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International comparison of dangerous goods transport and training schemes

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International Comparison of Dangerous Goods Transport and Training Schemes

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International Comparison of Dangerous Goods
Transport and Training Schemes

FOM Hochschule für Oekonomie & Management
FOM Institut für Logistik- & Dienstleistungsmanagement
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Table of contents

Abbreviations ............................................................................................................................................ IV

1.1 List of Figures .......................................................................................................................................... VI

1.2 List of Tables ............................................................................................................................................. VI

1 Introduction .................................................................................................................................................. 1

1.1 Research interest ...................................................................................................................................... 1

1.2 Objectives ................................................................................................................................................ 2

1.3 Scope of work .......................................................................................................................................... 2

2 Dangerous goods ....................................................................................................................................... 3

2.1 Basics of dangerous goods ..................................................................................................................... 3

2.2 Classification .......................................................................................................................................... 3

2.3 Accidents and their prevention, measurements ....................................................................................... 4

2.4 Accompanying documents ..................................................................................................................... 6

3 Transport of dangerous goods .................................................................................................................. 8

3.1 Involved parties of dangerous goods transports .................................................................................... 8

3.1.1 Sender ................................................................................................................................................. 9

3.1.2 Forwarder ......................................................................................................................................... 9

3.1.3 Carrier and vehicle driver ................................................................................................................. 10

3.2 Transport safety ..................................................................................................................................... 11

3.3 Road transport ....................................................................................................................................... 13

4 ADR ........................................................................................................................................................... 18

4.1 Trans-European Transport Network (TEN) ........................................................................................... 18

4.2 Basics of ADR ...................................................................................................................................... 20

4.3 Adoption and implementation of ADR in different European countries ........................................... 21

4.4 Successful implementations .................................................................................................................. 23

4.5 Problems and challenges with ADR implementation ........................................................................... 24

4.6 SWOT analysis of the ADR guideline .................................................................................................... 25

5 Trainings in line with dangerous goods and compliance of ADR .......................................................... 27
5.1 Current law situation and training opportunities ........................................ 29
5.2 Country-specific regulations and their meaning for training concepts .......... 32
5.3 Sustainability as competitive factor .......................................................... 33
6 Development of a training concept for the successful implementation of ADR and handling of dangerous goods .............................................................. 35
7 Conclusion .................................................................................................... 37
References ......................................................................................................... 39
## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3PL</td>
<td>Third Party Logistics</td>
</tr>
<tr>
<td>ADR</td>
<td>Accord européen relatif au transport international des marchandises Dangereuses par Route - European Agreement concerning the International Carriage of Dangerous Goods by Road</td>
</tr>
<tr>
<td>BAG</td>
<td>Bundesamt für Güterverkehr (Federal office for freight)</td>
</tr>
<tr>
<td>CF</td>
<td>Carbon Footprint</td>
</tr>
<tr>
<td>DG</td>
<td>Dangerous Goods</td>
</tr>
<tr>
<td>ECMT</td>
<td>European Conference of Ministers of Transport</td>
</tr>
<tr>
<td>e.g.</td>
<td>exempli gratia</td>
</tr>
<tr>
<td>GbV</td>
<td>Gefahrgutbeauftragtenverordnung (Dangerous goods officers regulation)</td>
</tr>
<tr>
<td>GGAU</td>
<td>Gefahrgut-Ausnahmeverordnung (Dangerous goods exemption regulation)</td>
</tr>
<tr>
<td>GGBefG</td>
<td>Gefahrgutbeförderungsgesetz (Dangerous goods transportation regulation)</td>
</tr>
<tr>
<td>GGKontrollIV</td>
<td>Verordnung über die Kontrollen von Gefahrguttransporten auf der Straße und in den Unternehmen (Regulation for the control of Dangerous Goods transportation on the street and in companies)</td>
</tr>
<tr>
<td>GGKostV</td>
<td>Kostenverordnung für Maßnahmen bei der Beförderung gefährlicher Güter (Costs ordinance for measures for the transportation of Dangerous Goods)</td>
</tr>
<tr>
<td>GGVSE</td>
<td>Gefahrgutverordnung Straße und Eisenbahn (Dangerous Goods Regulation road and rail)</td>
</tr>
<tr>
<td>GGVSEB</td>
<td>Verordnung über die innerstaatliche und grenzüberschreitende Beförderung gefährlicher Güter auf der Straße, mit Eisenbahnen und auf Binnengewässern (Gefahrgutverordnung Straße, Eisenbahn und Binnenschifffahrt) (Regulation for the intrastate and cross-border transport of Dangerous Goods on street, railroad and inland waterways)</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>GNP</td>
<td>Gross National Product</td>
</tr>
<tr>
<td>HAZMAT</td>
<td>Hazardous materials and items</td>
</tr>
<tr>
<td>ICC</td>
<td>International Chamber of Commerce</td>
</tr>
<tr>
<td>IHK</td>
<td>Industrie- und Handelskammer (Chamber of industry and commerce)</td>
</tr>
<tr>
<td>IMDG code</td>
<td>International Maritime Dangerous Goods Code</td>
</tr>
<tr>
<td>JIT</td>
<td>Just In Time</td>
</tr>
<tr>
<td>POGb</td>
<td>Gefahrgutbeauftragtenprüfungsverordnung (Dangerous Goods Officers Examination Regulation)</td>
</tr>
<tr>
<td>RID</td>
<td>Règlement concernant le transport international ferroviaire de marchandises Dangereuses - regulation concerning the Carriage of Dangerous Goods by Rail</td>
</tr>
<tr>
<td>RSE</td>
<td>Richtlinien zur Durchführung der Gefahrgutverordnung Straße und Eisenbahn (Guidelines for implementation of Dangerous Goods Regulation street and railroad)</td>
</tr>
<tr>
<td>SWOT</td>
<td>Strengths, Weaknesses, Opportunities, Threats</td>
</tr>
<tr>
<td>Tkm</td>
<td>Tonnenkilometer (Tonne-kilometers)</td>
</tr>
<tr>
<td>TRIBC</td>
<td>Technische Regeln IBC (Technical rules IBC)</td>
</tr>
<tr>
<td>TRS</td>
<td>Technische Regeln Straße (Technical rules street)</td>
</tr>
<tr>
<td>TRT</td>
<td>Technische Regeln Tanks (Technical rules tanks)</td>
</tr>
<tr>
<td>TRTC</td>
<td>Technische Regeln Tankcontainer (Technical rules tank containers)</td>
</tr>
<tr>
<td>TRTF</td>
<td>Technische Regeln Tankfahrzeuge (Technical rules tankers)</td>
</tr>
<tr>
<td>TRV</td>
<td>Technische Regeln Verpackungen (Technical rules packaging)</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>UNECE</td>
<td>United Nations Economic Commission for Europe</td>
</tr>
<tr>
<td>VAT</td>
<td>Value-added tax</td>
</tr>
</tbody>
</table>
List of Figures

Figure 1: Example of hazard labels. ................................................................. 4
Figure 2: Hazard signs for dangerous goods. .................................................. 5
Figure 3: Hazard sign for dangerous waste..................................................... 5
Figure 4: ADR certificate example. ................................................................. 7
Figure 5: Sustainability management. ............................................................ 19
Figure 6: Evolution of EU 27 road freight transport, 2004-2009 - based on tkm. .... 24
Figure 7: SWOT analysis of European ADR implementation. Own depiction. ....... 26
Figure 8: Overview of German dangerous goods legislation. .......................... 30

List of Tables

Table 1: Classification of dangerous goods.................................................... 3
Table 2: Transports of goods 2011 in Germany. ............................................. 15
1 Introduction
1.1 Research interest

The global trend of increasing traffic due to globalization leads to a higher number of dangerous goods transports, too. The importance of dangerous goods transports increases constantly in high-developed European economies, as it is used and inevitably for the supply of basic industry products and services e.g. energy (petrol, diesel, heating oil etc.). In 2007, a total of 352 million tons of dangerous goods were transported in Germany via truck, railway and ships. Concerning to the Federal Statistics Office, about each 12th ton (8.5 percent) of the whole transported quantity on road, rail and water were dangerous goods. Parallel to the increasing number of transports, the topic dangerous goods is increasingly spotlighted by experts due to the effects on environmental risks, accidents and for safety reasons. Therefore, the transports of dangerous goods and safety needs and expectations are increasingly of public interest, too. For implementing European standards for dangerous goods transports, European countries have to sign and follow the ADR guideline (Accord européen relatif au transport international des marchandises Dangereuses par Route). The ADR guideline regulates the cross-border transport of its member states on the basis of UN recommendations. Oftentimes, the management or employees of a company are not aware of dangerous goods being stored in their factory. Or the valid regulations and guidelines are unknown in detail, which evokes a substantial risk of liability for the involved persons and companies. Dangerous goods can – according to their chemical, physical, toxicological, physiological, radiological and other characteristics – be explosive, oxidizing, highly flammable, (easy) flammable, very toxic, toxic, harmful, caustic, sensitizing, cancer-causing, imperiling for reproduction, mutagenic, harmful to the environment, hazardous to water, infectious and / or radioactive, there are many prescriptions, which need to be followed. Due to these risks of dangerous goods concerning the health of people and the environment in general, it is very important that people being involved in production, treatment, transport and storage of dangerous goods are trained accordingly. Due to the high risk of dangerous goods, there is no way of ‘learning by doing’; ‘learning before doing’ is a must in the content of safety-relevant basics.

