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Towards Paperless Transport
Development Project for Automobile Industry

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Abstract <p>Freight transportation is an integral part of the product supply chain. Transport processes link together different economic players and hence generate extensive flows of information, which are traditionally conveyed through freight documents. Rapid development of technology is now transforming the communication between the parties. More and more companies are replacing paper-based documents with their digital alternatives. Electronic transmitting of data enables efficient, simplified and sustainable transport operations, thereby helping the companies retain their competitiveness. While digitalizing conventional transport operations, companies often face different challenges: legal barriers and operational uncertainties.</p> <p>The main objective of this study was to help an automobile manufacturer digitalize its transport processes and introduce the use of electronic freight documents in inbound logistics. The study was conducted using the Mixed Method Research. To assess the current practices, associated with the company's transport documentation, both qualitative and quantitative data was collected through secondary sources, by means of interviews, surveys. The acquired data on the transport documents in use, their functions and formats was analysed. Furthermore, legal research was performed to examine the legal framework regulating the use of electronic transport documents in Germany and the EU. Finally, new solutions, reducing paper-based documentation in processes, were proposed. Potential challenges of their implementation were discussed. Cost savings of the new concepts were calculated using the Standard Cost Model.</p> <p>The results of the research can be utilized by the company. When implemented, the suggested solutions improve operating times, significantly increase the cost-efficiency of transport operations and contribute to the sustainability of the business.</p>		
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1 Introduction

Chapter 1 provides a general background of the chosen topic. It describes the problem, suggests the research questions and sets the research limits.

1.1 Preface

Freight transport plays a crucial role in the product supply chain. It is indispensable for delivery of raw materials and semi-finished parts to production sites and final products to the customers. On average, the costs of transport can account for almost 10% of the total costs of a product (Rodrigue et al. 2013, 236). Thus, efficient freight transportation is fundamental to the company's competitiveness.

Freight transport is linking together different economic players including customers, suppliers, forwarders, authorities and hence generating extensive flows of information. Conventionally, the communication between the parties was carried out by means of paper-based documents. However, with the development of technology and increasing role of digitalisation more and more companies are taking advantage of electronic transport documents. Electronic transmitting of data enables efficient and simplified transport operations and leads to the decrease in costs associated with the transport processes, thereby helping the companies to retain their competitiveness (Towards paperless transport within the EU and across its borders 2018, 14).

The current thesis is going to focus on the use of electronic documents for road transport. The study's main objective is to help an automobile

manufacturer digitalize its transport processes and introduce the use of electronic freight documents.

1.2 Introduction to Mercedes-Benz AG

This study was assigned by Mercedes-Benz AG. The next subchapter gives a short overview of the history of the automobile manufacturer, introduces the company's current corporate strategy and demonstrates the importance of the current project for maintaining the company's leader's position on the market.

The history of the Mercedes-Benz AG dates back to 1886 when Gottlieb Daimler and Carl Benz independently from each other constructed their motor vehicles. Later they found their own companies Daimler Motoren Gesellschaft and Benz & Cie. In 1926, due to the increasing competition, the companies decided to combine their efforts in sales by merging into the Daimler-Benz AG. After going through the hard times of the Great Depression and two world wars, the carmaker started to expand. The company began investing in electronics, aviation and aerospace industries, turning into an integrated technology concern. At the beginning of 1990s, the company's strategy was changed, and the business was again focused on automobile manufacturing. In 1998 Daimler-Benz AG merged with the American Chrysler Corporations, but already in 2007 announced its separation. The company continued trading under the name of Daimler AG. (Daimler AG 2011.)

Already in 2019, it was decided to make the new structural changes. Daimler AG was divided into three legally independent entities: Mer-

Mercedes-Benz AG responsible for cars and vans, Daimler Truck AG manufacturing trucks and buses and Daimler Mobility AG - provider of financing, leasing and insurance services (see Figure 1). The company believed that the transformation would enable their business to faster respond to customer's needs and better focus on solutions for future mobility. (Daimler AG 2019a.)

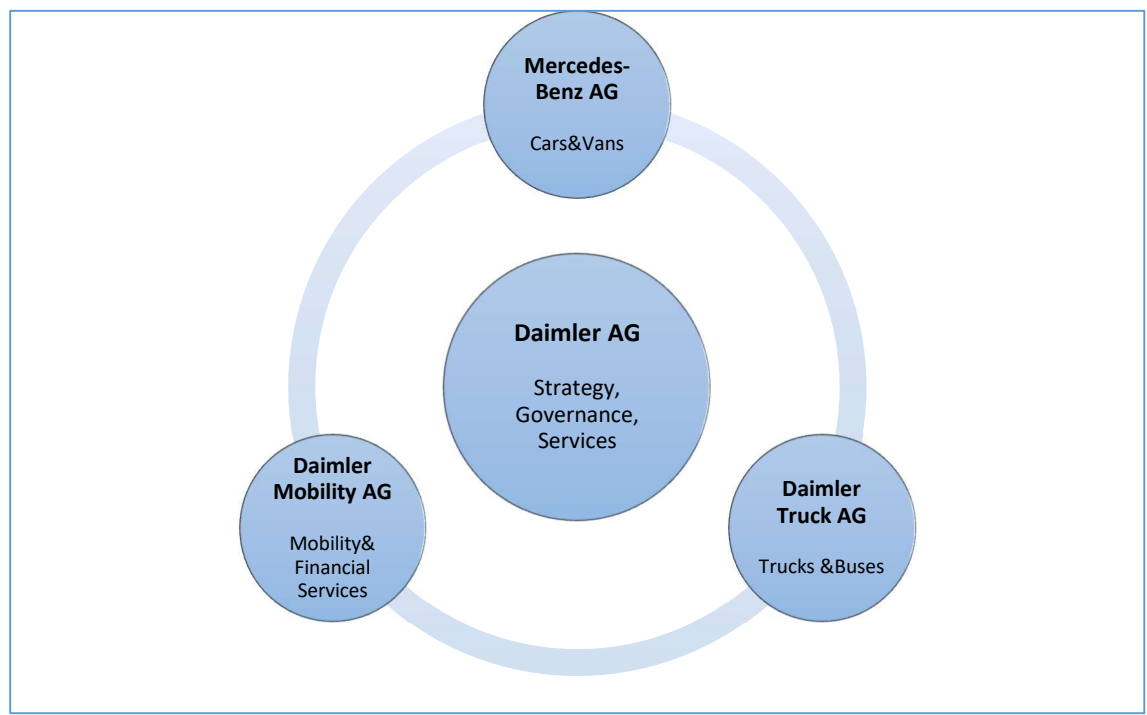


Figure 1. New Daimler Structure 2019 (adopted from Daimler AG 2019b)

Today Mercedes-Benz AG is one of the most successful auto manufacturers in the world. With its total annual revenue of around 110 billion €, 173.000 employees and over 40 production sites all over the world, Mercedes-Benz AG can also be considered one of the biggest global supplier of commercial vehicles. (Daimler AG 2019c.)

Business strategy of Mercedes-Benz AG is aiming at maintaining the leader's position on the market. Autonomous driving, efficiency, digitalization, electrification and sustainability among the others (see Figure 2) are the main areas of focus in the company's corporate strategy. (Daimler AG 2019d, 3.)

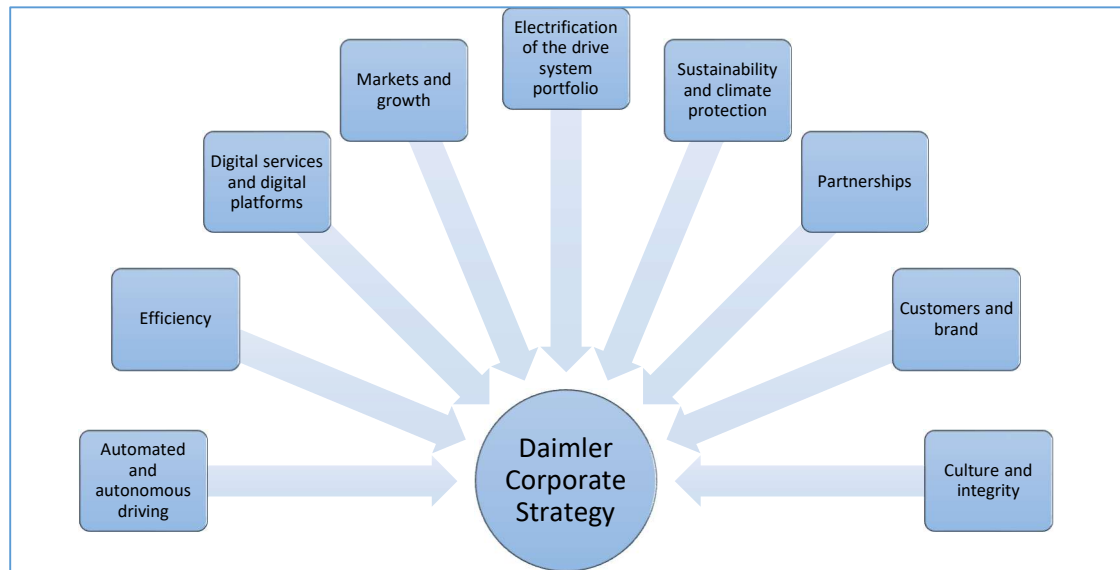


Figure 2. Daimler Corporate Strategy (adopted from Daimler AG 2019d, 53)

Sustainability ensures the long-term success of the company and that is why is considered to be one of the core concepts in Mercedes-Benz AG's business strategy. The company believes that being responsible for the economic, ecological and social impact of the company's activities is crucial for their business. Mercedes-Benz AG's sustainable business strategy is focusing on CO2 reduction, conservation of natural resources, data security and human rights throughout the whole supply chain. (ibid., 3-5.)

