions in the area of the importance of innovative technologies supporting the transport of dangerous goods. Providing security in the broad sense is becoming one of the strategic tasks for management boards in terms of the presence of many different threats and the management of economic entities providing transport services for dangerous goods. Actions for security are local, regional, national or international. The transport of dangerous goods, due to the need to ensure the safety of people and the environment, is subject to special rigors in terms of its admission to transport, selection of packaging, labeling and requirements relating to the driver, means of transport and transport. Security measures include permanent control of the conduct of all interested parties trading of dangerous goods in accordance with the detailed safety rules.

Keywords: innovative technologies, transport, dangerous goods

1 Introduction

Hazard during the transport of dangerous goods may arise when the requirements concerning the principles of proper and safe operation are not observed. The rules and requirements for safe transport specified in the ADR Agreement / RID Regulations / ADN Agreement / IMDG Code and ICAO regulations ensure a high degree of minimization of such risk. One of the most important problems in all types of transport (land, air and sea) is the knowledge of the accuracy parameters characterizing the current position of a moving object (car, train, plane, ship, etc.).

There is no one universally applicable definition of innovation, and it comes from the Latin language - innovare or "creating something new". Hence, the most common definition of innovation emphasizes that "innovation is a process of transforming existing opportunities into new ideas and putting them into practice. In the literature on the subject, a definition is often used which, simplifying it, says that innovation is the process of transforming existing possibilities into new ideas and putting them into practice. According to David Begg, innovation is "the application of new knowledge to the production process." It is considered a determinant of the development of enterprises and entire economies [2,4]. J. Schumpeter introduced this concept in 1911. His approach to this issue is considered classic to this day. The phenomenon of innovation is inseparable from the notion of change, novelty, reform or an idea perceived as new introduced into practice (especially in economic practice). One of the most popular is J.A. Schumpeter [13]. He understood innovation as:

1) introducing new products to production or improving the existing ones,

2) introduction of a new or improved production method,

3) opening a new market,

4) applying a new way of selling, purchasing or services.

Today, innovations and advanced technologies are the basis for the development of both the world's largest economies and individual dynamically developing enterprises. They are often associated with significant capital expenditures and large corporations, but in the modern economy, small and medium-sized enterprises play a huge role in their creation and dissemination.

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Their undoubted advantages are entrepreneurial dynamism, flexibility and commitment to implemented innovative projects. It is worth emphasizing that introducing and the use of modern technologies by small enterprises requires not only technical knowledge. They face great challenges in terms of knowledge of economic, legal and market issues as well as management competences. Moreover, in order to build and maintain their innovative potential, small and medium-sized enterprises need an appropriate environment in which they can obtain the resources and information they need. [3, 7].

The broad definition of innovation specifies that these can be new products or services, e.g. transport, fundamental changes in production methods, significant improvements to processes or products, new marketing concepts, new distribution methods, changes in management methods, new work organization or reorganization of employee tasks. An interesting definition is given by the OECD when it says that innovation involves transforming an idea into a salable product or service, a new or improved production, distribution or transportation process. Apart from the innovation itself, it can distinguish innovative activity; according to the OECD, this is a series of scientific (research), technical, organizational, financial and commercial activities aimed at developing and implementing new or significantly improved products or, for example, transport processes. Some of these activities are innovative in themselves, others are necessary for the development and implementation of innovation. Another concept is innovation policy, which is the general framework for innovative activities of enterprises. Its aim is to support the innovation of beneficial changes in the structure and methods of production, in the long term, of enterprises, especially small and medium-sized enterprises, by helping to introduce new technological processes, products, services and management techniques. This policy involves a set of measures by the state and regional authorities to stimulate technical innovation and ensure its flow.

Innovation policy is the result of a fusion between science and industry. The strategic goal is to achieve and maintain a high level of international competitiveness of goods produced in the country or region. Contemporary definitions cover a wider range of elements, from ideas to implementation, and are more useful for understanding the impact of innovation on a region's socio-economic development process. When considering where innovations mainly arise, one can cite their division according to the criterion related to the place of appearance, then innovations are divided into industrial and scientific. Industrial innovation often results from an informal search, long-term exchange of knowledge between independent entities. A dangerous goods transport innovation may include:

- knowledge related to technological solutions,
- the use of technologies introduced in other sectors,
- identification of technical problems and user needs, gradual development of previously unknown solutions targeted at new markets.