---

1.2 Objectives

This abstract follows two objectives: on one hand, the critical analysis of ADR implementation concepts in European countries. Chances and challenges coming along with the ADR ratification will be illustrated and by the help of a SWOT analysis, the strengths and weaknesses of the ADR implementation will be described. As basis for this analysis, dangerous goods and their contexts need to be explained in this paper. On the other hand, a concept / recommended procedure of how to train involved people in the framework of dangerous goods will be developed. Therefore, current training methods will be analyzed and training methods for trainers as well as for drivers and other effected persons will be proposed.

These ideas of concepts could then build the basis for countries, which have already implemented the ADR regulations and those like Turkey, which are still on the way to ratify the guideline.

1.3 Scope of work

In order to reach these targets, first an introduction about the current situation concerning dangerous goods and training methods is given. In chapter 2, dangerous goods and their classification are explained. Furthermore, the importance of accident prevention is pointed out and current measurements concerning dangerous goods accidents mentioned. Chapter 3 deals with the transport of dangerous goods. The duties of the different in the transport involved parties are illustrated and the importance of transport safety in the area of dangerous goods is emphasized. Due to the focus of the ADR guideline on international road transports of dangerous goods, road haulage as transport mode is highlighted. Chapter 4 includes the background and explanation of the ADR guideline. The guideline’s adoption in different European countries as well as successful implementation are exemplified and problems and challenges coming along with the implementation are mentioned. By the help of a SWOT analysis, the strengths and weaknesses, opportunities and threats coming along with the ADR implementation are depicted. Chapter 5 analyzes current training opportunities and gives a description of country-specific regulations and training opportunities concerning ADR and dangerous goods. Furthermore, the importance of sustainability as nowadays’ competitive factor is explained. In chapter 6, a training concept for the successful implementation of ADR and the right handling of dangerous goods is developed, which shall be seen as proposal for training opportunities. Chapter 7 provides a summary of the paper and gives an outlook about future developments.
2 Dangerous goods

2.1 Basics of dangerous goods

Dangerous Goods are substances and materials that could mean danger for the public safety, public policy, particularly for the general public, for important public property, for life and health of human beings, animals and property based on their nature, quality characteristics and in connection with their forwarding. The definition of forwarding includes the transport, but also packing and unpacking, loading and unloading and the short-term interim storage of goods. In Germany a law for the forwarding of dangerous goods Gefahrgutbeförderungsgesetz – GGBefG regulates the transport of dangerous goods for all modes of transport.\(^8\)

2.2 Classification

The classification of dangerous goods is undertaken by the manufacturer themselves, due to the fact of best knowing their products with focus on their physical and chemical quality characteristics. Freight forwarders generally receive classified products. The classification of dangerous goods is conducted under the directive of their basic characteristics.\(^9\)

Table 1: Classification of dangerous goods

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Explosives</td>
<td>pyrotechnic material, munitions</td>
</tr>
<tr>
<td>2</td>
<td>Gases</td>
<td>propane, dioxygen</td>
</tr>
<tr>
<td>3</td>
<td>Flammable liquids</td>
<td>fuel, ethanol</td>
</tr>
<tr>
<td>4.1</td>
<td>Flammable solids</td>
<td>matches, celluloid</td>
</tr>
<tr>
<td>4.2</td>
<td>Self-flammable solids</td>
<td>white phosphor</td>
</tr>
<tr>
<td>4.3</td>
<td>Water reactive solids</td>
<td>calcium carbide</td>
</tr>
<tr>
<td>5.1</td>
<td>Oxidizing substances</td>
<td>fertilizer containing ammonium nitrate</td>
</tr>
<tr>
<td>5.2</td>
<td>Organic peroxides</td>
<td>plastic adhesive</td>
</tr>
<tr>
<td>6.1</td>
<td>Toxic substances</td>
<td>Insecticide</td>
</tr>
<tr>
<td>6.2</td>
<td>Infectious substances</td>
<td>hospital waste</td>
</tr>
<tr>
<td>7</td>
<td>Radioactive substances</td>
<td>uranium metal</td>
</tr>
<tr>
<td>8</td>
<td>Corrosives</td>
<td>oil, wax</td>
</tr>
<tr>
<td>9</td>
<td>Miscellaneous dangerous goods</td>
<td></td>
</tr>
</tbody>
</table>

Source: Dischinger et al. (2005), p. 111.

To avouch a safe transport of dangerous goods the ADR contains a general map of all dangerous goods a UN-number is dedicated to. This register enables user – with the help of codes- to get the information which regulations have to been considered for the transport of a specific dangerous good. The UN-Number is a four-digit number for the identification of substances or subjects in accordance with the UN-rules and regulations. If the ADR does not require anything else, every package has to be durable add with the related UN-number.

Dangerous goods have provided with a hazard label, which display the dangerous good class. If the substance or subject features more than one main hazard, additional hazard label become essential. These labels have to placed nearby and always be visible. The following figure exemplarily shows the design of hazard labels.\(^\text{10}\)

**Figure 1: Example of hazard labels**

![Flammable Liquids](image1) ![Water reactive solids](image2)

Source: Dischinger et al. (2005), p. 113.

### 2.3 Accidents and their prevention, measurements

All rules and regulations for the transportation of dangerous goods are MADE with the aim of reducing the amount of accidents. In case of an accident the prevention standards should keep the hazard for human beings and the environment as small as possible. To provide safety, several different preventions should be kept in mind by all participants. One starting point is the equipment of the transportation vehicles and the vehicle occupants. Vehicles that transport dangerous goods have to be provided with quadrant, reflecting orange warning signs. This signs have to be fixed in front and at the back of the vehicle. If no dangerous goods are transported with the vehicle, the warning signs need to be hided or removed for the time of this transport. The registered keeper of the vehicle is responsible for the necessary equipment of dangerous goods, like signs or hazard labels, while the vehicle driver is responsible for the installation and removal of the adequate equipment. The hazard number is displayed at the top of the hazard sign, the underpart shows the UN-number. Is the hazard of the transported good sufficiently described by the number ‘3’, a ‘0’ will be added behind the first num-

\(^{10}\) Cp. Dischinger et al. (2005), p. 112.
ber, like in the first figure. Is the first number doubled, as pictured also in the first figure, the transported good features an increasing danger of the loaded good. Is the transport about dangerous waste, the installation of an additional hazard sign with the letter ‘A’ is required. These presented hazard signs need to be utilized in case of dangerous good transports with tank trucks and the haulage of containers, which are loaded with consolidated substances in bulk filling.\textsuperscript{11}

\textbf{Figure 2: Hazard signs for Dangerous Goods}

\begin{tabular}{|c|c|}
\hline
30 & 33 \\
1202 & 1203 \\
\hline
\end{tabular}

\textit{Source: Dischinger et al. (2005), p. 113.}

\textbf{Figure 3: Hazard sign for Dangerous Waste}

\begin{tabular}{|c|}
\hline
A \\
\hline
\end{tabular}

\textit{Source: Dischinger et al. (2005), p. 113.}

Numbered hazard signs are not required for the transport of dangerous goods packages. For this purpose neutral orange coloured hazard signs without identification number are installed at the transporting tank truck or container.