Digitization is another fundamental concept of the company's business strategy. Digital platforms and services are increasingly integrated into the daily business, guaranteeing efficiency, profitability and customer

satisfaction. Mercedes-Benz AG is not only focusing on innovation in digital customer solutions but is also aiming at digitalizing the company's processes throughout all stages of the value chain. (ibid., 12-13.)

Mercedes-Benz AG has already launched multiple projects realizing the implementation of the future business strategy, many of them focusing on sustainability and digitalization. For instance, starting from 2017 the company is actively developing new digital solutions that will stimulate its employees to avoid usage of paper and switch to paperless offices (Daimler AG 2017). Another big initiative on the way to sustainable and digital future was the development of paperless manufacturing at some of the plants (Daimler AG 2018a). Today many Mercedes-Benz AG plants have significantly reduced or even eliminated paper in the production and intralogistics processes (Daimler AG 2019e).

The current study on paperless transportation can be seen as the next logical step towards sustainability and digitalization. This project intends to help the company achieving higher efficiency, improving profitability and reducing the environmental impact of the transport operations.

1.3 Targets

The main targets of this study are:

- to study and analyse the legal framework of the paperless transportation in Germany and in the EU
- to determine and evaluate current practices associated with transport documentation at the plants of the OEM

- to suggest solutions that will reduce paper-based documentation, cut costs and improve efficiency of the transportation processes

1.4 Research Questions

Thus, several questions will be examined and answered in this thesis work:

- 1) How is the use of electronic and paper-based transport documents regulated in Germany and in the EU?
- 2) What is the status of using the electronic freight documents in the company?
 - What paper-based documents are the plants currently receiving with goods?
 - Who needs these documents?
 - What are the functions of these documents?
 - In which format (paper-based, electronic document) are the documents required?
- 3) How to reduce the amount of paper-based documentation in transport processes?

1.5 Research Limits

The current study is going to focus on the documents for incoming goods and transported by road transport. The data will be collected from several production sites across Europe. The research on the legal framework will be limited to the national German and European regulations. Due to

the time limitations, new solutions for reducing paper-based documentation, their cost-savings and challenges will be presented only for the national carriages within Germany.

2 Theoretical Background

In Chapter 2, the literature review supports the introduction to the topic by analysis of the existing studies on paperless transport. The methods for the current study are defined.

2.1 Previous Studies

“Going paperless” and abolishing the use of paper-based documents was already considered by many industries. The developments towards digital alternatives were brought up for discussion in multiple research papers. Electronic health records (EHRs) are replacing the handwritten clinical documentation in the healthcare industry (Adler-Milstein and Bates 2010, 119-130). In the warehouse management, traditional order picking methods are substituted by the paperless ones such as pick-to-light, voice picking, RFID tags and barcodes handheld picking (Battini et al. 2015, 483-503). The first steps towards the paperless future were also made in the sphere of education, where the use of tablets and laptops is transforming the learning process from traditional to digital (Duncan 2012). More and more companies are switching to paperless offices by adopting digital solutions for administration and document management (Orantes-Jimenez 2015, 47-55). Other studies, encouraging the “change towards paperless”, were conducted for archaeological practice (Wallrodt 2016, 33-50), landscape architecture (Fabos 1983, 13-18), court processes (Espinosa 2014, 99-110) and customs procedures (Małgorzata Czermińska 2016, 20-36).

The industry of transportation was not an exception. Multiple researchers have discussed the opportunities, challenges and developments of the paperless operations in transportation in their studies. This chapter will summarize their main findings, present the research methods used in their works and identify the gaps in existing knowledge.

Even though transport operations are usually associated with the international context, the existing studies on paperless transport often focus on one specific country or group of countries. As an example, Lynch (2011, 2-4), Piers and colleagues (2018a, 21-41) evaluated the current state of digitization of the freight documents in the countries of the European Union. Laryea (2005, 121-142) gave an overview of the policies for the paperless transport documentation in Asia. Oseledets (2014, 68-73) examined the regulatory framework for the electronic shipping documents in Russia's supply chain. Mei and Dinwoodie (2005, 198-205) studied the potential of the electronic shipping documentation in China. It can be observed that differences in legislation and infrastructure for paperless transport between different countries compel the researchers to limit the scope of the studies and focus their research works on one country or region. Likewise, the current research will be mainly focused on German legislation. In addition, this study will be one of the first research works dedicated to the paperless transport documentation in Germany.

Furthermore, most of the existing studies focused on electronic documentation for a specific mode of transport. Multiple studies on electronic documents were carried out for sea transportation. For instance, Fruth and Teuteberg (2017, 28-32) studied the state of digitization of the

freight documents for maritime logistics. Similarly, Oseledets (2014, 68-73) discussed barriers to use of the electronic documents in the carriage of goods by sea. In the same way, Doan (2018, 22-33), Mei and Dinwoodie (2005, 198-205) and Brunner (2007, 12-24) examined the legal aspects of the electronic Bills of Lading in their studies. Only a few researchers studied the use of electronic documents in air transportation. Even fewer studies on the digitization of freight documents were carried out for road, inland waterway and multimodal transport. The only extensive study across all the transport modes was published by the European Commission in September 2018. Piers and colleagues (2018a, 21-81) studied the current legal framework, barriers and possible policy measures for the use of the electronic transport documents separately for each mode of transport in the EU countries. Overall, the previous studies were mostly dedicated to the development and implementation of electronic transport documents in maritime logistics. The gaps in research for the other modes of transport are still to be completed by future studies.

Many authors raised a question concerning the barriers for digitalizing of freight documents in their studies. According to United Nations (2001,13) legal aspects are the factors that are mostly hindering the use of electronic transport documents. Civelek and colleagues (2016, 74) mention that the lack of standardization of the transport documents is one of the main barriers on the way to paperless logistics. Laryea (2005, 3) points out both operational and legal challenges on the way to paperless transport. In the same way, Piers and colleagues (2018a, 45-72) discuss both legal and operational uncertainties and define three main

problem drivers in the EU: lack of acceptance of the electronic documents by authorities, legal uncertainties on acceptance of the e-documents by authorities, banks and insurance companies and lack of electronic systems for the B2A communication. In addition to the legal and technical barriers, some researchers conclude that companies might face other challenges on the way to their paperless operations. For instance, according to Björk (2006, 644), psychological factors of the employees, that were traditionally using paper-based documents, can resist the implementation of electronic documentation. To sum up, the researched literature reveals three main barriers for paperless transportation: legal, operational (technical) and psychological.

Benefits of the paperless operations were another subject of research in the previous studies. According to Laryea (2002, 1), electronic documentation has considerable advantages in comparison with the paper, as it makes the processes faster, more convenient and cost-effective. Moreover, it reduces the number of errors and facilitates efficient storage, retrieval and analysis of the information (ibid, 1). Similarly, the study of Cepero and Vyšín (2019, 36) concludes, that the implementation of paperless or even semi-paperless processes has a significant impact on the company's efficiency and profitability. Additionally, Piers and colleagues (2018a, 119-120) state that the digitalization of the documents can make the business more sustainable by reducing the CO₂ emissions and ensuring the efficient use of natural resources. Thus, the previous studies indicate that the use of electronic transport documents enables more efficient and sustainable operations and thus strengthens the competitiveness of the businesses.

A few researchers studied the phenomenon of implementation of electronic transport documents in practice. In their papers, they deployed different research methodologies to achieve the studies' goals.

Cepero and Vyšín (2019, 19-28) studied the impact of the semi-paperless solutions on the operations of five large organizations in Europe. The data collection was done by means of interviews with the employees. Later the qualitative data was analysed with the coding technic. The study concluded that semi-paperless solutions could become a good alternative for the companies in the period of transition from paper-based processes to fully paperless operations. The financial and social benefits of the hybrid-paperless solutions are similar to the fully paperless ones; however, fewer investments are required for their implementation. (ibid., 19-38.)

Syrjänen (2017, 8-15) examined the cost benefits of the electronic consignment notes in his study. Similarly to the previous example, interviews were used for collecting the information for the study. The Standard Cost Model method was applied to calculate the cost savings. The dissertation estimated that switching to the electronic consignment note can cut labour costs for processing the paper-based document by 50%. (ibid., 2.)

Lertkitcha (2009, 55) carried out a similar study for maritime logistics. The project aimed at estimating the time and cost savings of an electronic Bill of lading. In this study the data was collected using a survey questionnaire that was sent to 27 organizations. A fishbone diagram was

used to assess the current situation and analyse the issues caused by using paper-based transport documents. When calculating and comparing the costs for the traditional Bill of lading and its electronic alternative, the researcher also considered the companies' investments in a new EDI (Electronic Data Interchange) system. The project reveals that the implementation of an EDI system for processing the Bills of lading can generate significant financial savings and reduce the processing time by almost 70%. (ibid., 55-67.)