Scientific innovation, in turn, is the result of a formal and planned research process carried out to develop new products or services. As a result of the activities of the above-described entities, innovations arise, which may be radical or incremental. The criteria for the division are the time and scope of the impact.

The first shot leads to fundamental changes in the business. However, radical innovations arise less frequently and are combined with significant scientific and technical inventions, e.g. nuclear energy. Radical innovations are a deliberately designed and implemented change involving a product, process, work organization or management method that is new to a given branch. The second type is more common, it is called incremental innovation. It leads to gradual ones and influences the company's position.

The use of such an innovation may be related to the introduction of new solutions or the improvement of the existing ones. In the description of innovative processes, two theoretical trends can be distinguished.

The first approach is a systemic approach based on evolutionary theories of economic and technological change. This theory emphasizes the evolutionary nature of the innovation process resulting from the institutional context. Innovation appears as a derivative of the evolution of various institutions and changes. It is a process that can be historically traced and linked to the development of a given territory.

The second approach exposes the role of various institutions, knowledge and interactive learning in the system. This trend sees knowledge as a fundamental resource in modern economy, emphasizing the learning process as key. This concept emphasizes the social nature of this process and the participation of many actors and factors. Innovation is created by a system of interdependent units forming networks of dependencies. It is considered to be the product of a collective learning process. Innovations can be the result of both research and development activities and companies' response to market demand. According to the so-called the paradox of innovation innovation activity is a process by which collaboration is used to strengthen competition and competition.

As a result of mutual dependencies, innovative clusters are created, i.e. groups of enterprises and related institutions and organizations interconnected by an extensive network of formal and informal relations, based on joint technological development and common markets.

Knowledge and innovation are essential tools to increase the competitiveness of the economy, and to achieve economic growth, it is essential to increase the level of investment in research and development and to take steps to ensure that research results are then transformed into innovative products and common markets.

Nowadays, in the era of rapid technological development, the issues of cooperation between science and industry are becoming an extremely important factor determining competitiveness and attractiveness of manufactured products, and thus economic success. Development trends in industry show that only building a competitive advantage based on knowledge and innovation can guarantee sustainable development and new jobs. Enterprises that implement innovations are more profitable than those that do not invest in innovation. An innovative enterprise is an intelligent organization that generates and implements innovations. Nowadays, the pace of changes in technique and technology and organization ensures that only an enterprise capable of introducing innovation can survive on the market [4].

Currently, transport companies are under a strong pressure of the need to implement innovations and at the same time often in many areas (new products, technologies, organization, relationships with partners). Today, the challenge in the medium and long term is to increase the internal ability to absorb technologies with the appropriate potential, and innovation will have to gradually take over as the main engine of growth [7].

Innovation is purposeful, focused work that requires knowledge, diligence, persistence, commitment, and requires innovators to use their strengths and they are an effect induced in the economy and society, as they change the behavior of both entrepreneurs and consumers [14]. Innovations can facilitate, and make our lives difficult by constantly complicating the environment. In terms of innovation sensu strictly ignores innovations related to social and organizational changes, focusing on technical and technological innovations. A technological innovation occurs when a new or modernized product is placed on the market or when a new or changed process is applied to production [1, 2, 6, 8, 11, 12, 18].

2 Modern technologies used in transport

In the last years of the second millennium, the position of the object in air and sea transport was determined in the vast majority of cases with the use of satellite navigation systems. Increasingly, these systems are also used in land transport. GPS monitoring - satellite navigation system (GPS - Global Positioning System, is an American system that is the first and fully operational satellite navigation system - NSS). In the logistics industry, it is not only the tracking of goods transported in tractor trailers. It is also the ability to control goods contained in containers used in road, rail and sea transport and container management. Despite its many advantages, the GPS system in the last decade of the 20th century did not in all cases meet the precision requirements of many users, in particular maritime users in coastal shipping, port approaches, etc.