Next to the safety of the transportation vehicle itself, the safety of involved persons is indispensable. Driver and fellow passenger have to be provided with appropriate protective equipment, which depends on the type of dangerous good or waste and is always needed to be carried along with the transportation vehicle. Accident procedure sheets exemplify the needed equipment for information only and without responsibility. Parts of this safety equipment are sealed protective glasses, proper protective gloves and a shovel. Other possibly needed equipment could be a oil- and acid-resistant apron and boots, an eye wash bottle with clear water, a reflective vest, a portable illuminator, an additional escape mask and in case of petrol transports antistatic footwear.\textsuperscript{12}

Accidents and the far-reaching outcome and problems for human being and the environment could also be reduced by appropriate driving behavior especially in case of dangerous goods or waste transport. The driving behavior is prescribed for multitude possible occurring situations, which have to be obeyed from the beginning of the transport, starting with the loading of the goods or substances, up to the unloading at the end of the transportation process. One important point is the handling of fire and fire drenchers. It is not allowed to entry the vehicle with lighted cigarettes, this also obtains the loading and unloading process, as well as the handling of packages. The driver of a dangerous goods transport needs to visually check the vehicle, especially the necessary hazard signs before the transport is allowed to start. Another important point are the required documents that need to be completed, wherefore the driver is responsible.\textsuperscript{13}

Risk prevention officers have to be written determined in companies that organize and operate dangerous goods transport. Persons are only allowed to act as risk prevention officers that own a qualification certificate, which is valid for five years and is granted by the responsible chamber of commerce. The qualification certificate will be extended for further five years, if the risk prevention officer takes part at a retraining and pass an exam successfully. The adherence of all rules and regulations regarding the haulage of dangerous goods transport is only one challenge of the risk prevention officer. Additionally challenges are advisory service for the company for all questions regarding the handling of dangerous goods, furthermore he/she is responsible for the generation of an annual report, which includes information about the kind and amount of transported dangerous goods and all accidents with dangerous goods.\textsuperscript{14}

Since the January 1\textsuperscript{st} 2003 for all heavy accidents occurring with dangerous goods an ADR conform accident report needs to be prepared and published to the responsible public authority in the domestic country. In Germany this public authority is represented by the BAG (Bundesamt für Güterverkehr).\textsuperscript{15}

\subsection{Accompanying documents}

Every driver of a transport vehicle that transports goods or packages is obligated to carry along accompanying documents, regarding loaded subjects, substances or packages. Regulations define which accompanying documents are necessary, especially

\textsuperscript{14} Cp. Dischinger et al. (2005), p. 117.
for dangerous goods transports. A transport document, written instructions and an ADR certificate are compulsory accompanying documents. A transport documents is for example a bill of lading, which describes the specifications of a dangerous good. This includes the UN-number, the official denotation of this good or substance in big letters, the dangerous good class, the packing group and the inscription ‘ADR’ in big letters. Furthermore the amount and description of packages as well as the whole amount of dangerous goods have to be record in the transport documents just as the addresses of the forwarder and consignee. The denotation of the substance or subject, the classification and the UN-number also has to be noted on the written instructions like accident information sheets. Additional information’s which are observed in this written instructions are the kind of danger that appear with dangerous goods, general measures for e.g. notifying the police, alert other traffic participants. Special measures are observed in case of special needed handling for specific dangerous goods.¹⁶

**Figure 4: ADR certificate example**

![ADR Certificate Example](https://www.iru.org/)


All accompanying documents have to be preserved in the drivers cab. In case of an accident, all accompanying documents need to be hold in readiness for the arriving action force.

The third accompanying document - the ADR certificate - is one of the most important requirements to drive a transport vehicle loaded with dangerous goods.¹⁷

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3 Transport of dangerous goods

The entitlement of improved transport conditions by increased frequency, speed or a better infrastructure become more and more important in the whole transport section and can have the same impact on reliability issues as the relocation of subcontractors. In terms of reliability, the relocation of suppliers is an important factor as well as new transport arrangements and information technology (and information flows). These improvements are an opportunity for bringing the parts of the supply chain closer in time, which then leads to better control mechanisms and flexibility of the whole production process.\textsuperscript{18}

As mentioned before, dangerous goods and their transportation need careful and special handling due to their characteristics causing harm to people and the environment in general.

Despite all harmonizing efforts on an international basis, no consistent set of rules and regulations for the transport of dangerous goods could be succeeded up to now.\textsuperscript{19}

But, nevertheless, there are some principles and regulations found for preventing accidents to human beings and property as well as damage to the environment, transported goods or to other goods (as good as they can be avoided). Parallel, it is important for regulations to be framed “so as not to impede the movement of such goods, other than those too dangerous to be accepted for transport. With this exception, the aim of regulations is to make transport feasible by eliminating risks or reducing them to a minimum.”\textsuperscript{20} Therefore, reducing these risks is not only a safety topic, but also one of transport facilitation.\textsuperscript{21}

3.1 Involved parties of dangerous goods transports

As there are several parties being involved in the transport of dangerous goods as well as in transport generally, there are many duties and regulations, which need to be followed. There are several liabilities and considerable points in conjunction with dangerous goods for all involved parties. For the sender of dangerous goods as well as for the forwarder, the transporter/carrier, the packer, the goods receiver and others, special caution is needed for guaranteeing the dangerous goods transport’s safety. Due to the limited framework of this paper, only the duties of the sender, forwarder, carrier and the vehicle driver are explained.

3.1.1 Sender
Sender in the meaning of § 2 GGVSEB as well as chapter 1.2.1 ADR/RID is a company, which sends dangerous goods on its own or for a third party. If the transport is done based on a contract for carriage, the sender is the one acting as sender as per contract.\(^{22}\) The sender can therefore be the contract body of the carrier, too.\(^{23}\)

The sender is only allowed to let those dangerous goods be transported, which are licensed for the carriage in road traffic. Furthermore, he has to advert the forwarder to a mandatory routing and needs to take care of an orderly filled transport document. Additionally, he/she has to take care of the exceptional admission referring to §5 GGVSEB being handed out to the driver before the transportation as well as a copy of the admission about transporting (class 1) dangerous goods, a copy of the terms of carriage of the appropriate authority for the transportation of certain organic peroxides, information when transporting radioactive materials and a container packing certificate.\(^{24}\)

The main contractual liability of the sender is the liability of freight payment (regulated in § 407 paragraph 2 HGB), which is due by delivery. Collateral duties include packaging duties, the labelling liability, information duties, loading liabilities, unloading liabilities, the presentation of documents and the bill of lading’s compilation. In case of dangerous goods transports, the sender has to advise the carrier in due time of the detailed constitution of the danger in written form and if necessary, inform him about precautionary measures to be taken. If there are documents about the dangerous goods’ constitution, the sender does not have to additionally inform the carrier in written form. If there are special needs for the curatorial treatment of the goods before their delivery, for example for customs handling, the sender’s duty here is informing the carrier, too. Therefore, the sender of the dangerous goods has a special duty to care towards the carrier. The mentioned liabilities referring to packaging and labelling of the dangerous goods include that the goods are adequately packed, so that they are secured from deprivation and damage and that there are no damages and risks for the carrier.\(^{25}\)

3.1.2 Forwarder
The forwarder generally is the responsible director of loading. He has to act on his own authority and also has the right to decline the loading of improper or fail equipped vehicles. If no such regulation is in existence in the forwarding company, the responsibility

for these decisions fall to the supervisor or (on a higher basis) to the chief executive officer. The management then is also responsible for load securing, as long as the responsibility has not been conferred on another person (but it is not possible to confer this responsibility to the driver). However, the forwarder does not have to execute measurements for load securing. If the driver ensures the cargo, he/she has to receive instructions for adequate load securing by the forwarder. Furthermore, the forwarder has to control the orderly executing of the process.\textsuperscript{26}

Concerning to chapter 1.4.1 ADR, the forwarder has to carry out the following duties:\textsuperscript{27}

- he may only turn the goods over to the carrier, when they are accredited for transport in agreement with ADR;
- has to check the goods’ packaging concerning potential damages when turning the packed dangerous goods or uncleaned, empty packages over. The forwarder is only allowed to consign a dangerous good with damaged packaging (especially untight packaging, that allows the good to escape), when the deficit has been abolished. The same thing is valid for uncleaned and empty packings;
- when loading packed dangerous goods on board of vehicles, very large containers or small containers, the forwarder has to comply with regulations concerning loading and handling;
- after loading the dangerous goods on containers, he/she has to pay attention to the identification of hazards referring to chapter 5.3 ADR;
- when lading packages, the forwarder needs to pay regard to prohibitions on mixed loading and consider those dangerous goods, which are already in the vehicle or container as well as those regulations concerning the separation of foods, luxury foodstuffs and animal feed.

