

Selected Issues on Transport of Dangerous and Oversize Goods

Dmytro Bugayko

National Aviation University Kiev, Ukraine

Tadeusz Popkowski

The International University of Logistics and Transport in Wrocław, Poland

Abstract: the material contained in this study is a signal of the key issues of transport safety in the area of planning, organization and implementation of the transport of dangerous and oversized cargo. The material was created mainly on the basis of available publications as well as conclusions and opinions of experts. Both in the text and at the end of the article, there are numerous references to source materials and similar (partial) studies on selected issues in the area of organization and management theory. It will allow, among others, students to individually analyse the characteristic cases of this class of transport, constituting in a sense an extended outline of the necessary knowledge allowing the student to prepare for lectures, exercises and laboratories. However, this does not exclude the purposefulness of using specialized (directional) literature items containing scientific foundations analytically describing the logistic processes under consideration.

Keywords: dangerous and oversize cargo, ADR agreement, TN catalogue, risk of a dangerous event

1. INTRODUCTION

The transport of dangerous and oversize goods is one of the most difficult specialties in the transport industry in public transport, in particular in road and rail transport. Such transport is regulated by a number of legal acts that do not apply to companies carrying out tasks related to the transport of loads, the so-called neutral. The main legal act here is the International ADR Agreement¹, which is valid on all continents, supplemented by acts of local law, which in Poland and Ukraine include, inter alia, the Act on the Transport of Dangerous Goods, including the Act on Weapons and Ammunition². Each of these documents introduces appropriate regulations, and additionally, in relation to international transport, it is important whether the potentially transit countries, and even more the destination countries, do not introduce local periodic restrictions applicable to the planned transport route.

Dangerous goods - as it is already clear from the term itself, these are goods which, by the nature of their physical characteristics, chemical composition, dimensions, or other specific features and nature (live animals or fish), for some reason endanger human life or health, the environment natural or general

¹ ADR – (fr. L' Accord européen relatif au transport international des marchandises Dangereuses par Route) the agreement drawn up in Geneva on September 30, 1957 was prepared and published by the European Committee of Inner Transport, ratified by Poland in 1975.

² Journal of Laws 1999 No.53, item. 549. Journal of Laws · 1999 · 53; item 549. The Act of May 21.

order or material goods, including those with the features of the principles of humanitarianism. The United Nations has created a closed TN catalogue, giving everyone a four-digit "UN number", at the same time dividing them into classes depending on the threat or the predominant threat. The provisions of the ADR agreement relate, inter alia, to the rules (requirements) for TN transport in terms of limiting the possible effects of a potential release of hazardous substances (for example as a result of road or rail collisions), as well as, above all, the forms and principles of preventing the occurrence of such events. The set of regulations also applies to the rules for equipping and labelling vehicles, training their crews, as well as other people involved in the implementation of transport, such as forwarders, warehousemen or equipment service³.

Generally, the above-mentioned features, limitations and conditions apply to road transport. Of course, other modes of transport with a significant share in the global transport of goods, including dangerous and oversized goods, are not to be overlooked here. We are talking about air, sea and inland shipping. The specificity of these transports with regard to the nature, specific conditions and rules with regard to safety, requires a separate discussion, also due to the current set of provisions resulting from the law on both maritime and inland navigation and the use of airspace in relation to cargo transport. This is especially important for international (intercontinental) transport due to the restrictions on air space and territorial waters.

The organization of the transport of hazardous materials requires a comprehensive view of the vehicle, packaging and cargo (means of transport and packaging should be adapted to the transported goods) as well as in relation to the people involved in the preparation of transport⁴. Incorrect handling of dangerous goods during storage or transport poses a risk of disturbing the balance of the functioning of living organisms (including death of humans and animals), as well as a serious threat to the environment.

The development of the existing as well as the emergence of new production branches is naturally associated with an increase in the demand for transport services, including the transport of goods included in the group of dangerous goods. The transport of dangerous goods in accordance with safety regulations and standards includes a guarantee of minimizing the risks resulting from the transport itself, as well as its effectiveness.

