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Connecting Authorities for Safer Heavy Goods Traffic in the Baltic Sea Region

RISK MANAGEMENT IN LOGISTICS

Empirical Results from the Baltic Sea Region from 2010 until 2012

Wolfgang Kersten

Meike Schröder

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Baltic Sea Region Programme 2007-2013

Part-financed by the European Union (European Regional Development Fund)

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Wolfgang Kersten
Meike Schröder
Carolin Singer
Max Feser

Institute of Business Logistics and General Management,
Schwarzenbergstrasse 95
21073 Hamburg, Germany

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EXECUTIVE SUMMARY

This document belongs to the C.A.S.H. publication series. The C.A.S.H. project (Connecting Authorities for Safer Heavy Goods Traffic in the Baltic Sea Region) ran from September 2009 until September 2012.

In this report, the empirical results in the field of risk management in the Baltic Sea Region (BSR) achieved in the course of the project are presented.

In **chapter 1-2,** the basics of logistics and transport, logistics in the BSR and in the European Union as well as fundamentals of risk management are presented. Transport is the most important economic activity among the components of business logistics, also in the BSR, one of Europe's most dynamic regions.

Chapter 3 deals with the application of techniques for data collection. The advantages and disadvantages of a survey, of workshops and expert interviews are described. For this research project, different techniques for data collection are used successively.

In **chapter 4,** the empirical results in the field of risk management are discussed which were obtained within the project by the survey, the workshops and the expert interviews. More than 80 manufacturing companies and logistics service providers participated in the survey in 2010.

In addition to the survey and the workhops, 16 expert interviews were conducted. In the expert interviews, the focus was set on the implementation of risk management and on possible risks which may occur in transport.

Chapter 5 deals with the compilation of risk mitigation measures. First, an overview of existing types of mitigation measures and strategies is given. Afterwards a framework of potential measures to handle road transport risks is described which helps company representatives to mitigate road transport risks and therefore enable a smooth flow of goods.

Chapter 6 contains the implementation of information technology (IT) tools in risk management. Besides, requirements for an IT-tool in risk management and a comparison of available IT-tools are presented.

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LIST OF ACRONYMS

BSR	=	Baltic Sea Region
C.A.S.H.	=	Connecting Authorities for Safer Heavy Goods Traffic in the Baltic Sea Region
CSCMP	=	Council of Supply Chain Management Professionals
EEA	=	European Economic Area
EU	=	European Union
FMEA	=	Failure Mode and Effects Analysis
GDP	=	Gross Domestic Product
GPS	=	Global Positioning System
HGV	=	Heavy Goods Vehicle
IT	=	Information Technology
KonTraG	=	Gesetz zur Kontrolle und Transparenz im Unternehmensbereich (a German law)
KPI	=	Key Performance Indicator
LogOn Baltic	=	Logistics in the Baltic Sea Region
LPI	=	Logistics Performance Indicator
LSP	=	Logistics Service Provider
MC	=	Manufacturing Company
NOFOMA	=	Nordic Logistics Research Network
POMS	=	Production and Operations Management Society
R&D	=	Research and Development
SOP	=	Standard Operation Procedures
SWOT	=	Strengths, Weaknesses, Opportunities, and Threats
TEU	=	Twenty-Foot Equivalent Unit
TUHH	=	Technische Universität Hamburg-Harburg (Hamburg University of Technology)
VGTU	=	Vilnius Gedimino Technical University

1 INTRODUCTION

This study is part of the C.A.S.H. project – Connecting Authorities for Safer Heavy Goods Traffic in the Baltic Sea Region. The C.A.S.H. project is part-financed by the European Union (EU) (European Regional Development Fund) through the Baltic Sea Region Programme 2007-2013. To find out more about the programme, visit http://eu.baltic.net/.

In the following, the project and its regional partners are described. Furthermore, the purpose of this report is explained.

1.1 Project introduction – C.A.S.H.

The C.A.S.H. (Connecting Authorities for Safer Heavy Goods Traffic in the Baltic Sea Region) project aims at developing practical solutions to make international road freight transport safer, more predictable and affordable in the Baltic Sea Region (BSR). The project intends to do this by:

- improving cooperation between authorities
- harmonizing training of inspection officials
- testing safety equipment and information technology (IT) systems to be used by relevant authorities

The C.A.S.H. project is due to run for three years, from September 2009 to September 2012. The project will benefit not only the authorities inspecting the traffic through harmonized practices, but logistics business as a whole. The project is co-ordinated by Turku School of Economics in Finland, as part of University of Turku.

The C.A.S.H. project partnership is made up of 13 organisations in eight countries around the BSR (Figure 1), including:

- police and other authorities dealing with road traffic safety
- regional councils
- research institutes

Figure 1: The locations of the C.A.S.H. partner organisations and countries

With about one million road haulage companies in Europe and over 560,000 million tonne kilometres of goods transported annually on the roads of the BSR, road freight transport is big business.

Despite similar regulations, authorities in European countries may apply different practices and equipment to inspect the traffic. This puts additional pressure on road haulage companies which have to comply with regulations when they are already facing the challenges of a very competitive market.

In addition, more than 1,300 fatalities involving a heavy goods vehicle took place in the BSR in 2007, equal to 10 % of all accidents.

This is why 13 organisations from eight countries in the Baltic Sea area created the C.A.S.H. project. The project brings together police officers and other authorities inspecting Heavy Goods Vehicles (HGV) in the Baltic Sea area in order to spread good inspection practices across the region.

To find out more about the project and the different work packages, please visit the project website www.cash-project.eu.

1.2 Regional partner introduction

The following organisations are partners of the C.A.S.H. project:

- *Danish National Police, National Traffic Center, Denmark*
- *Hamburg University of Technology (TUHH), Germany*
- *Hamburg Waterways Police, Germany*
- *Latvian Transport Development and Education Association, Latvia*
- *National Police Board, Sweden*
- *Norwegian Mobile Police Service, Norway*
- *Personal Protection and Law Enforcement Police / Traffic Supervision Division, Estonia*
- *Police of Finland, Finland*
- *Regional Council of Kymenlaakso, Finland*
- *Regional Council of South Karelia, Finland*
- *Regional Council of Southwest Finland, Finland*
- *Turku School of Economics (University of Turku), Finland*
- *University of Turku, Finland*
- *Vilnius Gedimino Technical University (VGTU), Lithuania*

1.3 Purpose of this study

This research paper “Risk Management in Logistics – Empirical results from the Baltic Sea Region from 2010 until 2012” is part of work package 5 – “Equipment, Safety and Risk” – of the C.A.S.H. project.

The aim of work package 5 is to support related equipment and risk analysis investments through equipment testing in practical use and through analytic work. This work package is not meant for the investments themselves, but to provide useful information for equipment and IT investments outside the project.

Work package 5 is divided into three activities: (1) Equipment testing, (2) security issues, and (3) risk analysis methods. These activities comprise the following sub-activities:

(1) Equipment Testing

- Recommendations for the BSR roadside checks
- Recommendations for the BSR road police corps when investing in up-to-date digital tachograph analysis
- Creation of a traffic police equipment database and a network of equipment experts in the BSR

(2) Security Issues

- Plan for improved cross-border cooperation in procurement of HGV control equipment
- Plan for improved cross-border research and development (R&D) cooperation with HGV control equipment users, manufacturers and technology agencies

(3) Risk Analysis Methods

- Risk analysis methods and frameworks applied in HGV traffic control
- Recommendations for the BSR road police corps when investing in risk analysis IT solutions and related tools

This report refers to the sub-activity (3) Risk Analysis Methods – Risk analysis methods and frameworks applied in HGV traffic control.

In this report, the empirical results in the field of risk management in the BSR which were achieved in the course of the project are presented. One of the aims of this report is to identify and analyse risks which may occur in transport. Therefore, the transport risks from the police authorities' point of view and from the company representatives' perspective are considered. In the report, only risks are contemplated which have an effect on one company but also risks leading to disruptions in the road transport chain and therefore impacting at least two companies.

Furthermore, within the report, the research question is answered what kind of risk management strategies exist and are most adequate to use in the field of road transport. In order to deal with road transport risks, company representatives should be aware of the different options to manage these kinds of risks. Therefore, a framework of potential measures to handle road transport risks is developed which helps company representatives to handle road transport risks and therefore enables a smooth flow of goods.

Moreover, IT-tools used in risk management are described. Besides, requirements for an IT-tool in risk management, and a comparison of available IT-tools are presented.

2 STATE-OF-THE-ART

In the following, the substantial concepts underlying this report are explained. Therefore, the basics of logistics and transport, logistics in the BSR and in the EU as well as the fundamentals of risk management are discussed.

2.1 Logistics and transport

This chapter gives an overview of the classification of transport into logistics and of the players in the transport process. In addition, the outsourcing of logistics' activities is described.

2.1.1 Classification of transport into logistics

There is no consistent understanding of the term logistics. This is reflected by the numerous existing definitions and furthermore by the scope of duties which are allocated to logistics and which differ from each other (Göpfert, 2005; Arnold et al., 2004). Following Russell – and based on Plowman – logistics aims at getting "the right product to the right customer, at the right time, at the right place, in the right condition, in the right quantity, at the right cost" (Russell, 2007, p. 59; Plowman, 1964).

In the following, a definition of logistics is introduced which emphasizes transport as an important activity as well as a key element in the logistics chain (Weber and Kummer, 1998). The Council of Supply Chain Management Professionals (CSCMP) defines logistics as "the process of planning, implementing, and controlling procedures for the efficient and effective transport and storage of goods including services and related information from the point of origin to the point of consumption for the purpose of conforming to customer requirement. This definition includes inbound, outbound, internal, and external movements" (CSCMP, 2012).

Transport plays a connective role among the several steps which result from the conversion of resources into useful goods in the name

of the ultimate consumer. It is the planning of all these functions and sub-functions into a system of goods' movement in order to minimize cost, maximize service to the customers and provide better logistics efficiency (Fair and Williams, 1981).

Figure 2 shows the components of logistics costs (Tseng, 2005 modified Chang, 1998). This analysis shows transport represents the highest costs, amouting to 29.4% of logistics costs, and is followed by inventory costs (17.4%), warehousing costs (17,0%), packaging costs (11.9%), management costs (11.0%), movement costs (7.8%) and ordering costs (5.5%). The ratio of transport to total logistics costs is almost one-third. The transport costs here include the means of transport, corridors, containers, pallets, terminals, labours, and time. This figure signifies not only the cost structure of logistics systems but also the order of importance in improvement processing.

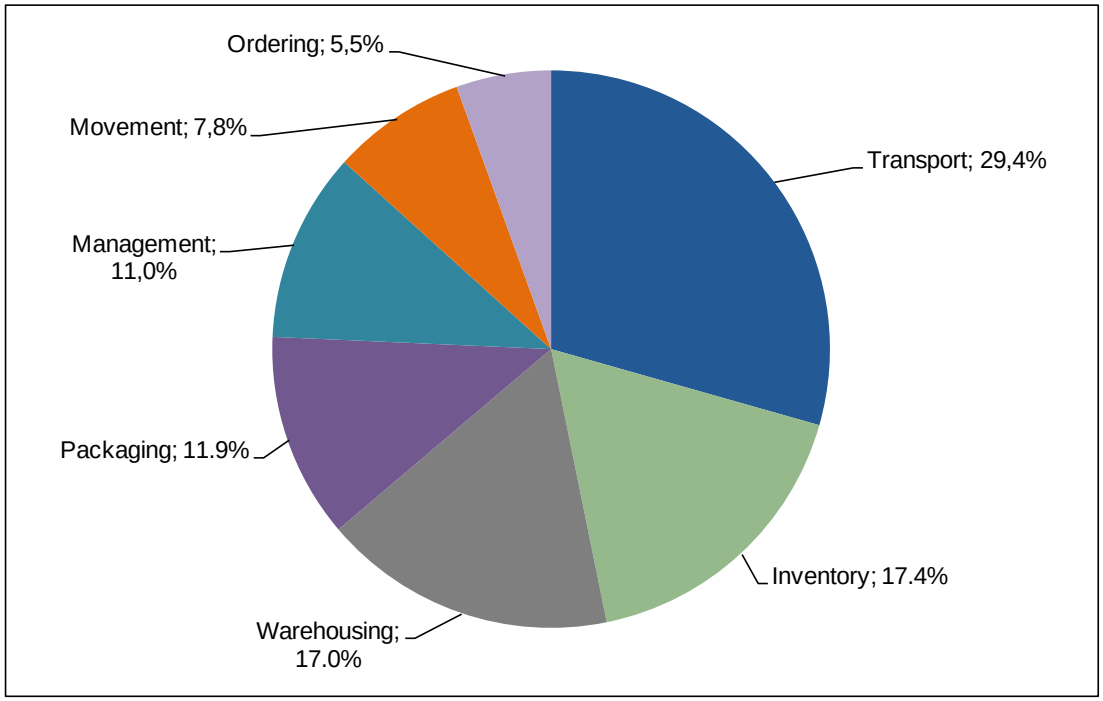

Figure 2: Cost ratio of logistics items

(Tseng, 2005, p. 1661 modified: Chang, 1998)

Therefore, transport is the most important economic activity among the components of business logistics. It moves goods and products at the least-cost principle and it affects the results of logistics activities and influences production and sale (Tseng et al., 2005). A good transport system can provide increased logistics efficiency, it can

reduce operational cost, and it can promote service quality. However, the share of transport modes is usually not uniform.

Transport modes represent an essential component of transport systems since they constitute the means by which mobility is supported.

There are several modes of transport such as:

- Land Transport
  - Road Transport
  - Railway Transport
  - Pipeline Transport
- Air Transport
- Water Transport
- Inland Water Transport and
- Ocean Transport

Each mode has its own requirements and features, and is adapted to serve the specific demands of freight and passenger traffic. This gives rise to marked differences in the ways the modes are deployed and utilized in different parts of the world.

Road transport has become the dominant land transport system today. McKinnon highlights the importance of road transport within supply chains as “Road transport has a near monopoly in the distribution of finished products at the lower levels of the supply chain, particularly in the delivery of retail supplies” (2006, p. 230).

It possesses significant advantages over other modes. The capital cost of vehicles is relatively small and it makes it comparatively easy for new users to gain entry, which helps to ensure that innovations and new technologies can diffuse quickly through the industry. Another advantage is the relatively high speed of the vehicle. One of its most important attributes is the flexibility of route choice. These multiple advantages made cars and trucks the modes of choice for a great number of trip purposes and led to the market dominance of cars and trucks for short-distance trips (Rodrigue et al., 2006).

In contrast, the initial capital costs of railway transport are high because the construction of rail tracks and the provision of rolling stocks are expensive. The ability of trains to haul large quantities of goods and significant numbers of people over long distances is the mode’s primary asset. Trains can offer a high speed – high capacity service (Rodrigue et al., 2006).

Rail transport is the most commonly used mode for heavy and bulky loads over long land hauls (in general, greater than or equal to

200 km) without paying enormous charges. Some of the advantages are constancy, low-cost guarantee, greater reliability and rail transport is not affected by the weather and traffic conditions. The main disadvantages constitute inflexibility and specified routes between fixed terminals. Moreover, rail transport does not stop at intermediate points (Tuzkaya, 2009).

Shipping exploits the water routes which cross the oceans as well as rivers and lakes. Many of the oceanic routes are in international waters and are provided at no costs to the users (Rodrigue et al., 2006). The main advantage of sea transport is the ability to transport large amounts of bulk freights, liquids and containerized freights by ships and vessels. In addition, it is the cheapest transport mode and there are no duty or transit-passing transactions between the starting and arrival points. However, the risk of damage is high, transit times are long and there is a limitation and inflexibility with regard to finding appropriate ports (Tuzkaya, 2009). Shipping has traditionally been facing two drawbacks. It is slow with speed at sea. Secondly, delays are encountered in ports where loading and unloading takes place (Rodrigue et al., 2006).

Air transport, compared with other modes, has the obvious advantage of speed, but it is limited by operating costs, fuel consumption and carrying capacities (Rodrigue et al., 2006). Air transport is therefore the most convenient mode when slow speed is unacceptable. Loading and unloading operations can be carried out frequently and the flexibility level can be increased. However, aircraft operations create noise, higher emissions than other transport modes and waste disposal problems (Tuzkaya, 2009).

Sometimes, it may not be possible to use one transport mode instead of the other because of geographical or infrastructural reasons, freight type, etc. However, the advantages and disadvantages of transport modes should be considered for transport projects (Tuzkaya, 2009).

In the following, this report focuses on the field of road transport.

2.1.2 Players in the transport process

The multitude of actors integrated into the road transport process as well as their diversity increases the number of potential risks. Bowersox et al. (2010) differ between six different players influencing transport

decisions: shipper (consignor), destination party (consignee), carriers and agents, government, Internet and the public.

Figure 3 illustrates the relationship among these involved parties.

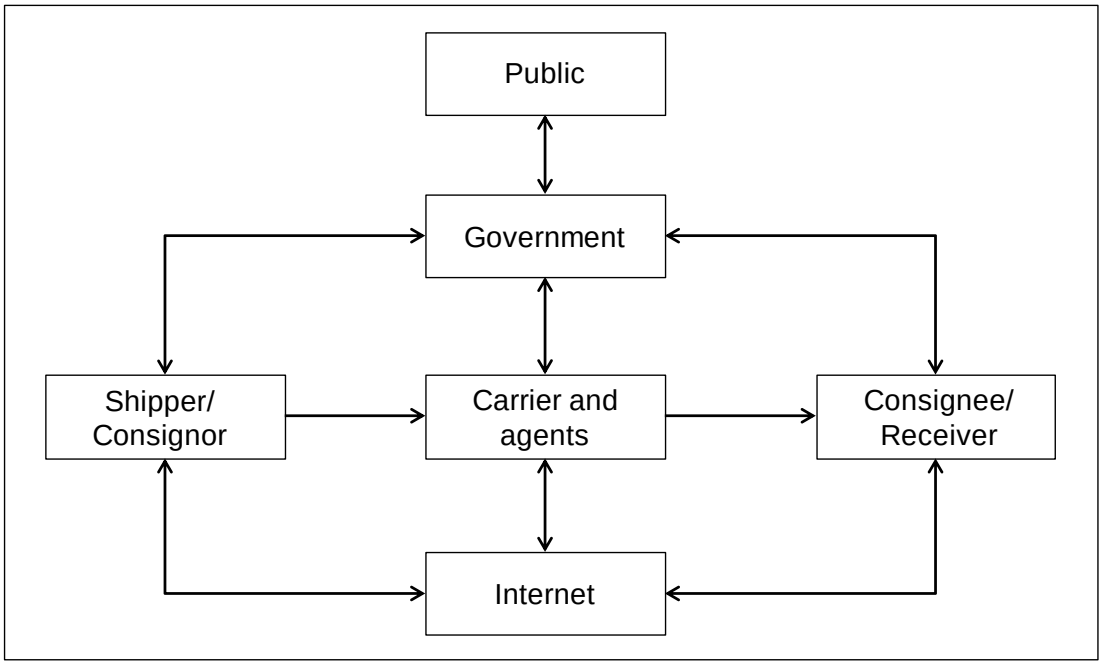

Figure 3: The relationship among players in the transport process (Bowersox et al., 2010, p. 195)

Both, the shipper and consignee/receiver have a common interest in moving goods from origin to destination. This should happen within a given time at the lowest cost as possible. Specified pickup and delivery times as well as predictable transit time and the exchange of information and invoices characterize the services related to the transport process (Bowersox et al., 2010).

Apart from the shipper and consignee, the carrier is another player in the transport process. It performs the transport service and aims to charge the customers the highest rate possible. At the same time, the carrier tries to minimize labour, fuel and vehicle costs. Carriers are supported by transport agents like brokers and freight forwarders.

Due to the critical importance of reliable services for economic and social well-being, the government is also interested in transport. They strive for an efficient transport environment to support economic growth. This includes e.g. that carriers provide their services at reasonable costs. Therefore, in some countries, the government is directly involved in providing transport services (e.g. United States Postal Service).

An important development in the transport industry is the offer of Internet-based services. By using the Internet, real-time information can be shared with all players integrated into the transport process. During the last years, a wide variety of Web-based enterprises has been launched. They typically provide two types of marketplaces: one form to exchange information for matching carrier freight capacity with available shipments and another form to exchange information relates to the purchase of fuel, equipment, parts, and suppliers (Bowersox et al., 2010).

Last but not least, the public can be identified as the final participant in the transport system. It is e.g. concerned with transport accessibility, expense as well as environmental and safety standards. Due to the demand for purchasing goods the public influences transport in an indirect way. The price, the environmental impact as well as safety are important issues for the consumers, because they pay for the outcome (Bowersox et al, 2010).