Currently, practically all sea vessels, such as: commercial, fishing, passenger, rescue, warships, specialized and research and development units are equipped with at least one NSS receiver. In the case of maritime transport, however, it can be stated that each new unit is already equipped with one or more NSS receivers. Satellite navigation systems have found widespread use in many areas of the economy, in particular in all modes of transport. The most important group of users of satellite navigation systems are land transport users and everything indicates that they will also be users in the future.

Thanks to the use of computer systems and appropriate software supporting logistics operations with many complex tasks, such as delivery planning and inventory management, have largely become routine tasks. Moreover, computer simulations of entire logistics systems enable the development of an optimal solution ensuring an appropriate level of customer service. The considerations made so far show that one of the basic conditions for success in modern logistics activities is the implementation of modern technologies and information systems [13].

The development of technologies supporting the transmission of information (Information Technologies - IT), such as EDI (Electronic Data Interchange), as well as the dynamic development of the Internet in the last few years, on the one hand, facilitated the work of shippers, on the other, increased expectations the customer as to the quality of services provided. It is not about online purchases (e-commerce), which contributed to an increase in the value of retail sales and, consequently, an increase in the demand for transport services. Changes in the way entities operating on the transport services market operate. Thanks to the Internet, it has become possible to transfer information faster and cheaper between shippers and their contractors. However, not always the entity offering logistics services is able

to meet the growing expectations of customers and constantly adapt the software it uses to the changes taking place in the client's enterprise.

For several years, there has been a growing demand for various types of hazardous materials transported in sea transport in containers, and at the same time the demand for a much larger tonnage of hazardous materials loaded on a single ship.

Currently, two basic types of activities of transport companies in the field of IT can be distinguished to maintain the competitiveness of services:

a) focus on supply chain management between production companies and striving to standardize IT systems used by partners providing transport services,

b) the ability to track the cargo during its transport.

The above-mentioned activities related to the improvement of the information transmission system between the client and his contractor should not be confused with e-commerce, which is a rather new, important tool supporting the distribution system and product promotion. The IMDG Code, i.e. the International Maritime Dangerous Goods Code, regulates the transport of packaged dangerous goods by sea. This document was issued in 1965 by the International Maritime Organization (IMO). In line with the recent amendments to the SOLAS Convention, the IMDG Code has become a mandatory document for the first time, and not the IMO recommended document. The share of dangerous goods transported by sea is systematically increasing. This is related to with the increasing transportation of dangerous goods. It is estimated that approx. 50% of the total weight of cargo transported by sea is classified as dangerous or threatening the marine environment. Most of them are bulk cargo, incl. chemicals, liquefied gases, raw materials and oil products, and dry bulk cargo [5]. This problem of international scope was regulated by the International Maritime Organization - IMO, which presented its view and recommendations in the document MSC.1 / Circ.1216 of 02.26.2007, which is a revised version of the repealed MSC / Circ.675 of 30.01.1995. The current Circular, i.e. Recommendations, is in line with the IMO Code, which emphasizes the importance of ensuring a smooth course of cargo work in order to prevent disagreements between the ship and the shore. This recommendation distinguishes between "taking care of the goods", "keeping" (as in the case of the Port and PKP or the Port and the ship) from storage. Class 1 hazardous material, temporarily located in a seaport as part of a transport chain, is not considered to be storage, as its presence is only related to waiting for loading and for onward transport by another type of transport [14]. Storage, which means keeping goods for an indefinite period of time, not directly related to the transport process, is treated as a function outside the scope of the Recommendation.

3 Basic obligations of participants in the transport of dangerous goods

The basic obligations of participants in the transport of dangerous goods and reasons for the emergence of threats during their handling, and they may be as follows:

- types and types of packaging, loading units, means of transport not compliant with the requirements of RID, ADR and IMDG,
- inadequate technical condition of packaging and loading units, which, due to excessive wear and damage, does not ensure tightness and allows the cargo to escape into the atmosphere,
- lack of theoretical and practical preparation for carrying out transport activities with dangerous goods in individual links of the transport chain,
- improper organization or technology of transporting dangerous goods [9].