\textbf{3.1.3 Carrier and vehicle driver}

Concerning to UN, a carrier is “any person, organization or government undertaking the transport of dangerous goods by any means of transport. The term includes both carriers for hire or reward (known as common or contract carriers in some countries) and carriers on own account (known as private carriers in some countries).”\textsuperscript{28}

The main liability of the carrier is the transport and delivery duty. That means that he has to supply the transported good within the agreed or usual time to the recipient. Co-

lateral duties embrace the instruction debt collectible by delivery and transport barriers, special duties agreed in the contract (e.g. cashing on delivery) and the contribution in the bill of lading’s provision.\(^{29}\)

Carrier or vehicle owner are responsible for the provision of an adequate vehicle for the (dangerous goods) transport appropriate to the forwarder’s order as well as for the operationally reliable loading. This primarily includes the backpedaling of allowable cargo and load distribution, control of a transport safe loading and the implementation of competent drivers. The carrier or accordingly the vehicle owner can apply the fleet manager, an authorized agent or the driver as assigned person by order.\(^{30}\)

The vehicle driver mainly has to carry out the following duties: preoccupation of the vehicle’s appearance and workmanship as well as carried load securing equipment according to regulations, provision of the vehicle for loading (with a cleaned surface!), compliance to allowable carrying capacity and the load distribution plan and the control of loading and the load securing before and during the drive.\(^{31}\)

Furthermore, the driver is responsible for his view and sense of hearing during the drive not being impacted by manning, animals, loading, equipment or the condition of the vehicle. He has to care for the vehicle and the loading being adequate to regulations and that road safety of the vehicle does not suffer from the loading or manning. Therefore, he has a control duty and an obligation to communicate information on the loading by the sender and the tight to grant directions concerning changes in loading towards the (dangerous goods) sender.\(^{32}\)

### 3.2 Transport safety

In the 1990s, the trend of a growing transport volume in the European domestic market parallel to a decreasing in-house production depth and increasing JIT (just in time) deliveries already existed. The topics of a higher degree of capacity utilization and transport safety have been increasingly spotlighted since then. Therefore, the ecological challenges of improvements in ecology and safety of the different modes of transport as well as improving infrastructure, packaging modes and traffic management systems were a topic at this time, too.\(^{33}\)
One big problem coming along with the transport of dangerous goods is still transport safety of trucks on German roads. Concerning to the parliament announcer of the Hessian Greens, Jürgen Frömmrich, dangerous goods transports and heavy loads are loose cannons on German autobahns. More controls would be necessary and trucks more often would have to be stopped for the continuation of their journeys, if lacks of safety were assessed. Supplementary, more pressure would need to be carried out on the transport sector for preventing that those trucks with safety lacks are not even applied for traffic. Concerning to the Greens, an inquiry of 2602 controls in 2010 resulted in every second transport of dangerous goods not meeting legal obligations, which showed that there are many open issues to work on.\(^{34}\)

One decisive factor for the transport safety of dangerous goods is the right packaging. Parallel to extensive standards, some constitutional lawful rules have to be considered for the adoption of packaging by the manufacturer as well as by other partners of the logistics supply chain. Starting with the law on product reliability, which generally implies the packed good to reach the receiver in an unharmed and adequate way, e.g. the chemicals law is important for the packaging of chemical products. In case of dangerous goods, additionally the law on dangerous goods (German translation: Gefahr- gutgesetz) with its specifications for the different modes of transport like the dangerous goods act road/railway (German translation: Gefahr- gut-Verordnung Straße/Eisenbahn), inland water transportation and maritime law or air traffic law, the rules on packaging including validation rules, accreditation rules and labeling rules for dangerous goods packaging have to be taken into account as well as road traffic regulations.\(^{35}\)

Concerning transport safety of dangerous goods, it can be said that more dangerous goods are transported via inland waterway transportation than via road transport or rail transport. Parallel to the safety aspect, a high volume of goods can be transported via this mode of transport. Eventually, problems can occur due to a lack of the opportunity to build networks and infrastructural preconditions. Furthermore, the water transportation is strongly dependent on weather conditions like ice, fog or water level.\(^{36}\)

Another factor influencing the transport safety directly is the right storage and load securing, which redound to foreclosing the hazard of the environment by chemical products on all modes of transport. Especially in this area of predominantly manual operations, the human factor is very deciding. Only by sensitizing the logistics employees, occupational health and safety as well as the quality of work can be kept on a high

standard. Precise job instructions, task descriptions and responsibilities are necessary in the content of a quality assurance management.37

As analyzed before, it can be concluded that transport safety is a very essential topic and precondition for safe transport of dangerous goods. If there is a lack in transport safety, there are great risks for people and the environment due to the characteristics of the goods.

3.3 Road transport

As stated before, the transport of dangerous goods on the road is regulated via the ADR guideline for national as well as for international transports for member states.38

Transport safety for (dangerous goods) road transports and the reduction of road accidents are therefore an important topic in nowadays’ world.

“In Europe alone, the annual total cost of road accidents amounts to more than 160 billion Euros, which is the equivalent of 2% of Europe’s GNP. Moreover, not only financial costs are a daily bother, numerous deaths and injuries add to an intolerable social cost.”39

Concerning to these numbers, drivers (generally, not specific for drivers of dangerous goods transports) have to deal with more and more complex traffic environments, which include distinct types of road layout as well as all signage kinds, some of them already supported by telematics.40

In the transport sector, road haulage has a great meaning and a high rate, though there were some problems after the depression in 2009. In 2010, road transport increased by 3 percent compared to the depression year 2009, but was still by 9 percent below the level of 2007. Based on the EU commission for domestic transports’ report on road transport 2010, its share in the whole domestic goods traffic business – compared to railway, water and pipelines – reached a number of 73 percent in 2010. Referring to this report, it can be said that the sector in Eastern Europe recovered faster from the crisis’ impact than the rest of the continent. Within the twelve new EU member states (primarily in the East), which entered between 2004 and 2007, 2010’s numbers beat the level of 2007 by 8 percent. Compared to that, the goods appearance (measured in

ton kilometre) in the 15 old EU member states, stays by 13 percent below the numbers of 2007.\footnote{41 Cp. Verkehrsrundschau (2011), w.p.}

In the area of cabotage, the EU discovers considerable effects for the most new EU member states since the restrictions were abolished on May 01, 2009. This is due to the fact that in 2010, cabotage runs rose by 17 percent compared to 2009. In this area, trucks accredited in Poland, drove the most cabotage ton kilometre in the last year (21 percent), followed by trucks from the Netherlands (12 percent), Luxembourg (10 percent) and Germany (9 percent). A geographical comparison showed that most of the cabotage was exercised on German roads (31 percent), followed by France (30 percent) and Italy (7 percent). About 2.5 percent of all road transports in Germany in 2010 were cabotage runs.\footnote{42 Cp. Verkehrsrundschau (2011), w.p.}

Another interesting transport field to consider is the empty runnings. The EU average for empty runnings added up to 23.9 percent in 2010, which is about 1 percent less than in the years between 2006 and 2009, in which in each case 25 percent were measured. The lowest empty running quotas in 2010 could be found from Denmark (below 15 percent), Sweden (about 15 percent) and Germany (fair 17 percent).\footnote{43 Cp. Verkehrsrundschau (2011), w.p.}

As shown in the following table, freight traffic in Germany rose conspicuously in 2011. Referring to provisional figures of the German Census Bureau, the whole freight transport volume in Germany rose by 6.5 percent to 4.3 billion tons compared to the previous year. The biggest stake in the transport appearance had road haulage with 77.5 percent of the transported volume. Concerning to approximations of the Federal Ministry of traffic, building and urban development, about 3.4 billion tons and therefore 7.7 percent more than in 2010, were transported via road, which meant the highest growth rate within all transport sectors shown in the following table.
Table 2: Transports of goods 2011 in Germany

<table>
<thead>
<tr>
<th>Mode of transport</th>
<th>2011 Tons</th>
<th>2011 Ton kilometre</th>
<th>2010 Tons</th>
<th>2010 Ton kilometre</th>
<th>Change 2011 compared to 2010 Tons</th>
<th>Ton kilometre in percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road</td>
<td>3357.6 Million</td>
<td>453.6 Billion</td>
<td>3116.2 Million</td>
<td>434.0 Billion</td>
<td>7.7</td>
<td>4.5</td>
</tr>
<tr>
<td>thereunder:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>domestic trucks</td>
<td>2940.0 Million</td>
<td>291.5 Billion</td>
<td>2917.3 Million</td>
<td>281.9 Billion</td>
<td>8.2</td>
<td>3.4</td>
</tr>
<tr>
<td>Railway</td>
<td>373.8 Million</td>
<td>113.0 Billion</td>
<td>355.7 Million</td>
<td>107.3 Billion</td>
<td>5.1</td>
<td>5.3</td>
</tr>
<tr>
<td>inland water vessel</td>
<td>219.7 Million</td>
<td>55.6 Billion</td>
<td>229.6 Million</td>
<td>62.3 Billion</td>
<td>-4.3</td>
<td>-10.6</td>
</tr>
<tr>
<td>seagoing vessel</td>
<td>291.5 Million</td>
<td>x</td>
<td>272.9 Million</td>
<td>x</td>
<td>6.8</td>
<td>x</td>
</tr>
<tr>
<td>pipeline (crude oil)</td>
<td>86.7 Million</td>
<td>15.5 Billion</td>
<td>88.8 Million</td>
<td>16.3 Billion</td>
<td>-2.5</td>
<td>-4.6</td>
</tr>
<tr>
<td>aviation</td>
<td>4.4 Million</td>
<td>x</td>
<td>4.2 Million</td>
<td>x</td>
<td>4.8</td>
<td>2.9</td>
</tr>
<tr>
<td>Total</td>
<td>4333.6 Million</td>
<td>637.7 Billion</td>
<td>4067.4 Million</td>
<td>619.9 Billion</td>
<td>6.5</td>
<td></td>
</tr>
</tbody>
</table>

x = information not expedient.