Piers and colleagues (2018a, 7-9) carried out another extensive study that examined the implementation of electronic transport documents over all modes of transport in the European Union. To assess the current state of digitization of documents in the transportation industry, one of the research groups carried out an online survey among the authorities and private stakeholders. To examine the current legislation in the member states and build the legal framework, regulating the use of electronic transport documents in the EU, the researchers utilized legal surveys, followed up by targeted qualitative interviews. The collected data was visualized and analysed with the help of taxonomical tables, maps, pie and bar charts. To test the implementation of the electronic transport documents and estimate the cost savings, several case studies, focusing on air, sea, road transportations and the transport of dangerous goods were designed. (ibid., 7-19.)

2.2 Methodology

It can be observed that the authors used different research methods to study the digitalization of freight documents. The next chapter analyses

the approaches used in the previous studies and based on it defines the research methods for the current study. Afterwards, the plan with all the steps and methods, required to answer the research questions, is presented.

The previous chapter reveals that most of the researchers were choosing surveys and/or interviews for data collection. Interviews were mostly used, in case an in-depth assessment of the situation was necessary, while surveys were more effective for getting a representative sample of a larger number of respondents. The current study will deal with a large number of different documents and involve many respondents from different production plants. Thus, to assess the current situation, the current study will use an online survey for the collection of quantitative data. Tables will be used to visualize the collected data, analogously to the study of Piers and colleagues (2018a, 7-19). However, the collection of qualitative data will also be used to support the results of the survey. Qualitative data collection methods will provide additional information on the researched phenomenon, clarify the quantitative findings and improve the understanding of processes (Kabir 2016, 202).

The method of combining the methods of qualitative and quantitative research is known as Mixed Method Research. The strengths of this method include the possibility to get a complete understanding of the phenomenon and minimize the limits of the quantitative and qualitative approaches applied separately. (Creswell 2014, 266.)

Unlike to the study of Piers and colleagues (2018a, 7-19), that used legal surveys and expert interviews for building the legal framework for the

EU countries, the current study will examine the current regulatory framework by means of the legal research. Firstly, it will help to save time for data collection. Secondly, the current study will be limited to the regulations written either in German or English languages, thus, there is no need to involve external experts for analysing the legislation available only in local languages (unlike the study for all the European countries). The more detailed description of the methodology for legal research is presented in the chapter “Legal Framework”.

The previous studies rarely presented the collected data with the help of taxonomical tables, matrices or charts however, the study of Piers and colleagues (2018a, 7-19) used them almost in every stage of the research. The reason for that might be the big number of different documents, authorities and countries involved in the research. Likewise, the current study will deal with the various transport documents at different production sites, thus the matrices will often be utilized to present the collected data. The use of matrices known as Matrix Method is very frequently deployed for the analysis of the cross-functional, qualitative data in business-related applied research; this way of data analysis will help the researcher find the answers to the research questions (Groenland 2014, 4).

Syrjänen (2017, 66-71) demonstrated successful application of the Standard Cost Model method for calculating the administrative costs of manual and electronic consignment notes. Therefore, it was decided to adopt the model to estimate the cost savings of the new solutions at the end of the project. The quantitative methodology for cost calculation will be defined in chapter 5.4.

To sum up, the following methods will be applied to answer the research questions of the study:

Research Question 1

To answer research question 1 (how is the use of electronic and paper-based transport documents regulated in Germany and in the EU?), legal research for the use of transport documents will be conducted. The legal research will be focused on the type of documents, required for transportation, and the format (paper-based or electronic) of those documents. The collected information will be presented with the matrices, which will later be used to find the new solutions for the company.

Research Question 2

In order to assess the current situation in the company and answer the second research question (what is the status of using the electronic freight documents by the company?), both quantitative and qualitative data will be collected. Firstly, the general quantitative data on the use of different documents over European plants will be collected by means of an e-mail survey. Secondly, the follow-up e-mail and phone interviews will provide the qualitative data on the usage, functions and formats of those documents. It will clarify and complete the quantitative data from the survey. Thirdly, to collect information about the processes, associated with the freight documents, and later discuss the possible process improvements, interviews with the transportation companies and personnel at the plant's goods receipt will be conducted. These interviews will also be supported by human observations on the sites. Fourthly, the qualitative data will also be collected from the secondary data sources -

internal and external regulations and specifications of the company, company's internal database, textbooks, academic journals. Finally, quantitative and qualitative data will be summarized, and the analysis will be presented with matrices and flowcharts, which will represent the answers to the research question 2.

Research Question 3

In the next step, the data collected for research questions 1 and 2, will be analysed together. A comparative and critical approach will be used to contrast the current situation and legislation. The analysis will reveal the answer to the last research question (How to reduce the amount of paper-based documentation in transport processes?) As a result, the documents in paper form that are not required by the law should be eliminated in the company's processes. Based on data collected for research question 2, modifications in the processes (solutions) will be presented.

Results

In conclusion, proof of concept, challenges and benefits of the suggested solutions will be discussed. The time and cost-savings will be estimated with the help of the Standard Cost Model method.

2.3 Background Research: Documents Used in Road Freight Transportation

All the documents used in the transportation could be divided into the following groups: documents related to the transported goods, documents concerning the vehicle and documents associated with the personnel performing the transport (Towards paperless transport within the EU and across its borders 2018, 21). Figure 3 presents this classification.

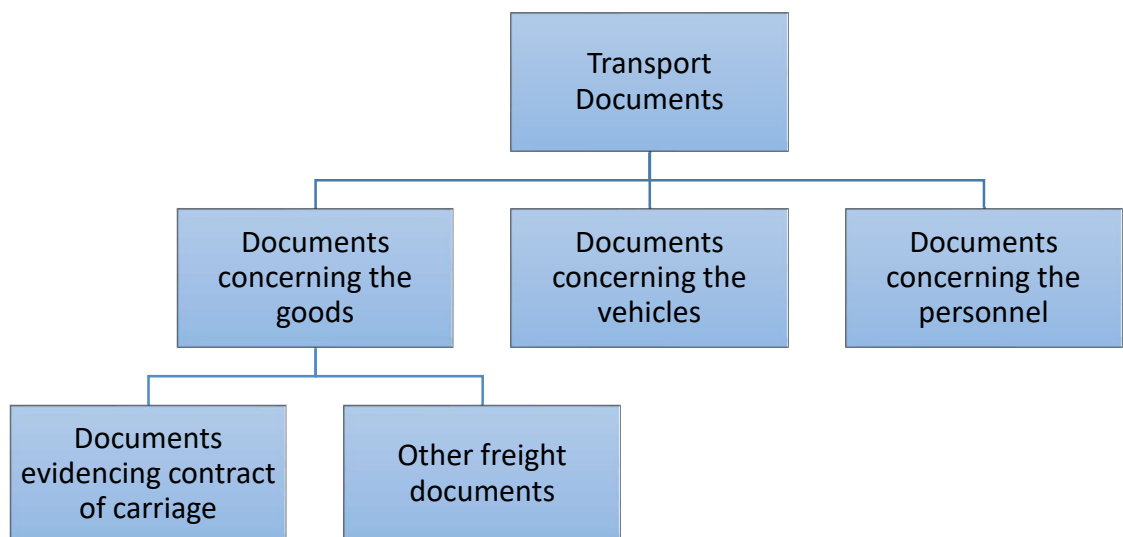


Figure 3. Transport Documents (adopted from Towards paperless transport within the EU and across its borders 2018, 21)

For road transport, personnel-related documents can include

- ID-card (passport)
- visa (if applicable)
- driving licence
- tachograph driver card, digitally recording the speed, operating and rest periods

- the document proving the required qualifications of the truck driver e.g. across Europe Driver Certificate of Professional Competence (Driver CPC)
- Proves of special qualifications (e.g. ADR licence for driving a vehicle carrying dangerous goods, licence for crane operations).

(ibid., 22.)

The list of documents concerning the vehicle usually consists of

- Vehicle Registration Document
- Community licence
- Insurance documents
- Certificate of Roadworthiness (CRW) certifying that the vehicle complies with basic safety requirements
- Certificate of Conformity (COC) - approval certificate issued by a manufacturer, stating the vehicle fulfils the basic technical requirements
- ADR approval - certificate for vehicles carrying certain dangerous goods. (ibid., 22.)

It can be seen that the documents, representing the vehicle and personnel, are often issued and governed by authorities. It obliges the companies to use these documents in the format that is required by legislation. Hence, the companies are unable to replace these documents with electronic alternatives without the authorities' involvement. Moreover, the documents, concerning the personnel and vehicle, do not generate variable transaction costs for the companies, as they are not reissued for every shipment and are rarely monitored within each consignment. Therefore, it was decided to disregard the documents, representing the personnel

and vehicle, in the current study. The later research will focus on the documents representing the transported goods.

The transport documents concerning the goods can be divided into two groups: the documents that are representing the cargo and the documents, serving as proof that the goods have been dispatched or have been handed over to the carrier for transport. In road transportation, the latter group is often represented by the CMR - consignment note for international road transport. In the national transport, it can be replaced by other transport documents, evidencing the contract of carriage. CMR Convention, in French 'Convention relative au contrat de transport international de Marchandises par route,' enacts the use of the standardized waybill in the cross-border road transport. (The German Insurance Association 1998.)

The CMR serves as an agreement between the sender and the carrier for cargo transport. The document is to be issued in three copies: for consigner, carrier and consignee; additional copies can be necessary for the customs procedures. (CMR 2017.)