The above-mentioned threats show that the overriding duty of all entities, regardless of their legal nature, involved in the transport of dangerous goods is to provide all technical and organizational measures regarding safety, depending on the nature and scope of threats, in order to prevent threats, and in the case of such occurrence in order to minimize its effects. When conducting research on the transport of dangerous goods, the observation method was used as one of the oldest research methods, which consisted in registering specific facts and recognizing them in mutual relations and dependencies. (Fig.1).

In accordance with the applicable procedures, it is the duty of entities involved in the transport of dangerous goods to notify emergency services in the event of an imminent threat during the transport and reloading of dangerous goods and to provide them with all information needed to conduct rescue operations. Securing the loading of dangerous goods onto a ship in a seaport should be carried out in accordance with the "Technological instruction for the handling



Figure 1. Pallets with dangerous goods prepared for loading into containers

of explosives in a seaport" and the port facility security plan, approved by the Maritime Office, in compliance with the requirements contained in the current IMDG Code and in the "Revised recommendations on the safe transport of dangerous cargoes and related activities in port areas MSC.l /Circ.1216, 26 February 2007 [14]. Correct application of the rules on the transport of dangerous goods and compliance with them during work depends to a large extent on making all persons involved in cargo handling aware of the sources and type of risk, as well as on a thorough understanding of the regulations (Fig. 2). This should be achieved by conducting properly planned periodic training in the safe handling of dangerous goods.



Figure 2. Pallets with dangerous goods after loading into a container

The applicable training topics and other related details are presented in IMDG Chapter 1.3 and 1.4, as well as in ADR and RID regulations. Employees performing the following activities should undergo mandatory training:

- rolling and maneuvering containers with explosives (CTU - Cargo Transport Unit - means a transport container

(universal and tank),

- unloading wagons and trucks from the CTU, unloading and loading the CTU onto the ship: (stevedores, foremen, mechanized equipment operators, crane operators),
- removal of impurities and spilled residues of class 1 hazardous materials in the event of CTU damage,
- repair of damaged packaging with the consent and supervision of an expert.

In addition, all supervision employees should be trained, i.e. the manager of the organizational unit responsible for the operation, health and safety service, quay owner - cargo handling coordinator, senior foremen, rolling stock maneuver manager, representatives of the cargo operator. Such training is aimed at acquainting employees with the applicable regulations, proper preparation for proper conduct in the event of emergency situations and mastering the ability to recognize threats posed by dangerous goods [14]. The following form of training is adopted, depending on the scope of responsibilities and duties of the person concerned. Employees of the port or container terminal should be familiar with the general requirements contained in the regulations on the transport of dangerous goods - RID, ADR and IMDG. Persons employed in the reloading of dangerous goods should be trained and must be authorized to handle dangerous goods in accordance with applicable regulations, and employees with valid qualifications in this field, confirmed by a training certificate, should be assigned.

Transhipment workers (dockers) should complete training in handling hazardous materials and fire rules, renewed every 5 years. The scope of the training should include the properties of hazardous materials, rules of safe handling, rules of conduct in emergency situations, rules of fire protection. Duration of training, including the exam, approx. 16 teaching hours (x45 minutes). Supervisors should complete the training as above, with particular emphasis on the knowledge of the current Instruction ... on the rules of handling dangerous goods in a sea port, renewed every 3 years. The training plan is approved by the plant manager or a person authorized by him. Regardless of the training, employees should read the current manual on the principles of handling dangerous goods. The training referred to above may be organized by the workplace, with the participation of specialists from outside the workplace as lecturers, if necessary, or its organization may be commissioned to an authorized external entity in this regard. The training should end with an exam. The certificates remain in the personal files of each employee subject to training. Each time before starting activities related to the handling of hazardous materials, employees should go through the so-called workplace training covering topics related to work with hazardous materials. The training should be conducted by an expert with the participation of health and safety services of seaports.

The largest of them are transported by sea, and a particular challenge in this respect is the introduction of such cargo on board a ship or barge. (Fig.3).