Transport usually does not belong to the core activities of manufacturing and trading companies. In order to save resources and to improve the existing core competencies of a company, outsourcing of transport may be an option. Therefore, chapter 2.1.3. gives a short overview of the outsourcing of logistics' activities.

2.1.3 Outsourcing of logistics' activities

In the literature, many papers deal with the advantages and disadvantages of outsourcing. Besides, motives for and benefits of outsourcing are frequently disussed as well.

Table 1 shows several factors facilitating logistics outsourcing which have been identified in recent years.

Cost reduction and cost related aspects belong to the key factors in logistics outsourcing. Focussing on core business/on core competencies form the second most mentioned motive for logistics services, followed by the improvement of service level and service quality. Other motives, like e.g. gaining flexibility, the transfer of provider's know-how, considerations linked to labour or the ability to handle capacity bottlenecks are mentioned by less authors (Kersten et al., 2007a).

Table 1: Motives for logistics outsourcing (Kersten et al., 2007a, modified)

Motives for Logistics Outsourcing
Cost reduction
Focus on core business/core competencies
Improvement of service level/service quality
Changes in cost structure (elimination of fixed costs)
Gaining flexibility
Know-how transfer/usage
Labour considerations
Capacity improvement/handling peaks/customer demand
Decrease in capital employed
Access to new IT
Increase in speed
Company restructuring/development of supply chain partnership
Centralized facilities/distribution systems
Management and political considerations
Global capabilities
Economies of scale (realized by service provider)
Gaining more cost transparency
Change implementation

Transport belongs to one of the most commonly outsourced logistics operations. This is proved by the results of a logistics survey which was conducted during the EU project LogOn Baltic in 2007. In total, more than 1,200 companies within the BSR participated in the study. 38% of the experts represented manufacturing companies, 33% were from trading companies and 29% of the experts acted for logistics service providers.

The survey results show that transport, reverse logistics and freight forwarding are the most commonly outsourced logistics operations in the surveyed companies. Figure 4 gives an overview of the outsourcing of different logistics functions by manufacturing and trading companies in the Southern Metropolitan Region of Hamburg. About 75% of the companies declared that more than 75% of their domestic and international transport are handled by an external service provider. About 20% of these companies stated they outsourced 1%-75% of their domestic transport (15% of the companies for international

transport respectively) (Kersten et al., 2012b). Transport does not belong to the core competence of manufacturing companies, thus they do not lose know-how when outsourcing them. The areas transport, freight forwarding, and reverse logistics have a long history of expertise in the world of logistics service providers. The main criteria for outsourcing decisions are usually cost factors, thus, these functions are outsourced to third parties (Kersten et al., 2012b).

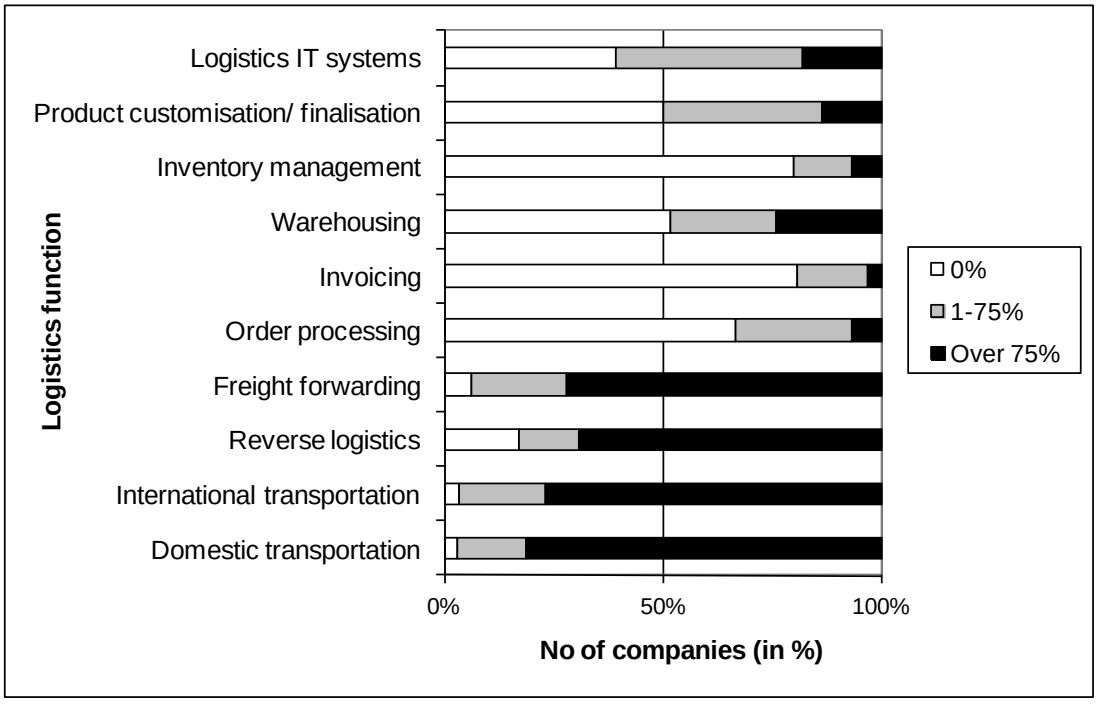

Figure 4: Outsourcing of different logistics functions by manufacturing and trading companies in the Southern Metropolitan Region of Hamburg (Kersten et al., 2007b)

Since companies particularly prefer to keep control of their own operations (product customisation/finalisation as well as logistics IT systems), they spend a relatively small amount on third party warehousing and inventory management. It is the same for invoicing and order processing. As these activities mean direct customer contact, companies are often unwilling to leave this field to service providers (figure 4).

In the survey, manufacturing and trading companies in the BSR were asked up to which percentage different functions are outsourced to external companies. The results show that national and international transport services combined have the highest share of outsourcing. Concerning national transport services, the regions Hamburg (Germany), Östergötland (Sweden) and Sout-West Finland rank the highest.

These logistically further developed regions have a majority of manufacturing and trading companies outsourcing more than 75% of all inland transport services to external service providers (figure 5). Estonia and Latvia are in the middle of the range. In St. Petersburg, only 20% of the companies indicated that they outsource inland transport to more than 75%.

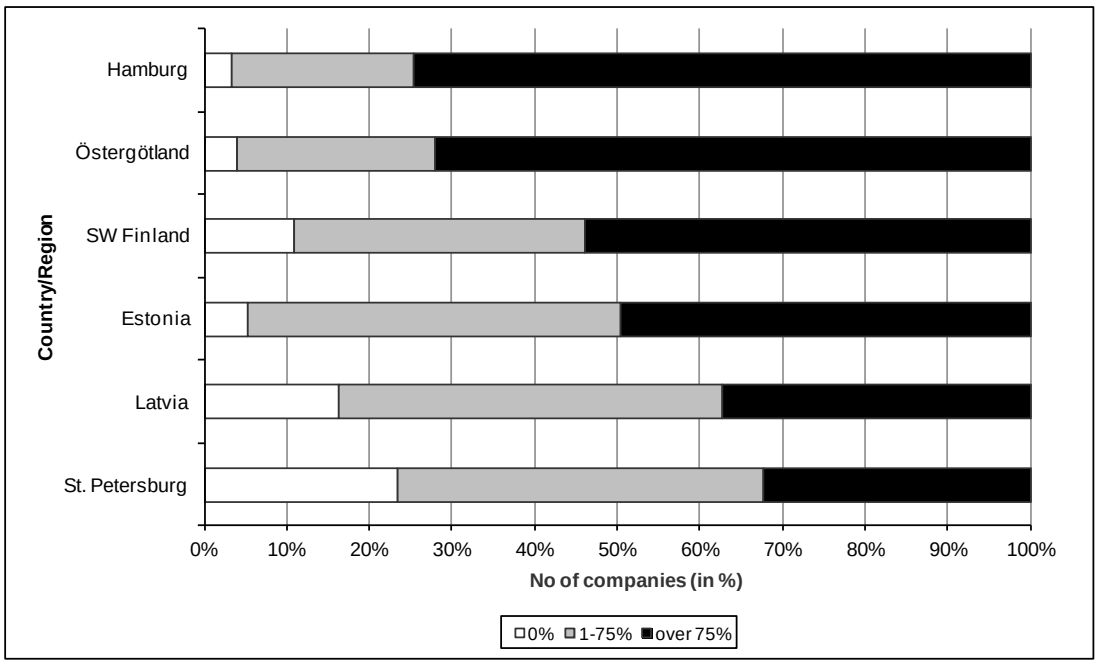

Figure 5: Share of outsourced national transport services by manufacturing and trading companies (Kersten et al., 2012b, modified)

Prices for logistics services in many cases dropped to a very low level with two consequences: First, manufacturing and trading companies cannot further reduce their transport costs. They have to find new ways to increase their competitiveness by reducing costs in other areas, such as inventory and warehouse management, and/or increasing the quality of their goods. Second, and correspondingly, logistics service providers cannot only compete in pricing but more in extending their range of services and in offering high-quality services (Kersten et al., 2012b).

The results show that there is a trend towards outsourcing national and international transport services. Therefore, companies have to prepare for the specified future challenges in order to remain competitive in the long run.

2.2 Logistics within the Baltic Sea Region and within the European Union

This chapter first gives an overview of the BSR within the EU. As the countries within this region have different stages of economic development, they are analysed in detail. Furthermore, the importance and the characteristics of logistics and especially of transport in the EU as well as in the BSR are described in the following.

2.2.1 The Baltic Sea Region as part of the European Union[1]

The BSR is situated in the North-East of the European mainland and consists of Denmark, Estonia, Finland, Northern Germany, Iceland, Latvia, Lithuania, Norway, Northern Poland, Northwest Russia and Sweden. The region has close to 60 million inhabitants, approximately 500,000 less in comparison to the highest value in the year 1997. The Nordic countries (Denmark, Finland, Norway, and Sweden) account for roughly 45% of the population (Baltic Development Forum, 2011).

All countries beside Norway and Russia are member states of the EU. However, Norway is a member of the European Economic Area (EEA). Therefore, the country has access to the internal market of the EU.

Within the BSR, all countries have strong trade relations with each other. The states from the region always form part of the top ten import and export partners for each individual country. However, the BSR is as versatile as the EU itself. Due to this, the following chapter analyses the economic development of the individual countries.

2.2.2 The economic importance of the Baltic Sea Region[2]

According to the ”Global Competitiveness Report 2011-2012“ published by the World Economic Forum, the countries Sweden, Finland,

[1] This chapter is an excerpt of a paper submitted by the same authors to ”Deutsch-Russischer Logistik und SCM Workshop DR-LOG 2011” (May 2011) and is published in the conference proceedings (see Kersten et al., 2011a). This paper also forms part of C.A.S.H. report 3:2011 (Kersten et al., 2011b). However, the data was updated.

[2] This chapter is an excerpt of a paper submitted by the same authors to ”Deutsch-Russischer Logistik und SCM Workshop DR-LOG 2011” (May 2011) and is published in the conference proceedings (see Kersten et al., 2011a). This paper also forms part of C.A.S.H. report 3:2011 (Kersten et al., 2011b). However, the data was updated.

Germany, and Denmark belong to the world's ten most competitive economic countries. The companies in the BSR not only have access to the consumers of their area, but also to the markets of the other EU member states as well as Russia, comprising 640 million inhabitants in total (World Economic Forum, 2011).

The BSR accounts for approximately 11% of EU's gross domestic product (GDP) (Purchasing power parity adjusted). In this calculation, the Nordic countries contribute 62%, the northern parts of Germany and Northwestern Russia 13% each, all Baltic States combined roughly 7%, and Northern Poland 5% to the overall value of 1,300 billion Euros (Baltic Development Forum, 2011).

The GDP shows that the BSR evolved into an important European growth region over the last ten years. With growth rates between seven and ten percent in 2007, the Baltic States grew above average of the EU. However, in the Nordic countries and Germany there was only an increase between one and six percent (Figure 6).

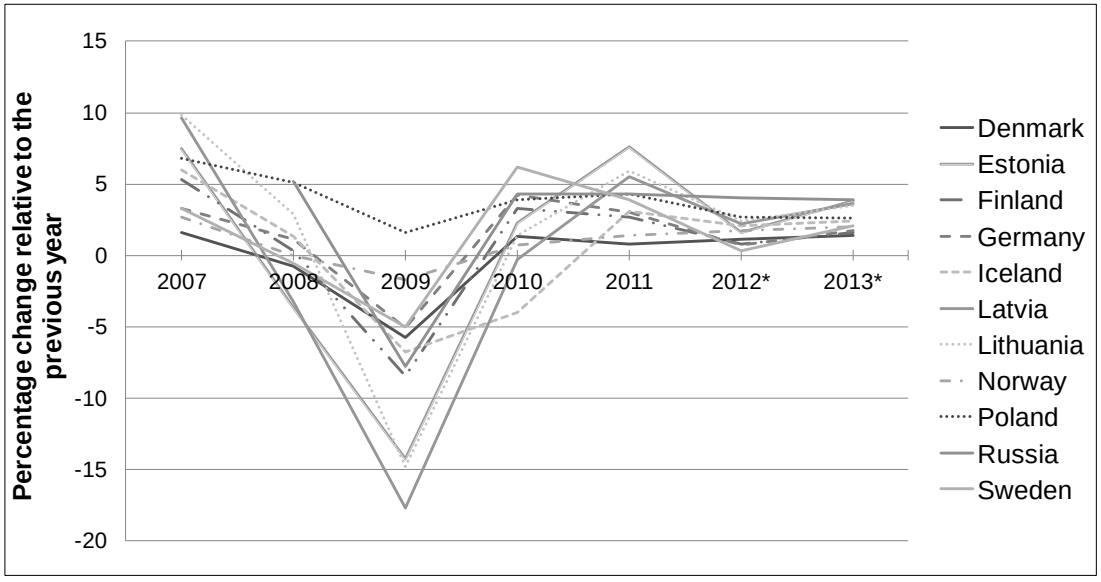

Figure 6: GDP growth rates. Growth rates relative to the previous year in the BSR (European Commission, 2012 and International Monetary Fund for Russia, 2012)

Strong growth rates were recorded in the BSR prior entering the world economic crisis in 2008/2009. The crisis still shows its effect. It is reflected particularly in the Baltic States and even leads to an increase in the economic differences between developed and transitional countries in the BSR. Only Poland had a low positive growth rate during the crisis. The downturn in Russia was not as high as in the Baltic States. The values for 2010/2011 reflect an economic recovery in the

whole BSR, but it seems that the predicted growth rates will be on a lower level than before the crisis in the near future (European Commission 2012).

In the following chapter, an overview of logistics in the EU and the BSR is given.

2.2.3 Logistics in the European Union and in the Baltic Sea Region[3]

The movement of goods to international markets is the assumption for trade. In the last decade, international trade has rapidly increased within the EU and resulted economic growth. In 2006, road freight services accounted for 45.6% of the entire transport volume of the EU-27, shipping totals 37.3% and rail amounts to 10.5% (Eurostat, 2009).

In national freight traffic, the predominance of road freight transport is even more obvious since it adds up to almost 80% of tonne-kilometres in the EU-27. For the period from 2000 to 2008 the transport volume of EU-27 inland freight had even greater growth rates (overall 4.0% higher) than the constant price GDP (Eurostat, 2011).

Due to the importance of logistics for the economic development, the EU aims to ensure effective transport. In 2011 a White Paper was published as the latest roadmap to achieve this goal. The Commission highlights that economic, social and environmental needs have to be considered to prepare future transport in Europe (European Commission, 2011).

An international study estimates the EU-29[4] logistics market to equal 930 billion Euros in 2008. This means that approximately 7% of the cumulative GDP in the EU-29 is generated by logistics services (Klaus et al., 2009).

Due to the geographic location and the dynamic economic development, logistics takes a central role in the BSR. Many goods are transported from Russia – as a country rich in resources – via the BSR to Central and Western Europe. The Baltic Sea forms a major axis for freight transport in Europe. Freight traffic is split up into road and rail

[3] This chapter is an excerpt of a paper submitted by the same authors to ”Deutsch-Russischer Logistik und SCM Workshop DR-LOG 2011” (May 2011) and is published in the conference proceedings (see Kersten et al., 2011a). This paper also forms part of C.A.S.H. report 3:2011 (Kersten et al., 2011b). However, the data was updated.

[4] This means all countries of the EU-27 as well as Switzerland and Norway.

traffic, pipelines, air freight, inland water transport and shipping in this region (Eurostat, 2009).

Naturally, shipping plays an important role for the BSR and ensures a good connection to all important economic regions worldwide. Figure 7 gives an overview of the ten biggest ports (according to the turnover of twenty-foot equivalent units (TEU)) in the BSR in 2011.

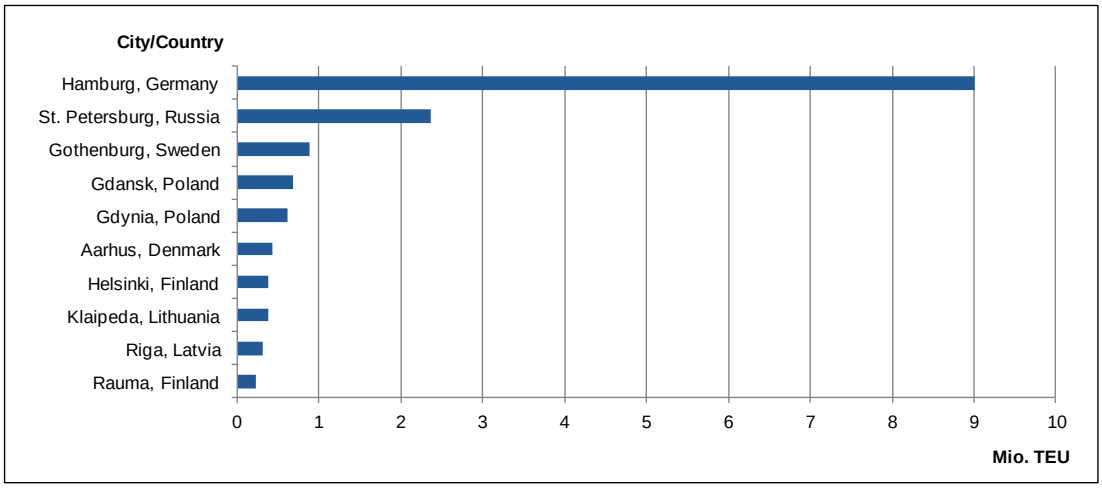

Figure 7: Top ten ports in the BSR in 2011 in Mio. TEU (Hafen Hamburg, 2012)

The BSR includes four of the ten largest logistics markets of the enlarged EU-29: Germany, Poland, Finland and Norway. The German and Polish logistics markets are not completely included in the spatial separation of the BSR. Nevertheless, the following figures highlight the importance of logistics in this region. The total logistics expenditure referred to GDP is above-average in the BSR (8.7%) compared to the EU-29 (7.1%). In addition, Finland (14.4%) and Estonia (14.5%) had the highest proportion of logistics expenditure of GDP in 2008. Both in the BSR and in the EU-29, Germany had the highest volume of transport (3,597.3 million tonnes per year) by far as well as the highest logistics expenditure in 2008, amounting to € 218.1 billion (8.8% of GDP) (Klaus et al., 2009).

The Logistics Performance Indicator (LPI) of the World Bank highlights the different development stages of logistics in the countries of the BSR. The evaluation of the LPI is mainly based on the following indicators (Arvis et al., 2012, p. 1):

- “The efficiency of the clearance process (speed, simplicity, and predictability of formalities) by border control agencies, including customs.

- The quality of trade- and transport-related infrastructure (ports, railroads, roads, information technology).
- The ease of arranging competitively priced shipments.
- The competence and quality of logistics services (transport operators, customs brokers).
- The ability to track and trace consignments.
- The frequency with which shipments reach the consignee within the scheduled or expected delivery time"

With these measures, the LPI ranked Finland as third best logistics performer in 2012. Overall, three countries of the BSR (Finland (3rd), Germany (4th), and Denmark (6th) are classified within the top ten of 155 countries. Sweden and Norway are ranked 13th and 22nd and also belong to the top performers. Moreover, Poland (30th) and Iceland (32nd) have a relatively good rank. The development of logistics in the Baltic States is not yet equal to the Western European ones. Lithuania (58th), Estonia (65th), and Latvia (76th) are in the middle of logistics performers worldwide. The ranking of Russia (95th) reveals room for improvement (Arvis et al., 2012).