The CMR or other transport contracts are central and irreplaceable documents in road transportation. They are the main documents that regulate the conditions of the transport operation and are most frequently used by businesses and authorities. (Towards paperless transport within the EU and across its borders 2018, 19.)

Other documents that often accompany the cargo during transport are delivery notes. A delivery note is a document that usually confirms the delivery of shipment. The document is not mandatory; however, it is widely used in international and national transportation. A delivery note

is signed by a consignee upon the arrival of goods. The signed copy serves as proof of delivery of shipping and certifies that the goods and its quantity, indicated in the sale contract, match with the goods, delivered to the buyer. (Delivery Note 2020.)

Unlike the waybill and delivery note that are usually used for any road transport, the list of other documents accompanying the cargo can vary a lot and depends on the type of transported goods. E.g. the laws require special documentation for the transport of dangerous goods, waste, animals, foodstuff. Additionally, the number of required documents can be significantly extended, in case the goods are subjected to import/export.

The transportation of dangerous goods (e.g. explosives, radioactive, flammable materials, etc.) requires the use of additional freight documents. In Europe, the road transport of hazardous goods is regulated by ADR (Accord Dangereux Routier). According to United Nations (2018, 255), every shipment of dangerous substances and materials should be accompanied by the ADR transport document and written instructions. ADR Transport document contains the general information on the type of dangerous goods; instructions in writing provide the vehicle crew with the plan of actions in case of emergency or accident. (ibid., 255-267.)

3 Legal Framework

Chapter 3 discusses the legal framework of the paperless transport in Germany and Europe. Local and European legislation are examined by means of legal research.

3.1 Methodology of Legal Research

The term “legal research” can be generally described as the process of searching for information on the specific legal issue to support the decision-making process. The sources used to perform legal research are divided into primary and secondary ones. (Legal research: an overview 2005.)

Primary sources contain the original laws themselves. Those sources include the constitutions, statutes, governmental and local regulations, case law and treaties. Secondary sources are used to interpret, explain, criticize and review the primary laws. They include legal dictionaries, books, journals, legal encyclopaedias and manuals. (Larson 2018.)

The framework for conducting legal research suggests the following steps:

- As a first step, a legal issue has to be defined. After collecting and analysing the data on the current situation, the research questions have to be formulated and potential search terms are to be defined. (Blechner 2018.)
- In a second step, the secondary sources have to be checked. As secondary sources often explain the laws more extensively and

highlight the important details, starting the research from reviewing those sources first will help to save a lot of time and prevent redundant research. The main objectives of the second step are to get a general understanding of the key terms and concepts of the legal issue and identify the primary sources of law applicable to it. (ibid.)

- The third step is consulting the primary sources, found with the help of the previous step. Browsing through the primary legal sources will help to find the answers to the research question. (ibid.)
- As the last step, the acquired data can be applied to the current legal issue (ibid.).

3.2 Conducting Legal Research

3.2.1 Defining Legal Questions

In the first step of legal research, the legal question was defined. As already mentioned in Chapter 1 of the current thesis, the research question “How is the use of electronic and paper-based transport documents regulated in Germany and EU?” had to be answered. The research question can be broken down into two sub-questions. 1) What documents must accompany the goods, according to existing German and European legislation? 2) What are the format requirements for these documents? The answers to these questions will support the decision-making processes in chapter 5. The following search terms were suggested for conducting the legal research: “transport documents”, “paperless transport”, “accompanying documents”, “format”, “electronic”, “paper-based”, “original”, shipping documents”.

3.2.2 Review of Secondary Sources

As the second step of legal research, the secondary sources were reviewed. The data was collected from trade dictionaries, journal articles, law reviews, reports of the European Commission and Implementation Appraisal of the European parliament. It helped to define the key concepts in the legislation on transport documents and form a general understanding of the current legal issue.

The legal framework for transport documents is formed with international conventions, EU regulations and national German laws. One of the most important international laws, regulating the international carriage of goods by road, is the CMR convention. It lays down the regulations on the use of the CMR consignment note – a mandatory document in the international carriage that serves as an evidence of contract (Goede 2015, 90.)

The CMR convention was ratified by Germany in 1961. Since then the law is directly applicable and has the same power as other German laws. Currently, the CMR convention is a valid law in all the Member States of the EU. (Wegner 2019.)

The use of the electronic version of the CMR document is regulated by the additional e-CMR protocol to the CMR convention. It came into force in 2011. However, before the e-CMR protocol is valid, the country has to sign and ratify it. After ratification, the electronic version of the CMR waybill becomes equivalent to its paper-based version; thus on the territory of the country, the traditional CMR can be replaced by its electronic alternative. (Kulikowska-Wielgus 2019.)

At this moment (March 2020), 25 contracting parties have ratified the additional e-CMR protocol concerning the use of the electronic consignment notes (see Figure 4). It can be observed that Germany and its close neighbours such as Austria, Belgium, Italy have not ratified the e-CMR protocol yet; thus, the electronic CMR is not valid in these countries. However, some of the European countries can benefit from the use of electronic waybill, while performing the international carriage of goods between the contracting parties. Those countries include Denmark, Sweden, Finland, France, Spain, Poland, Check Republic, Slovakia, etc. (United Nations Economic Commission for Europe 2020.)



Figure 4. Countries that have ratified the e-CMR Protocol. Status on March 2020 (United Nations Economic Commission for Europe 2020)

The European regulations and laws often include only general principles of the transport operations and seldom provide information on the transport documentation and its format requirements. For instance, Regulation (EC) No 1072/2009 on common rules for access to the international road haulage market does not define any rules for the road

transport documentation; the regulation only contains the general requirements for the documents for cabotage transport. (Piers et al. 2018a, 27.)

The Council Regulation No 11/1960 concerning the abolition of discrimination in transport rates and conditions, in the implementation of Article 79 (3) of the Treaty establishing the European Economic Community regulates the transports by all modes that are performed on the territory of the EU. It sets the general requirements for the transport documents in article 6. The transport document (evidence of the contract of carriage) should contain specific details such as consigner, consignee, weight and amount of goods, etc. and should be issued in two duplicates. Even though the electronic format of the document is not discussed in the regulation, the formulation makes it clear that a paper-based document is required. (Remáč 2018, 2.)

Though the documents for road transport are almost not normalized by the European legislation, the special legal acts, setting the requirements for documentation, exist for some specific groups of commodities. For instance, the Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste contains the regulations on the documents for the transport of waste. In addition, the Council Regulation (EC) No 1/2005 on the protection of animals during transport sets the document requirements for the transport of the livestock. (ibid., 8.)

Another example is the regulation for the transport of dangerous goods - European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR). It entered in force in 1968. (ADR 2020.)

The ADR regulations also lay down the rules for the documentation. The information on the requirements for the documents and their format can be found in article 5.4. Generally, the regulations allow the use of the electronic ADR transport documents; however, it must be ensured that the electronic equivalent can be accessed by the crew and authorities during the whole transport. (Piers et al. 2018b, 241.)

What do the German national laws say about the freight documents and their format? In the national legislation, there are no general rules regulating the transport documents and their format for all modes of transport. In general terms, the electronic documents are allowed, but there is no law stating that all the authorities must accept the electronic documents. (ibid., 300.)

The information about the documents required in road transportation can be found in the Güterkraftverkehrsgesetzes (GüKG) [Road Transport Act]. After the reform of the act in 1998, there is no obligation to have paper-based accompanying transport documents on the board of the truck. However, Bundesverband Wirtschaft, Verkehr und Logistik (BWVL) [Federal Association of Economy, Transport and Logistics] recommends carrying the existing delivery papers together with goods in case of the roadside checks. (Federal Association of Economy, Transport and Logistics 2008.)

Güterkraftverkehrsgesetzes (GüKG) § 7 states that driving personnel must carry an accompanying document or its alternative and make it available to the authority during the roadside check. The document should specify the goods, the place of loading and unloading, and the customer. The regulation does not require hard copies of the document. The required information can also be provided in electronic form; however, it must be ensured that the data is accessible on the tablet, smartphone or other devices at any time. (Güterkraftverkehrsgesetz (GüKG) - Wissen für LKW-Fahrer [Freight Transport Act (GüKG) - knowledge for truck drivers] 2019.)

Likewise, the Handelsgesetzbuch (HGB) § 408 [Commercial Code] indicates that the electronic version of the waybill is equivalent to its paper-based alternative. In the national transport within Germany, the driving personnel must not carry the printed waybill if the electronic document is available. However, it cannot be applied to the CMR consignment note, which is mandatory in cross-border road freight transport, as Germany has not ratified the e-CMR protocol. (Kunert 2019.)

The roadside checks in road transportation are performed by the Police and Federal Office for Goods Transport. The authorities usually control the consignment notes or waybills and the documents on the dangerous goods. The documents on dangerous goods mentioned in article 5.4 of ADR do not have to bear a handwritten signature and can also be provided in the electronic format in accordance with the ADR. The German law regulating the transport of dangerous goods is represented by the "Richtlinien zur Durchführung der Gefahrgutverordnung Straße, Eisenbahn und Binnenschifffahrt (RSEB)" [Guidelines on responsibility for the

Ordinance on Dangerous Goods by Road, Railways and Inland Navigation]. (Piers et al. 2018b, 299-307.)

While performing the international transport of dangerous goods, extra attention must be paid to the country-specific requirements. For instance, according to the national legislation of France, dangerous goods certificates are only accepted, if they have a handwritten signature (Piers et al. 2018b, 292). In the same way, Spanish authorities would also not accept the electronic documents on dangerous goods (ibid., 381).