Road transport is the deciding traffic carrier in the domestic overland transport as well as in the overland transport within Europe. In the framework of realizing the European inland market, the accompanying deregulation of industrial road transport concerning free market access, formation of prices and a step-by-step implementation of a complete cabotage freedom gain in importance. After decades of an ongoing deregulation of road haulage, nowadays a free market access exists principally, which is confined to preconditions for profession access and concession preconditions. For example, a company within EU, which aims at actuating road haulage with vehicles up to a total weight of 3.5 tons, first has to fulfill certain preconditions for profession's access like personal reliability, financial performance and professional qualification. Beyond that, a concession liability for the commercial transaction of cross-border road transport is in existence. At this point, corporate licenses (EU licenses / Community Authorizations) need to be distinguished from ECMT Permits (yearly to be applied for, multinational approvals for the professional road transportation) as well as bilateral respectively third-countries approbations (bilateral road haulage permits: approvals on the basis of cross-national administrative agreements).

Compared to all other modes of transport, road haulage holds the highest ability to network creation at high speed and territorial flexibility. Contrary to these points it can be said that, nevertheless, road transport is not capable for mass transport. In contrast to railway or inland water transport, which additionally does not need to keep regulations concerning factory embargoes on Sundays and holidays, road transport is less qualified for the transport of dangerous goods. Due to its high energy consumption, the environmental burden of road haulage is rather high.

Supplementary to the system advantages, some other strengths of road transport can be found: For nearly every transport challenge, technically specified and economical vehicles can be found, amongst others also motor trucks being suitable for the transport of 20 foot and 40 foot ISO containers. They can therefore easily cooperate in intermodal transport chains with marine freight, rail freight services or inland water transport. Furthermore, road transport often obtains as cost-effective because a renouncement of foreruns and off-carriages is more often possible and direct transports are facilitated. Parallel to that, another advantage can be seen in the constant supervision of the freight by the goods' driver.

Another advantage of road haulage is its flexibility in transporting goods. Generally, all objects of international logistics activities (including dangerous goods as well) can be transported on the road.

With its special purpose vehicles, road haulage is able to transport dry and wet bulk commodities. For great distances, usually railway, waterway or pipeline transport is used as economical alternative, but for their forerun, trucks will remain a cheap – if not the only – mode of transport. Dangerous goods are often classified as bulk commodities (concerning to UN classifications), too. Road transport of course is very important for the transport of general cargos, especially, when they are valuable, sensitive and time-critical.\textsuperscript{47} Due to the focus of this paper, further details concerning the transport of general cargos will not be explained here.

4 ADR

4.1 Trans-European Transport Network (TEN)

Standardized rules and regulation enable fair competition between ADR member states and ease the transport of goods through all this states. Next to the simplifications that result of the ADR agreement, the transport infrastructure network is a major factor, for unproblematic transports through participating countries. An initiative of the EU-Institution formed a concept for the development of the transport infrastructure, which includes inter alia roads, waterways, railways, air- and seaports and inland ports, with the aim of the extension and improvement of the existing one and additionally to connect the peripheral areas with the central areas to create a multimodal and multination- al European transport network. But in addition to the physical part of the transport infrastructure, which is meant by constructions and establishments, there is also a non-physical part that includes the management of transport infrastructure. In the beginning the EU member states invested in their own transport infrastructure while they paid less attention to transnational guiding idea of this project. After those initial difficulties, a first positive change came with the common infrastructure network politics in 1978, but first the Maastricht Treaty in 1992 leveraged the development of a Trans-European transport infrastructure network. In the course of the new transport policy, a non-discrimination rule was passed, which prohibit discriminating transport prices that would inhibit fair competition between all member states. Further trade restrictions emerged from cross border barriers. The reduction of these barriers additionally was an important factor to ensure the economic and social development, to enhance living- and employment conditions and to render possible unhampered transport of all transportation modes through Europe. As we have seen in the past, all segments need to invest in the development of infrastructure, which will not change, when future market challenges should be practicable for all participants. The freight transport will steadily increase and especially the road transport has to develop very fast to keep up with the demand on the logistic sector.

Freight haulage regulations and sustainability

Regulations for the freight haulage have a common aim to implement positive effects in the transport sector. These effects could occur due to regulations with different inten-

51 Cp. ibid., p. 286.
tions. With regard to many traffic deaths in consequence of preventable accidents, the safety should be increased through the adherence of driving- and rest periods for driver, the acceptance of technical regulations and good driving training with help of well educated driving instructors. Furthermore, regulations should entail the reduction of technical restrictions, including common dimensions and weights as well as the reciprocal acceptance of driver licenses in the EU. The third type of regulation is not only for the safety of human beings, as instead in respect of the environment and the outcome for the future. Even if the logistic sector is only one part of the carbon footprint origin, it increases the environmental burden. Sustainability can be raised by e.g. technical regulations regarding the carbon emission and rules for the environmental liability. To make sustainability comparable, it is necessary to create a transparency, which is also important for a successful sustainability management that pay regard to the fulfillment of the appropriate rules and regulations. Furthermore the transparency is needed to measure the sustainability’s benefit and to provide reporting’s. Sustainability is measured by drivers performance indicators of the economy, ecology and social dimension.

**Figure 5: Sustainability management**

Perfomances of the freight haulage include mainly transport, handling and storage processes, belong to the ecological dimension. Main indicator for the accurate evalua-

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54 Cp. ibid., p. 233
tion of the emission, emerging from the freight haulage companies is the carbon foot-
print, which includes all causes of CO2- and other greenhouse gas-emissions along a
complete supply chain.\textsuperscript{55}

4.2 Basics of ADR

Due to the ongoing internationalization, goods are globally procured and transported to
their destinations.

To achieve international standards, the United Nations developed comprehensive clas-
sification criteria and communication tools for dangerous goods transport. The UNECE
(United Nations Economic Commission for Europe) supports countries with regional
agreements to ensure the successful implementation of these mechanisms for danger-
ous goods.\textsuperscript{56} The ADR guideline was adopted on 30 September 1957 in Geneva and
entered into force on 29 January 1968. It is a European agreement concerning the in-
ternational carriage of dangerous goods by road.\textsuperscript{57} The agreement is only allowed to
use for cross-border transports between ADR parties, which signed and accepted the
agreement for their federal territory. The utilization does not depend on the vehicle li-
cense or the drivers' nationality.\textsuperscript{58} Due to the development of new technologies, the
ADR agreement is updated every two years.\textsuperscript{59}

The ADR agreement is kept short and is divided into Annex A, and Annex B. Annex A
exemplifies the \textit{General provisions and provisions concerning dangerous articles and
substances}. It is subdivided into 7 parts. Annex B exemplifies the \textit{Provisions concern-
ing transport equipment and transport operations} and is subdivided into Part 8 and 9.\textsuperscript{60}

The following \textsc{AUFTEILUNG} exemplifies the Applicability of ADR 2011 that was pub-
lished by the United Nations:\textsuperscript{61}

\begin{itemize}
\item Part 1 General provisions
\item Part 2 Classification
\item Part 3 Dangerous goods list, special provisions and exemptions related to limited and
excepted quantities
\item Part 4 Packing and tank provisions
\end{itemize}

\textsuperscript{57} Cp. UNECE (2011b), \url{http://www.unece.org} (2011b); UNECE (2011c), \url{http://www.unece.org} (2011c),
Part 5 Consignment procedures

Part 6 Requirements for the construction and testing of packagings, intermediate bulk containers (IBCs), large packagings and tanks

Part 8 Requirements for vehicle crews, equipment, operation and documentation

Part 9 Requirements concerning the construction and approval of vehicles

4.3 Adoption and implementation of ADR in different European countries

The nine parties that signed ADR in 1957 set the cornerstone and exemplified the implementation for all following parties.62