2. DANGEROUS AND OVERSIZE GOODS IN ROAD AND RAIL TRANSPORT

In road transport, there are three basic methods of transporting dangerous goods: in tankers, in packages and in bulk. Each method has its own requirements⁵. And so:

- transport of the shipment in pieces - each piece of goods should be marked with a warning label and UN number, and in the case of explosive goods with a label with the name of the material contained in the package. If the goods present several different hazards, separate labels indicate toxicity, corrosivity and flammability. Transport in pieces may be carried out using crates, containers, on platforms or vehicles with a specially adapted body,

³ Popkowski T., *Transport ładunków niebezpiecznych i ponadnormatywnych*, Library of the International University of Logistics and Transport in Wrocław, Publishing House Atut, Wrocław 2021.

⁴ Rogalski G., Pyza D., *Organizacja przewozów towarów niebezpiecznych w transporcie drogowym*, „Prace Naukowe Politechniki Warszawskiej. Transport”, 120 (2018), pp. 341-350.

⁵ Zielińska S., Zelent S., *ADR 2007–2009. Transport samochodowy towarów niebezpiecznych*, Ośrodek Doradztwa i Doskonalenia Kadr, Gdańsk 2008.

- transport in bulk without packaging - it is carried out using box vehicles or containers (dedicated to low-risk vehicles),
- transport in tanks - each tank has a so-called tank code, i.e., requirements that must be met for the transport of a specific load, e.g., type of vehicle, degree of tank filling, appropriate marking.

Pursuant to the regulations in force, transport with hazardous material should take place, if possible, on roads with good surface and low traffic, avoiding roads running in the vicinity of active leisure and sports centres, and avoiding built-up areas of cities, in particular streets located in the city centre. When planning the transport of hazardous materials, parking should be avoided as much as possible, especially in built-up areas. The transport of certain materials is subject to notification to the competent commander of the Provincial Police and the State Fire Service. Certain types of materials also require the permission of the local Police Station or the Police Station and the Commander of the State Border Guard for loading and unloading. In the case of domestic transport, this declaration must be made at least 5 days prior to the commencement of transport. The obligation to notify rests with the carrier (if it is a domestic company) or the sender (if he orders the service to a foreign entity). If, on the other hand, the transport begins abroad, the notification is made by the competent control office of the Border Guard before issuing the permit to enter the territory of Poland. The effect of this notification is not only the approval of transport, but also the determination of the route of transport. Packaging as well as vehicles transporting hazardous materials should contain appropriate markings indicating the individual materials, as well as the corresponding UN numbers (four-digit number identifying the substances). If a given product poses several different hazards, the three most important ones should be indicated by stickers, e.g., toxicity, corrosivity, flammability. For collective packaging and packaging with a large capacity of more than 450 liters, labels shall be placed on both sides of the packaging. The collective packaging should contain all labels and UN numbers of the goods contained inside. Vehicles or vehicle combinations transporting dangerous goods by road must be marked with rectangular orange-coloured plates at the front and rear, vertically / perpendicular to the vehicle axis⁶. At the top of the plate is the hazard identification number, consisting of two or three digits, e.g. (223, 48, X323). The numbers preceded by the letter X mean that the transported substance reacts dangerously with water and should not be used to extinguish a fire. The most common number 33 on warning boards indicates a very strong and dangerous concentration of the easily or pyrophoric liquid (gases) being transported. The lower figure represents the number under which the substance is classified in the UN Catalogue of Hazardous Materials. A vehicle transporting dangerous goods in bulk, in a container or in a tanker is marked at the front and rear with plates without numbers. At the same time, on the sides it must have plates with numbers appropriate to the transported dangerous goods. When it comes to multi-compartment tanks, such plates should be placed on both sides of each compartment with the number assigned to a given hazardous substance. The essence of such marking is the standardization of the hazard identification process, thus facilitating and streamlining control in each country that has adopted the ADR convention in its legal regulations.

