Modes of exploitation and manning regulations of inland waterway transportation

An inquiry on the frequency of and decision-making process for modes of exploitation by companies in the inland waterway transportation cargo segments

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Master thesis

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Similar too many industries, the state of the inland waterway transport (IWT) sector is strongly influenced by the worldwide and European economic crises. This fueled the discussion about the current modes of exploitation and the associated manning regulations for the sector on its most important river: the Rhine. These are restrictions implemented to make sailing on the river more safe. However, these regulations are also more and more seen as outdated. Therefore, a revision of the regulations is desired by many parties in the sector. **This research aims on sketching a reliable image of the current frequencies of the modes of exploitation and how the barge operators decide which mode is ideal for their business. Also, the opinions of barge operators and skippers about the current regulations and possible changes are discussed.** The main reasons for barge operators to choose or change the mode of exploitation are often not included in the regulations. The influence of the supply of cargo and the route to reach the destination are significant, but play no role in the current regulations. The opinions about innovation and modernization in the sector are rather mixed. On one hand, companies think modernization is not supported enough. On the other hand, not all companies think it is a good idea to trust on technology instead of manpower. A more complex framework of regulations seems to be the only way to increase flexibility.

Preface

This thesis report was written to complete the master's program 'Urban, Port and Transport Economics' at the Erasmus University in Rotterdam.

This research was done for and in collaboration with the 'Centraal Bureau voor Rijn- en Binnenvaart' (CBRB), a business organization for inland waterway transportation companies. This organization contacted professor Bart Kuipers of the Erasmus University to find a student to conduct this research on the frequencies of the modes of exploitation in IWT and the opinions of barge operators on the manning regulations. Bart Kuipers was also the supervisor of the Erasmus University on this research. Supervision by the CBRB was done by Mr. Jan Vogelaar (juridical commission) and Mr. Michiel Koning (social commission).

I would like to thank the three supervisors for advising how to start and structure the research, helping on finding good sources for the literature review and assisting on the construction of both the interview and survey questionnaires. I would also like to thank Thomas Wermer for translating the survey questions into a digital survey and Petra Arts for making the last changes before sending out the survey. At last, I would like to thank all participants of the survey, the experts for their time and expertise during the interviews and Mr. Martin Quispel for sharing a research by Panteia.

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Executive summary

To make and keep the transport of goods over the Rhine safe for everyone on and around the river, the current 'Central Commission for the Navigation of the Rhine' (CCNR) implemented restrictions for inland waterway transportation (IWT) cargo transporters. These restrictions are defined in modes of exploitation: a number of restrictions (e.g. amount of hours) set for certain ship lengths. It includes a manning regulation, in which is determined which composition of crew members is minimally required to make use of a certain mode of exploitation. This way, the CCNR wants to minimize unfair competition and increase safety. However, more and more companies perceive these regulations as outdated and unbalanced. To discover what could be improved, the goal of this report is to find out what the important factors are in deciding which current mode of exploitation is ideal. The main question for this research is: *'What is the opinion on and the effect of the modes of exploitation and its bottlenecks in the current manning regulations under companies in IWT, and are there possibilities to improve their efficiency by revising the manning regulations?'*

To answer this question, six sub questions were set. These questions are answered with the help of a literature review, interviews with experts and a survey for barge operators and owners. The first sub question takes a look at the more basic aspects of the sector and the different sub segments in IWT specifically. The second sub question looks at the role innovation and technology play in the sector and the regulations. The third sub question focuses on the regulations. The fourth sub question is part of the research that is done through the interviews and mainly the survey and looks at which modes are chosen in which segments. In addition to this question, the fifth question is about which factors determine the selection process of the modes of exploitation. The last sub question focuses on the problems barge operators and owners have with the modes. What could be improved?

The conclusion that is drawn is that the certain parts of current regulations are hindering companies to work efficiently. The lack of flexibility, the little support for innovation and the strict educational requirements for crew members are, among others, reasons why multiple companies are dissatisfied with the regulations.