2.2.4 Road transport in the European Union and in the Baltic Sea Region[5]

In national freight traffic of the EU-27, road freight services accounted for 76.4%, rail mounted up to 17.8%, and inland waterways came to 5.8% in 2008 (Eurostat, 2011). For the international freight traffic, shipping plays an important role. However, in the following, the focus is set on national freight traffic.

Road transport offers greater flexibility than other types of traffic (see chapter 2.1.1). Figure 8 provides an overview of the existing road infrastructure in the BSR and shows a dense road network, which is characterized by a good connection between the Baltic ports and the hinterland. Regionally, however, it has a different density or assumes different forms.

The quality of the roads in the BSR was assessed by the World Economic Forum in the "Global Competitiveness Report 2011-2012". The report is based on a survey and contains an evaluation of road

[5] This chapter is an excerpt of a paper submitted by the same authors to "Deutsch-Russischer Logistik und SCM Workshop DR-LOG 2011" (May 2011) and is published in the conference proceedings (see Kersten et al. 2011a). This paper also forms part of C.A.S.H. report 3:2011 (Kersten et al. 2011b). However, the data was updated.

quality amongst others. Six countries of the BSR (Denmark, Germany, Finland, Sweden, Iceland, and Lithuania) are ranked within the first 32 countries out of 142. Two more (Estonia and Norway) are on average. Latvia is ranked as 101st and has room for improvement. Russia and Poland on the other hand are rated within the last 20 countries. Therefore, there is a real need for action in these countries (Word Economic Forum, 2011).

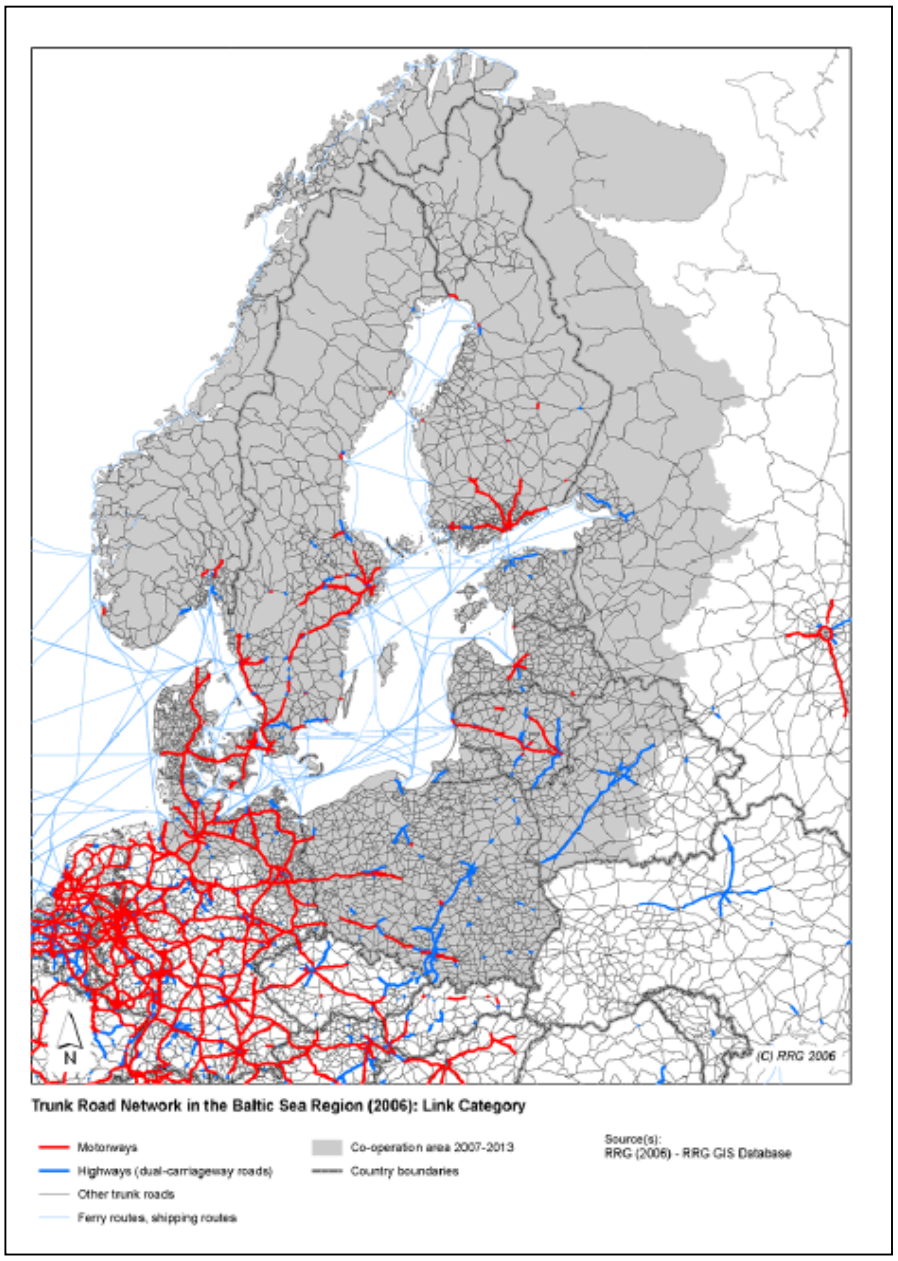

Figure 8: Road infrastructure in the BSR in 2006 (Schürmann and Spiekermann, 2006, p. 8)

The brief overview of logistics in the BSR highlights that road freight transport plays a decisive role. As today's business models as

well as production and logistics systems (just in time, highly distributed production, outsourcing etc.) place increasing requirements on logistics operations, it is important to establish beneficial conditions for logistics to cope with these challenges. The allocation of adequate infrastructure and areas for the settlement of logistics enterprises are important issues. Furthermore, logistics service providers, manufacturers, and commercial enterprises need to manage potential risks they are faced with in order to remain competitive.

2.3 Fundamentals of risk management[6]

It is necessary to implement risk management in enterprises to manage risks and their potential negative effects. Otherwise, enterprises could be endangered to the effect that profits are not realised. In Germany, e.g. the board of managing directors of limited companies and accordingly the management of companies with other corporate structures are obligated by law (KonTraG) to take measures, especially incorporating a monitoring system, to identify risks at an early stage, which endanger the continuance of the company. The undertaken measures are controlled in the annual audit. Similar acts are in force in the other BSR countries (Kajüter, 2007).

In the following, risk and uncertainty as well as the risk management process are explained.

2.3.1 Risk and uncertainty[7]

Within the framework of decision theory, risks result from the uncertainty of future events, named the sources of risks or uncertainty (Gabler Wirtschaftslexikon, 2004). On the one hand, in the case of certainty, it is doubtless which state of environment will occur. On the other hand, uncertainty in the broader sense encompasses risk as well as uncertainty in the narrower sense, depending on the level of knowl-

[6] This subchapter represents an excerpt from a paper submitted by the same authors to ”Deutsch-Russischer Logistik und SCM Workshop DR-LOG 2011” (May 2011) and is published in the conference proceedings (see Kersten et al., 2011a). It also forms part of C.A.S.H. report 3:2011; Kersten et al., 2011b.

[7] This subchapter represents an excerpt from a paper submitted by the same authors to ”Deutsch-Russischer Logistik und SCM Workshop DR-LOG 2011” (May 2011) and is published in the conference proceedings (see Kersten et al., 2011a). It also forms part of C.A.S.H. report 3:2011; Kersten et al., 2011b.

edge about the probability of occurrence. In the case of risk, subjective or objective probabilities of occurrences are known. In the case of uncertainty, the decision maker only knows the potential states of the environment (Bamberg et al., 2008 and Laux, 2005). In 1921, Knight already distinguished between measurable uncertainty, also known as risk, and non-measurable uncertainty (Knight, 1921).

Even if risk is understood as related to its effect, there are different approaches between the disciplines. In the field of mathematics, the construct “risk” is defined as value-free, while in the field of business economics it is mainly understood as the opposite of a “chance”, thus a potential loss or damage (Holzbaur, 2000 and Diederichs, 2004). This paper follows the latter approach.

2.3.2 The risk management process[8]

In order to cope with risks and to achieve corporate goals, it is necessary to implement risk management. Due to several corporate crises and insolvencies, specific pronouncements as well as regulatory requirements exist in numerous countries relating to the analysis, communication and monitoring of risks (Kajüter, 2003). The typical risk management process is based on the generic management process (e.g. see Terry, 1972) and encompasses the following steps: risk identification, assessment, mitigation and control.

2.3.2.1 Risk identification[9]

The risk identification step is often considered as most important since only those risks which have been identified can be managed afterwards. It is not realistic to detect all potential risks, though. At the same time, collecting risks leads to costs so that benefits and costs have to be balanced. Nevertheless, several risks which seem harmless on their own may accumulate and hence result in severe damage in case they are not identified. Basically, like the risk management process, risk

[8] This subchapter is based on an excerpt from a paper submitted by the same authors to ”NOFOMA 2012” (June 2012) and is published in the conference proceedings (see Kersten et al., 2012a).

[9] This subchapter is based on an excerpt from a paper submitted by the same authors to ”NOFOMA 2012” (June 2012) and is published in the conference proceedings (see Kersten et al., 2012a).

identification should be carried out continuously since changes consistently occur in the company, supply chain and environment (Eberle, 2005; Singer, 2012).

According to Romeike (2003a), there are different methods for risk identification. For example, interviews, checklists, and strengths, weaknesses, opportunities, and threats (SWOT) analyses are targeted on existent and obvious risks, while e.g. brainstorming, brainwriting as well as failure mode and effects analysis (FMEA) aim at the identification of future and so far unknown risks. Therefore, it makes sense to use a combination of methods (Eberle, 2005).

Depending on the applied method to identify risks, a risk classification may support the process step. However, risks can be classified in different ways. While Tummala and Leung (1996) e.g. distinguish between catastrophic, critical, marginal and negligible risks on the level of hazard severity, Narasimhan and Sahasranam (2007) differentiate between strategic, tactical and operational risks on the planning level. According to the business function or area of operation, Christopher and Peck (2004) refer to supply, demand, process, control and environmental risks while Rogler (2002) names supply, production, distribution, financial and personnel risks. Transport risks form part of both supply and distribution risks in the latter case and can be specified as default (loss of the entire cargo), quantitative (partial destruction during transport), quality (damage during transport), costs (increase in transport costs) and time risks (delay/earliness of delivery).

2.3.2.2 Risk assessment[10]

During risk analysis, the gathered risks are assessed at first by indicating the likelihood of occurrence and the possible damage. The evaluation can either be done quantitatively or qualitatively.
If enough historical data are available, it may be possible to use quantitative methods to assess risks. Qualitative methods have the disadvantage of leading to subjective results but time and effort may be lower. Several methods which can be applied for risk identification may also be used for risk assessment, e.g. brainstorming or FMEA. Again, it is

[10] This subchapter is based on an excerpt from a paper submitted by the same authors to ”NOFOMA 2012” (June 2012) and is published in the conference proceedings (see Kersten et al., 2012a).

sensible to utilize a combination of methods (Romeike, 2003b; Ziegenbein, 2007; Singer, 2012).

For visualizing the single risks, risk maps can be employed, consisting of the two axes “likelihood of occurrence” and “possible damage”. The scale may be chosen individually either qualitatively or quantitatively (Kajüter, 2003).

After evaluating risks, they are prioritized in preparation for the risk mitigation step.

2.3.2.3 Risk mitigation[11]

Risk handling represents the third step of the risk management process. Depending on the kind of risk, the enterprise, supply chain, and their objectives, company representatives select strategies and measures to mitigate the prioritized risks. When deciding on the mitigation strategies and measures, costs for their implementation and occurrence of further potential risks should also be taken into account.

Since Porter (1998, p. 55) declares a strategy to characterize “[...] the creation of a unique and valuable position, involving a different set of activities”, there are various measures which can be assigned to a strategy. In general, the number of potential measures in order to handle risks is high. Chapter 5 focuses on the available strategies and measures to handle risks.

2.3.2.4 Risk control[12]

Finally, during risk control it is the intention to review whether the measures have been applied and if they have been effective. If necessary, further measures need to be taken, especially in case changes occurred in the environment. A method which can be applied within the risk control step is for example the balanced scorecard (Kajüter, 2003; Singer, 2012).

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[11] This subchapter is based on an excerpt from a paper submitted by the same authors to ”NOFOMA 2012” (June 2012) and is published in the conference proceedings (see Kersten et al., 2012a).

[12] This subchapter is based on an excerpt from a paper submitted by the same authors to ”NOFOMA 2012” (June 2012) and is published in the conference proceedings (see Kersten et al., 2012a).

Generally, the risk management process should be run through iteratively because single risks or the whole risk situation may change over time (Eberle, 2005).

3 APPLICATION OF TECHNIQUES FOR DATA COLLECTION

Within this study, several techniques for data collection are applied. Therefore, at first, the differences between qualitative and quantitative research families and their objectives are described. Afterwards, the focus is set on the analysis of the research approaches, i.e. a survey, workshops and expert interviews are explained. Finally, the adoption of the methodologies for the present research objectives is presented.

3.1 Qualitative and quantitative research[13]

Usually, empirical research is classified into two research families, also known as general strategies, i. e. qualitative and quantitative research. Table 2 shows their differences.

Table 2: Differences between qualitative and quantitative research (Blaxter et al., 2006)

Qualitative paradigms	**Quantitative paradigms**
Concerned with understanding behaviour from actors' own frames of reference	Seeks the facts/causes of social phenomena
Close to the data: the "insider" perspective	Removed from the data: the "outsider" perspective
Grounded, discovery-oriented, exploratory, expansionist, descriptive, inductive	Ungrounded, verification-oriented, reductionist, hypothetico-deductive
Process-oriented	Outcome-oriented
Valid: real, rich, deep data	Reliable: hard and replicable data
Holistic	Particularistic

[13] This subchapter is based on an excerpt from C.A.S.H. report 3:2011 by the same authors; Kersten et al., 2011b.

Very often, quantitative research aims at gathering facts, while qualitative research is about understanding the behaviour of aspects from a different perspective. Therefore, the former can be called particularistic and outcome-oriented, whereas the latter is usually process-oriented and holistic (Blaxter et al., 2006).

On the one hand, quantitative research mostly takes an "outsider" perspective and strives for reliability, i. e. by collecting data which tends to be replicable. On the other hand, qualitative research methods work discovery-oriented as well as exploratory and aim at achieving deep data. The researcher usually takes the "insider" perspective (Blaxter et al., 2006).

Empirical results which are described in this report are gained by the application of a survey, two workshops and expert interviews. The use of a questionnaire in order to conduct a survey can be regarded as quantitative research whereas conducting workshops with a focus group and leading expert interviews may be seen as qualitative research. However, the two research families bear resemblances.

Quantitative research is used for testing theory in many cases and strives for a statistical analysis of an observable section of reality. It may also be utilized in order to explore an area and generate hypotheses and theory, though. Furthermore, quantitative approaches (e.g. large-scale surveys) can collect qualitative (i. e. non numeric) data by asking open-ended questions (Blaxter et al., 2006).

3.2 Analysis of the research approaches

In this subchapter, the methodologies of a survey, workshops and expert interviews are explained.

3.2.1 Methodology of the survey[14]

In the following, a survey is explained as a research approach and its advantages as well as disadvantages are listed. Last but not least, types of survey questions are highlighted.

[14] This subchapter is based on an excerpt from C.A.S.H. report 3:2011 by the same authors, Kersten et al., 2011b.

Survey as a research approach

If participants in a study answer questionnaires in written form, the method on hand is a survey (Bortz and Döring, 2002). The questionnaire usually encompasses a set of questions which the respondents are asked to answer (Hair et al., 2007).

The research approach is suitable for homogenous groups, in case the content of the questionnaire is highly structured and if the interviewer does not need to intervene (Bortz and Döring, 2002).

Since the researchers are usually not able to interact with the respondents, the questionnaire needs to be tested by other researchers or company representatives concerning design, wording and comprehension (Bortz and Döring, 2002; Hair et al., 2007).

Furthermore, the literature reveals that the way how questionnaires are distributed is linked with the response rate, i.e. if they are handed out face-by-face a higher response rate can usually be expected (Blaxter et al., 2006).

Advantages and disadvantages of surveys

The choice of a survey as a research approach has advantages as well as disadvantages.

On the one hand, the researcher does not necessarily know who answered the questionnaire and whether the participant maintained the order when giving the responses. Furthermore, the time duration for filling in the questionnaire remains unknown. On the other hand, a survey is highly standardized (Bortz and Döring, 2002). That means that the answers of the participants should be relatively easy to compare. In this case, the advantage outweighs the disadvantages.

Another advantage often mentioned in the literature is the anonymity the respondents feel when answering a questionnaire in written form (Bortz and Döring, 2002), especially with a sensitive topic like risk management.

Types of survey questions

When designing a questionnaire, the researcher has a range of categories to choose from in order to formulate the questions.

Open-ended questions are comparatively easy to phrase because the answers are completely given by the respondents. Therefore, if the researcher does not know the possible answers, it is recommendable to use an open-ended question. Moreover, selecting an open-ended question can be useful if the alternative answers the researcher can think of, will influence the experts (Hair et al., 2007).

Whereas open-ended questions are likely to provide the researcher with rich information and insight into the answer, the participants in the survey have to be willing to articulate and to spend the time to give a complete and comprehensible answer which may take the researcher considerable time and effort to understand.

Closed questions are more time-consuming and difficult to formulate. However, when phrasing them, preparations can be made to facilitate data collection, data input and computer analysis. They are very often used in quantitative studies, e.g. in (large-scale) surveys (Hair et al., 2007). Closed questions can make use of the following types of questions: Quantity or information, category, list/multiple choice, scale, ranking and complex grid or table (Blaxter et al., 2006).

3.2.2 Methodology of the workshops[15]

In the following, workshops of focus groups are explained as a research approach and advantages as well as disadvantages are listed.

Workshops of focus groups as a research approach

A focus group is a gathering of individuals who discuss and comment on a certain topic from their personal experience. These meetings of persons are also known as “collective activities”, “social events”, “organised discussions” or “interactions”. Usually, one or two moderators motivate the participants to interact so that insight is provided into the content of a conversation and the way how the members of the focus group speak about the specific topic (Eriksson and Kovalainen, 2008).

Advantages and disadvantages of workshops

Selecting a workshop of a focus group as a research approach both has advantages as well as disadvantages.

On the one hand, people who either think they do not have enough expertise or who assume they have nothing to say feel confirmed to make contributions. Moreover, those who do not like to be interviewed on their own are also encouraged to take an active part. In addition, participants may feel motivated to analyse questions themselves and to develop their own analyses (Eriksson and Kovalainen, 2008).

[15] This subchapter is based on an excerpt from C.A.S.H. report 3:2011 by the same authors; Kersten et al., 2011b.

On the other hand, focus group research does not have a defined end and the outcome is hard to be predetermined. Furthermore, some people may be intimidated and consequently may not be willing to talk in a group. The background of participants may also lead to different results. Besides, geographical distance and associated costs can be an obstacle to a focus group (Eriksson and Kovalainen, 2008).

Since one workshop with a focus group took place in combination with a regular project meeting and discussion on further topics, the last-mentioned aspect was supposed to be of little importance in this case. However, both focus group workshops were involved with accurate planning. Likewise, the background of participants was taken as given since the first group was made up of project partners who were either members of police authorities or researchers while the second group consisted of company representatives or researchers. This way, the authors were able to ask a group of people with similar professions at the same time. In general, the above-mentioned advantages were assumed to overbalance the disadvantages.

In the following, the methodology of the expert interviews is explained.

3.2.3 Methodology of the expert interviews

Now, the characteristics of expert interviews and their advantages as well as disadvantages are analysed.

Expert interviews as a research approach

When expert interviews represent the method of choice, several experts are asked about a certain issue by an interviewer. This is mostly done face to face, but e.g. the telephone may also be used (Eriksson and Kovalainen, 2008).

The process and the questions of an expert interview can vary from completely open to completely standardized. By using an interview guideline, the data is usually more simple to structure and to compare afterwards (Mayer, 2009). In all cases, it helps if the interview questions are precisely formulated and easily answered. While standardized interviews enhance the comparability of the data even further, they should not prohibit additional comments and remarks (Bortz and Döring, 2002).

Before the interviews, a general decision is whether to only take notes or to record the interviews. While recording requires a lot of time

to transcribe and analyze the tapes, more information is made accessible. Furthermore, it is far less likely, the researchers miss an important piece of information when concentrating also on asking questions (Blaxter et al., 2006). Mostly, expert interviews are led with one interviewer and one interviewee (Eriksson and Kovalainen, 2008). Nevertheless, in this case, mostly two interviewers were present to better manage the complex task of asking questions, listening and already taking notes (Blaxter et al., 2006).