Contrary to road transport, rail transport does not have most of the restrictions as for vehicles carrying out oversized transport. For this reason, many shipping companies choose railroads as a form of carrying out this type of logistics operations. An oversized cargo is one that exceeds the standard weight or dimension. In the case of rolling stock, the key parameters are the maximum payload of the wagon and the permissible load on the axle of the wagon or a running meter of rail. Appropriate load limits have been developed for individual speeds and classes of lines. At the same time, it is necessary to take into account the maximum heights of transported loads due to the height of the railway traction. Nevertheless, properly planned rail

⁶ The exception is the small amount of cargo in vehicle transporting individual shipments.

transport does not encounter most of the obstacles typical of large-size transports as in road traffic, which is why it is eagerly chosen by business customers.

Despite a number of structural changes in the national and European economy, rail transport is still one of the key sectors in the entire freight transport system. It mainly concerns the transport of fuels, raw materials and industrial materials. Due to the speed of delivery, the ease of organizing the forwarding process or the ability to transport many thousands of tons of cargo, rail is one of the most-chosen means in modern logistics. The planning of deliveries and their implementation are favoured by a fairly extensive network of railway connections, both in Poland and in Ukraine, and the speed of transport performed in this way. Moreover, rail is one of the safest and least accidental forms of modern freight forwarding, hence the relatively high interest of entities from many sectors in this form of cargo transport.

3. TRANSPORT OF DANGEROUS AND OVERSIZED GOODS BY WATER

Waterway transport offers many more possibilities for the transport of special loads. Sea transport is one of the forms of water navigation consisting in the delivery of goods using the waterways of the seas and oceans. It is based on a specially adapted fleet, e.g. general cargo, bulk carriers or container ships. In road transport, oversize cargo is also said when its weight exceeds the permissible axle loads of the vehicle. These restrictions do not apply to the standards in force in maritime transport, because in practice, oversize loads are only those whose dimensions are several dozen or even several hundred meters, and the weight is from several hundred to several dozen thousand tons, and they are transported in specially designed units.

The development of world trade meant that many enterprises, in order to reduce costs, moved their production areas to distant regions of the world. Moving cargo with parameters exceeding the capabilities of traditional means of transport is gaining more and more economic importance. The largest of them are transported by sea, and the only particular challenge in this respect is the introduction of such cargo on board a ship or barge.

A separate branch of shipping is passenger transport, focusing on the transport of people and goods within the broadly understood tourist traffic. This does not apply to that extent to inland and coastal shipping⁷. For example, in the region of South-East Asian countries, coastal and inland navigation is still the basic means of passenger transport, but also freight, supported, if possible, by short-range air transport (mainly in countries with territories spread over many islands).

In sea transport, special cargo is referred to when it is to be transported in a sea container, ro-ro ship or special ship. Heavy loads are loads with a large unladen weight. This type of cargo includes: heavy working machines for construction and road construction, tanks and mobile guns for the defense industry and the army, segments of wind towers, industrial machines, boats, ships in parts (ship sections, superstructures, hatch covers, etc.), railway carriages, trams. The weight of this type of cargo, transported by road or rail, generally does not exceed the range from 70 to even 100 tons. In the case of transport by water (by sea), heavy goods are considered to be those whose volume is less than 1 m³ per tonne.

⁷ Byvetro2018 in Blog Posted November 12.

Poland has favourable natural conditions for river transport, but statistics show that inland navigation is used minimally in relation to the existing potential. Cargo transportation by river routes accounts for only 0.3 percent of the total land transport in Poland⁸.

Our country is characterized by a relatively high waterway network density index compared to other European countries. In 2016, there were 11.7 km of navigable routes per 1000 km². For comparison, the EU average is 9.3 km / 1000 km². Only 6 countries have a higher density index: the Netherlands (150.7 km), Belgium (49.7 km), Finland (24.0 km), Germany (21.5 km), Hungary (20.0 km) and Luxembourg (14.3 km).