Poland had ratified the ADR agreement in 1975.63 By using the example of Poland, the need for more safety on Poland’s roads will be demonstrated by following horrific facts. Even, if the ADR agreement is ratified, unfortunately there are still problems in the transport sector, especially problems regarding the transport of dangerous goods. The forwarding of dangerous goods at Polish streets offers extensive deficiency. In accordance with the final report of a large-scaled control in Poland between July and December 2002, the amount of 100 accidents with dangerous goods occurred, whereof 36 of these accidents caused a leak of dangerous material. The control of dangerous goods carriage contained about 3000 vehicles that did not provide fire drencher equipment. Every fifth vehicle transporting dangerous goods was not even displayed as such a vehicle. Shipping documents were missing on every tenth vehicle. In 41 cases of these 100 accidents, the drivers were influenced by alcohol. Furthermore, the safety provisions in most of the Polish cities were deficient by the reason of missing road signs, which prohibit the transit of dangerous good transports. Polish stakeholders expected improvements of provisions valid from January 2003, which instructed all Polish forwarding companies to occupy a risk prevention officer.64

Next to these difficulties, Poland has a strong developing logistic market and an excellent basis of service provider, consumer and infrastructure from different branches, including the industrial- and the trading sector. The polish logistic market, as a former transport service provider emerges to a serious logistic country that offers the whole range of logistic services. Even if the infrastructure is well developed, it could not compete with other western European countries. The main problem are missing motorway connections between the Baltic Sea and Poland’s economic areas of high population

density, like Warsaw, Poznan or Gliwice, as well as east-west- and north-south connections for efficient transport routes to reach all consumer areas. Beside a still developing road infrastructure, the railway infrastructure needs to be modernized too, even if the trend shows more potential in the road transport for the future. The EU tries to stop this development with high subsidies for the railway. Other subsidies are provided to expand the capacities of polish airports.

Many companies do not plan an establishment in Poland, because of a high value-added tax of 22% and ambiguous legal regulations regarding the VAT. Another reason against the decision for a polish establishment could be the high fluctuation of employees. Despite all adversities the Dell corporate group, which has a production plant in Ireland, decided to build a second production plant in Poland. This is a clear signal for the attractiveness of the polish market and logistic sector and an enabler for other companies and corporate groups to discover Poland as a company location. If the polish infrastructure is modernized, a strong increase of the polish logistic sector and economy is estimated. Nowadays a important part of Poland’s logistic sector are cabotage transports in neighboring countries. Behind Germany, the Netherlands, Luxembourg and Belgium, Poland is ranked number five in the international comparison of cabotage transports.\(^65\)

Romania, which is a recently joined EU member state, ratified the ADR agreement in 1994, posses a relatively well developed road network, including three east-west and one north-south connection. Only the biggest sea port is not connected via a motorway, though it is the biggest transshipment center at the Black Sea with a channel towards the river Danube, which enables direct access to the interior. With a transport volume of only 20 to per inhabitant, Romania is still a logistic developing country (in comparison to the German transport volume of 44 to per inhabitant). Even if the potential of Romania particularly with respect to the logistic sector is enormous, the Top 10 top-selling logistic companies are all Romanian and only fewest companies of European countries are located there.\(^66\)

Denmark has ratified the ADR agreement in 1981 and is experienced in the transport of dangerous goods. The transport volume of 46.3 to per inhabitant is higher than the German transport volume per inhabitant. The main reason for the significant logistic relevance is the gateway and bridge-function of Denmark that enables the connection of middle-European counties to the Nordic countries Norway and Sweden. The Øre-

sund Bridge is the existing continuous connection between Central Europe and Sweden. With help of the Fehmarnbeltbridge between Fehmarn and the Danish Rødby, which should be building till 2020, the Scandinavian-European connection will be shortened extremely.67

4.4 Successful implementations

One successful way of implementing ADR could e.g. be a cooperation between two companies, of which one of them already adopted the ADR guideline successfully, the other one not yet, but it could benefit from the experiences. A German sophisticated company could assist a logistic company in another country, which has not implemented ADR successfully, with the aim of considerable advantages for both parties. The foreign company would have support in implementing the guidelines due to know-how transfer which results of experience implementation of ADR and in the daily business. The German logistics company Lehnkering and a Hungarian logistic company ADR Logistics built a cooperation with the common aim of creating a strategic storage of dangerous materials in central Europe, but also mutually dependent aims. Hungary becomes more important for the chemical and pharmaceutical industry as a strong market and as a distribution center for central- and east Europe. As a 3PL service provider, Lehnkering is interested in attending this new way with their customers. With ADR Logistics, Lehnkering acquired a reliable Hungarian partner with domestic contacts and know-how. Furthermore, Lehnkering has immediate market access to Hungary and bordering countries like Rumania and Slovakia. The storage for dangerous materials is located near the airport of Budapest with the possibility of storing all ADR classes of dangerous goods except explosive, radioactive and infectious materials. Their main reason to cooperate with Lehnkering is the access to long lasting experiences, the Lehnkering warehouse- and distribution network in west Europe and of course new customers, which come to the new market Hungary.68 ADR Logistics strongly benefits from this cooperation and became one of the most qualified market leaders for dangerous goods warehousing in this chemical and pharmaceutical logistic sector.69

Figure 6: Evolution of EU 27 road freight transport, 2004-2009 - based on tkm


4.5 Problems and challenges with ADR implementation
Implementing ADR is the appropriate way for a country to remain in global and fair competition for domestic companies and the country itself. Not to be neglected is the safety of individuals and the protection of the environment. The way up to a successful implementation is often not easy and could be a long-lasting challenge where different hassle has to be sorted out.

One of the difficulties could occur during the ADR implementation preparations. Throughout the time a government decides to adopt ADR, the infrastructure could appropriately be adapted or the progress for a functional infrastructure could seem to be developed in time. The truck fleet of companies transporting and working with dangerous goods could furthermore be out of date and not be fitting the ADR requirements. Especially small and medium-sized enterprises do not have the financial means to exchange the truck fleet and buy new modern vehicles, appropriate to the ADR requirements. That would mean unfair competition in the domestic country, due to competitive advantages of big enterprises with existing financial means with all its consequences.

Another challenge is the certification of all drivers of dangerous goods transports, due to the fact of insufficient trainings. Organizations in those countries usually have no
experience with the ADR guideline and all necessary requirements. Solutions to close this know-how gap will be described in chapter 4 of this paper.

With a similar training concept like the one for drivers and trainers (which will be described later), the possible problem of missing qualified personnel could be solved. Missing qualified personnel leads to uncertainties in the auditing process as well as in the inspections, which are essential for a successful implementation. A conventional safety advisor is probably not the right person to control such a complex and challenging adoption and realization of rules and regulations. All auditings while the implementation and all needed inspections of companies and their truck fleet should be conducted by well trained personnel.

When all ADR requirements are fulfilled and the implementation of ADR is successfully completed, the control standards for the adherence of required regulations could be one of the final challenges for the domestic country. Therefore additional national legislation is essential, as well as supplemental administrative arrangements. Important for the control of ADR requirements are organizations, which provide qualified authorities. Next to trained personnel, different procedures are necessary. These procedures should regulate all inspections of the truck fleet, all tanks as well as the packaging and needed certifications. The control standards could be too low by the reason of different facts. On the one hand, control organizations like the police or other public or private organizations are not well trained; on the other hand there are not enough control instances to guarantee enough controls. Furthermore, it could be possible, that these organizations are not very interested in catching drivers and their vehicles, which are not conform to ADR requirements. This lack of interest could be generated by money that is paid in an unsatisfactory control situation. This corruption could especially occur in countries with a weak government. To avoid deficits in the control procedures, a strong relation between participants and control organizations should be given.  

4.6 SWOT analysis of the ADR guideline

As stated before, the transport of dangerous goods is an essential and growing topic in many countries. A discussion of high-level speakers from the German, French, Kazakh, Turkish and the UK Governments as well as experts of the European Commission and other international organizations stated that the transport of dangerous goods is and will remain a topic for the 56 countries of the UNECE (United Nations Economic Commission for Europe). Concerning to this discussion, the “mechanisms put in place by

the United Nations for regulating the transport of dangerous goods by all modes of transport at global and regional levels are efficient and ensure a high level of safety when effectively implemented by Governments.\textsuperscript{71}

The precondition for such a Europe-wide working collaboration and implementation of ADR standards is, of course, the successful adoption of the ADR guideline by the involved governments. Several strengths and opportunities come along for countries by the ADR ratification in the field of dangerous goods transports, such as lower barriers and uniform regulations. But, on the other hand, there are also threats and some weaknesses coming along with the ADR implementation (e.g. country-specific circumstances, which complicate the implementation process or corruption problems). The following figure provides a SWOT analysis concerning the ADR guideline implementation on a general level. It can be seen as summary of the previous analysis and statements of the authors.