Another transport document, that is associated with the goods, is the Confirmation of arrival (in German "Gelangensbestätigung"). This document was introduced in Germany only in 2013 and now is used as an evidence that the goods were delivered to another EU country and thus are exempt from VAT. The document should contain the consignee's name and address, name and quantity of the received goods, place and date of goods receipt, date of issue and the consignee's signature. (Gelangensbestätigung [Confirmation of arrival] 2014.)

The Confirmation of arrival must not accompany the goods; it can comprise several deliveries and be issued weekly, monthly or quarterly. Confirmation of arrival can be transmitted by e-mail or by means of electronic data interchange. Confirmation of dispatch (CMR) or carrier's receipt are alternative documents to prove the Intra-community delivery, however, the Confirmation of arrival is still the most preferable option for the German tax office. In Germany, the usage and format of the Confirmation of arrival and its alternatives are regulated by § 17 of the Sales

Tax Implementation ordinance. (“Umsatzsteuer-Durchführungsverordnung”). (Gelangensbestätigung [Confirmation of arrival] 2014.)

3.2.3 Review of Primary Sources

The information collected from the primary sources – the actual text of laws and regulations proves and complements the data collected from the secondary sources. The results of this phase of legal research are presented in table 1.

Table 1. Legal Framework

Regulation	Scope	Document	Content of the document	Format
Convention on the Contract for the International Carriage of Goods by Road (CMR). (United Nations 1956)	Applies to every carriage of goods by road between the two different countries (Article 1)	Consignment note (Article 4)	-Place and date of issue -Name and address of the sender, carrier, consignee -Place and date of taking over of the goods -Amount, weight, nature of goods -Charges -Instructions for customs procedures and other details if applicable (Article 6)	- "shall be made out in three original copies" -should be signed or stamped by the carrier and the sender -One copy is accompanying the goods -Another copy is given to the sender -The last copy is kept by the carrier (Article 5)
Additional Protocol to the CMR concerning the electronic consignment note (e-CMR)(United Nations 2008)	Same as for CMR	Same as for CMR	Same as for CMR	An electronic consignment note is equivalent to the conventional consignment note defined by the CMR Convention (Article 2)
Regulation No 11 concerning the abolition of discrimination in transport rates and conditions, in implementation of Article 79 (3) of the Treaty establishing the European Economic Community (Council of the European Union 1960)	Applies to every consignment of goods within the Community (Article 6)	A transport document providing the information from column 4 (Article 6)	-Name and address of the sender -Amount, weight, nature of goods -Place and date of taking over of the goods -route or distance in case these factors "justify a rate different from that normally applicable" -customs instructions if applicable. -charges (Article 6)	-should be made in two numbered copies -One copy is accompanying goods -Another copy must be "retained by the carrier for 2 years " (Article 6)
GüKG (Güterkraftverkehrsgesetz [Road haulage law]) (GüKG. Revised 2019)	Applies to every consignment of goods within Germany (§ 7)	A transport document providing the information from column 4 (§ 7)	-transported goods -place of loading and unloading -customer for the carriage (§ 7)	"ein Begleitpapier oder ein sonstiger Nachweis" [an accompanying document or any other type of proof] (§ 7)
HGB (Handelsgesetzbuch[Commercial Code]) (HGB. Revised 2019)	Applies to every consignment when goods are to be transported by road, inland waterways or air, and the transport is an operation of a commercial company (§ 407)	A document evidencing the contract of carriage (Frachtbrief [Waybill]) (§ 407)	The carrier can request the issuing of a waybill with the following data: -Place and date of issue -Name and address of the sender, carrier, consignee -Place and date of taking over of the goods -Amount, weight, nature of goods -Charges -Other details that the parties consider appropriate (§ 408)	An electronic waybill that fulfils the same functions and provides the same information is equivalent to the conventional consignment note (§ 408)

Continued on next page

Regulation	Scope	Document	Content of the document	Format
ADR (European Agreement Concerning the International Carriage of Dangerous Goods by Road) (United Nations 1957)	Applies to any carriage of goods classified as "dangerous goods" by ADR (5.4.0.1.)	-A transport document(s) providing the information from column 4 (5.4.1.1.1.)	-Name and address of the sender, consignee -Amount, weight, nature of goods -UN number -Packaging group -Shipping name -other details on the classification of dangerous goods, packaging, etc. if applicable (5.4.1.1.1.) The information can be incorporated into the existing cargo document (5.4.1.4.2.)	-The use of electronic data is possible if the availability of the transport documents during the whole transport is ensured (5.4.0.2.)
		-Instruction in writing (5.4.3.)	Actions to be taken by the vehicle crew in case of emergency (5.4.3.)	Printed document in the languages the crew members understand (5.4.3.)
GGVSEB (Richtlinien zur Durchführung der Gefahrgutverordnung Straße, Eisenbahn und Binnenschifffahrt [Guidelines for carrying the Dangerous Goods by road, rail-road and Inland waterways]) (GGVSEB. Revised 2019)	Applies to every national (Germany) or cross-border carriage of dangerous goods by road, rail or inland waterways (§ 1)	Documents required by the ADR (Erläuterungen zum ADR 8-1[Interpretation of ADR])	The same as for ADR	The availability of electronic documentation (mentioned in 5.4 ADR) is equivalent to the paper-based document if the electronic record can be viewed or printed out in the crew's cabin if required (Erläuterungen zum ADR 5-13.1 [Interpretation of ADR])
UStDV Umsatzsteuer-Durchführungsverordnung [Sales Tax Implementation ordinance] (UStDV. Revised 2019)	Applies for the purposes of the VAT exemption for the goods transported within the EU Community (§ 17b)	Gelangensbestätigung [Confirmation of arrival] (§ 17b)	-consignee's name and address -name and quantity of the received goods -place and day of goods receipt - data of issue of the certificate -consignee's signature (§ 17b)	-Electronic transmission is possible, the signature is not required -A document can comprise several consignments and be issued monthly or quarterly (§ 17b)
		Or alternatively - Confirmation of dispatch (CMR, waybill) (§ 17b)	-consignee's signature -carrier's signature -other details of the waybill (§ 17b)	no format specifications (§ 17b)
		Or alternatively -Forwarder's receipt (§ 17b)	-consignee's and carrier's name and address -name and quantity of the received goods -place and day of goods receipt - data of issue of the certificate -consignee's signature -carrier's signature (§ 17b)	Electronic transmission is possible, the signature is not required (§ 17b)

3.3 Results: Current Legal Framework

The results of the legal research applied to the current legal issue are presented in table 2. The matrix summarizes the collected data and provides an overview of the required transport documents and their format.

Table 2. Freight documents, regulated by law

Transport	Required documents by legislation	Required format
National Transport within Germany	A document providing the information on -transported goods -place of loading and unloading -customer for the carriage	Paper document or its alternative (electronic format)
International Transport from/to Germany	A consignment note (CMR)	3 original paper-based copies
	Confirmation of Arrival	Electronic document
	other country-specific documents if applicable	
International Transport between the EU countries that ratified the e-CMR protocol	e-CMR	Electronic document
	other country-specific documents if applicable	
National and international transport of Dangerous goods	Transport documents providing the information in accordance with ADR 5.4.1.1.1.	Electronic format is allowed in Germany
		some countries e.g. France, Spain require a paper format
	Written instructions	A printed document is required

3.4 Future Developments in Legislation

It can be observed that the national transport within Germany in most cases allows electronic documents, whereas international transport within the EU still requires the use of paper-based transport documents. In fact, only 1% of the transport documents in road transportation in the EU are currently electronic (Piers et al. 2018a, 8). Since 2016 the European Parliament has been working on the digitisation of transport documents in all of the EU Member States (Remáč 2018, 4). The European Commission has analysed different policy measures and suggested future developments for the legal framework (Piers et al. 2018a, 9).

One of the suggested measures was the requirement of ratification of all the existing Conventions and protocols on the electronic transport documents by all the Member states (Piers et al. 2018b, 182). It will result in the ratification of the e-CMR protocol by Germany and all the other EU members. Obviously, these changes will significantly decrease the use of paper-based transport documents and offer new solutions for European companies.

When will the cross-border transport in Europe become paperless? At the moment the e-CMR protocol is ratified by 25 countries; Germany, Italy and Norway are planning to implement the protocol in the nearest future (Ratification e-CMR protocol 2019). The more concrete dates and specifications cannot be found. According to Zernahle, transport companies will be able to use electronic freight documents anywhere in the EU by 2025 (Zernahle 2019).

Another measure, suggested by the European Commission, was the requirement for the authorities to accept the electronic transport documents. In April 2020, the European Council adopted the new regulations concerning this issue at first reading. The new rules will enter in force 20 days after their adoption at second reading and their publication in the Official Journal. According to the new legal framework, all public authorities will have to accept the transport documents in digital form for all transport modes, if the data is provided on a certified platform. In this way, the electronic information will replace the documents in the paper format during the checks by the authorities. The usage of paper-based freight documents, however, will still be possible. (Digitalisation of freight transport information – Council adopts new rules 2020.)

Moreover, the European Commission is planning to establish a single freight document that can be used in the electronic format for any type of transport within the European Union. This document should significantly reduce the number of documents, accompanying the cargo during the whole carriage across all modes of transport. (Remáč 2018, 4.)