It is also important that although the network of waterways in Poland is 3,654 km long, most of their standard is not adapted to the requirements of modern navigation. Only 6 percent. waterways of international importance, allows for the navigation of ships with a tonnage over 1000 tons, which is a total of just over 214 km.

It is also not good when it comes to the fleet sailing on Polish rivers. And although in recent years the quantity of towing fleet (the number of pushers and tugs) of inland navigation has gradually increased, they are practically worn out⁹.

Inland navigation is currently used mainly in servicing seaports and ensuring their connection with the hinterland. In 2017, approx. 1.5 million tonnes of cargo were transported as part of servicing Polish seaports, which in total accounts for approx. 26% of all cargo transported in total by inland waterway. Admittedly, in 2017, regular coal transport from Gliwice to the CHP plant in Wrocław was launched, unfortunately for a short time. Transport of approx. 120 thousand tonnes of coal is a significant share in the overall transport balance along the upper canalised section of the Odra River. Unfortunately, this positive trend does not apply to the following years, mainly as a result of unfavourable hydrotechnical conditions caused by widespread drought, but also significantly deteriorating technical condition of vessels and hydrotechnical devices.

Climate changes, taking place particularly intensively in recent years, have an impact on the navigability of sections of water courses, and more and more often in relation to entire routes that were once used very intensively. The periodic low water level, resulting from the commonly noticeable drought, practically periodically completely prevents the navigation of vessels with even a slight draft.

4. AIR FORWARDING

Each decision regarding the indication of a specific type of transport requires a thorough analysis in terms of the principles and feasibility of this project, taking into account the amount and type of cargo, its sensitivity to external factors, implementation time and, of course, costs. It is one of the most expensive forms of transporting goods, but it has many advantages and is irreplaceable in many situations. It is also one of the most dynamically developing modes of transport.

An increasing number of entrepreneurs successfully send their goods to various parts of the world using air transport. Of course, this is often associated with expensive investments, but the requirements of the modern market in terms of effective delivery of shipments mean that air freight may be the optimal, and sometimes the only solution. First of all, airplanes make it possible to reach places that cannot be

⁸ From the CSO report "Inland navigation in Poland in 2014-2017".

⁹ The data from the Central Statistical Office show that in 2017, compared to 2014, the number of pushers and tugs increased by 5.8%.

reached by other means of transport or such a journey would take a relatively long time. This problem is especially current when it comes to Ukraine, and relatively, for natural reasons, less so when it comes to Poland, of course in the context of internal transport.

The undeniable advantage of air transport is the possibility of transporting various types of goods. Thanks to specialized aircraft, air transport creates virtually unlimited possibilities with regard to the range of cargo transported. Undoubtedly, the main advantage of air transport is the speed of movement, especially important in the case of transporting goods such as medicines, fresh fruit and the like, especially in relation to intercontinental transport, for example.

In every field, including aviation, safety is the basic criterion determining the dynamics of changes. Air transport is now considered a safe mode of transport. The service life of the machines is also a significant advantage. If properly used and serviced, airplanes can be used for several hours a day, maintaining efficiency for up to 30 years.

Air transport, like any branch of transport, is not without its drawbacks. Here, the relatively high cost is definitely in the first place, which is the resultant of the purchase and maintenance costs of aircraft, as well as the operation of airport infrastructure. The significant dependence of air transport on the weather and natural disasters is not without significance. In extreme cases (such as a volcanic eruption), planes can be grounded for up to a considerable period of time.

A significant limitation is usually the low availability of airports, which in principle causes the need to use a second means of transport in an intermodal system, which generates additional costs, extends the time of delivery to the destination, and increases the risk of damage or even loss of part of the cargo during transshipment (e.g., from a truck to special containers).

Modern transport aircraft, depending on the type, have a transport capacity of up to 250 tons of cargo. It should also be remembered that the payload of the aircraft is variable and depends, inter alia, on the distance it can travel without refuelling, as well as the airport's ability to receive and take off the aircraft determined by the length of the runway. An important, natural limitation is the structure of the aircraft, which determines the possibility of loading goods with strictly defined parameters in relation to weight and dimensions.