**Figure 7: SWOT analysis of European ADR implementation**

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>• uniform regulations and instructions</td>
<td>• better European cooperation and collaboration</td>
</tr>
<tr>
<td>• lower barriers</td>
<td>• faster processes and handling of dangerous goods transports</td>
</tr>
<tr>
<td>• clarified safety and transport standards</td>
<td>• safer transports</td>
</tr>
<tr>
<td>• reduction of DG transport accidents (e.g. Poland)</td>
<td>• more (fair) competition</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weaknesses</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>• country-specific problems cannot always be considered</td>
<td>• challenges especially for SMEs to implement the ADR requirements</td>
</tr>
<tr>
<td>• long ADR-adoption process</td>
<td>• costs of change management</td>
</tr>
<tr>
<td>• constitution of weak governments (corruption)</td>
<td>• implementation of control mechanisms</td>
</tr>
</tbody>
</table>

**Source:** Own depiction.

5 Trainings in line with dangerous goods and compliance of ADR

As dangerous goods and their transport need special handling and attention due to their risk for the environment and health of people\textsuperscript{72}, the training of any persons having to deal with those goods is very essential for a safe processing. Requirements for those trainings can be found in chapter 1.3 of the ADR/RID/IMDG-Code as well as in chapter 8.2.3 of ADR and in §6 of the German Gefahrgutbeauftragtenverordnung (GbV). Concerning chapter 1.3 of the ADR/RID/IMDG-Code, every employee, which has to exercise the duties of dangerous goods regulations, needs to be specifically trained, especially:\textsuperscript{73}

- Manufacturer or owner of dangerous goods,
- Owner of tank containers or outfitters (inland waterway vessel traffic),
- Persons carrying out forwarder duties,
- Persons, writing transport documents,
- Persons working for the dangerous goods receiving; goods receiver,
- Packers,
- Filling personal of tanks,
- Vehicle drivers, who do not need an ADR certificate (little quantity transports of goods),
- Persons carrying out carrier and vehicle owner duties.

There are different ways and opportunities of training involved persons concerning dangerous goods and their treatment:\textsuperscript{74}

- **General awareness of dangerous goods/training for familiarization**: These basic trainings shall help people getting familiar with general provisions and requirements concerning dangerous goods transports. As a rule, these trainings give the participants an understanding of the dangerous goods classes and the requirements in terms of labelling and marking dangerous goods as well as their placarding and parcelling, their segregation and compatibility. Furthermore, the purpose and contents of dangerous goods transport documents shall be described and available emergency response documents are mentioned.

- **Function-specific trainings**: These specific trainings shall convey specific requirements for dangerous goods transports, which support the trained persons in its job function.

- **Safety training**: Due to the risks coming along with the dangerous goods treatment and transport, affected people need to be trained in the following safety-relevant areas:
  
  o Methods for the avoidance of accidents, e.g. by safer use of packaging equipment or improved ways of storing dangerous goods,
  
  o Which emergency response information are available and how they have to be used,
  
  o Other dangers coming along with the various dangerous goods classes as well as information about how the exposure of the hazards can be prevented and how human protective clothes and equipment are used,
  
  o Emergency procedures for the case of undesired releases, including emergency response procedures and protection procedures, which need to be followed.

The proves or records of such dangerous goods trainings should accurately be kept by the employer, which has to make the documents available to the employees or competent authorities upon request. Some trainings furthermore need to be periodically refreshed or repeated.\(^75\)

For drivers transporting dangerous goods, the ADR certificate (dangerous goods driver’s license) is indispensable. It proves the participation in a driver training for the transport of dangerous goods. The aim of the ADR certificate is, that the drivers

- "are aware of the hazards arising in the carriage of dangerous goods
- can take steps to reduce the likelihood of an incident taking place
- can take all necessary measures for their own safety and that of the public and the environment to limit the effects of any incident that does occur
- have individual practical experience of the actions they will need to take."\(^76\)

The certificate is valid for five years and is in Germany drawn and prolonged by the IHK (International Chamber of Commerce, ICC). It takes two and a half days for the drivers to participate in the training, the examination is additionally. A refreshing course takes one and a half days. Between those time windows, the ADR drivers regularly need to

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be instructed by the employer. Meanwhile, the ADR member states administrate lists of all exposed ADR certificates for identifying possible terrorists.\textsuperscript{77}

5.1 Current law situation and training opportunities

As mentioned above, the training of safety and dangerous goods topics is very essential for a risk and accident minimization in the handling of dangerous goods and their transports.

One part of current dangerous goods training concepts can be seen as train-the-trainer concept, by e.g. educating a risk prevention officer in the companies.

The law situation and number of regulations for the field of dangerous goods and their treatment (and transport) is very complex.

Figure 8 shows the complex law situation in the dangerous goods field in Germany. For a better understanding should be mentioned, that the law abbreviations have been kept by the authors; the explanations of the abbreviations’ meanings were translated from German to English.

Due to the complex structure and the multiplicity of rules to be considered, the training of people in the field of dangerous goods is inevitable for a processing, which is compliant to the rules and regulations.

Owing to circumstances, companies have to define a risk prevention officer, independent from their position as potential manufacturer, trader, forwarder, filler, importer or carrier of (dangerous) goods. These assigned or other responsible persons need to be trained within the companies. As a rule, persons, who are involved in the transport preparation, e.g. employees of a distribution department, are assigned as risk prevention officer. The legal principle at this point is the German risk prevention officer provision (Gefahrgutbeauftragtenverordnung).\textsuperscript{78} Training risk prevention officers is mandatory for companies. Within five years after the successful passing of the exam, an advanced training exam has to be passed.\textsuperscript{79}

As mentioned before, the safe transport of dangerous goods is now more important than ever. The economy has a high interest in that just as the industry and logistic companies. Due to existing prescriptions for packaging, load securing and labeling and

their determination in the ADR guideline, the driver of dangerous goods needs an ADR certificate and has to prove (like other attached persons) his knowledge.\(^80\)

The trainings for risk prevention officers and dangerous goods drivers are for example offered by the several different International Chambers of Commerce (ICC) in Germany (German: IHKs).

Furthermore, the ICC provides special dangerous goods presentations like the “4. Deutsche Gefahrgut-Sicherheitstage 2011.”\(^81\) This event e.g. supports the dialogue between the economy and the institutions for improving and intensifying the safety. Additionally, participants receive incitements about better communication of the topic dangerous goods in their companies.\(^82\)

Comparable training opportunities are offered for example by the TÜV Rheinland for ADR drivers, risk prevention officers, EU drivers, in different logistics areas and others.\(^83\) Another company, which could be mentioned at this point, is Wesselhoeft Gefahrgutservice und Beratung.\(^84\)

Additionally to presence trainings, there are different companies and institutions offering online trainings, software-based computer trainings and trainings based on DVDs. One example for such a company is WEKA Gefahrguttransport.\(^85\)

Internationally, there can other training organizations and experts be found as well, which provide training and services concerning dangerous goods.

In Poland, for example, Döhle Poland provides training sessions and training materials for people involved in the hazardous materials (HAZMAT) treatment, which is approved by the Polish Maritime Administration.\(^86\)

Another example for successful dangerous goods training opportunities is the company BSD Training Ltd, which is located in Northern Ireland. It is accredited by 14 awarding authorities, of which some are recognized on an international level. BSD Training Ltd. offers five day training sessions for the driver ADR certificate in vehicles. The courses aim at giving the participants the needed knowledge for completing the course’s end

examination and include vehicle transport packages of the dangerous goods classes 2, 3, 4, 5, 6, 8 and 9. Parallel to the ADR certificate training courses, many other training opportunities in the fields health & safety, driver trainings, goods handling etc. are offered.\(^{87}\)

Another international example of ADR trainings and the opportunity to be educated for the ADR drivers certificate is via the Scottish Qualifications Authority (SQA). It is the national Scottish accreditation and awarding corporation, which is supported by the Government’s Learning Directorate and, amongst others, provides a list of approved ADR driver training providers.\(^ {88}\)

Of course, there are several training opportunities beyond Europe and the European Union, for example in the USA, but, as the ADR is an European guideline, other training opportunities for dangerous goods have not been considered for this work.