According to the European Commission, the current document-centric approach is becoming obsolete. The use of the unstructured data in the form of PDF documents is inefficient and has several weaknesses in comparison to the structured standardized data sets. Thus, the future developments in legislation should focus on the new data-driven solution, which will provide better availability, flexibility and accuracy of data to all the parties of the supply chain. (Towards paperless transport within the EU and across its borders 2018, 56-58.)

4 Data Collection

Chapter 4 describes the process of data collection. The overview of different types of freight documents used by the company, their functions and formats are presented; the processes, associated with these freight documents are illustrated. Additionally, the chapter provides the data on possible solutions for process optimization and reduction of paper-based documentation.

4.1 Survey

The quantitative data for this part of study was collected with the help of the e-mail survey. The aim of the survey was to find out which freight documents on the incoming goods are used by different production sites of the OEM in Europe. Thus, the question for the survey was formulated as follows: “Which freight paper-based documents is the driving personnel required to provide for registration and unloading of incoming goods at your plant? Please list these documents.”

The participants were chosen based on their field of work and function in the company. People, working in the transport logistics and responsible for the receipt of incoming goods, were included in the mailing list. The questionnaire was sent to 56 people working in 25 different production sites in Germany, Spain, Hungary, Poland, Turkey and Romania. The answers were received from 14 respondents. Thus, the response rate amounted to 25%. The results of the data collection are summarized in table 3.

4.2 Interviews

The collection of quantitative data was followed up by the two-tier interviews. The goal of the interviews was to collect the qualitative data, which would explain and complement the information acquired with the survey. The interviews were conducted using the iterative interviewing approach. During primary interviews, the basic information on documents in use and processes associated with them was collected. These interviews were conducted with the survey respondents (post-survey interviews), forwarding companies and personnel at the receipt of goods at one of the plants. During secondary interviews, the focus of the research was narrowed to collect the information on possible solutions for process optimization and reduction of paper-based documentation. The same forwarding companies and the personnel at the receipt of goods were participating in these interviews. The lists of the questions used in the primary and secondary phases of the interviews are presented in the appendices 1-6 both in English and in German language.

The list of the questions for the post-survey interview varied for different participants and depended on their answers given in the survey. Most of the questions aimed at providing the following information: "Why do you use each of the documents, mentioned in your survey answer?". They were sent to 14 respondents by email or discussed on the phone. Additionally, several questions were formulated to address the subjects of dangerous goods transport and the documents associated with VAT. Those questions were directly sent to the members of the team, responsible for those topics.

The interview with the personnel at the receipt of goods was held in person and was supported by human observations. The processes of registration of a truck at the counter, unloading of goods and documentation workflows were observed for five consecutive deliveries. The summary of the interview is presented in appendix 7.

The interviews with transportation companies were conducted via Skype. Three companies-participants were selected by management based on the level of cooperation. The conversations were held with people in the leading positions: CEO, cluster managers or key account manager. The interviews were also supported by the visit to one of the three companies, where processing of freight documents was observed. The human observations were conducted for 2,5 hours, and processing of documentation for five trucks was monitored. The summaries of interviews can be found in the appendices 8-10.

4.3 Secondary Data Sources

In parallel to the survey and interviews, the data was also being collected from the secondary data sources: internal and external regulations and specifications of the company, company's internal database, documents and publicly available textbooks and journals. One of the internal sources was the "Lastenheft" – the official document issued by the company. It contains the main rules and specifications that the transportation and forwarding companies must follow, while they are working with the OEM. The document also includes the chapter dedicated to the documents that should accompany each consignment. Another source for

data collection was the “EDI Manual” – the collection of different documents that should or should not be transmitted by the supplier per EDI. Moreover, some information about the processing of the documentation at the counter for registration at the plant was received from the instructions that are used for guiding the employees through the process of goods receipt.

Finally, sample documents that are used for registration and receipt of goods at different production sites were also used for the data collection. The set of sample documents were received from four production sites and included the cover sheet for delivery, forwarding order, EDI goods accompanying slip, loading lists, CMR, delivery note and unloading list.

4.4 Results of Data Collection

4.4.1 Freight Documents in Use

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4.4.2 Delivery of Goods. Process Description.

Detailed process description below indicates how, by whom and at what time the freight documents are being processed, providing the complete information on the documents and information flows between the parties. This subchapter complements the data presented in table 4 and completes the answer to research question 2.

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4.4.3 Digitalization of Processes

The secondary interviews, which were aimed at collection of information on possible solutions for process optimization and reduction of paper-based documentation, have revealed the following results:

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5 Analysis of Research Results

Chapter 5 analyses the data collected in the previous stages of research and suggests new solutions for the reduction of paper in the transportation process. The evaluation of concept for the new solutions is presented. Possible challenges of implementation and benefits are discussed.

5.1 New Solutions

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5.2 Evaluation of Concept

To verify the validity of suggested changes, the evaluation of concept was performed. The feasibility of the new solutions and the practicality of their implementation were discussed with the management of the OEM. The process descriptions below demonstrate how electronic document workflows can be integrated in the existing delivery processes in practice. The delivery process with the registration at the counter and delivery process in case of registration-free arrival are presented separately (see Figures 6 and 7).

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5.2.1 Delivery Process with Registration

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5.2.2 Registration-free Delivery Process

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5.3 Challenges of Implementation

The implementation of the suggested concepts in practice can be accompanied by different operational challenges. Based on the research results, the following prerequisites are to be considered before the practical application of the solutions:

- As none of the interviewed companies has experience in using an electronic waybill, the reaction of the authorities in case of presenting an electronic alternative of the paper-based document during roadside checks cannot be predicted. Even though electronic waybills are allowed by the legislation, some of the authorities might still prefer traditional documents. This issue could be clarified by testing the concept with a pilot, in which the electronic documents will be accompanied by the hard copy of the waybill. The paper-based waybill could be presented to the authority, in case of non-acceptance of the electronic document.
- To enable fast and secure exchange of electronic documents between the parties, the implementation of customized software is needed. In case of utilizing the application, provided by an external software provider, data security has to be taken into consideration.
- To ensure the data integrity and simplify the transfer of data, it might be necessary to unify and interconnect the applications for transport data across the production sites and transportation companies. The interfaces between the IT-systems in use are to be configured.

- In the suggested solution, the goods takeover at the supplier's and the receipt of goods by the OEM is confirmed only with an electronic signature. Hence, it has to be guaranteed that all the parties, involved in the transportation process, including the insurance companies, courts and other authorities accept the legitimacy of the electronic signatures. In case of disputes, the electronic confirmations have to be recognised by all the parties. To ensure the legitimacy of the electronic documents, the OEM could incorporate the requirements for using and accepting the electronic documentation into the agreements with the transportation companies.
- The registration-free entry of the truck to the OEM's plant is only possible if the suppliers of goods regularly and punctually send error-free delivery data per EDI. Thus, before the implementation of this solution, the quality of data sent by the supplier must be analysed; if necessary, new data standards and specifications have to be introduced.
- In order to ensure the availability of electronic documents during the whole transportation process, all the drivers have to be equipped with smartphones or tablets. The devices should always be in commission and charged; the documents are to be accessed at any time.
- To enable successful implementation of the solutions, an implementation plan has to be created. It has to be decided, if the implementation is done at once for all the transportation companies or gradually, by introducing the solution at one company at a time. Moreover, it must be ensured that the personnel of the OEM and transportation companies get familiar with the new processes

(and software) and receive all the necessary trainings beforehand. To facilitate the smooth implementation process it might also be feasible to test the solutions in a pilot with a couple of transportation companies.

- The introduction of the new processes is very likely to be accompanied by the counteraction from the employees. Comprehensive personnel trainings, gradual implementation process and effective communication between management and employees might help to successfully overcome this change resistance.

5.4 Benefits

5.4.1 Standard Cost Model

In order to estimate the annual savings of suggested solutions, the Standard Cost method was utilized. The Standard Cost Model is a quantitative methodology that was developed in the Netherlands in 2003 (The Standard Cost Model 2004, 2). It defines a framework for calculating administrative costs for businesses and can be applied in any country (ibid.).

The International Standard Cost Model Manual suggests the following steps for implementation of the standard cost analysis: preparatory analysis, data collection, calculations and reporting (Figure 6). In the first step, the business process in question is broken down into the associated administrative activities, the cost parameters and the data requirements are defined. In the second phase, the interviews with the selected participants are conducted, the collected empirical data is used to complete the gaps in the data model. In the final step, the calculations are carried out and the results are presented for reporting. (International Standard Cost Model Manual 2005, 20-45.)

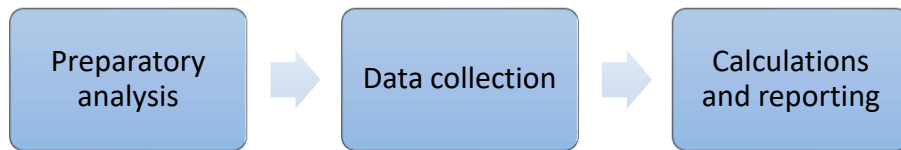


Figure 6. Phases of Standard Cost Analysis (adopted from International Standard Cost Model Manual 2005, 20-21).

The basic structure of the standard cost model consists of the cost for performing the administrative tasks and the number of these tasks in a year. The costs of a task are calculated using the information on the gross salary of a performer (including the insurances, vacation allowance etc.), the time that is required for performing the task, material costs associated with the activity and external costs (Figure 7). (The Standard Cost Model 2004, 18-22.)