Recommendations given in this report, based on the perspectives of the experts and respondents through the interviews and survey, focus on improvements of the regulations. It is important to increase the influence of important factors that, at this moment, play no role in the regulations: the route sailed and obstacles that are met during sailing. Also, modernization should be supported more, for instance by implementing advantages for modern vessels and/or disadvantages for old vessels. An optional ICT-system could be set up to give participating companies the possibility to make use of a more flexible regulations framework.

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Glossary

Barge operator – Larger company which navigates its own vessels or contracts individual barge owners to transport cargo.

Barge owner – Company that owns a vessel and mainly transports cargo for larger barge operators.

Cargo – The products or goods transported by different modalities.

CEMT-classification – Distribution of vessels into classes, established by the Conférence Européenne des Ministres de Transport, that makes clear which ships are able and allowed to navigate through specific waterways.

Consignee – The receiver of the product. In many cases a retailers or wholesaler, but also producers in case of dry and liquid bulk.

Convoy – One or more non-powered inland waterways transport vessels which are towed or pushed by one or more powered IWT vessels.

Double-hulled – Vessels with two layers at the bottom and sides. It is an extra safety measure, compared to the single-hulled vessels, in case the outer hull is damaged and starts to leak.

Emission – Discharging of substances like CO_2 into the air which damages the air quality.

Family company/business - In this report refers to companies in which husband and wife navigate a vessel.

Inland terminal – A location inland where cargo can be transshipped between multiple modalities.

Inland waterway transportation – The transportation of cargo by inland vessels between (inland) ports, wharfs and quays. Abbreviated as IWT.

Manning regulations – Regulations regarding the crew requirements on inland vessels. In this report, the regulations regarding technologies and monitoring instruments will also be included.

Rhine-area – The Rhine river, but also connecting waterways in Germany and the Donau.

Rhine-patent - A Rhine-Patent (Rijnpatent) gives a person the competence to navigate on (parts of) the Rhine river.

Shipper – The party in the supply chain that demands transport to move goods to another party.

Tachograph – Device to control whether the vessel is sailing or not.

Trimodal location – An inland location that has access to the three main modalities: road, rail and water.

Vertical integration – Expand the role in a supply chain by performing an increased number of proceedings, in most cases to reduce costs and increase efficiency and power.

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1. Introduction

1.1 Background

Inland waterway transportation (IWT) is an important and interesting topic in inland transport discussions. Compared to other modes of transportation for cargo, IWT it offers interesting advantages. Examples are economies of scale, which creates a favorable environmental performance per unit of cargo transported, and a large (unutilized) infrastructure capacity (Macharis, 2000), especially compared to road transport. This is a reason for ports like Rotterdam to implement a modal split-goal that focuses on more inland barge transportation (Port of Rotterdam, 2011).

Downsides of IWT transport

However, at this moment, IWT also has its downsides. It appeared that the performance of inland waterway transportation is not increasing anymore. The share of IWT in total freight transportation in and from the Netherlands has been decreasing since 2002 (Geerlings, Van der Horst, Kort, & Kuipers, 2012). There must be something obstructing the growth of inland waterway transport. A first possible reason is the increasing number of bottlenecks at locks and bridges (Geerlings et al., 2012). It slows down the transport and therefore weakens the competitive position of IWT in the transport sector. Another major restriction of today's inland waterway transport is found in the legislation regarding the required crew members on board and monitoring instruments, which can be considered outdated, as it is not consistent with the current need for flexibility in the modern economy and the development of modern monitoring instruments. These instruments advanced very quickly, e.g. see the increased use of ICT systems. This could make controlling easier, but it is not in line with the current legislation which still requires the manual notation of the operations of the vessel and its crew members.

Problems for cargo segments

Especially small IWT businesses, like family companies, that only operate one or maybe two barges, perceive the regulations as problems. Wages become a very large burden, compared to the incomes following from the operations. Revision of the current regulations is needed to restore the competitiveness of IWT companies, especially in the segments that encounter large problems since the economic downturns of 2008 and 2010. For example, the transport of sand and gravel came under pressure because of a lower number of construction projects (ING Economisch Bureau, 2013).

1.2 Goal of the research

The CBRB (Centraal Bureau voor de Rijn- en Binnenvaart) wishes to gain more insights about how inland barge operators and barge owners choose their way of operating their vessels and what the

influence of and their opinion on the current regulations is. As a sector organization, the CBRB more and more often picks up signals about these opinions and the demand for change.