The natural method of transporting goods is to create the so-called loading units with the use of containers and pallets, which significantly facilitates reloading and cargo handling. To improve the safety of loads, especially when handling pallets, but also for aesthetic reasons and protection against the effects of weather conditions, goods transported on light pallets are usually additionally covered with foil or special nets.

5. THE RISK OF DANGEROUS INCIDENT OCCURRENCE IN TRANSPORT

Each business activity is burdened with a certain risk, and the process of reducing its impact on the functioning of the entity is related to its management. Appropriate risk management is also an important tool in transport activities. Events that may occur during transport, e.g. by road, may have a tragic effect not only for the person in charge of a given means of transport, but also for other people and the natural environment.

Risk management is of particular importance in the case of the transport of dangerous and oversized goods. We are systematically observing a growing demand for transport services, also when it comes to dangerous

goods, mainly liquid fuels. These transports are associated with a high risk of adverse events, reaching over 80% of all incidents in land (mainly road), air and water traffic - both sea and inland. In order to minimize the likelihood of such events occurring, transport companies systematically implement various methods and tools. This form of transport brings so many arguments "for" and "against". On the one hand, the use of road transport allows for quick and possibly efficient movement of cargo, and most importantly - it enables direct transport from the sender to the recipient. On the other hand, fuels are most often transported on the main national roads and highways, which is usually accompanied by heavy traffic. The risk related to transport in such conditions necessitates proper organization in terms of safety. The aforementioned ADR agreement (The European Agreement concerning the International Carriage of Dangerous Goods by Road) essentially meets these activities as the basic normative act that was implemented in Poland under the Act on Road Transport of Dangerous Goods¹⁰. In addition, these provisions were established by the relevant ordinance of the Minister of Infrastructure, as well as by the Road Transport Act of September 6, 2001 and the Road Traffic Law of June 20, 1997 together with the ordinances of the Minister of Infrastructure on road signs and signals for vehicles carrying dangerous goods¹¹. Another regulation of August 18, 2003 deals with restrictions and temporary traffic bans for certain vehicles on public roads. From January 1, 2003, every entity dealing in any way with activities related to the handling of dangerous goods has been obliged to cooperate with Dangerous Goods Safety Advisers (DGSA).

Even with full compliance with the rules for the transport of dangerous goods and absolute compliance with these rules on the part of the personnel directly responsible for the entire process of such transport from loading to unloading at the destination, there is always a certain margin of random event, including one caused by unconscious action resulting from the lack of sufficient knowledge and skills.

The most common causes of the risk related to the transport of dangerous goods include:

- use of means of transport, loading units or packaging not compliant with RID requirements¹²,
- poor technical condition of means of transport, loading units or packaging,
- application of improper methods of loading and securing goods on the freight wagons,
- poor technical condition of the reloading infrastructure, inadequate equipment of points reloading,
- improper organization or technology of transporting dangerous goods,
- lack of adequate theoretical and practical preparation of personnel for carrying out transport activities with dangerous goods,
- failures and random or human error events.

Table 4.1 presents exemplary data of the General Road Transport Inspectorate from inspections carried out on the territory of Poland for the years 2006-2009¹³. The analysis of partial data for the following years shows that these indicators are all the more worrying.

¹⁰ Act of 19 August 2011 (Journal of Laws No. 199, item 1671).

¹¹ Regulation of the Minister of Infrastructure of July 31, 2002.

¹² Regulations C to the Convention on International Carriage by Rail (COTIF) - Appendix 2.

¹³ Applies to domestic, Union carriers and carriers from outside the European Union.