### 5.2 Country-specific regulations and their meaning for training concepts

Additionally to the ADR guideline, several country-specific circumstances and prescriptions have to be considered for parties involved in the dangerous goods transports. Some ADR member states enacted further clauses on the basis of chapter 1.9 of ADR for their sovereignty territorial, which also need to be followed by foreign vehicle drivers. Examples for these additional regulations are the tunnel arrangements and regularizations in Switzerland and Austria, the routing system in the Netherlands as well as the route planner for hazardous materials in Germany.\(^ {89}\) Another example for special rules and regulations to be considered is the Øresund Bridge, which connects Denmark and Sweden. Generally, dangerous can be transported via this bridge, but with some constraints concerning traffic and the bridge’s staff. In general, tunnels for the dangerous goods transport are classified into five tunnel categories (A-E). The Øresund Bridge is to certain times defined as category E (restriction/embargo for those dangerous goods, which need a labeling concerning ADR except special UN numbers) or category B (restriction/embargo for dangerous goods, which tend to result in very big explosions).\(^ {90}\)

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Due to these country-specific regulations, it is very important for companies to be up-to-date and to know these regulations for hazardous materials. Parallel to the domestic country’s regulations, it is important for drivers of dangerous goods transports as well as for other involved persons to know the rules and regulations of other European countries in case of cross-border transports. Therefore, all necessary and specific provisions have to be trained in detail by the responsible persons.

5.3 Sustainability as competitive factor

Due to nowadays’ growing economical complexity, the meaning of an international logistics increases as well. The flow of information and goods needs to be planned, realized and controlled on a transnational basis. A great challenge coming along with those global logistics processes and the increasing expectations of forwarders is the protection of the environment and climate. Though savings in fuel consumptions and an improved efficiency of the vehicles can be noted down, freight traffic still is little environmentally sound. The main reason for this can be found in the constant growth of the transported quantity, which compensates the successes in vehicle-specific emission reduction. Parallel, the freight traffic forecast fears the worst, as the quantity of goods traffic in 2025 shall be by 28 percent above the level of 2004. The biggest part in that will be long-distance road transport with a growth of 55 percent. These forecasts show: without further ambitious and effective measurements, not only the emission volumes of carbon dioxide and azote will rise constantly, but also the burden for people and environment by traffic noise, particulate matters and the urban development.

In the recent past, environment and resource protection in logistics gained in importance. Origins of this development can be found in the different demand groups and drivers, which call for an ecological direction of logistics.

Not only political developments, but also calls from forwarders due to customer requirements carry innovation pressure on logistics companies. A logistics provider being able to provide green logistics therefore will in the long run have a competitive advantage. One example, which can be mentioned at this point, is the compilation of the carbon footprint, which becomes increasingly spotlighted in the public. This CO2 balance displays the product’s or service’s part in global warming over its life cycle. In the production environment, transport, recycling and disposal of waste are included in this

carbon footprint, too. In the future, it will be a basic requirement for logistics providers to being able to provide information about all caused emissions, particulate matters, traffic and operating noise as well as their resource and energy efficiency measurement. Furthermore, they will have to be able to develop solutions for the continuous improvement and optimization of the resource and energy efficiency and prove these. Logistics companies need to follow green logistic strategies as well as green marketing strategies. For the success of these strategies, management as well as employees need to follow and implement the different strategies' parts and measurements.\textsuperscript{94}

Therefore, it can be said that green business models and green strategy implementation mean a competitive factor for companies. Investments in sustainability and greener processes and products will become more and more important within the next years.

Development of a training concept for the successful implementation of ADR and handling of dangerous goods

As described in the chapters before, the ADR implementation and the knowledge transfer concerning dangerous goods is very complex. This is not at least often the result of deficient training concepts and methods.

Nowadays, one problem coming along with the instruction in the field of dangerous goods is the long time period, which lasts between the training units. Oftentimes, new legal changes are added up to dangerous goods provisions and changes to the ADR guideline are made in the meantime. Furthermore, important facts may have been forgotten by the training participants, if e.g. a refreshing of a training (like for risk prevention officers) is repeated only every five years. Furthermore, the willingness to acquire new skills usually depends on the instructor and his/her methods. Additionally, the costs of the trainings are a decisive factor. The more costs the training participant has to pay on his own, the lower is his willingness to learn. On the other side: the more costs the company or institution is willing to pay, the bigger is the participant’s willingness to take part in specific trainings.95

Due to the described problems, a new training concept for the knowledge transfer of dangerous goods and their regulations needs to consider these existing weaknesses and work against them.

There are different ways of offering certain countries and their companies the opportunity of the necessary transfer of knowledge concerning dangerous goods and ADR requirements. Depending on the country’s circumstances and the individual company’s needs, the participants need to find their best practice for implementing ADR and training concepts. Due to individual requirements and desires and ways of realizing ADR standards, there is no one and only method of finding the right knowledge transfer concept. The subsequent options shall therefore be seen as proposal and can individually be implemented and enhanced.

One opportunity of training involved persons in the field of dangerous goods is the way of building cooperations between different companies. This opportunity is already established in some cases (e.g. Lehnkering with a Hungarian company). The idea behind this is that companies of countries, which have already implemented and ratified the ADR guideline, support those companies of countries, where this is not the case yet.

By the know-how transfer, a win-win situation is created and the collaboration of these companies can be improved. An idea here could be to enhance the concept of knowledge cooperations, so that public and private organizations are involved into dangerous goods knowledge transfer as well. The more cooperation partners in different countries are found, the better ADR regulations can be implemented and conveyed and therefore existing rules observed.

Examples for private organizations supporting the ADR and dangerous goods experience exchange and skills improvement are the International Chamber of Commerce or the German TÜV organizations. The aim should be the enhancement of their training offer in different countries. In case of the organizations not being wide-spread in other countries, it could eventually be reasonable to establish an office in such a specific country or to send training personnel to other private or public organizations for transferring the required know-how. In this case, a good train-the-trainer concept could be established and developed.

An easier way of transferring specific dangerous goods knowledge could be the collaboration with subsidiaries of companies, which are already following the ADR regulations, in other countries. In such cases, an internal know-how transfer and training concept could be developed. Furthermore, country-specific provisions could be considered by the cooperation with domestic personnel and all necessary persons of the subsidiary be trained.

Another possibility for the refreshment of knowledge could be additional training sessions (not only every five years). By the shorter time intervals, current dangerous goods topics and regulation developments could be implemented and kept in the participants’ minds. Due to the regularity of training units, the session times of ADR trainings could be reduced and the participants would be aware of current developments just-in-time. These more frequent trainings could then also be executed via an online training concept and also be ended with an online examination.

A more innovative way of transferring dangerous goods and ADR knowledge could be – parallel to online learning platforms – the sending of periodical e-mail newsletters. By this communication method, all current legal and regulatory developments could be spread as well as new training course opportunities, training organizations etc.
7 Conclusion

Due to the fact that European Standards and uniform regulations become more and more important in the field of dangerous goods as well as in other (logistic) areas, the meaning of the ADR guideline’s ratification and the compliance to its regulations is and will be an important topic in the European countries in the future.

The concentration on dangerous goods and safety regulations concerning the goods' transport and handling is a must for ensuring a safe processing without causing harm to human beings and the environment.

The implementation of all required ADR conditions could be more or less difficult in different countries - depending on the existing preconditions. The political, legal, infrastructural and economic situation of a country could be a success factor influencing the procedure of the implementation, as well as the willingness and ability of each single country/company towards it. Due to differing circumstances and standards like a better developed infrastructure, strict laws, continual and consequent controls of all vehicles, especially trucks, a corruption prohibition and high punishments in case of breach of law, western European countries have less difficulties with the guideline implementation than eastern European countries.

The previous description of the ADR implementation situation in different European countries showed, that there are several different difficulties and challenges, which can occur on the way of the guideline’s ratification – for the country as well as for individual companies. For satisfying the requirements and regulations of ADR, the states’ governments often need to adapt directives and provisions as well as infrastructural activities. A consequence out of these adaptations could also be changes in law and other legal regulations. Furthermore, the governmental directions have to be realized by the involved companies, which means much practical, bureaucratic and monetary effort for them. These high investments and process changes often build a massive burden especially for SMEs. They usually cannot bear the costs as easily as big enterprises, e.g. for exchanging the truck fleet, which may be necessary to be compliant to the high standards of the ADR guideline. This could lead to several SMEs being squeezed out of the market, though the original objectives of the regulation of more safety and protection of the environment by uniform standards should lead to more fair cross-border competition in Europe.

One existing problem for the fast and effective implementation of the ADR standards can be found in missing qualified personnel and control organizations, which complicates the necessary knowledge transfer. Furthermore, a more uniform and standard-
ized training concept in the field of dangerous goods and the ADR regulations needs to be developed to overcome the described lack of knowledge.

As stated before, there are different preconditions and circumstances in the individual countries and companies implementing the ADR standard, which leads to diverse implementation strategies. Therefore, it is not possible to find the one and only standard way for a successful implementation as well as training concept and know-how transfer.
References

(a) Monographs and papers


(b) Online references


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