Advantages and disadvantages of expert interviews

Using expert interviews as a research approach has advantages as well as disadvantages.

On the one hand, through expert interviews it is possible to collect data which would maybe not be made accessible by other techniques (Blaxter et al., 2006). Therefore, the method is especially helpful to collect data when dealing with complex or/and sensitive issues which is both the case for risk management (Hair et al., 2007).

Another advantage is that the researcher can interact with the interviewee. This leads to more in-depth information since it is possible to ask comprehension questions. In addition, the researcher can obtain feedback and use visual aids in case it is a face to face interview (Hair et al., 2007).

On the other hand, it is helpful for data collection, if the interviewer manages to create a relaxed atmosphere during the interview which is not necessarily easy (Hair et al., 2007). Furthermore, the course of the interview is not predictable (Bortz and Döring, 2002). Hence, the interviewer needs a high degree of sensitivity with regard to asking further questions for additional information, to posing the questions from the interview guideline for wanted, informative, evaluable and precise data and therefore time management on the whole (Mayer, 2009). In this case, the advantages outweigh the disadvantages according to the authors' opinions.

3.3 Adoption of the methodologies for the present research project

For this research project, different techniques for data collection are used successively. In order to take advantage of the single approaches, at first a quantitative approach has been used (i.e. a survey has been conducted). Afterwards, workshops and expert interviews

have been selected which are regarded as qualitative research. This way, a general understanding of the certain topic under investigation was developed initially. Then, the authors were able to choose smaller fields for in-depth analyses.

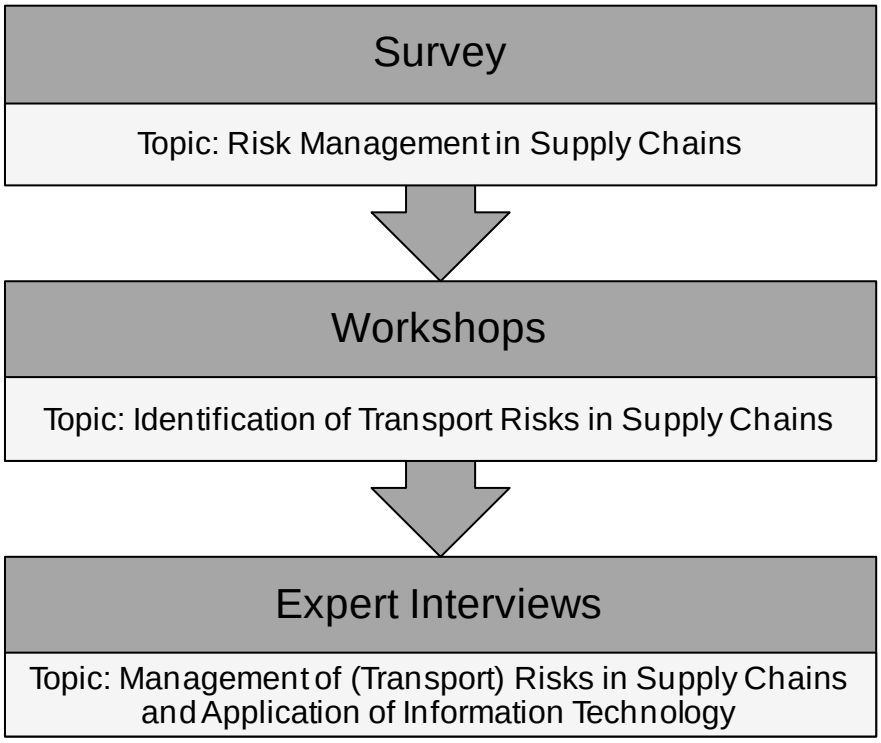

Figure 9: Sequence of methods used for data collection for the present research project

At first, the survey focused on the status quo of risk and risk management in business practice (see figure 9). Then, it was zoomed in on detail by two different focus groups and hence within separate workshops in order to identify transport risks. Finally, expert interviews have been conducted which covered the companies' understanding and application of risk management, transport risks as well as IT.

4 RISK MANAGEMENT IN BUSINESS PRACTICE – EMPIRICAL RESULTS

In the following, the empirical results concerning risk management in business practice are presented. They stem from a survey as a base analysis, two workshops with regard to the identification of transport risks as an extended analysis and from expert interviews as a detailed analysis. Last, an interim conclusion is drawn.

4.1 Base analysis of risk management in business practice – results from a survey[16]

From January until April 2010 the authors conducted an empirical study to analyse the status quo of risk and risk management in business practice as part of the C.A.S.H. project. In this early stage of the project there was no focus on the different regions. In the following, results of the study are presented.

4.1.1 Participants in the survey[17]

The target group of the empirical study were German manufacturers (62 replies) and logistics service providers (25 replies). The respondents mainly had the following jobs or worked in the following areas: (administration) procurement, (administration) supply chain management, (administration) logistics, (administration) controlling, business management or member of the management board.

The definition of the EU was considered in order to distinguish the size range of enterprises (European Commission, 2006). 16 replies were from small, ten from medium, and 61 from large enterprises. The

[16] This subchapter represents an excerpt from a paper submitted by the same authors to ”Deutsch-Russischer Logistik und SCM Workshop DR-LOG 2011” (May 2011) and is published in the conference proceedings (see Kersten et al., 2011a).

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share of small, medium, and large companies of logistics service providers and manufacturing companies is illustrated in figure 10. Only a small proportion of replies come from medium enterprises in both corporate forms, while large enterprises provide the majority (Kersten and Singer, 2010).

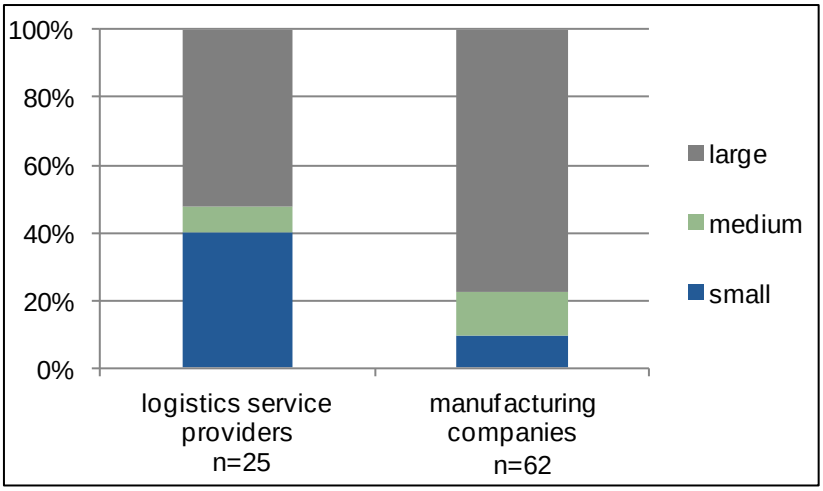

Figure 10: Percentage of small, medium and large enterprises of the replies of logistics service providers and manufacturing companies (Kersten and Singer, 2010, p. 198)

According to several telephone calls and emails, further company representatives tended to support the study, but they were not authorized by their supervisors to provide information. It can be assumed that the reason for this circumstance is the sensitive issue of risk management.

4.1.2 Findings from the survey[18]

At the beginning of the questionnaire, participants were asked to indicate their understanding of the construct risk on the basis of a given statement. 88% positive and 12% negative responses show that most of the company representatives consider risk as a potential damage. Afterwards, the question was raised whether the enterprises have

[18] This subchapter represents excerpts from a paper submitted by the same authors to ”Deutsch-Russischer Logistik und SCM Workshop DR-LOG 2011” (May 2011) which is published in the conference proceedings (see Kersten et al., 2011a) and from a paper submitted by the same authors to ”NOFOMA 2012” (June 2012) which is also published in the conference proceedings (see Kersten et al., 2012a).

institutionalised risk management. 51 participants answered with "yes" (59%) and 35 with "no" (41%). The shares of manufacturing companies and logistics service providers are similar; however, they differ between the size ranges of enterprises: All large logistics service providers have an institutionalised risk management, while this is only the case in about two thirds of the large manufacturing companies (Kersten and Singer, 2010).

Even if only 60% of the responding enterprises have an institutionalised risk management, almost all participants (90%) use tools to identify and analyse risks in their usual business processes. Nearly three quarters of those enterprises which do not have an institutionalised risk management stated that they apply risk identification and analytical tools in their daily processes (see figure 11). Used methods include the assessment of suppliers, financial checks, supplier self-reports, key performance indicators such as delivery reliability, quality assessment, credit checks and the FMEA (Kersten and Singer, 2010).

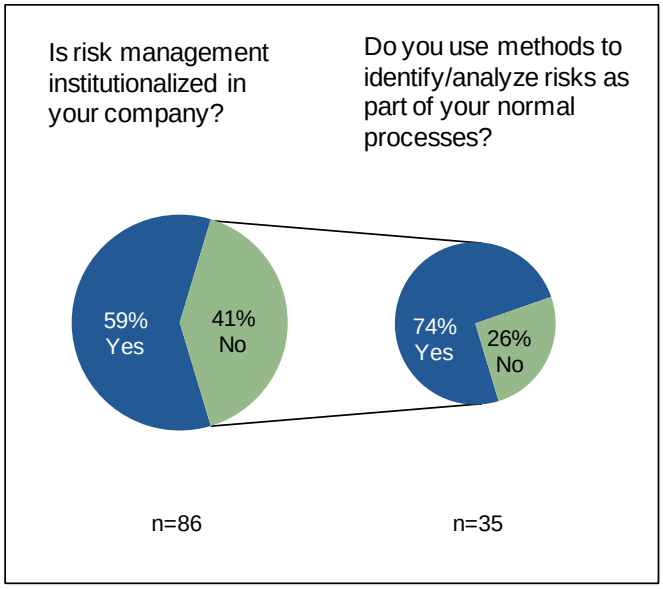

Figure 11: Application of risk analysis methods as part of usual processes in companies with no institutionalised risk management (Kersten and Singer 2010, p. 199)

Then, the experts indicated the general importance of supply chain risk management on a Likert scale ranging from 1 (very low) to 5 (very high) for the past (2005), present (2010) and future (2015). The results show it has been increasing considerably for the last years. While for 2005 the mean value amounts to 2.7, its current average

rating is 3.7 and the relevance of supply chain risk management is expected to rise to a mean value of 4.3 in 2015. The assessments of company representatives from manufacturing companies and logistics service providers are very similar (Kersten and Singer, 2010).

In a next step, company representatives were asked to generally appraise the importance of certain logistics risks for the logistics sector on a five-point Likert scale. Figure 12 shows the result. The delay/untimeliness of delivery (time risk) was regarded as the highest risk, followed by damage during transport (quality risk). The increase in transport costs (cost risk) was ranked close to the quality risk. The loss of the entire cargo (default risk) and the partial destruction during transport (quantitative risk) were ranked less important. Manufacturing companies rank transport risks as presented in figure 12. Logistics service providers on the other hand rank time risk as most important as well, but it is followed by costs and quality risks.

Since the 1980s, costs, quality, and time have been counted among the strategic success factors in companies. In recent years, the time factor was considered most important (Kaluza and Blecker, 2005). Following Schulte-Zurhausen (1995), these three aspects form the “magic triangle” of project management. The relevance of these factors can be seen in the study, as in all cases time, quality and cost risks were regarded most important.

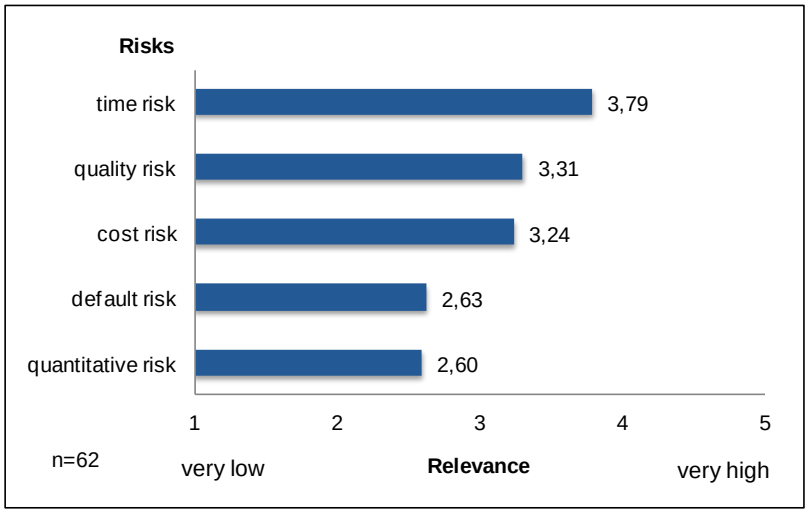

Figure 12: Relevance of transport risks for the logistics sector in general (Kersten et al., 2011a, p. 360)

In the risk management process, the assessment of risks follows the identification of risks. While 8% of the company representatives report that they do not assess their risks, two thirds classify their risks

qualitatively. 40% of the experts accurately quantify the two dimensions probability of occurrence and amount of damage. When answering this question, it was possible to agree with several statements or to reject them.

In order to manage the previously studied risks four logistics strategies were evaluated with regard to their suitability and application (figure 13). The figure only shows the responses of manufacturing companies, as not all of the strategies apply to logistics service providers.

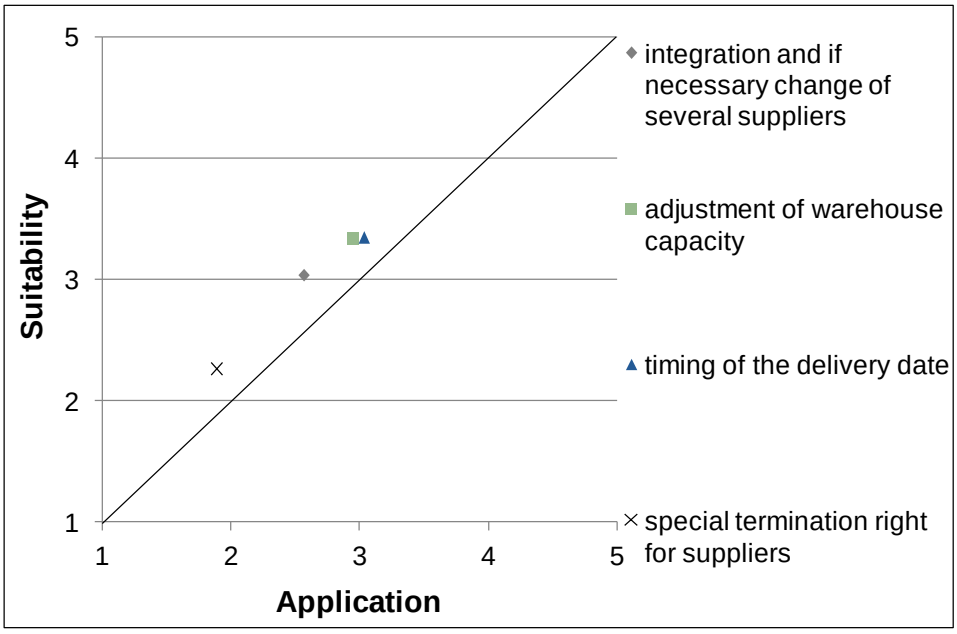

Figure 13: Suitability and application of logistics strategies in risk management for the supply side (Kersten et al., 2011a, p. 361)

The respondents rated all specified strategies in terms of suitability higher than in their actual application. The strategy to terminate the contract with suppliers was recognized as least suitable and applicable. The strategy to integrate or change several suppliers was applied and rated as suitable. The respondents evaluated the strategies to adjust the warehouse capacity and to change the timing of the delivery date to have additional buffer time as most suitable and applied. These results give a good impression about the common strategies in practice. Furthermore, this evaluation of logistics strategies in risk management for the supply side is the basis for the development of additional strategies, which can be applied in transnational road freight transport.

4.2 Extended analysis with regard to the identification of transport risks – results of two workshops

Two workshops on transport risks have been held within the C.A.S.H. project in June 2010 and in April 2011. They are explained in the following. The workshops targeted at deepening the results gained in the survey, especially the perceived transport risks. While the aim of the first workshop was to identify transport risks from the perspective of police authorities, the second workshop targeted on detecting transport risks from the companies' view.

Below, the two fields of vision are highlighted and discussed afterwards.

4.2.1 The police authorities' view[19]

It is necessary to identify transport risks at first, in order to be able to develop suitable and efficient logistics strategies to minimize risks in transnational road freight transport (chapter 5). For this purpose, the authors conducted a workshop with representatives of road police authorities from Denmark, Estonia, Finland, Germany, Lithuania, Norway and Sweden as well as researchers from Germany, Finland, Latvia and Lithuania within the C.A.S.H. project. The workshop took place with 25 participants in Tallinn, Estonia, in June 2010.

The participants from police authorities were mainly in leading positions of units related to the control of HGV. Some were even specialists in the field of dangerous goods. The researchers either worked in the area of business logistics or they were psychologists conducting studies in the field of logistics. The workshop aimed at finding as many and diverse transport risks as possible before starting to cluster the risks through a discussion.

As a result of the workshop, different kinds of risks were identified. They were then clustered according to the categories truck driver, company, truck and external risks (see figure 14).

[19] This subchapter represents an excerpt from a paper submitted by the same authors to "Deutsch-Russischer Logistik und SCM Workshop DR-LOG 2011" (May 2011) and is published in the conference proceedings (see Kersten et al., 2011a). It also forms part of C.A.S.H. report 3:2011, Kersten et al., 2011b.

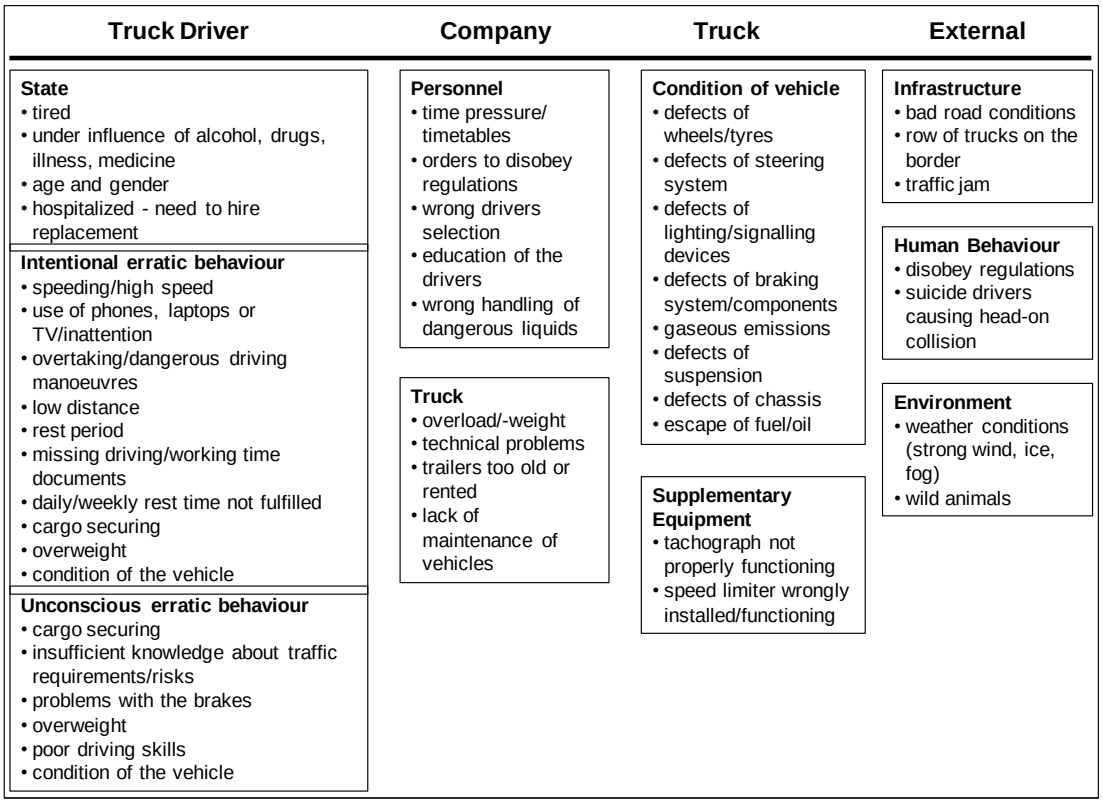

Figure 14: Results of the workshop on transport risks (police authorities' view) (Kersten et al., 2011a, p. 33)

The highest number and diversity of risks were found within the category of "truck driver" risks. Furthermore, within this category, risks were classified into state, intentional erratic behaviour and unconscious erratic behaviour risks. Risks in the category "truck" were also listed several times. Truck risks include risks in the field of basic equipment (condition of vehicle) as well as risks related to supplementary equipment. Risks in the category "company" were named less often. Last but not least, some "external" risks were mentioned by the participants in the workshop. They were classified into the sub-categories infrastructure, human behaviour and environment.