Table 4.1. Lists of infringements of the provisions on the carriage of dangerous goods by road, ranked by category

Pos.	The Category of the discovered ADR rules breach	The number of infringements that have occurred in each year			
		2006	2007	2008	2009
K1	Incomplete documentation	1084	915	540	771
K2	Improper technical condition of the means of transport or of the loading unit	53	32	25	25
K3	Improper conditions for the cargo transportation	194	75	93	95
K4	Improper marking of the of the means of transport or of the loading unit (pieces, shipment)	369	187	167	150
K5	Lack of the required protective equipment	818	580	706	693
K6	Exceeding external measurements or improper lashing of the load	57	47	31	38
K7	Not following the ban on smoking while loading	0	0	0	0
K8	Carriage of passengers	26	9	6	6
SUM		1601	1845	1568	1778

Source: Data of the General Road Transport Inspectorate for the years 2006 - 2009¹⁴

The above data should be additionally provided with a common denominator including the impact of the human factor. Therefore, the current research work is aimed at identifying universal models, also taking into account the human factor to the foreseeable extent possible.

Failure to comply with elementary rules, as well as typical negligence, can be, and unfortunately is often the cause of serious accidents. Only adequate knowledge and awareness of potential threats can protect both people and the environment from the effects of these events.

Effective enforcement of compliance with the requirements and regulations contained in legal acts concerning the conditions of transport and reloading of hazardous materials is an important factor in reducing the number of accidents to a minimum. Of course, a separate problem is the possibility of random causes (temperature changes, lightning, heavy rainfall, violent storms). However, the possibility of predicting such phenomena with some advance is possible a chance to undertake specific preventive actions, which, if not eliminated, will at least significantly reduce the effects of such phenomena. Currently, the market offers many solutions, also for multiple use, and at the same time not requiring excessive interference in the basic structure of both the means of transport and the transported cargo.

The current transport market is often a complex supply chain, the purpose of which is to ensure comprehensive delivery from producer to consumer at times and under sometimes extreme conditions. This makes it necessary to constantly update and expand the professional qualifications of all personnel handling such a process. For this purpose, numerous trainings are organized with the participation of experts in the field of transport, including the transport of dangerous goods, road traffic law, as well as providing help and behaviour in the event of an accident. These trainings mainly concern ADR regulations - in the field of road transport, but also the storage and labelling of hazardous materials. More and more often we encounter the organization of the supply chain using modal transport, based on two or more modes of transport. Thus, knowledge of the current regulations and rules for classifying, packing, labelling, storing, loading and unloading, and transporting,

¹⁴ Popkowski T., *Transport ładunków niebezpiecznych i ponadnormatywnych...* op. cit., p. 159.

above all, hazardous materials, taking into account the specificity of road, rail, sea and air transport, becomes a natural requirement in the transport industry. Specialized training centres today have an offer that keeps up with the dynamics of changes in the regulations in force both in the country and in the European Union and non-EU countries, such as Ukraine.

5.1 IDENTIFICATION OF THREATS AND ASSESSMENT OF THE RISK OF ADVERSE EVENTS RESULTING FROM ROAD TRANSPORT OF HAZARDOUS MATERIALS

In the group of materials classified as dangerous, we distinguish some as posing the greatest risk during transport and requiring special conditions to reduce the risk of a hazard to people and the environment. These materials include:

- explosive materials and articles constituting approx. 1% of the mass of transported goods,
- flammable liquids (approx. 66% of the mass of transported goods),
- gases (more than 24% by weight of goods transported),
- poisonous materials (approx. 0.3% of the mass of transported goods),
- infectious substances (approx. 0.23% of the mass of transported goods).

The transport of this type of material is subject to separate regulations specifying the requirements for compliance with special procedures, including the appropriate marking of the transported materials, the vehicle transporting these materials, including its equipment and design features.

The basic division of hazardous materials used in practical assessment distinguishes three groups, i.e.:

- materials not accepted for transport - materials that create special, impossible
- to eliminate the risk and therefore are not allowed for transport,
- approved for transport in accordance with ADR,
- exempt from ADR - exempt from ADR regulations due to low risk the transported goods create for people and the environment.