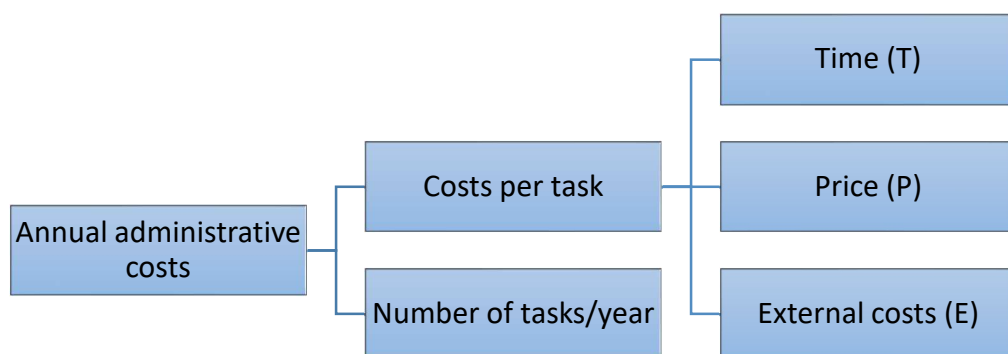


Figure 7. Annual administrative costs using the SCM method (adopted from (The Standard Cost Model 2004).

An example of a reporting sheet for the Standard Cost analysis can be seen below (Table 5). The values of the variables S (Salaries per hour), T (Time for each activity), N (number of tasks per year) can be defined based on the data collected from the interviews. Afterwards, labour costs (C) and total annual costs (A) can be calculated.

Table 3. Calculation model for annual administrative costs (adopted from International Standard Cost Model Manual 2005, 59).

No.	Work steps	Performer/ Participant	Tariff S / hour)	Time T (min)	Costs/ task C	Num- ber of tasks/ year N	Total annual costs A
1	Activity 1	Performer 1	S_1	T_1	$C_1 = T_1/60 * S_1$		
2	Activity 2	Performer 2	S_2	T_2	$C_2 = T_2/60 * S_2$		
...		
n	Activity n	Performer n	S_n	T_n	$C_n = T_n/60 * S_n$		
Sum				$T = \sum_{i=1}^n T_i$	$C = \sum_{i=1}^n C_i$	N	$A = N * C$

5.4.2 Cost Savings

In the current study, the Standard Cost Model was adopted to include labour costs and printing and material (paper) costs for each task. Firstly, the method was applied to calculate the net annual costs of the current documentation workflows. Secondly, two suggested solutions were analysed in the same way. Finally, the results of the calculations were compared.

After the delivery process was broken down into different work steps, related to the freight documentation, the cost parameters were defined. The data on salaries of the process participants, time for performing each task, number of pages in documents, paper and printing costs was collected.

The salaries were estimated based on the data from the glassdoor.de – the platform where people share salaries for different positions in different companies. Both direct and indirect personnel costs were considered in the calculation of the hourly labour costs. The total costs of an employee in Germany amount to an average of 1,7 from the gross salary (Personalkosten pro Arbeitnehmer [Personnel costs per employee] 2020). This factor was also used to estimate the hourly labour costs.

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5.4.3 Other Benefits

Besides considerable time and cost savings, the company could also benefit from further advantages of suggested solutions. Electronic freight documents would facilitate automatic archiving and more efficient storage of files. The data could be accessed by the parties anytime, and thus, improve the transparency of the processes. The replacement of delivery notes and loading lists with the data transferred per EDI would also improve data integrity.

Moreover, the replacement of paper-based freight documents with their electronic alternatives would contribute to the sustainability of business and reduce the impact of transport operations on environment. Significant reduction of paper, used in the processes (see Table 11) would decrease deforestation, thereby lowering carbon dioxide (CO₂) emissions.

6 Discussion

6.1 Conclusion

The current research has studied transport processes and associated with them documentation workflows at different production sites of the OEM. It has also analysed the legal framework, regulating the usage of transport documents within Germany and the EU. Based on the results, new solutions, reducing the use of paper-based documents, their benefits and challenges were discussed. The goals set at the beginning of the study were accomplished; the answers to the research question were presented in the thesis.

The study has shown, how optimization and digitalization of the freight document workflows can influence the competitiveness of a company. Even though the format of some transport documents is regulated by the legislation and thus cannot be changed, most of the documentation requirements can be created by a company itself. Critical analysis of the operations and digitalization of traditional documents can help reduce the costs associated with transport processes.

6.2 Reflection

Reliability and validity of the research results were assured through triangulation. The phenomenon of documentation workflow in transport processes was studied using different quantitative and qualitative methods: survey, interviews, human observations, review of secondary sources. The data from multiple sources was collected and cross-verified to provide complete and reliable results.

Quantitative data for the research was collected through a survey. The response rate accounted for 25%, which can be considered quite low for internal surveys. It resulted in a 75% non-response bias that usually would affect the results. However, the given answers have provided the data, representing 14 out of 25 European plants that produce different types of products. Moreover, in the current research, it was more essential to obtain a general overview of documents in use at European plants, rather than to compare different production sites. The validity of collected data was later confirmed by the evaluation on the site. Thus, the quality and number of survey answers were sufficient to draw reliable conclusions.

The qualitative data was collected from interviews and secondary sources. The interviews were conducted internally (with the employees of the OEM) and externally (with three transportation companies). The interviews with transportation companies were held in the same conditions (time available, language of communication); the same formulated questions were used; the interviewees had similar positions and experience at the companies. Additionally, the interviews were supported by human observations that helped to improve the validity and reliability of results.

Most of the research was conducted in German language. It considerably increased the amount of available information, collected from secondary sources, and improved the quality of the results from the survey and interviews (as German was the native language for all the respondents). However, at the same time, it could have caused differences in the interpretations of data. To prevent or minimize the loss and distortion of data

in the thesis through translation, interview questions were presented in both languages. For the same purposes, direct citations of terms, laws and company-specific vocabulary were duplicated in German throughout the whole text of the thesis.

The study was carried out during the global pandemic. It had a significant impact on the planned outcome of the research project. The implementation of the new solution within a pilot project, that was initially planned, could not take place in the conditions of the pandemics. Reduced working hours, absence of the employees and impossibility of personal contact were impeding the communication between the study participants, which made the research process more difficult and time-consuming. Nonetheless, available time and information resources were sufficient to obtain reliable and valid results and to present a theoretical concept that can be implemented in the future.

6.3 Suggestions for Future Studies

The current research has studied the processes associated with paper-based transport documentation and has suggested new solutions that would replace hard copies with electronic documents. As the new concept was studied in theory, the actual implementation in practice and its challenges are to be examined by the future research. Thus, prospective studies could help the commissioning party introduce the new customized software for electronic document interchange, unify all the applications in use, analyse the quality of data provided by suppliers, plan the pilot and the actual implementation of the concepts.

As the current study has analysed the inbound processes and documentation associated with them, the next logical step could be optimization and digitalization of the intralogistics and outbound operations. Moreover, new solutions for paperless transport could be suggested based on future developments in legislation.

Another idea for future research could be the analysis of the archiving of transport documents. Similarly to the current study, the legal requirement for achieving of freight documents could be compared to existing practices. Based on the results, the processes are to be optimized; the number of documents and duration of storage is to be reduced to a minimum throughout the whole supply chain.

As the electronic document-based approach is becoming obsolete, it can also be recommended to focus future studies on data-driven solutions for exchanging information between the parties. Transport data can be shared per EDI, with the help of the mobile applications or QR codes. A prerequisite for these future developments would be the standardization of delivery processes, information workflows and IT- infrastructure throughout the supply chain.

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Appendices

Appendix 1. Interview Questions for the Plants (German)

Original text of questions.

- Welche Funktionen hat der Beladeplan?
- Wer und warum braucht den Speditionsauftrag?
- Welche Funktionen hat der DFÜ-Warenbegleitschein? Wie wird er benutzt?
- Was ist die Funktion des Deckblatts für die Warenlieferung?
- Warum benötigen Sie zwei verschiedene Ladelisten: sortiert nach Lieferanten und nach Entladestellen?
- Was ist der Unterschied zwischen der Ladeliste nach Entladestellen und der Entladeliste?
- Welche Gefahrgutdokumente werden am Wareneingangsschalter in den Werken verwendet? In welchem Format?
- Gibt es Dokumente, die für die Mehrwertsteuerbefreiung erforderlich sind? Was sind Sie? In welchem Format sollen sie bereitgestellt werden?

Appendix 2. Interview Questions for the Plants (English)

Translation of questions.

- Which functions does the load plan have?
- Who needs the document with the forwarding instructions (forwarding order)? Why?
- What is the role of the goods accompanying slip? How is it used?
- What is the function of the cover sheet for the goods delivery?
- Why do you need two different loading lists: sorted by the supplier and by the unloading station?
- What is the difference between the loading list sorted by the unloading station and the unloading list?
- What dangerous goods documents are used at the goods receipt counter at the factories? In which format?
- Are there any documents that are necessary for the VAT exemption? What are they? In which format should they be provided?

Appendix 3. Interview Questions for Transportation Companies (German)

Original text of questions.