Figure 3. Ship at the port quay prepared to load explosives

Securing workplaces related to the technological process consists, among others, in the appropriate marking of the reloading stand and its equipment with:

1) technological equipment for reloading - as needed;
2) handheld firefighting equipment - as needed;
3) signs prohibiting the entry and presence of unauthorized persons;
4) warning and prohibition signs. Signs and plates appropriate for reloaded containers with dangerous goods should be placed at all entrances and approaches to the reloading berth at a distance that determines the protection zone (Fig. 4);
5) information boards should be placed in a visible place, designated by the Terminal Manager;
6) other protection - as needed;
7) first aid measures - according to the Material Safety Data Sheet;
8) Material Safety Data Sheet.



Figure 4. Rail transport with containers with explosives and fire protection at the loading bay

4 The use of drones in surveillance

Drone technologies - a tool used by both attackers and security - can have a major impact on the environment of seaports. Drones using artificial intelligence algorithms and traditional tracking algorithms represent new promising opportunities for ports. Usually a very large area has to be monitored in ports. Automatic and quick dispatch of the drone to the scene of the incident allows for visual verification and is also a deterrent.As a result, you can not only react to incidents faster, but also better manage ongoing operating costs. Thanks to the new ability to link alerts based on geospatial data with drone tracking equipped with video cameras, ports will be able to create surveillance routes and react faster to events verified by the drone control. In this way, ports will also be able to manage day-to-day operational costs, including security guards, security vehicles, training, fuel, etc. Despite these prospects, drone-based detection and defense is still a growing market. Currently, drones can be used for video surveillance in patrolling and automatic incident response, but the problems with the automatic charging of devices' batteries and the type of their housings are still not fully resolved. Autonomous control legislation is also evolving as a limiting factor in the implementation of fully automated systems. Already today, thanks to innovations in camera technology and the use of artificial intelligence in analytics, ports are getting more and more perfect surveillance solutions. In the future, as artificial intelligence develops in the context of the video surveillance system and the use of drones for surveillance,

the possibilities will become even greater. Port terminal operators will have more proactive solutions at their disposal, offering more effective and efficient monitoring. Operators of quayside cranes and other reloading and transport equipment of containers with hazardous materials occupy their workplaces and carry out reloading activities (Fig. 5).



Figure 5. Ship at the port quay and containers with explosives

Advisors for the safety of the transport of dangerous goods IMDG / RID / AD:

a) supervise the transport of dangerous goods by rail or road before entering the terminal, and in the area of sea ports and port container terminals (Fig. 6);

b) supervise the securing of reloading works at the quay;

c) supervise reloading works, stowage and securing of cargo;

d) they decide on the method of handling damaged, leaky containers.

It should be assumed and recognized that the reloading operation of dangerous goods in a port is one of the elements of the transport chain, which begins at the producer of the dangerous goods through intra-factory transport, and then by road or rail (in accordance with ADR and RID regulations) to the place of transfer to the ship. Due to the fact that the reloading operation in a designated place - in the area of sea ports is associated with the temporary collection of dangerous goods, it is necessary to define safety zones for important elements of the port infrastructure and its surroundings [15]. Already today, thanks to innovations in camera technology and the use of artificial intelligence in analytics, ports are getting more and more perfect surveillance solutions. In the future, as artificial intelligence develops in the context of the video surveillance system and the use of drones for surveillance, the possibilities will become even greater. Port terminal operators will have more proactive solutions at their disposal, offering more effective and efficient monitoring. Among the many advanced technologies used in video surveillance, manufacturers pay special attention to artificial intelligence and innovations in video analytics. They are considered key, among others in monitoring facilities such as a port container terminal. The use of artificial intelligence algorithms in cameras allows more effective monitoring of the so-called port soft events. These are incidents that do not result, for example, in a burglary, but relate to suspicious activities that may indicate a real threat, vandalism or other form of security breach. As a result of the development of intelligent algorithms for tracking moving objects, which will provide faster and more detailed searches of recorded video and data from other security sensors, investigative processes can be improved and the right information can be found more efficiently. The combination of artificial intelligence, machine learning and video analytics technologies is one of the most desirable features of surveillance systems - proactivity. The ability to recognize unusual or suspicious behavior before an incident occurs is crucial for the security of facilities. Machine learning and artificial intelligence offer some of the most promising improvements in transport, especially at airports and ports. They make applications like facial recognition more accurate. They also make it easier to identify anomalies that may indicate a security risk in environments where traditional analytics cannot cope with the