The basic means of transport are cisterns (approx. 79%), shipments in pieces (approx. 20%) and in bulk (approx. 1%). These are, among others: fuels, gases and waste. About 58% of them are transported by road, 25% by rail and 17% by inland waterways. These relationships are only indicative values, which may undergo certain periodic changes as a function of many factors related to the dynamics both in the area of production and consumption preferences.

The presented characteristics and division of hazardous materials relates directly to the chemical and physical properties of these materials. The safety of the entire process of transporting hazardous materials depends on many external and organizational factors, such as:

- packaging of hazardous materials,
- marking of packages,
- correct preparation of shipping documents.

An equally important impact on the safety of the entire transport process is the systematic process of training drivers, resulting from current needs, taking into account the knowledge of the procedure and handling activities in emergency situations.

About 100 million tons¹⁵ of hazardous materials are transported by road in Poland annually. In the case of Ukraine, these values are difficult to estimate, but the available data show that these values are much higher. This type of transport is dominated by liquid fuels (nearly 70%), transported by tankers. Acids and hydroxides as well as liquefied gases - propane-butane, chlorine and ammonia - constitute approx. 19% of all transported goods.

The number of transports of hazardous materials by road is constantly increasing. For a long time (the Covid-19 pandemic), it has been difficult to clearly assess and forecast both the volumes and the relationships in terms of shipments, including the structure of loads. The world economy is, in a sense, a system of connected vessels, into which the economic system of Poland and Ukraine is naturally integrated.

Each entity involved in the transport of dangerous goods, preparation of goods for transport, and loading or unloading should appoint at least one safety advisor, who is responsible for checking compliance with ADR regulations in a given company and controlling the company's operations in terms of the correctness of the implementation of tasks related to dangerous goods. This obligation includes, inter alia, checking the adaptation of the vehicle to the transport of goods (e.g. required equipment), as well as conducting training of the company's employees in the scope covering the overall issues of transporting dangerous goods, their loading, unloading and storage. A separate department within the competence of a safety advisor is undertaking rescue actions in the event of an accident related to the transport of dangerous goods.

The responsibilities of the carrier, including the driver driving the vehicle and the organizer, include careful keeping of the shipping documentation. The provisions on the rules for dealing with dangerous goods in transport and storage are universal and to a large extent apply to all basic modes of transport, of course with the specificity resulting from the limitations that are specific, in particular with regard to air and rail transport.

6. CONCLUSIONS

The intention of the authors of this article was basically limited to gathering the most important information and opinions possible in the field of transport, including mainly the rules and obligations of the organizers of oversize and dangerous cargo transport. The information provided here should be an index to source materials constituting formal and legal material as the basis for taking practical steps towards the organization and implementation of such transports. The dynamics of changes in the field of logistics is subject to conditions resulting from global cultural trends, market requirements, consumption levels and particularly intense climate changes¹⁶.

Currently, the logistics departments of production and commercial enterprises, as well as companies providing logistics services outside, are increasingly integrating their activities mainly through the use of information technology. IT becomes a natural element of supporting the implementation of logistics processes as components of an integrated market structure. It is a natural necessity that allows you to take full advantage of all the possibilities offered by the modern logistics concept.

Training of drivers, tram drivers, train drivers and operators of equipment used, for example, when loading or moving dangerous goods, including oversized cargo, is one of the basic factors reducing the likelihood of undesirable events. Lack of awareness and basic knowledge in this field is usually the main cause of the

¹⁵ Abbreviation "m t" – tonne-kilometres.

¹⁶ Popkowski T., *Transport ładunków niebezpiecznych i ponadnormatywnych...* op. cit., p. 163

occurrence of events, the effects of which may have the nature of material losses, environmental contamination, and - most importantly - threats to human health and life. However, it should be remembered about the specificity of the provisions in force for individual modes of transport, as well as the regulations defined by the above-mentioned provisions of national law, not always clearly consistent with the provisions of the ADR agreement.

Functioning in the conditions of global competition, also associated with the naturally forced shortening of the life of the market offer (product, service), it is necessary to launch mechanisms allowing for the parallel implementation of effective changes in the field of technical equipment, as well as economic conditions and organization and management technologies, under the common name broadly defined as logistics, including transport logistics. This is particularly important in international (intercontinental) transport due to restrictions, including those relating to air space and territorial waters.