Phase 1

1.1 Wie informiert Sie der Lieferant über die bevorstehende Lieferung?

1.2 Wie erhält der LKW-Fahrer einen Speditionsauftrag (in der App, per E-Mail, in Papierform)?

2.1 Welche Unterlagen und in welchem Format holt der LKW-Fahrer beim Lieferanten ab?

2.2 Wie viele Kopien desselben Dokuments erhält er?

2.3 Woher bekommt der LKW-Fahrer diese Dokumente?

2.4 Wie lange dauert die Abholung der Dokumente?

3.1 Wie läuft der Prozess der Quittierung beim Lieferanten ab?

3.2 Erhält der LKW-Fahrer auch eine Quittung oder bleibt der Nachweis nur beim Lieferanten?

4.1 Welche Unterlagen werden von den Behörden bei den Straßenkontrollen geprüft?

4.2 Hat sich in diesem Zusammenhang in der aktuellen Situation der Pandemien etwas geändert? Wenn ja, was?

5.1 Wie bearbeiten Sie die Versandpapiere?

5.2 Wie viel Zeit benötigen Sie für die Bearbeitung der Dokumente?

5.3 In welchem Format stellen Sie das Deckblatt zur Lieferung aus? (Verwenden Sie die elektronische Plattform für die Inboundlogistik oder füllt der LKW-Fahrer das Blatt vor der Registrierung im Werk manuell aus?)

5.4 Wie viel Zeit benötigen Sie, um das Deckblatt für die Lieferung auszustellen?

6.1 Welche Unterlagen bringen Sie zum Schalter im Werk mit?

6.2 Wie lange dauert normalerweise der Registrierungsprozess am Schalter?

6.3 Welche Papiere bringt der LKW-Fahrer zur Entladestation?

7.1 Wie wird die Lieferung der Ware bestätigt? (Wie läuft der Prozess der Quittierung im Werk ab?)

Phase 2

1.1 Haben Sie eine eigene digitale Lösung für den elektronischen Dokumentaustausch im Einsatz?

2.1 Läuft der Prozess der Quittierung beim Lieferanten bei den anderen Firmen gleich ab? Wie wird die Abholung von Waren bei den Lieferanten anderer Unternehmen (Ihren Kunden) bestätigt?

3.1 Nach den geltenden Rechtsvorschriften kann der Speditionsauftrag durch den elektronischen Nachweis (z. B. elektronisches Dokument auf dem Smartphone oder Tablet) ersetzt und bei Straßenkontrollen von den Behörden akzeptiert werden. Haben Sie Erfahrung darin, den Speditionsauftrag in anderen Branchen oder bei anderen Kunden durch die elektronische Version zu ersetzen?

4.1 Welche Lieferbestätigung benötigen Sie vom OEM?

4.2 Wäre die Zweiterfassung von den Waren in digitaler Form (z. B. per E-Mail) eine Möglichkeit der Quittierung?

4.3 Wie läuft der Prozess der Quittierung bei der Zustellung bei den anderen Firmen (Ihren Kunden) ab?

4.4 Haben Sie eine eigene digitale Lösung für den elektronischen Zustellnachweis im Einsatz?

Appendix 4. Interview Questions for Transportation Companies (English)

Translation of questions

Phase 1

1.1 How does the supplier inform you about the upcoming delivery?

1.2 How does the truck driver receive a freight forwarding order (in the app, per email, as paper)?

2.1 Which shipping documents and in which format does the truck driver pick up at the supplier's site?

2.2 How many copies of the same document does he get?

2.3 Where does the truck driver get these documents?

2.4 How long does the pick-up of the documents take?

3.1 How does the driver confirm the receipt of goods?

3.2 Does the truck driver also receive a receipt or does the confirmation remain only at the supplier?

4.1 What shipping documents are checked by the authorities during the roadside checks?

4.2 Has anything changed in the current situation of pandemics in this context? If so, what?

5.1 How do you process the shipping documents?

5.2 How much time do you need for processing of the documents?

5.3 In which format do you issue the cover sheet for delivery? (Do you use the electronic platform for inbound logistics or does the truck driver fill it in manually before the registration at the plant?)

5.4 How much time do you need to issue the cover sheet for delivery?

6.1 Which documents do you bring to the registration counter at the Mercedes-Benz plant?

6.2 How long does the registration process at the counter normally take?

6.3 What papers does the truck driver bring to the unloading station?

7.1 How is the delivery of goods confirmed?

Phase 2

1.1 Do you have your own digital solution for the electronic document and file exchange in use?

2.1 Is the process of confirmation of goods receipt always the same?

How is the pick-up of goods confirmed at the suppliers of other companies (your customers)?

3.1 According to the current legislation, the freight forwarding order can be replaced with the digital alternative (e.g. electronic document shown on the smartphone or tablet) and can be accepted by the authorities in case of the roadside checks. Do you have experience in replacing the freight forwarding order with its electronic version in other industries with different customers?

4.1 What kind of confirmation of delivery do you need from the OEM?

4.2 Would the confirmation of recorded received goods in digital form (e.g. per e-mail) be an option for you?

4.3 How is the delivery of goods confirmed by other companies (your customers)?

4.4 Do you have your own digital solution for electronic proof of delivery?

Appendix 5. Interview Questions for OEM's Employees: Registration counter, Unloading station (German)

Original text of questions.

Phase 1

1.1 Welche Papiere und in welchem Format braucht der Schalter für die Registrierung?

1.2 Welche digitalen Informationen über die Lieferungen im System haben die Mitarbeiter am Schalter?

1.3 Wer ist verantwortlich, wenn die Daten fehlen?

1.4 Wie lange dauert normalerweise der Anmeldeprozess am Schalter?

1.5 Wie werden die Dokumente bearbeitet?

1.6 Welche Papiere werden dem Fahrer zurückgegeben?

2.1 Wie funktioniert die Leitstelfreie Anfahrt?

2.2 Wie viel Zeit spart die Leitstelfreie Anfahrt?

3.1 Wie läuft die Quittierung pro Abladestelle ab?

4.1 Welche Clearings Fälle gibt es?

4.2 Wie werden sie verarbeitet?

4.3 Wie funktioniert der Clearings Prozess beim Wareneingang bei der Leitstelle freien Anfahrt? (Welche Unterlagen/Daten werden korrigiert und wie?)

Phase 2

5.1 Welche Voraussetzungen muss man erfüllen, damit die Leitstelfreie Anfahrt möglich ist?

5.2 Wäre es möglich, dass der Fahrer die Zweiterfassung der empfangenen Waren in digitaler Form bekommt (z.B. per E-Mail)?

5.3 Wäre das eine Möglichkeit zur Quittierung des Wareneingangs?

5.4 Würde es reichen, wenn der Fahrer die DFÜ Warenbegleitschein, ggf. andere Dokumente in digitaler Form (z. B. auf dem Smartphone) zu Verfügung stellen würde und das elektronische Deckblatt nur auf der IBL-Plattform verfügbar wäre?

Appendix 6. Interview Questions for OEM's Employees: Registration Counter, Unloading Station (English)

Translation of questions.

Phase 1

1.1 What documents and in which format does the employees at the counter need for registration of the delivery?

1.2 What digital information on the upcoming deliveries in the system do these employees have?

1.3 Who is responsible if the data is missing?

1.4 How long does the registration process at the counter normally take?

1.5 How are the documents processed?

1.6 What documents are returned to the driver?

2.1 How does the delivery of goods without registration at the counter work?

2.2 How much time does it save?

3.1 How is the delivery of goods confirmed?

4.1 Which clearing cases are there?

4.2 How are they processed?

4.3 How does the clearing process for incoming goods work in case of registration-free deliveries? (Which documents are corrected and how?)

Phase 2

5.1 What are the prerequisites to enable registration-free deliveries?

5.2 Would it be possible to provide the driver with the confirmation of recorded received goods in digital form (e.g. per e-mail)?

5.3 Would this be a way to confirm the receipt of goods?

5.4 Would it be enough if the driver only provided the EDI goods accompanying slip and other documents (if necessary) in digital form (e.g. on the smartphone) and the electronic cover sheet would be available on the electronic platform?

Appendix 7. Interview Summary 1.

The content has been omitted due to confidentiality reasons.

The content has been omitted due to confidentiality reasons.

The content has been omitted due to confidentiality reasons.

The content has been omitted due to confidentiality reasons.

Appendix 8. Interview Summary 2.

The content has been omitted due to confidentiality reasons.

The content has been omitted due to confidentiality reasons.

Appendix 9. Interview Summary 3.

The content has been omitted due to confidentiality reasons.

The content has been omitted due to confidentiality reasons.

The content has been omitted due to confidentiality reasons.

Appendix 10. Interview Summary 4.

The content has been omitted due to confidentiality reasons.

The content has been omitted due to confidentiality reasons.

Appendix 11. Cover Sheet for Delivery

The content has been omitted due to confidentiality reasons.

Appendix 12. Forwarding Order

The content has been omitted due to confidentiality reasons.

Appendix 13. EDI Goods Accompanying Slip

The content has been omitted due to confidentiality reasons.

Appendix 14. Loading Lists

The content has been omitted due to confidentiality reasons.

Appendix 15. Load Plan

The content has been omitted due to confidentiality reasons.

Appendix 16. CMR

The content has been omitted due to confidentiality reasons.

Appendix 17. Delivery Note

The content has been omitted due to confidentiality reasons.

Appendix 18. Unloading List

The content has been omitted due to confidentiality reasons.