As representatives of logistics companies did not attend the workshop, it was decided to organize a second workshop to complete the overview.

4.2.2 The companies' perspective[20]

Since representatives of companies were absent at the first workshop, a second workshop was held with researchers and with company representatives. This time, no representatives of police authorities were present. The workshop took place in Riga, Latvia, in April 2011. Most of the experts represented logistics service providers. They were mainly in leading management positions in the logistics field.

Like the first workshop, the second workshop also aimed at finding as many and diverse transport risks as possible. The results show that there is a large overlap of risks mentioned by both workshop groups. For the second workshop group, risks were classified into the categories "truck driver", "company", "truck", "environment" and "political". Within the first four of these categories, a high number of risks were named which were also listed during the first workshop, e.g. a bad knowledge or condition of the truck driver, the selection of non-optimal transport routing of the company, technical defects of the truck or bad road conditions (figure 15). It should be specified that the risks overlap with the different categories.

Truck Driver	Company	Truck	Environment	Political
• illness of driver • fear to lose job • dishonesty of driver • use of alcohol • distraction (TV, phone etc.) • absence of coordination (with partners) • low know-how of young drivers • lack of experience • inofficial rules • problems during transport (police inspection) due to unknown regulations • absence of or bad communication between driver and owner	• non-optimal transport routing • time pressure • poor business rules • absence of information / bad information exchange among parties • reputation risk • wrong handling of goods • incorrect documentation • mindless / profit-oriented behaviour of the company	• bad condition of the truck due to technical defects • loss of goods due to a disruption in the cold chain • no adequate equipment • truck failure • manipulation • no comfortable information custom system • incorrect lashing / loading • loss of goods during transport • problems with dangerous goods	• bad road conditions/ decline (steep roads) • narrow roads • traffic jam • no parking spaces / no secured parking spaces • natural catastrophes (earth quake, fire, flood) • weather conditions • wild animals • theft (security)	• change in legislation in the transit countries / tax legislation • problems at border-crossing / delay due to problems with customs • delay due to unprofessional border handling • corruption • delay due to labour strikes • labour restriction • loss of goods due to crime situation / terrorism • delay due to different handling of police inspection

Figure 15: Results of the second workshop on transport risks (company respresentatives and researchers)

[20] The content of this subchapter was submitted as part of a German paper by the same authors to "SciNet Wissenschaftsforum 2012" (Oktober 2012).

The category “political” encompasses risks like corruption or loss of goods due to the crime situation in a country as well as risks in connection with border crossing and handling of goods have been summarized.

Furthermore, risks like the delay due to different handling of police inspections within the countries as well as the different country-specific labour restrictions were mentioned.

4.2.3 Discussion of the two points of view[21]

The analysis of the workshop results shows that the risks mentioned by the police authorities are mainly cause-related (e.g. defects of steering system, time pressure) while the different risks mentioned by company representatives and researchers may be cause related or effect-related (e.g. loss of goods due to a disruption in the cold chain).

It becomes clear that apart from general risks a lot of country-specific risks, e.g. problems at border crossing, or frozen goods during transport due to weather conditions, must be kept in mind.

The number and dimension of possible risks also depends on the country-specific construction and condition of infrastructure as well as on the country’s security level. All identified risks differ in the amount and extent of damage.

Therefore, it becomes clear that a comprehensive risk management process should be implemented within a company and a supply chain. It should not only focus on one or two of the above-mentioned categories, but should encompass all categories in the best case, including country-specific risks.

4.3 Detailed analysis of risk management in business practice – results from expert interviews

The authors of this report conducted expert interviews in the core time from November 2011 until March 2012. The aim was to analyse the status quo of risk management in logistics. In the following, an overview of the participants in the expert interviews is given as well as

[21] The content of this subchapter was submitted as part of a German paper by the same authors to ”SciNet Wissenschaftsforum 2012” (Oktober 2012).

the structure of the interviews is described. Subsequently, results are discussed.

4.3.1 Participants in the expert interviews[22]

A total of 16 firms (ten logistics service providers, six manufacturing companies) were studied. Table 3 gives an overview of the experts, their company type, the company size and the duration of the interviews.

Table 3: Overview of conducted interviews (LSP – Logistics Service Provider; MC – Manufacturing Company)

No.	Type	Interviewee	Company Size	Duration
1	LSP	Program Manager	T/over: 51 billion EUR; Employees: 420,000	1 hour 10 minutes
2	LSP	Regional Account Manager	T/over: 15 billion EUR; Employees: 91,000	1 hour 50 minutes
3	MC	Logistics Manager	T/over: 80 million EUR; Employees: 500	1 hour 15 minutes
4	MC	Manager Purchasing/ Marketing	T/over: 480 million EUR; Employees: 2,500	1 hour 45 minutes
5	LSP	CEO	T/over: 12 million EUR; Employees: 15	50 minutes
6	MC	Logistics Director and Innovation Manager	T/over: 10 billion EUR; Employees: 6,800	55 minutes
7	LSP	Managing Director	T/over: 80 million EUR; Employees: 230	1 hour 10 minutes
8	LSP	Director Risk Management	T/over: 46 billion EUR; Employees: 450,000	1 hour 10 minutes
9	MC	Operations Manager	T/over: 25 billion EUR; Employees: 119,000	60 minutes

[22] This subchapter represents an excerpt from a paper submitted by the same authors to ”NOFOMA 2012” (June 2012) and is published in the conference proceedings (see Kersten et al., 2012a).

No.	Type	Interviewee	Company Size	Duration
10	LSP	Branch Manager	T/over: 5.5 million EUR; Employees: 10	45 minutes
11	LSP	Senior Director Operations	T/over: 6 billion EUR; Employees: 6,900	1 hour 30 minutes
12	MC	Division Quality Manager	T/over: 73 billion EUR; Employees: 400,000	50 minutes
13	LSP	Managing Director	T/over: 6.5 million EUR; Employees: 25	1 hour 30 minutes
14	LSP	Managing Director	T/over: 43 million EUR; Employees: 100	1 hour 30 minutes
15	LSP	CEO	T/over: 900 million EUR; Employees: 3,400	45 minutes
16	MC	Manager Regional Sourcing	T/over: 115 billion EUR; Employees: 503,000	1 hour 10 minutes

The interviews were conducted according to a half-standardized interview guideline. The interview language was German. Most of the questions represented open questions. A quantitative scale was used in addition to qualitative answers, when it seemed useful for a later comparison of the interviews.

The interview guideline comprises four major parts. The first part covers general questions concerning the company and its services. The second part deals with questions about the company's understanding of risk, risk management and mitigation measures as well as transport risks. Furthermore, the use of IT-equipment within the risk management process was discussed. At the end, the interviewees were able to express wishes and recommendations.

4.3.2 Findings from the expert interviews

The results from the interviews are presented according to the general structure of the above-described guideline. First, general information of the company sample is given. Subsequently, detailed information on the management of transport risks is presented. Finally, the use of IT-systems within the management process of transport risks is analysed. Further results of the expert interviews are described in chapter 5.2.2 and 6.2.

4.3.2.1 General information on the companies

The company representatives gave an overview of the proportion of logistics services which are fulfilled in the case of logistics service providers or requested by manufacturing firms. Figure 16 illustrates the order of logistics services for the interview sample.

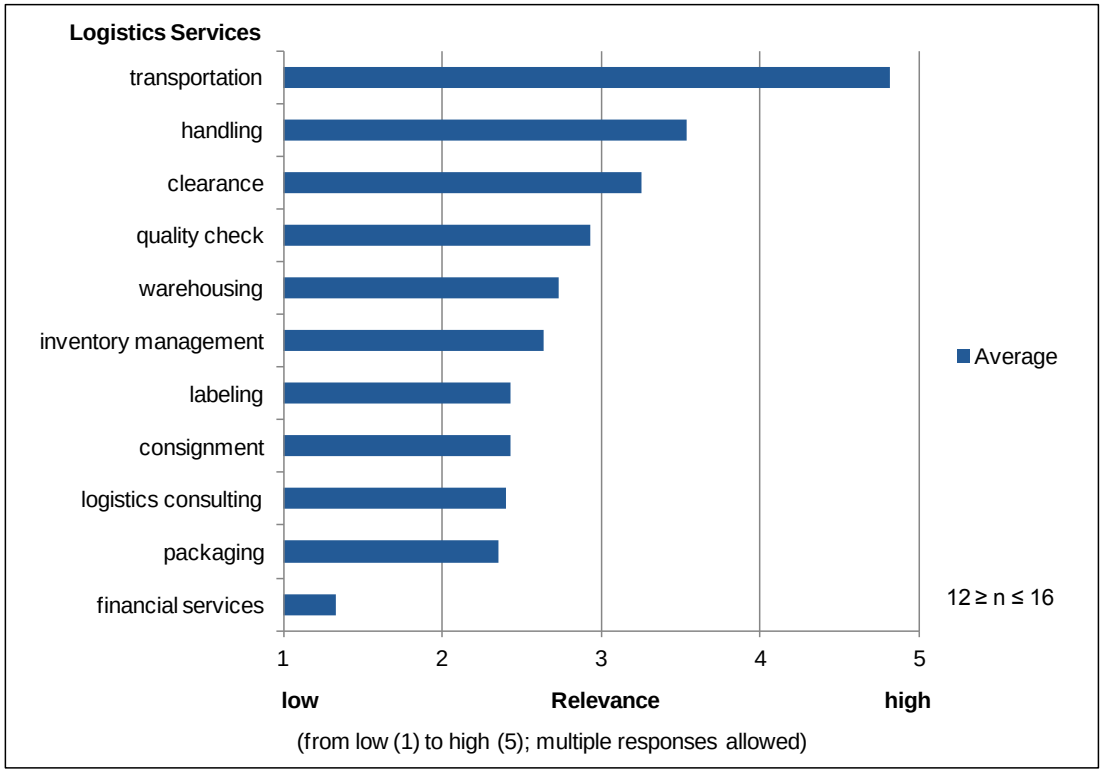

Figure 16: Proportion of requested/fulfilled logistics services

Transport is fulfilled by all interviewed logistics service providers as well as requested by all manufacturers. Furthermore, on average, the proportion of transport in comparison to all other logistics services is high. In addition, handling and clearance is an important topic for the analyzed firms. The high proportion of customs clearance highlights the international focus of the company sample. Moreover, the interviewees are experienced in quality checks, warehousing, inventory management, labeling, consignment, logistics consulting, and packaging as logistics services. In contrast, financial services are not frequently performed in the analyzed companies.

Figure 17 provides an overview of the operating areas of the interviewed firms.

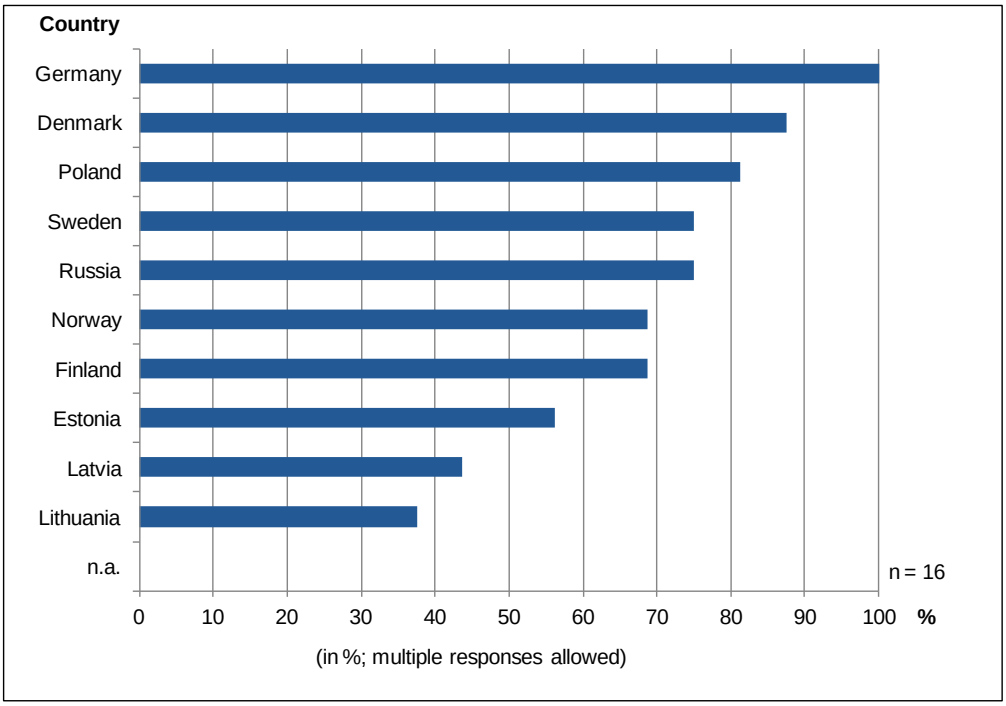

Figure 17: Operating area of interviewed companies

All companies of the sample do business in Germany. Furthermore, Denmark, Poland, Sweden, Russia, Norway, Finland, and Estonia are covered by at least half of the interviewed companies. Seven companies (43.75%) are active in Latvia and six companies (37.50%) deal with Lithuania. Therefore, the company sample is experienced in business within the countries of the BSR.

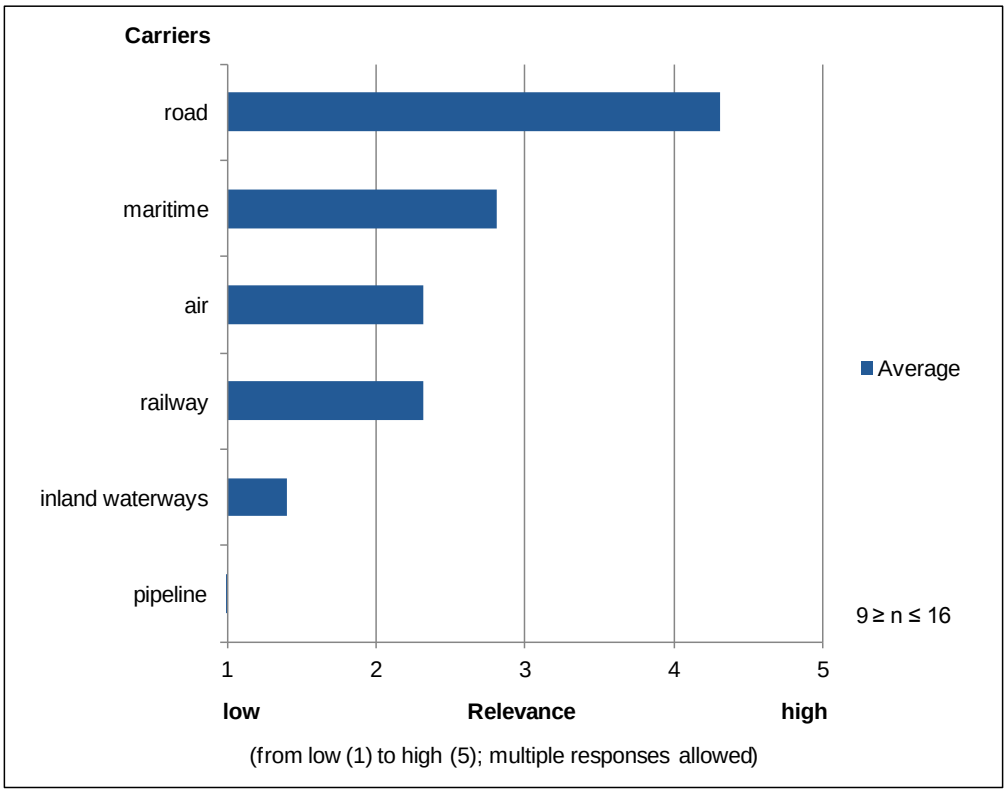

Figure 18: Proportional use of carriers

The analyzed companies mostly use road transport, followed by maritime, air, railway and inland waterways carriage. Pipelines are only utilized in individual cases and therefore represent a low proportion. Figure 18 illustrates this.

4.3.2.2 Management of transport risks[23]

Like in the base analysis, the interviewed experts primarily understand the term risk as a negative event which affects the company itself. Hence, risk is seen as a threat to the success of the company or the company's aims. Only one expert defined risk as a deviation from a plan so that from his point of view, a holistic perspective on risks also has to consider positive deviations (opportunities). Moreover, the majority associates risks with a financial impact on their company. Two interviewees highlighted that risks do not only have an impact on their own company but have consequences for the company's overall supply

[23] This subchapter includes in some parts excerpts from a paper submitted by the same authors to "NOFOMA 2012" (June 2012) and is published in the conference proceedings (see Kersten et al., 2012a).

chain. Furthermore, two experts expressed an understanding of risk, which includes economical, ecological and social components. In summary, all experts regard risk to have a negative impact on at least their own company.

The professionals comprehend risk management as the implementation of measures to ensure the success of their company and to achieve corporate objectives. Appendix 1 provides an extract of the individual answers of the interviewees. In six of the cases, risk management is seen as a process with different phases (numbers (nos.) 3, 4, 6, 8, 10, and 13 in appendix 1). This risk management process has been described in more detail in section 2.3: risk identification, assessment, mitigation and control. While three of the experts stem from manufacturing companies, the others constitute logistics service providers. Therefore, it is not possible to draw conclusions from the company type. Furthermore, some company representatives emphasize the reporting function of risk management or see risk management as part of quality management.

After these introductory questions, the interviews were focused on the road transport function. Nine companies (56.25%) have institutionalised risk management which considers transport risks (see figure 19).

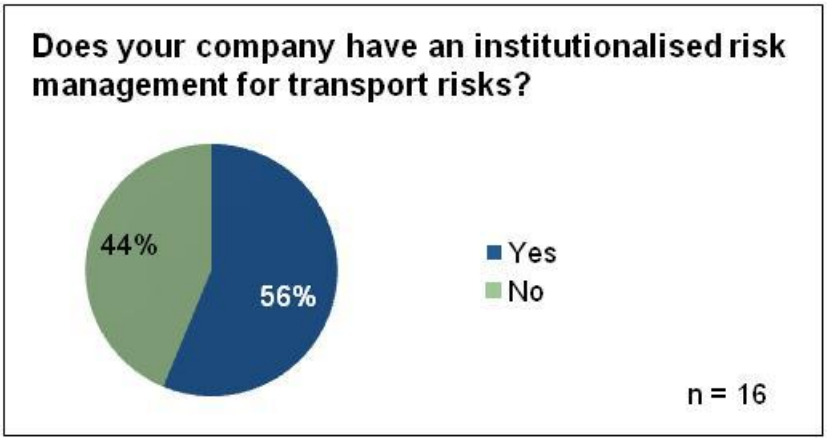

Figure 19: Proportion of companies with an institutionalised risk management

Seven of them represent logistics service providers (nos. 1, 2, 7, 8, 13, 14, and 15 in appendix 2) and two answers were given by manufacturing companies (nos. 6 and 9 in appendix 2). However, in most cases, transport risk is just one category within many of the institutionalised risk management and there are perceptible differences as how important these risks are considered. Companies without an

institutionalised risk management for the transport process deal with risks as part of their daily business, e.g. by appointing emergency teams. An extract of the interview transcripts based on the tape recordings gives an overview of the company specific explanations regarding an institutionalised risk management for the transport process (see appendix 2).

In the following, it is analysed what kind of road transport risks are most important and what kind of measures are used to handle these risks.

The experts were asked to name the ten most important transport risks to their company and to asses these in terms of damage and probability of occurrence on a Likert scale ranging from 1 (very low) to 5 (very high). Overall, the sixteen interviewees named 123 transport risks (including a large number of multiple responses) which are listed in appendix 3.

Taking a bottom-up approach, the authors of this paper clustered the risks in subgroups describing the sources of risks. The subgroups were then allocated to groups which specify the type of impact of each mentioned risk. The groups were chosen in accordance with Rogler (2002) and have been discussed in 2.3.2.1 and 4.1.2. Since the assignment of risks to the groups “default” and “quantitative” turned out to be ambiguous, these groups have been consolidated.