The data and summaries underlying the analyses and comparisons carried out by the authors of the article are often purely statistical in nature, which, unfortunately, is also the result of a special situation in the global economy caused by the COVID-19 pandemic, but they are certainly a reflection of the general characteristic trends for transport issues, including the transport of dangerous goods.

REFERENCES

- [1] Drewek W., *Charakterystyka przedsięwzięć związanych z organizacją transportu materiałów niebezpiecznych w ruchu samochodowym*, "Logistyka", (2010)/6, CD.
- [2] *Drogowy przewóz towarów niebezpiecznych. Poradnik dla strażaków OSP*, Szkoła Aspirantów PSP, Kraków 2005.
- [3] Grzegorzczak K., Hancyk B., Buchcar R., *Towary niebezpieczne w transporcie drogowym ADR 2007–2009*, Wydawnictwo Buch-Car, Błonie 2011.
- [4] Grzegorzczak K., Buchcar R., *Przewóz towarów niebezpiecznych ADR 2019*. Wydawnictwo ADR Buch-Car, Błonie 2019.
- [5] Kociotek K. T., *Drogowy przewóz towarów niebezpiecznych*, Tarbonus, Warszawa 2010.
- [6] Kokociński M., *Praktyczne aspekty stosowania ADR w przewozie towarów niebezpiecznych*, SPH Credo, Piła 2009.
- [7] Kukulska M., *Transport drogowy towarów niebezpiecznych ze szczególnym uwzględnieniem paliw płynnych. Materiały dydaktyczne dla nauczycieli. Wyższa Szkoła Logistyki. Materiały Studiów Podyplomowych „Logistyka dla nauczycieli”*, Poznań 2012.
- [8] Mazurkiewicz A., *Transport drogowy towarów niebezpiecznych, zagrożenia i sposoby zabezpieczeń*, "Logistyka", (2008)/2, CD
- [9] Popkowski T., *Transport ładunków niebezpiecznych i ponadwymiarowych*, Biblioteka Międzynarodowej Wyższej Szkoły Logistyki i Transportu we Wrocławiu, Oficyna Wydawnicza Atut, Wrocław 2021
- [10] Pusty T., *Przewóz towarów niebezpiecznych – poradnik kierowcy*, Wydawnictwa Komunikacji i Łączności, Warszawa 2009.
- [11] Rogalski G., Pyza D., *Organizacja przewozów towarów niebezpiecznych w transporcie drogowym*, „Prace Naukowe Politechniki Warszawskiej. Transport”, 120 (2018), pp. 341-350.
- [12] Sadowski J., *Bezpieczeństwo transportu drogowego ładunków niebezpiecznych*, "Logistyka", (2011)/3, pp. 2415-2422, CD.
- [13] Zamiar Z., Bujak A., *Zarys infrastruktury i technologii przewozów podstawowych gałęzi transportu*, Biblioteka Międzynarodowej Wyższej Szkoły Logistyki i Transportu we Wrocławiu, CL Consulting & Logistyka NDiO, Wrocław 2007.

- [14] Zamiar Z., Surowiecki A., *Przykłady szybkich technologii odbudowy infrastruktury transportowej w sytuacjach kryzysowych*, "Logistyka i Transport", 1 (2005)/1, pp. 83-91.
- [15] Zielińska S., Zelent S., *ADR 2007–2009. Transport samochodowy towarów niebezpiecznych*, Ośrodek Doradztwa i Doskonalenia Kadr, Gdańsk 2008.

Dmytro Bugayko
National Aviation University Kiev, Ukraine
bugaiko@nau.edu.ua
ORCID: 0000-0001-9901-4792

Tadeusz Popkowski
International University of Logistics and Transport
in Wrocław, Poland
tpopkowski@mail.mwsl.eu
ORCID: 0000-0003-3825-3428