Figure 6. Marking of containers with explosives

complexity of the scene. The ability to detect and eliminate a threat can save lives and property in an environment with so many critical features. The development of deep learning and CNN (convolutional neural networks) and their contribution to improving the performance of video analytics is a very promising prospect for an environment such as port container terminals. The following algorithms should be indicated in this area:

- number plate recognition (LPR) and optical character recognition to control the movement of vehicles and containers entering, leaving and remaining in a given area,
- related to tracking various objects in motion: forklifts, trucks, cranes or containers,
- facial recognition and people counting applicable in cruise ship ports.

5 Cloud and edge computing solutions support the surveillance of the port area

Data processing in network edge devices (edge computing) and management in the cloud can play a key role in video surveillance of seaports due to the ease of maintenance of the system and low cost of its construction. The port container terminal is a vast space requiring a large number of cameras monitoring its entire area. Edge computing and the cloud can help the security of security operators to manage their systems more effectively. Without edge processing, the central management system would become overloaded. Moreover, due to the large area to be covered, cameras are usually installed in hard-to-reach places. Cloud-based management can greatly facilitate system maintenance and reduce its costs. Port container terminals are an operationally sensitive environment and unique in terms of daily security procedures. It is therefore imperative to implement an effective and thoughtful response plan that will help operators in the surveillance center to pre-define, coordinate and manage emergency responses in real time, as well as effectively manage routine security operations due to the structure. In addition, there is a lot of traffic, both for employees and visitors to the facility. Therefore, ports invest heavily in safety and security systems, including video surveillance and video analytics, intrusion and robbery, access control, sonar and radar, automatic identification and GPS. The use of drones is also increasing. When such a multitude of different systems is operational, it is a challenge and an opportunity to integrate them in a way that provides a common operational view, used by operators to proactively monitor, manage and ensure security of the port container terminal, people, ships and cargo. A centralized management platform for all elements of the security system can not only significantly reduce security risks and improve incident management, but also increase operational efficiency. Integration is a priority for the security operator in the port container terminal. Current installations often require the use of multiple cameras and additional security equipment to ensure comprehensive protection of the facility. Many container terminals are already

planning to expand the system, introducing the latest solutions so that they can operate efficiently and effectively. Security managers are looking for vendors that implement open platform designs that enable technology and systems to work together seamlessly [10].

6 Principles of risk prevention

In the issues discussed in the article, the elements related to the prevention of threats related to the transport of dangerous goods are mentioned. In the event of a breakdown or disaster resulting from an accident, there is a real threat to people and the environment. The required method of packing dangerous goods and the requirements for segregating these materials when packing a container, depending on the assigned compliance groups, are presented in the table - point 7.2.7.2.1.4 of the IMDG Code [13]. The risk of explosion during handling operations for dangerous goods exists when the requirements for correct and safe handling are not observed. Since it is not expected to store dangerous goods in bulk, containerization is also a factor increasing safety by some kind of isolation of the explosive from external stimuli that may initiate an uncontrolled explosion process, and the segregation of dangerous goods and requirements for safe handling specified in the IMDG Code ensure a high degree of minimization such risk. Nevertheless, one should take into account the fact that in the event of unfavorable technical and technological conditions, such threats may occur as a result of human errors as well as intended human activity. Therefore, it is important to have prepared procedures for dealing with all interested parties involved in the process of reloading and handling of dangerous goods in this circumstance. All loading, unloading and transhipment operations relate to all packaging and dangerous goods, including the entry (and subsequent removal) of any container, overpack, tank-container or portable tank on the vehicle. Checks prior to loading and transport of dangerous goods must be carried out in all circumstances [17]. The minister responsible for transport is responsible for the supervision of the transport of dangerous goods and of the units performing the tasks related to this transport. (except for the transport of dangerous goods by means of transport belonging to the armed forces - where the supervision is exercised by the Minister of National Defense). As part of the supervision, the minister responsible for transport in particular checks the correctness of:

- actions taken by inspection services (Road Transport Inspection);
- performing tasks by the Director of TDT in the following areas:
  - keeping records of advisers,
  - keeping records of entities conducting courses for advisers,
  - issuing an advisor's certificate and an ADR vehicle approval certificate;
  - activities performed by the voivodship marshal in the scope of issuing ADR certificates [16].