Table 4: Clustered road transport risks

Group	**Subgroup**	**Example** **Number for entries:**	**#**
time			**28**
	regulations	“delay due to problems with customs”	8
	delivery process	“additional expenditure of time”	7
	environment	“exterior influence (e.g. ice on roads)”	7
	communication	“language issue abroad”	6
			23

Group	Subgroup	Example Number for entries:	#
default/ quantitative			
	thievery	“theft of goods from lorry”	9
	loss	“loss of goods during transport”	7
	warehousing	“fire in warehouse”	4
	other	“lorry tilts over”	3
cost			**20**
	commodity price	“fluctuation of diesel price”	7
	supply chain partner	“cash loss due to bankruptcy of customer”	5
	delinquency	“fraud on freight exchange”	3
	shortage of cargo space	“competitive constraints”	2
	other	“traffic violation”	3
quality			**18**
	damaging	“disruption of cold chain”	13
	packaging	“deficient wrapping”	3
	other	“the production requires a certain mixing ratio of raw material”	2

Table 4 represents the grouped road transport risks as well as its subgroups and gives an example for each subgroup. Furthermore, the number of entries is listed for each subgroup and for each group the sum is highlighted in bold. Overall, 89 responses are clustered in the categories “time”, “default/quantitative”, “cost” and “quality”. In total, 28 responses concern the group “time”, 23 are allocated to “default/quantitative”, 20 make up “cost”, and 18 answers represent “quality”. One out of four subgroups within “time” is “regulations”. Eight entries are classified into this specific subgroup. One example for an entry is “delay due to problems with customs”.

In addition to the above-discussed risks, the experts named 34 risks which have different sources than the ones described in the formed subgroups and which impact multiple groups. Therefore, the classification is ambiguous for these risks. Their spectrum ranges from “the usage of a tank lorry for terrorist attacks” to political risks such as “damage of infrastructure” to company-specific risks like “loss of certificate as known consignor”. Only three subgroups can be formed

with multiple responses. Six mentioned risks concern the “qualification of lorry drivers”. Five further responses can be grouped into “weather”, while two others may be allocated to “infrastructure”. No multiple answers were given within the remaining 21 mentioned risks. This highlights the fact that road transport cannot be analysed independently from other business processes. Due to these existing interdependencies even financial risks may impact the road transport process.

The company representatives were asked if their company has a classification for transport risks. In ten companies (62.5%), no classification of transport risks exists. Figure 20 illustrates this status.

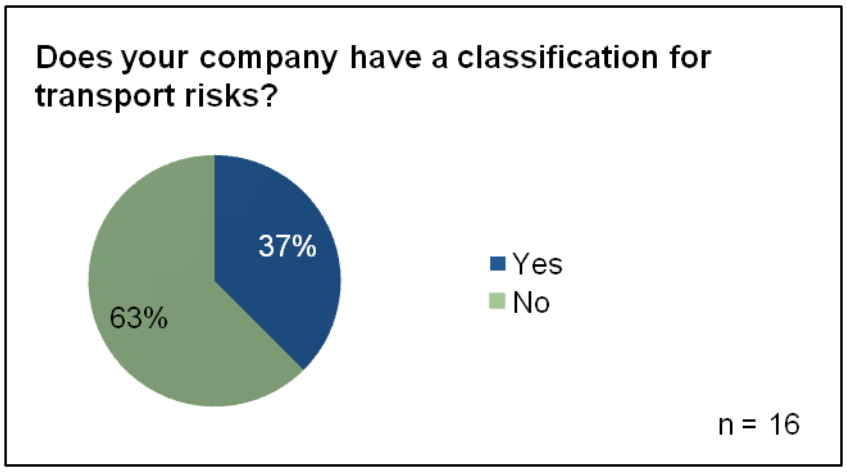

Figure 20: Proportion of companies with/without a classification for transport risks

One company applied an implicit classification. In this case, risks are divided into unpredictable and predictable ones. The predictable risks are captured within an implemented supply chain event management system. The unpredictable risks are not considered. Moreover, five interviewees reported that their company uses a classification for transport risks. One company classifies the identified risks regarding their causes. Another company formed the following categories for risks in general: legal, strategic, market, finance, and day-to-day business. The identified transport risks were classified into these categories as well. The third company uses a list including 45 risks with different classes. This list is utilized in combination with a standardized terminology to evaluate the potential damage of these risks. In addition, two of the classifications are based on estimated values for risks and therefore on risk assessment. One example for such a classification is the definition of three groups: the first group

includes risks with a value less than 1 million Euros. The second group encompasses those with more than 1 million Euros, but less than 5 million Euros, and the third group contains risks with a value of more than 5 million Euros.

In general, the assessment of road transport risks was a difficult task for the interviewed experts: An evaluation of road transport risks is only established in six out of 16 companies. Another four companies estimate risks in individual cases. Moreover, the evaluation is specific to each company, supply chain and even to each individual risk. These difficulties to assess road transport risks also reveal the need for action on both the scientific as well as the business side.

4.4 Interim conclusion of the empirical results[24]

The participants in the survey conducted within the C.A.S.H. project estimated the relevance of certain transport risks for the logistics sector in general. The results reflected that the time risk (delay/untimeliness of delivery) was regarded as the highest risk, followed by quality (damage during transport), cost (increase of transport costs), default (loss of the entire cargo) and quantitative risk (partial destruction during transport).

The evaluation of four logistics strategies with regard to their suitability and application showed that the respondents rated all specified strategies in the terms of suitability higher than in their actual application.

Moreover, the respondents regard the general importance of supply chain risk management to be increasing considerably over the last years.

The results gained in the survey were deepened with the help of two workshops. While the aim of the first workshop was to identify transport risks from the perspective of road police authorities, the second workshop aimed at detecting transport risks from the companies' view.

As a result of the workshops, different kinds of risks were identified and clustered according to the categories truck driver, company, truck, external/environmental and political risks.

While the risks mentioned by the police authorities were mainly cause-related, the different risks specified by company representatives

[24] The content of this subchapter was submitted as part of a German paper by the same authors to "SciNet Wissenschaftsforum 2012" (Oktober 2012).

were either cause-related or effect-related. The huge number of identified risks in the field of transport shows that due to their diversity a successful risk management must consider different perspectives.

In addition to the survey and the workhops, sixteen expert interviews were conducted. In the expert interviews, the focus was set on the implementation of risk management and on possible risks which may occur in transport. Within the interviews, a total of 123 transport risks (including a large number of multiple risks) were identified and allocated to groups which specify the type of impact of each mentioned risk. These groups were time, default (respectively quantity), cost, or quality of the transport process.

After the first two steps of the risk management process, i.e. risk identification and assessment, have been tackled, risk mitigation is covered in the following.

5 COMPILATION OF MEASURES AND STRATEGIES TO MANAGE TRANSPORT RISKS[25]

In chapter five, the report focuses on risk mitigation and hence on measures and strategies especially to manage transport risks. At the beginning, types of risk mitigation measures and strategies are introduced, before the compilation of risk mitigation measures and strategies is described. Last, an interim conclusion is drawn.

5.1 Types of risk mitigation measures and strategies

At first, the different types of risk mitigation measures and strategies are explained. As it was described in chapter 2.3.2.3, there are various measures which can be assigned to a strategy. Strategies in order to handle risks either target at avoiding, reducing, transferring, sharing or taking the risk (Norrman and Lindroth, 2004).
While avoiding risks aims at eliminating the trigger of an event, e.g. not taking a specific action, and therefore the likelihood of occurrence, reducing risks can either be targeted on the decrease of the probability, like improving supplier selection, or the consequence such as using multiple sources. Furthermore, risks may be transferred to insurance companies or to customers depending on the production strategy used (e.g. make-to-order manufacturing). In addition, it is possible to share risks through better collaboration with partners. Finally, risks may be accepted and hence no active measures be taken (Norrman and Lindroth, 2004).

The number of potential measures in order to handle risks is high. Several authors allocate mitigation measures to risks (Rice and Caniato, 2003; Johnson, 2001) or develop classifications for measures. For example, Tang (2006) chooses supply, demand, product and information management as categories while Manuj and Mentzer

[25] The content of this subchapter was submitted as part of a German paper by the same authors to ”SciNet Wissenschaftsforum 2012” (Oktober 2012).

(2008) distinguish between postponement, speculation, hedging, control/share/transfer, security and avoidance (Kersten and Singer, 2010). However, there is no composition of measures focusing on transport risks yet.

5.2 Compilation of risk mitigation measures and strategies

Within the compilation of risk mitigation measures and strategies, mitigation measures for risks in general and for transport risks can be distinguished.

5.2.1 Classification of mitigation measures for risks in general

Although different types of mitigation measures and strategies are often described in the academic literature, there is no classification which is used consistently.

Some authors differ between proactive and reactive measures. Both, proactive and reactive measures have different goals and require dissimilar approaches. While the proactive approach focuses on measures which should be applied before the damage occurs, the reactive approach comprises measures which should be taken following the damage (Kaliprasad, 2006).

However, the categorization of measures in terms of proactive and reactive is sometimes ambiguous. This will be illustrated with an example: IT-systems monitor the consignment of goods starting with the incoming orders and ending with the final delivery. The systems set a time stamp at the moment of the incoming order and check if the corresponding good is dispatched within a certain period of time. If there is a delay within this process, the systems forward the essential information to a call centre. Subsequently, the employees of the call centre have to handle the consignment. In this example, the described measure can be classified as both proactive (implementation of IT systems) and reactive (managing delay) (Kersten et al., 2012a).

Other authors use the five basic strategies which were described before, i.e. avoiding, reducing, transferring, sharing or taking the risk. It is possible to allocate the measures to these strategies. However, like the previous classification, this solution can be ambiguous and sometimes does not achieve the objective. For instance, the measure “redundancy of data” can be regarded as a strategy to avoid the “loss

of data", but on the other hand it may be contemplated as a strategy to reduce the impact if such a risk occurs (Kersten et al., 2012a).

In the following, the classification of mitigation measures for supply chain risk management developed by Kersten et al. (2009) is used. Here, measures are divided into different categories: mitigation measures for risks in general and mitigation measures for specific risks. From the last-mentioned class, mitigation measures for procurement risks are introduced exemplarily.

Mitigation measures for risks in general – as the first class – contain measures which are not applicable for specific risks. They should be applied in general within the supply chain risk management process. Thus, they can further be classified into four subcategories: generic risks, personnel, information/communication policy and planning/prevention of crises.

Figure 21 shows two examples for measures for each subcategory. "Building cross-functional teams" or "improving further education in risk management" are e.g. measures allocated to the category "personnel". However, "continuous performance improvement" or the "use of early warning signs" can be measures to plan and prevent crises.

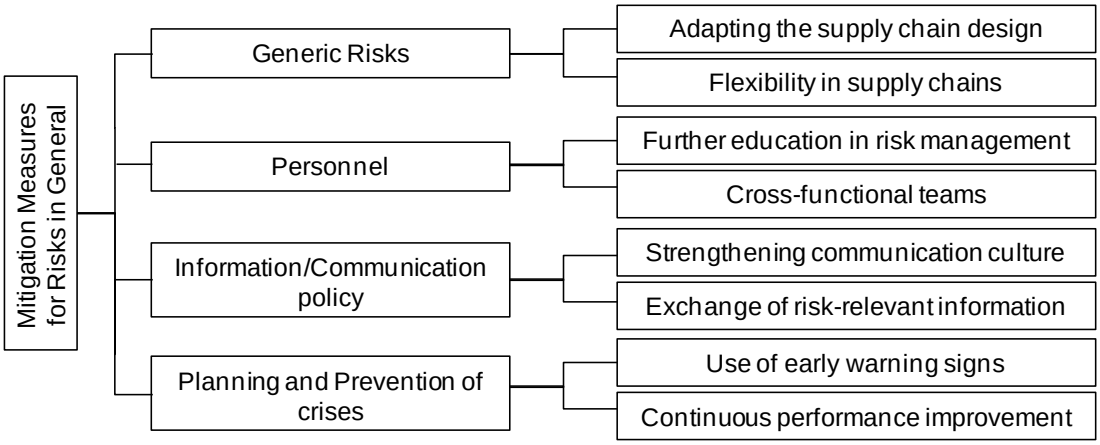

Figure 21: Mitigation measures for general risks

Mitigation measures for "procurement risks" – as the second class – represent the second and biggest category of mitigation measures for supply chain risk management used by Kersten et al. (2009). Here, the following subcategories are listed: supplier-/logistics service provider portfolio/ make or buy, supplier management, forecasting & planning, cooperation with supplier/LSP, contracts, calculation, product, inventory management and insurance. Apart from these, "transport" was added as another subcategory.

Figure 22 shows two examples for measures for each subcategory.

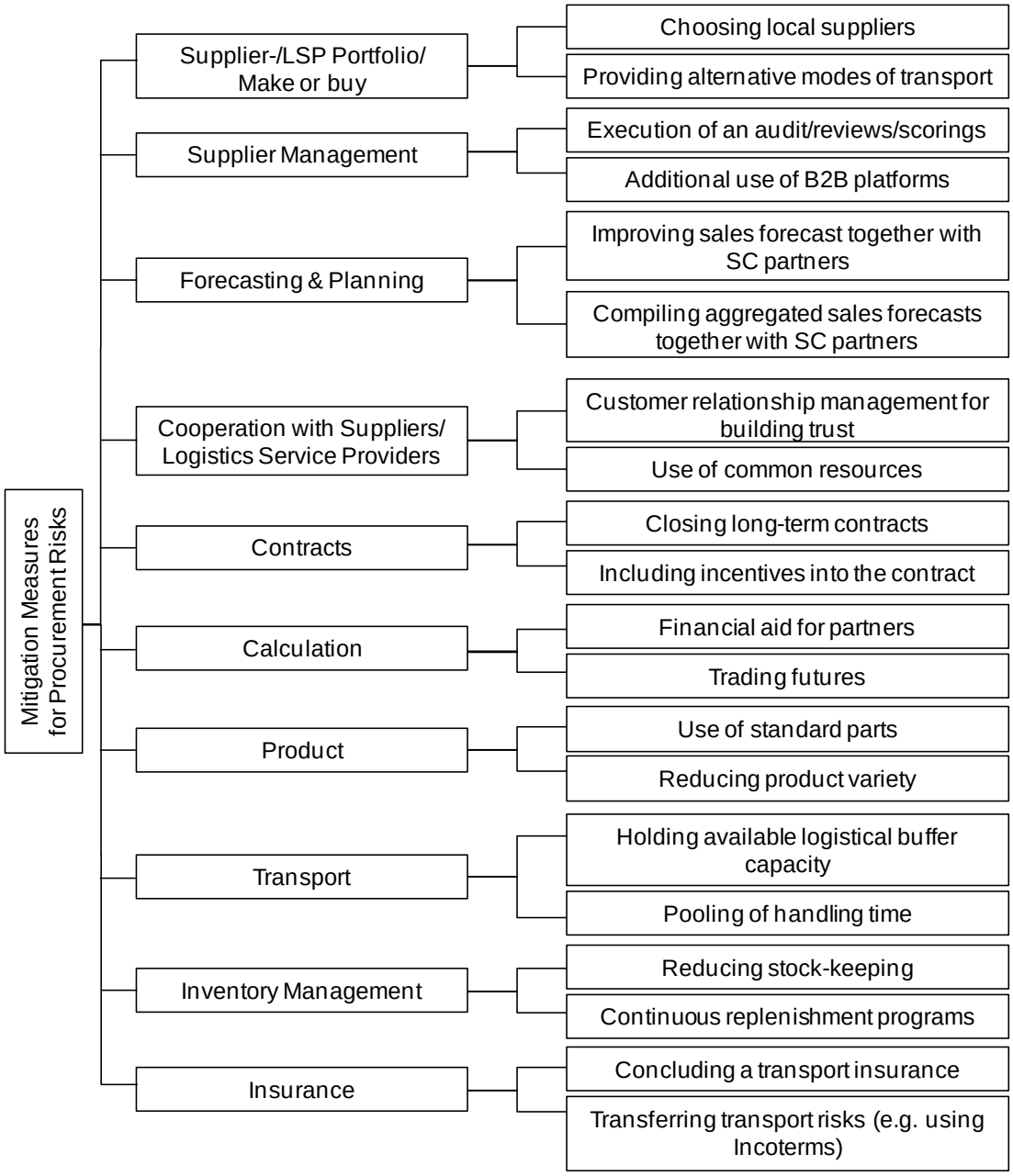

Figure 22: Mitigation measures for procurement risks

A differentiation among the listed measures can not only be made between their subject matter but also regarding their time horizon. The measure “customer relationship management for building trust” in the subcategory “cooperation with suppliers/LSP” or the measure “closing long-term contracts” in the subcategory “contracts” follow a long-term approach while e.g. the measure “additional use of

B2B platforms” represents a short-term approach (Kersten et al., 2009).

The third class “mitigation measures for other risks”, which is not looked at in detail in this report, contains measures in the field of control risks, process risks, demand risks and environmental risks.

In addition to the before-mentioned classification, and based on the five basic strategies, the measures can further be subdivided depending on whether they are cause-related or effect-related. Cause-related measures focus on recommendations for avoiding and reducing risks, such as ”the selection of suppliers corresponding their reliability”. In contrast, effect-related measures aim at limiting damage or sharing risk, e.g. ”the additional use of B2B platforms”. In some cases, measures can be allocated to both classes, cause and effect-related measures (Kersten et al., 2009).

In the follwing, the chaper focuses on mitigation measures for transport risks.

5.2.2 Classification of mitigation measures for transport risks[26]

During the interviews conducted within the C.A.S.H. project, the experts were not only asked to name the ten most important road transport risks to their company (chapter 4.3.2), but they were also requested to assign one or more measures to each of the risks. Overall, 124 mitigation measures were described during the interviews, including a large number of multiple responses. In some cases, multiple measures were allocated to one risk or several risks were assigned to one measure. In general, there were a high number of duplicate assignments in the complete evaluation.

Table 5 illustrates possible classes of measures for transport risks which were mentioned by the experts during the interviews. They were combined with measures named in Kersten et al. (2009).

The authors classified the mitigation measures for the subcategory “transport” in accordance with the common distinction in business administration: “organization”, “personnel” and “IT”.

[26] A part of this subchapter represents an excerpt from a paper submitted by the same authors to ”NOFOMA 2012” (June 2012) which is also published in the conference proceedings, Kersten et al., 2012a.

Table 5: Measures for transport risks (results of the expert interviews combined with Kersten et al., 2009)

Group	Subgroup	Measure
organization		
	collaboration	“long-term relationships with service providers as well as with customers”
	contracts	“bonus malus system with customer”
	insurance	“closing of an insurance contract” “concluding a transport insurance” “transferring transport risks (e.g. Incoterms)”
	make-or-buy	“own management of transports”
	prevention	“business continuity plan”
	reducing (delivery) time	“shortening of logistical through put time” “pooling of handling time” “changes in delivery times: deliveries on time with less traffic” “holding available logistical buffer capacity”
	reducing default risk	“timing longer transport times” “providing buffer time between delivery and manufacturing of vendor parts”
	security	“choosing mean of transport/route of transport/transport time with regard to safety issues” “secured parking spaces” “preventing/improving maintenance/servicing of the logistical equipment/mode of transport”

Group	Subgroup	Measure
		“improving safety measures for goods: use of special bins designed for transport security”
	service providers supply chain design	“supplier’s audit” “taking the logistics network into consideration when selecting the location”
personnel		
	reducing human capacity	“handling of cargo: eliminating/ reducing number of human intervention/of operating sequences”
	developing human resources	“training for fuel efficient driving”
	selection of employees	“requesting certificate of good conduct”
IT		
	monitoring	“proactive reporting of delayed transports” “redundancy of data” “positioning system (tracking and tracing)” “monitoring of the transport chain: alarm management/sabotage”
	security	“door monitoring system and technical alarm (brakes, temperature, tyre pressure, axle loading)”

For each group, several subgroups were formed and labelled with regard to their content. The group “organization” consists of ten subgroups: collaboration, contracts, insurance, make-or-buy, prevention, reducing (delivery) time, reducing default risk, security, service providers and supply chain design. “Personnel” includes the

three subgroups reducing human capacity, developing human resources and selecting employees, while “IT” has the subgroups “monitoring” and “security”.

Most of the measures affect the “organization” followed by “IT” and “Personnel”. ”Security” represents a large subgroup both in ”Organization” and ”IT”. Measures from the organizational aspect with regard to security are e.g. ”offering secured parking spaces”, “improving safety measures for goods by using special bins designed for transport security” while the use of a door monitoring system and technical alarm (brakes, temperature, tyre pressure, axle loading) are examples for measures from the IT aspect with regard to security.

The results of this chapter show that there is a huge number of identified measures, which the companies take in order to manage road transport risks. Nearly all of them can be allocated to the common classification “organization”, “personnel”, and “IT”.

The presented framework of measures to manage road transport risks may be used when applying the risk management process. (1) At first, risks have to be identified before they are evaluated (cp. figure 23). (2) After assessing the risks, they need to be prioritized in preparation for risk handling. (3) Subsequently, depending on the kind of transport risk, the enterprise, supply chain, and their objectives, company representatives may select measures from the compilation.

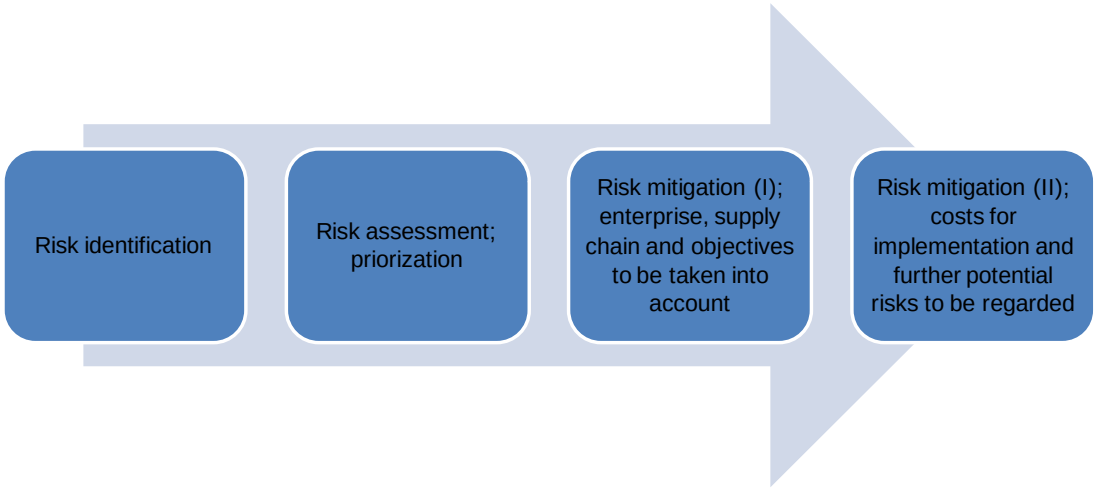

Figure 23: Steps for companies in the risk management process

Furthermore, it is possible to choose a measure from one of the groups depending on the impact the measure should have. (4) When deciding on the mitigation measures, costs for their implementation and occurrence of further potential risks should also be taken into account.

Hence, interdependencies with general operational risks must be observed to ensure an efficient road transport process (Kersten et al., 2012a).

5.3 Interim conclusion of the compilation of measures to manage transport risks

In the literature and in business practice there are different types of risk mitigation measures and strategies. Various measures can be assigned to a strategy. Strategies either target at avoiding, reducing, transferring, sharing or taking the risk. The number of potential measures in order to handle risks is high. Several authors allocate measures to risks or develop classifications for measures. However, there is no composition of measures focusing on transport risks yet.

In this report, the classification of mitigation measures for supply chain risk management developed by Kersten et al. (2009) was used. Therefore, measures were divided into three categories: mitigation measures for risks in general, mitigation measures for procurement risks and mitigation measures for other risks. Then, further subgroups for each category were added.

As part of mitigation measures for procurement risks, a closer look was taken at the subcategory “transport”. In accordance with the common distinction in business administration “organization”, “personnel” and “IT”, this subcategory was further classified. Most of the allocated measures affect the “organization” followed by “IT” and “personnel”. A distinction among the distributed measures can not only be made between their subject matters but also regarding their time horizon.

The results of this chapter show that there is a huge number of identified measures, which companies can use in order to manage their road transport risks. Therefore, the developed framework and hence compilation of measures to manage road transport risks may be used by the companies when applying the risk management process. However, costs for the implementation of the measures and the occurrence of further potential risks should also be taken into account.

6 IMPLEMENTATION OF INFORMATION TECHNOLOGY TOOLS IN RISK MANAGEMENT

An incremental part of business collaboration is the exchange of information. Therefore, not only the physical flow of goods is important, but also information management as this supports the cross-functional as well as cross-organizational coordination. IT-tools enhance the exchange of information. Especially in the field of risk management the use of IT system is helpful. They can support all phases of the risk management process and therefore reduce labour input (Erben and Romeike, 2002). Beside the advantages, it has to be kept in mind that the breakdown of an IT-system is itself a risk for the transport process (Siebrandt, 2010). Nevertheless, the implementation of efficient IT-solutions which have to be continuously refined and reviewed is important (Krupp and Wolf, 2010).

In the following, the objectives of IT-tools for risk management are described. Subsequently, the results of the conducted expert interviews regarding used IT-tools within risk management are presented and requirements are derived. These requirements are compared with available IT-tools for general risk management.

6.1 Objectives of an information technology tool in risk management for the transport process

IT-tools are used within the risk management to process the vast amount of data and to report crucial information to the decision-makers (Erben and Romeike, 2003). As the risk management process is relatively complex, it is recommended to use IT-tools to structure the sequence of operations (Wildemann, 2006). In the following, it is described how IT-tools can support the operations of each phase of the risk management process. Either one IT-tool can reproduce all these phases and therefore support the whole process or different tools are applied to the separate phases. In the latter case, the IT-tools support the specific tasks within each phase of the risk management process.

The first phase of the risk management process aims at identifying potential risks (chapter 2.3). IT-tools are able to support this phase by analysing data. Data sources can be e.g. the accounting division, inventory management, the legal department or internal claims records. Furthermore, IT-tools can be used to support activities with the aim to identify risks, e.g. by conducting workshops, interviews or FMEA (chapter 2.3, Erben and Romeike, 2003).

The assessment of risks is performed in the second phase of the risk management process. Especially for quantitative risks, IT-tools can be used for statistical methods or calculations (Erben and Romeike, 2003). One example is the use of Monte-Carlo-Simulations. In particular, for computationally intensive methods the use of IT is advantageous (Krahe, 2010).

For the selection of adequate measures in the third phase of the risk management process, IT-tools can be used e.g. for keeping catalogues ready in order to match risks with measures (Erben and Romeike, 2003).

The risk control phase can be supported by the simulation of the application of measures and its outcome. The aim is to choose the right measures for the identified and assessed risks. Furthermore, it has to be controlled that the used measures have been efficient. IT-tools can support these activities (Erben and Romeike, 2003).

The application of IT-tools is widespread within risk management. In addition, IT is an inherent part of logistics. According to Klaus et al. (2011), without IT-tools, it is not possible to manage the flow of goods and information within supply chains efficiently. On the one hand, IT-tools which support logistics functions are used within operational processes (e.g. accounting, order fulfilment, and human resources). On the other hand, specialised IT-tools are used for core business areas of logistics (e.g. transport management and warehouse management). Figure 24 illustrates this classification of IT-tools.

Risk management in the field of transport has to consider the core business areas of logistics. Therefore, the existing IT-tools are a good basis for gathering data. Nevertheless, in many cases, the IT-tools used within logistics are company or industry-specific developments (Krupp and Wolf, 2010). This situation makes it difficult to implement risk management functionalities within these existing tools.

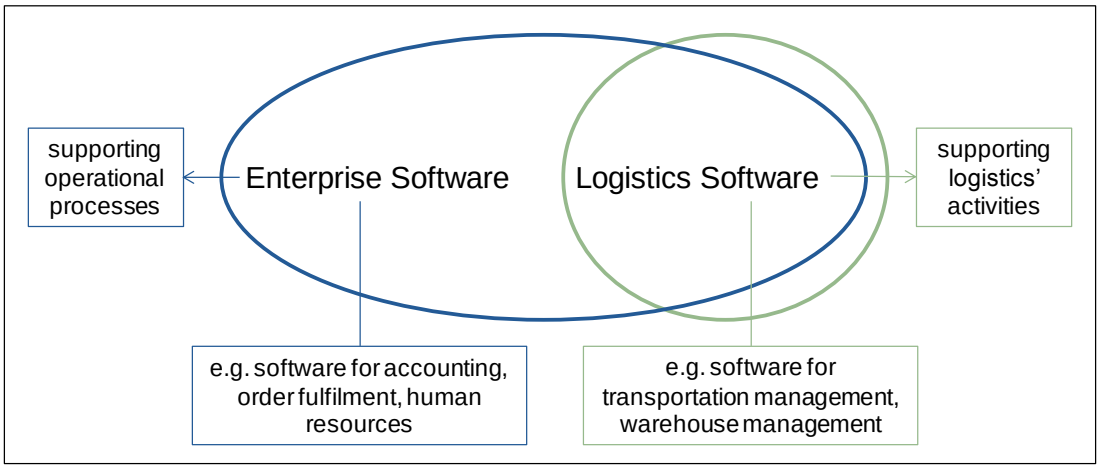

Figure 24: Classification of IT-tools supporting logistics activities (Krupp and Wolf, 2010, p. 21)

The following chapter analyses the status of used risk management IT-tools in the field of transport.

6.2 Analysis of used information technology systems in transport risk management[27]

The last questions in the conducted expert interviews focused on the use of IT-systems within the management of transport risks[28]. IT-systems are implemented by twelve (75%) of the analysed companies within their risk management process (figure 25). In the following, the application of IT-systems is explained in detail. This explanation can be helpful especially for companies which do not support their risk management process by IT-systems (like four of the companies in the interview sample).

[27] The content of this subchapter was submitted as part of a German paper by the same authors to "SciNet Wissenschaftsforum 2012" (Oktober 2012).

[28] Additional results of the expert interviews were described in chapters 4.3.2 and 5.2.2.

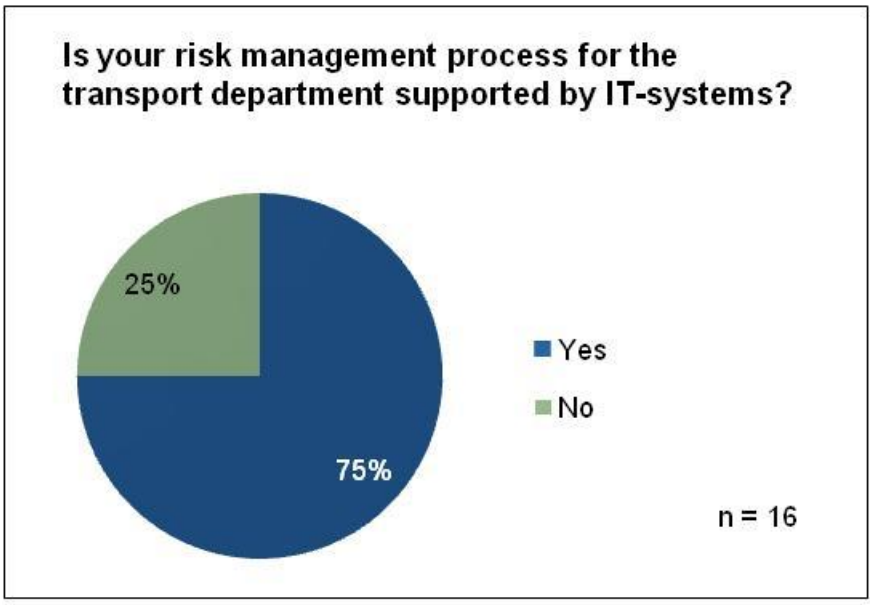

Figure 25: Companies with information technology systems to support the risk management process for transport risks

The most frequently applied software tools for supporting risk management are based on spreadsheet programs or word processing applications. Self-developed databases and IT-tools with the task to manage transport risks are only used in the minority of the cases. Furthermore, specific risk management programs are only used in individual cases. Simulation programs are not applied at all in the analysed companies. Within the category “other”, several software tools were mentioned. These tools are used on a regular basis, but their original purpose is not the support of the risk management process. Examples for these programs are enterprise resource planning tools which are used to gather data, but do not represent the risk management process. The application of order or warehouse-management software is similar since it can be applied to identify certain risks, but it does not support further steps within the process. One more example is specialised software for transport and freight management facilitating the transport process, but it does not have specific risk management functionalities. Figure 26 gives on overview of the frequency of the above-described software.

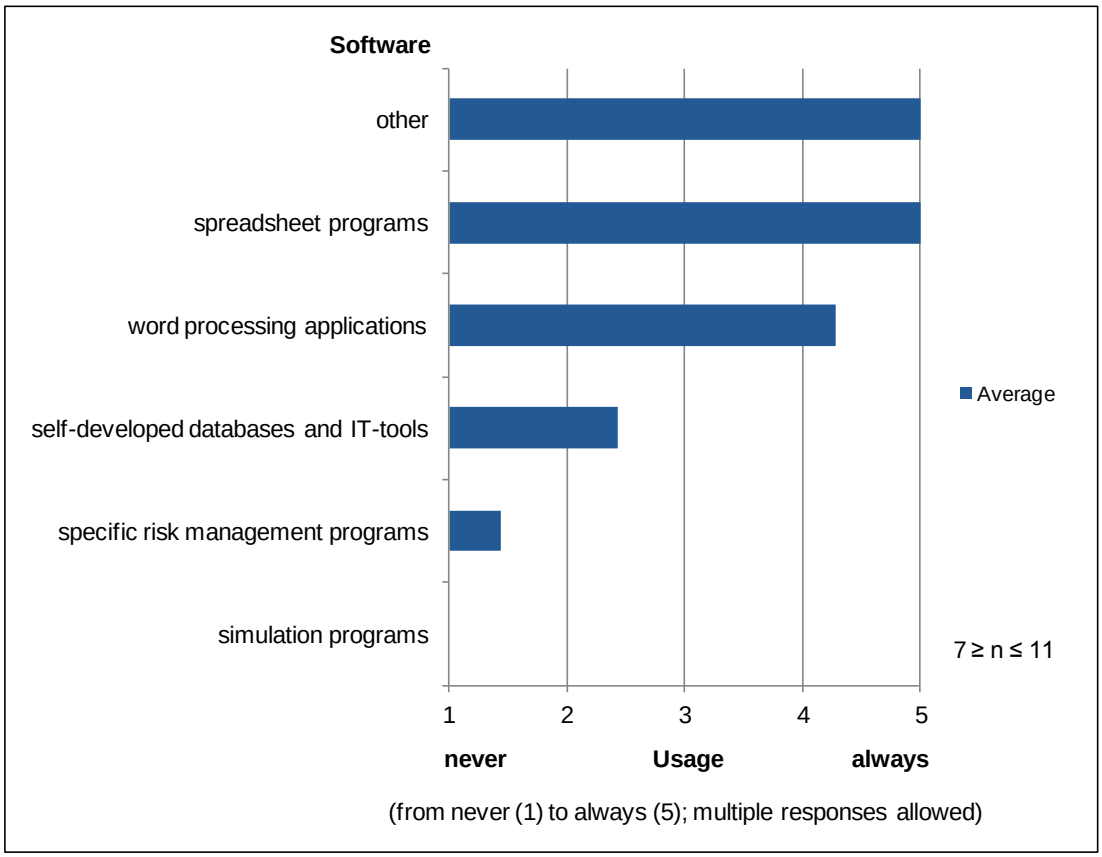

Figure 26: Used software within transport risk management

In addition, the interviewees were asked to rate the degree of integration of IT-systems with the phases of risk management. Most IT-systems are used to support risk identification or assessment. However, the answers vary considerably as some companies use software which supports all risk management phases and other companies do not apply any software for specific tasks of the risk management process. Therefore, an illustration of the average values is not significant.

More interesting are the different functionalities of the described IT-systems used in the field of transport. Many company representatives mentioned tracking and tracing systems. These systems are very useful to be kept up-to-date on the status of a transport process. Furthermore, logistics service providers can inform customers about delays in advance. Manufacturing companies use these systems to identify this risk as well.

A similar functionality can be achieved by installing global positioning systems (GPS) in vehicles. They can support the routeing of HGV. Some logistics service providers use GPS to cope with the problem of fulfilling all legislation regarding driving and resting hours as the companies are able to control their employees. A description of

regulations which are in place regarding driving and resting hours in Europe can be found in C.A.S.H. report 5:2012 (Kersten et al., 2012c).

Another important topic is the communication with supply chain partners. The interviewees highlighted the importance of information exchange with suppliers and customers. One company integrated the order process into an IT-solution. In this example, orders from customers are processed by an internet platform which is connected to the warehouse management system as well. Furthermore, all shipments are tracked by the systems and irregularities are automatically reported to a call centre. This centre informs the customer and initiates adequate countermeasures.

A very common method to support supplier management is the use of key performance indicators (KPI). KPI are often performed with IT-systems. These can be either standard spreadsheet programs or specific software tools. The aim of this supplier evaluation is to reduce the risk of breakdowns. Databases can support this task by providing up-to-date lists of assessed suppliers.

The analysed companies use other IT-tools within their daily business processes as well. Examples are checklists or systems which support the communication abroad. Translation systems are very helpful for going abroad or to inform foreign drivers about local regulations or to give instructions.

In summary, the following characteristics for IT-systems for the management of transport risks can be deduced:

- Software should be used which is easy to introduce. This can be standard software which has the advantage that employees do not have to be trained to be able to use it. Furthermore, standard software is cost-efficient. On the other hand, it may be time-consuming to adapt standard software to the specific needs of risk management activities. Therefore, it may be beneficial to introduce specific software solutions. In this case it is crucial that the functionalities of the software really meet the requirements of the company.
- All phases of the risk management process should be supported. Companies with the most sophisticated IT-systems are able to support all these phases. On the other side, the interviews highlight that many companies support the initial phases of the risk management process. To ensure the holistic implementation of risk management, it is

necessary to represent all phases with IT-systems as this makes the process efficient.

- Furthermore, risk management software has to have an interface with the existing systems which are currently in use within the transport business (e.g. tracking and tracing or GPS). The interviewees highlighted how useful these existing systems are for the risk management. However, the systems are not developed to represent the risk management process. Only a combination of software will enable an efficient risk management.
- In addition, the experts mentioned that information exchange with supply chain partners is essential. Therefore, the IT-systems have to consider standard interfaces to ensure an efficient communication.

6.3 Comparison of available information technology tools for risk management

The conducted interviews highlight that there are special needs for the implementation of IT-systems for risk management in the logistics sector. Similar results were compiled in a survey-based analysis in 2009 (Huth and Lohre, 2009).

There are several IT-tools which support the risk management process. Erben and Romeike, (2002) classify risk management tools according to their analytical and reporting/managerial skills. Figure 27 gives an overview of exemplary risk management software.

The basic analytical skill for IT-tools in risk management is the gathering of data. This can be performed by standard software (e.g. MS Excel/Access; http://office.microsoft.com) or specialised IT-solutions like Verismo (http://en.verismo-consulting.com). These programs have the same analytical power, but different report/management power. The next step on the analytical power axis is the assessment of gathered data which may be done by simple trend analyses. Statistical analyses are already more sophisticated. Afterwards, profitability analyses can be performed. The highest level of analytical skills is provided by causal analyses, modelling, or simulation. These functionalities can e.g. be provided by a plug-in for standard spreadsheet software (e.g. *@Risk*; http://www.palisade.com) (Erben and Romeike, 2002).