Knowledge of the regulations and good organization of transport ensure safety transport of dangerous goods. First of all, it is necessary to qualify the transported material to one of the separate classes of dangerous goods. In this way, it is possible to determine the correct handling of the goods during their movement and use appropriate means of transport. The analysis of failures and catastrophes during the transport of dangerous goods in Poland and more famous foreign disasters shows that they most often determine the threats and their causes are:

- non-compliant with the requirements of the ADR Agreement / RID Regulations / ADN Agreement / IMDG Maritime Code, types and types of packaging, loading units, means of transport,
- inadequate technical condition of packaging and loading units, which, due to excessive wear and damage, does not ensure tightness and allows the cargo to escape into the atmosphere,
- technical condition of the wagon or railway track not in accordance with the requirements, which may lead to a catastrophe, damage to the packaging or transport vessel, and thus the release of the transported cargo,
- inadequate equipment of reloading points, poor technical condition of infrastructure and reloading devices,
- man-made road collisions and rail accidents,
- lack of theoretical and practical preparation for carrying out transport activities with dangerous goods in individual links of the transport chain,
- improper organization or technology of transporting dangerous goods.

7 Conclusion

Conducted checking tests to develop a methodology for solving problems in raising issues, i.e. it is procedural with the prevention of threats during the transport of explosives. Thanks to decisions for ports and the involvement of security structures in all TV projects currently implemented by these programs, the latest technology of the 21st century, thanks to which we learned about the projects and facilities of port container terminals. Focusing on innovation and modern technologies is also a priority for the army and companies operating in the international arena of the economy. Global and European business directs its activities and investments where it is always safe.

Global container terminal operators must also reckon with rationalization and reorganization, also taking place in other areas of the transport chain, with a direct impact on their activities. Such a strategy is slow steaming, used by liner shipping companies, which imposes a new operating environment on the terminals. Slow evaporation, bullying in transit, longer release, kidnapping and I don't agree. The issue of scheduling reliability is expected to become even more relevant in the future as line service networks become increasingly tied.

Organization of the process and surety, storage and manipulation of funds, as well as the security of counteracting security with the availability of various service and security.

As a rule, these are positions included in the prevention system on the part of dispatchers, fire brigades, environmental protection inspectors, experts, rescuers and others. The safety factor also focuses on the supervision of other hazardous works in terms of fire, e.g. welding in the area of container storage, with notification of the need to start such works and personal and equipment protection in the event of an emergency. The failure to comply with the regulations on dangerous goods, disregarding threats - most often due to the lack of imagination, lack of sufficient "environmental awareness" - is clearly demonstrated by the results of road and rail transport of dangerous goods, publicized in the media.

The safety of the transport of dangerous goods depends on strict compliance with the requirements contained in the regulations on the organization of fire and environmental safety, alerting in danger, and detailed rules for organizing rescue and firefighting operations and evacuation of people from endangered zones during the organization of the reloading process. The transport of dangerous goods, as practice shows, creates many problems even for qualified practitioners. This is because a number of rules are required to reduce the risk. The monograph presents rules that may be useful for users who, due to their work, are obliged to use, for example, dangerous goods in everyday practice.

The transportation of this group of dangerous goods should follow the technological process. Each dangerous cargo must be accompanied by an accident manual which takes into account the specific characteristics of the cargo or group of loads. It is necessary to provide the fire brigade and rescue teams with convenient access to the reloading sites and access to documentation and instructions for reloading dangerous goods.

In order to minimize the risks associated with the transport of dangerous goods, it is necessary to pay attention to all its elements so that they are performed reliably, efficiently and effectively and in accordance with applicable regulations.

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