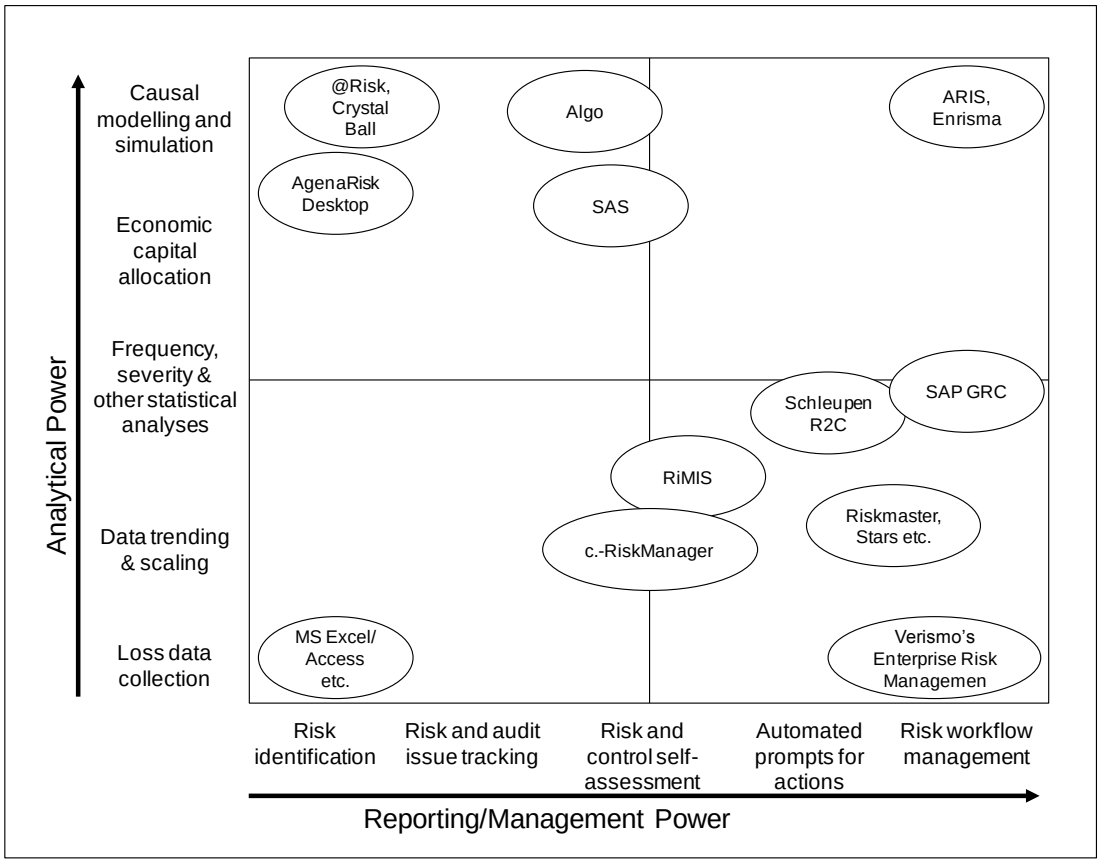

Figure 27: Classification of risk management software (Erben and Romeike, 2002, p. 584)

The fundamental reporting/managerial skill for risk management IT-tools is the identification of risks. The next step represents the tracking of risks and used measures. The control of risks as well as the self-assessment is already more sophisticated. The software *c.-RiskManager* of Cedros (http://www.cedros.com) is one example for an IT-tool which has the functionality of controlling risks. The next reporting/managerial step is the automatic generation of adequate measures. The highest level of reporting/managerial skill is the workflow management. The *ARIS* Risk & Compliance Manager of the Software AG provides e.g. this functionality (http://www.softwareag.com, Erben and Romeike, 2002).

This classification of risk management software highlights the variety of available products on the market. Decision makers can use this classification to cluster available software. However, the mentioned software is only seen to be exemplary and **not exclusive**. Appendix 4 provides further information on this selection of risk management software. The collection can be completed as well as updated by further research.

6.4 Interim conclusion of information technology tools in risk management

IT-tools play an important role within logistics. They enable the information flow within companies and between supply chain partners. Within the field of logistics, software is in use which supports operational processes within companies' as well as logistics' activities. These existing IT-tools can be used as data sources for risk management in logistics.

The application of IT-tools for risk management is common as well. The risk management process can be supported by IT-tools and therefore reduce the necessary labour input.

The conducted expert interviews highlighted that the majority of companies have implemented IT-tools to support the risk management process for transport risks. However, within the interview sample not all phases of the risk management process are supported similarly by IT-tools. Furthermore, standard software is preferred over specific risk management programs in many cases.

The experts formulated the need for IT-tools which are easy to introduce, support all phases of the risk management process, have an interface to existing software, and enable the information exchange with supply chain partners. Therefore, a combination of software with high analytical as well as reporting/management power is essential for successful risk management in logistics.

7 SUMMARY AND OUTLOOK

This document belongs to the C.A.S.H. (Connecting Authorities for Safer Heavy Goods Traffic in the Baltic Sea Region) publication series. The C.A.S.H. project was part-financed by the EU (European Regional Development Fund) through the Baltic Sea Region Programme 2007-2013 and ran from September 2009 until September 2012. The project aims to make heavy goods traffic and dangerous goods transports safer in the BSR.

In this report, the empirical results in the field of risk management in the BSR achieved in the course of the project are presented.

In **chapter 1-2,** the basics of logistics and transport, logistics in the BSR and in the EU as well as fundamentals of risk management are presented. Transport is the most important economic activity which is among the components of business logistics, also in the BSR, one of Europe's most dynamic regions. Logistics and transport have a central role in the BSR, due to the geographic location of the countries. But national and international transport may be affected by disruptive events. In this regard, the current awareness of supply chain risk management has been raised over recent years. It is necessary to implement risk management in enterprises to handle risks and their potential negative effects. Otherwise, enterprises could be endangered to the effect that profits are not realized and hence the companies are not competitive.

Chapter 3 deals with the application of techniques for data collection. The advantages and disadvantages of a survey, of workshops and expert interviews are described. For this research project, different techniques for data collection are used successively.

In **chapter 4,** the empirical results in the field of risk management are discussed which were obtained within the project through the survey, workshops and expert interviews. More than 80 manufacturing companies and logistics service providers participated in the survey in 2010. Even if only 60% of the responding enterprises have institutionalised risk management, almost all participants (90%) use tools to identify and analyse risks in their usual business processes. Nearly three quarters of those enterprises which have not institutionalised risk management stated that they apply risk

identification and analytical tools in their daily processes. The appraisal of importance of certain logistics risks has shown that time, quality and cost risks were regarded most important. While 8% of the company representatives report that they do not assess their risks, two thirds classify their risks qualitatively.

The workshop results show that the risks mentioned by the police authorities are either cause-related or effect-related. Apart from general risks, there are a lot of country-specific risks, such as risks at border crossing, or frozen goods during transport due to weather conditions. They must also be kept in mind. The number and dimension of possible risks also depends on the country-specific construction and condition of infrastructure as well as on the country's security level. All identified risks differ in the amount and extent of damage.

In addition to the survey and the workhops, expert interviews were conducted. In the expert interviews, the focus was set on the implementation of risk management and on possible risks which may occur in transport. Within the interviews, a total of 123 transport risks (including a large number of multiple risks) were identified and more than 120 measures were mentioned which are applied by the companies.

Chapter 5 deals with the compilation of risk mitigation measures. First, an overview of existing types of mitigation measures and strategies is given. Afterwards, a framework for potential measures to handle transport risks is described which helps company representatives to enable a smooth flow of goods.

Chapter 6 analyses the implementation of IT-tools in risk management. IT-tools support the risk management process and therefore reduce the necessary labour input. Furthermore, it is recommended that IT tools have an interface to existing software and enable the information exchange with supply chain partners. In addition, an approach was discussed to rank the analytical as well as reporting/management power of IT-tools.

The results of the survey, the workshops and the expert interviews show that the awareness to implement a supply chain risk management in companies has been raised during the last years. The high number and variety of possible transport risks require an application of different measures and strategies. They must be chosen carefully, reviewed continuously and adapted to the situation. Disruptions in the supply chain can only be avoided by applying a holistic risk management approach including measures which can be allocated to the suggested categories.

APPENDIX 1. EXTRACT OF INTERVIEW TRANSCRIPT – RISK MANAGEMENT[29]

No.	What do you understand by risk management?
1	The interviewee basically distinguishes between risk management concerning the company and risk management, which is offered to the customer. The company applies a (preventive) risk management system which is supported by an IT-system. This "Operations Monitoring System" measures the time from the purchase order in the system until booking in the warehouse. The aim of this system is to avoid contractual regulated damage claims of customers.
2	The interviewee understands developing awareness for risks and the way they can be minimized or avoided by risk management. This is ensured by a KPI report. For example, the specified time duration has to be met in 97% of the cases. A poor percentage regarding the delivery performance means an infringement against contractual arrangements. As a consequence, the company is not evaluated as good by its customers and is probably not considered for further contracts.
3	An indicator system is established in order to monitor risks so that counteractive measures can be initiated early (e.g. purchase management with the aid of an indicator system). It is important to evaluate service providers on a regular basis. The risk management process combines all these activities.
4	The process of minimizing risks consists of identification, control and monitoring of risks.
5	The interviewee understands risk management as a way to ensure that the available equipment is provided and it is taken care of, how the containers are handled, e.g. "where" the container was parked and "how" the container was treated. Further safety measures can only occur in agreement with the

[29] Translation from German into English by the authors.

	customer, e.g. accompanied transportation or GPS protection.
6	The interviewee understands risk management as a process with two stages: First, risks are ranked. Subsequently, it is decided how to handle the respective risks, e.g. to accept risks without initiating further measurements. For other risks, scenarios are developed for working against certain risks in the shortest time possible.
7	Risk management lies in the conflict of economical, ecological and social components.
8	The first step of risk management is identification. The second step considers the evaluation of the identified risks (Which impact do they have on the company's success or objective? What is the probability of occurrence? Is a risk relevant?). Finally, risk control is defined: a) proactive measures b) reactive measures (limiting the degree of damage) c) transfer options (insurance: sub-contractor)
9	The following aspects belong to risk management: - claim management - quality management (a guide gives explicit trans-sectoral hints (production, research & development, marketing) how to proceed in order to deliver all products with the specified quality).
10	Identification and analysis of risks. Defining and taking measures.
11	The proactive control/supervision of transport and payment risks, especially regarding prevention through partner selection, contracts, investigation and experienced data.
12	Risk management is the conscious handling of risks and risks are transferred into the operational business, which forms part of quality management.
13	Identification of risks, considering and evaluating measures. In the annual risk listing, all risks have to be named. An expected probability of occurrence and an amount of loss is determined. Then, measures are analysed. For analysing risks, and adequate measures respectively, the capital contribution is considered and an extrapolation for 3-5 years is calculated. Creating a risk matrix (very extensive) and classification in several risk classes. Different handling with risks due to risk analysis.
14	Management of risks.
15	Once a year, the management and board of directors communicate a "White Paper", stating the way a department has

	to be positioned, in order to maintain a proper risk management (more restrictive environmental/personal safety guidelines exist in Germany). All guidelines and processes of risk management are documented. The objective of risk management is to minimize risks and to ensure that the company acts conform to the law.
16	Managing risks in order to minimize them. Acquisition risk management: focus on financial risks to the suppliers. Logistics risk management: How can risks be minimized so that no halt of the production line occurs?

APPENDIX 2. EXTRACT OF INTERVIEW TRANSCRIPT – INSTITUTIONALIZED RISK MANAGEMENT FOR TRANSPORT RISKS[30]

No.	Does your company have an institutionalised risk management for transport? If yes, how is it incorporated?
1	The company possesses an institutionalised risk management. The applied system is not labelled as risk management but as a Supply Chain Event Management System. It covers preventive measures for reducing financial risks. The system e.g. enables the following measures: During an order at time t, a time marker is set. If the ordered part is not shipped at time t+x, an automatic message is sent to a call centre, which will ask for the status of the shipment. Subsequently, adequate measures will be taken. This happens fully automatically by the implemented operations monitoring system. In addition, key performance indicators are regularly calculated. For example, the allowed Inventory Shrinkage Rate is estimated in order to avoid contractual claims. Another tool in the Supply Chain Event Management System is the so-called Disaster Recovery Planning System. It works on predefined Standard Operation Procedures (SOP) for predictable cases. They help to handle risks. The SOP for example focuses on the case that computer system xyz does not function and therefore no customer orders can be placed. The SOP regulates how the standard process (in this example the replacement delivery for a customer) can still be performed. SOP are centrally developed and available in a so-called Disaster Recovery Manual. A SOP for a disaster contains three parts: 1. How is the problem identified? 2. How can it be handled?

[30] Translation from German into English by the authors.

	3. What has to be done when the failed system is running again? Furthermore, an important aspect is the arranged bonus malus system between the service provider and customer. Payments are rated by the agreed service levels and KPI. The company bears the risk that the customer invoice amount will be reduced. However, the margin is so low in the business that service providers have to fulfil the agreements to be profitable.
2	A centralized risk management department is situated in the headquarters. The department is responsible for the coordination of the contracts with customers. Primarily, they work on clauses, agreed amounts and rates for contracts. In addition, they take care of final checks in connection with contracts. The interview partner mentioned the method of payment as a risk management example. If the payment is agreed in Dollars, the company holds the risk, because they pay all bills in Euro. After the conclusion of a contract, the interviewee (account manager) supervises the contractual arranged KPI. This is done in cooperation with the key stakeholders (branch manager, department manager). The main function of these managers is to ensure that the KPI are met by the employees and to advise them in the case of mistakes. The account manager misses the overview on the concrete data (profit and loss) of each individual customer because the information is distributed locally.
3	-
4	Risk management results from needs of the particular process. Usually, the purchasing department is responsible for it. Transportation risks occur permanently, but they are not handled systematically.
5	No separate department performs an explicit risk management. This task is seen as a part of everyday business and therefore not addressed separately. Customers do not request the demand for risk management for container pre- and on-carriage. Therefore, the costs for such an instrument are not profitable. Customers demand specially secured transportation only 3-10 times a year. Thus, they do not have the willingness to pay for this service. If the service was free of charge, the customers would ask for it.
6	A risk management exists as a staff function for the entire enterprise. But on an operational level, each department executes its own risk management. There are quarterly meetings

	of the departments and the staff function. In these meetings, the risks are identified, evaluated and adequate measures are discussed.
7	The mapping of all processes is the basis of the implemented risk management. The processes are observed in connection with quality management. As part of risk management, these processes are evaluated in terms of sensitivity. This assessment is performed twice or three times a year. It is an attempt to perform risk management as a self-regulated system. In the context of these processes, many aspects are analysed, i.e. fines, complaints, handling problems and occurrences during loading and unloading among others. Measures are derived from these cases which are applied to the entire company. No individual person is punished for mistakes, but it is pointed out to the entire staff. The national law for public companies (KonTraG) is applied. One example is routeing, i.e. safer but longer routes may be selected.
8	An institutionalized risk management for the transportation sector exists within the framework of KonTraG. This formalized risk management has its focus on financial risks, which is separated from the operational sector.
9	Trans-sectoral instructions are followed up: - therefore, only class A carriers (certification, square metre-guidelines, self-assessment) are used, and - the company is certificated as known shipper.
10	No, every entity regulates this in its own responsibility. However, there is a central risk management department for finance (according to regulations by law). Hence, every production and logistics department conducts risk management, which also considers transport risks.
11	No.
12	No, it is the responsibility of each department. An institutionalised risk management exists for financial risk, but not for transport risks.
13	Risk management is part of each supervisory board meeting, but it is not specialised on transport risks.
14	Risk management is the responsibility of the executive board.
15	An institutionalised risk management exists, but it is not specialised on transport risks.
16	No explicit department for transport risks exists. In the case of a problem, emergency teams are arranged.

APPENDIX 3. RISK CLASSIFICATION[31]

Time	
Regulations	delay due to problems with customs
	documents (customs)
	problems with customs clearance
	contraband (drug smuggling)
	customs (corruption)
	customs (time consuming)
	ensure compliance, e.g. driving time and rest period
	delay due to legal requirements regarding transportation
Delivery process	delay of delivery during transportation process
	delay (delivery)
	compliance with a time limit
	additional expenditure of time
	late acceptance (container terminal overcrowded)
	late delivery (customer prepares acceptance of the goods)
	delay
Environment	strike
	blocked motorway/accident and traffic jam
	natural disaster (volcanic eruption)
	break-down of truck
	traffic jam
	exterior influence (e.g. ice on roads)
	infrastructural risks, e.g. a route for railway transportation or waterways is closed
Communication	computer system does not operate – this is not only a transportation risk, but a warehouse management risk
	communication problem (language problem/difficulties in comprehension in a foreign country)
	no information regarding the freight condition and value; time delay due to general communication problems
	language issue abroad
	order cannot be performed due to incorrect information, e.g. false

[31] Translation from German into English by the authors.

	customer address
	load with export container is interchanged and containers are shipped to wrong ports
Default / Quantitative	
Thievery	thievery
	thievery (also partial loss)
	thievery (entire container including towing vehicle are stolen)
	theft of freight from trucks
	thievery of raw material
	thievery of freight (partially or entire trucks)
	theft of goods from lorry
	organised crime
	thievery
Loss	loss
	loss
	loss
	loss
	loss during transportation
	loss of goods during transportation
	loss of freight
Warehousing	theft of freight from warehouses
	theft from warehouses (transhipment)
	fire in warehouse
	storage
Other	shipload does not arrive or technical risks occur during loading
	break
	Lorry tilts over
Cost	
Commodity price	currency risk as contractual risks (financial risk)
	financial risks – cost of diesel, toll, net rate
	financial risks due to price fluctuation of resources and freights
	changed price structure (e.g. air freight: fuel surcharges)
	higher costs
	energy costs (diesel, electricity on the railway)
	fluctuation of diesel price

SC partner	payment defaults
	monopoly (port, pricing)
	complaints
	unpaid duty
	loss of cash due to bankruptcy of customer
Delinquency	corruption
	corruption
	fraud on freight exchange
Shortage of cargo space	competitive constraints
	shortage of shipping capacity
Other	production down-time
	traffic violation
	financial impact of personal injury and environmental damage
Quality	
Damaging	damage
	damage
	freight damage
	freight damage
	freight damage during transportation
	damage – conscious and unconscious damage
	freight damage during transportation by courier or taxi from depository to end customer
	technical risks – damage, disruption during transportation
	container (damage); disruption of the supply of material and production process as a result of strikes, accidents, freight damage, storm, quality problems
	cold chain interruption
	disruption of cold chain

	load securing
	damage of the goods (or partial shipment is missing)
Packaging	damage of the wrapping
	deficient wrapping
	return shipments are problematic, e.g. the customer delivers goods in an egg carton
Other	loss in quality
	the production requires a certain mixing of raw materials
Other	
Qualification of lorry driver	lack of drivers
	professional drivers
	qualification of professional drivers (final instance for cargo securing and technical control of truck)
	professional drivers (training)
	safety of professional drivers
	reliability of professional drivers
Weather	damage to the environment (e.g. obligated declared goods are not correctly loaded, also very important)
	weather
	earthquakes
	nautical; environmental risks, e.g. volcanic eruption
	natural risks (e.g. weather, volcanic eruption or earthquake)
Infrastructure	infrastructure (e.g. heavy load and large volume transport)
	damage of infrastructure (politics)
Other	usage of a tank lorry for terrorist attacks
	load (e.g. dangerous goods)
	political
	protectionism (certificates, laboratory tests)
	personal; strike or employees' meeting
	missing registration papers
	service provider

	sub service provider or driver selection and their quality
	sub-contractor can become insolvent and cannot perform its service
	loss of certificate as known consignor
	personal injury without or with down time (very important, in case of down time, it has to be reported to the board of directors)
	a risk resulting from other risks can be a damage to a company's reputation
	loss of certificates (prerequisite for orders)
	data security
	replacement parts
	obsolete equipment
	load and unload (e.g. missing protective clothes)
	transfer of perils
	rolling stock (break-down of locomotive)
	truck is not safe for traffic (e.g. oil leaks)
	traffic accidents

APPENDIX 4. EXEMPLARY OVERVIEW OF INFORMATION TECHNOLOGY SYSTEMS FOR RISK MANAGEMENT[32]

Software	Provider	Homepage
@Risk	Palisade	http://www.palisade.com
AgenaRisk Desktop	Agena	http://www.agenarisk.com
Algo	Algorithmics Inc.	http://www.algorithmics.com
ARIS	Software AG	http://www.softwareag.com
c.-RiskManager	Cedros	http://www.cedros.com
Crystal Ball	ORACLE Deutschland B.V. & Co. KG	http://www.oracle.com
Enrisma	Enrisma GmbH	http://www.enrisma.de
MS Excel/ Access	Microsoft Corporation	http://office.microsoft.com
RiMIS	Antares GmbH	http://www.antares-is.de
Riskmaster	Computer Sciences Corporation	http://www.riskmaster.com
SAP GRC	SAP Deutschland AG & Co. KG	http://www.sap.com
SAS	SAS Institute Inc.	http://www.sas.com
Schleupen R2C	Schleupen AG	http://www.schleupen.de
Stars	CS STARS LLC	http://www.csstars.com
Verismo's Enterprise Risk Management	Verismo GmbH	http://en.verismo-consulting.com

[32] The information was gathered through internet research. The objective of this exemplary overview is to highlight the variety of available software in the market. Decision makers can use this overview as a basis for further research, however this selection is not exclusive. Therefore, the collection has to be completed as well as updated by further research.

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Authors: Wolfgang Kersten, Meike Schröder, Carolin Singer, Max Feser

This study is part of the C.A.S.H. project - Connecting Authorities for Safer Heavy Goods Traffic in the Baltic Sea Region - running from September 2009 to September 2012.

C.A.S.H. project aims to develop practical solutions to make international road freight transport safer, more predictable and affordable in the Baltic Sea region. The project intends to do this by:

- **improving co-operation between authorities**
- **harmonising training of inspection officials**
- **testing safety equipment and IT systems to be used by relevant authorities**

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