In this report, the visions of barge transport companies will be presented. This way, the need for changes in the regulations can be put into more concrete terms. As there is a need for more clarity about the different approaches to the regulations, this report will be used to gather these. Which modes are used in which sectors most often? How do companies decide which mode is ideal for their business? And how often do companies shift between the modes of exploitation?

1.3 Research question

For this research, the following main question with supporting sub questions is set:

> *'What is the opinion on and the effect of the modes of exploitation and its bottlenecks in the current manning regulations under companies in IWT, and are there possibilities to improve their efficiency by revising the manning regulations?'*

Several sub questions will be used to come to an answer. The first sub question, ***'What are the characteristics of the different IWT segments?'***, is part of the literature review. The second sub question is **'What is the role of innovation and technology in the demand for revised regulations?'**. **'What are the manning regulations?'** is the third sub question and aims on discussing the current manning regulations as how they were set by the Central Commission for the Navigation of the Rhine (CCNR). The fourth sub question is **'What is the frequency distribution of the modes of exploitation?'**. One of the main goals of this report is to sketch an image of which modes of exploitation are chosen by companies in each cargo segment, in different company sizes, for vessels with differing characteristics. In addition to this question, the fifth question is **'How do barge operators choose their mode of exploitation?'**. For this question, the goal is to figure out which factors determine the selection process of the modes of exploitation. The last sub question focuses on the problems barge operators and owners have with the modes. What could be improved? Therefore, the sixth sub question is **'What are the problems with the current modes of exploitation?'**.

1.4 Methodology

Background information from literature

To support the research question, the research consists of four chapters (besides this preliminary chapter). First, a literature review has been performed. It includes the basics about inland waterway transportation, explainsthe different sub segments and the role waterway transportation plays in the supply chain. The literature review is used to obtain a clear vision about the structure of IWT in

(Western) Europe and the possibilities in terms of technology. Then, this legislation and views on the current state have been used to gain insight in possible problems for the IWT companies. The state of the sector are discussed to make clear why companies plea for a revision of the regulations and why the opinions of the cargo segments differ from each other. It is used to set up questions for the last part of the research.

Discussion of the manning regulations

In the next chapter, the manning regulations are discussed. These regulations influence the way barge owners perform their activities. The current regulations are discussed. Later on in this report, the opinions of IWT companies, obtained through interviews and a survey, are reported. The aim is to represent the different segments of inland waterway transport in the report. For example, the exploitation and technical requirements of a container transporter may significantly differ from a dry bulk transport that makes use of convoys. As different commodities are transported in different types and sizes of ships, also different methods and procedures are performed. These factors could all have an effect on the influence of the regulations and how companies perceive these regulations.

Interviews with experts and survey

The next part of the approach consists of interviews with IWT businesses about their modes of exploitation. The interviews mentioned before are used in this chapter. For these interviews, six CBRB members are approached as the interviewed parties. The main topic during the interviews is how the companies decide which mode of exploitation to use for a certain vessel. Also, their opinions about the technical aspects and the manning regulations will a topic of discussion. Possible questions for the interviews are '*Which factors influence your decision for a mode of exploitation most?*' and '*Did the patterns in choosing the mode of exploitation change during the years?*'.

With these interviews, the goal is to find out in which ways the companies in the different segments of IWT operate and whether there are any large differences between these segments in terms of choosing the mode of exploitation. How do companies determine which mode is the ideal way to operate their ships? What are the most important factors in determining this mode of exploitation? And should the differences between the segments play a role in the regulations?

Another goal of the interviews is to clearly distinguish the problems that certain companies have with the modes of exploitation, and how these problems could be solved. In chapter 4, a more extensive description of the interviews and their planning and design will be given. In the end, the results of these interviews lead to a survey, through which quantitative data has been acquired. This survey has been spread among a larger number of barge operators that are a member of the CBRB. The larger part of the questions will have the same intention as the ones asked during the interviews.

More details on this part of the research, for example the selection criteria for the interviews with the experts, are given in chapter 4.

Discussion of the results

In the last part, the results from the survey and the interviews are discussed, including possible efficiency improvements. It will include recommendations for possible further research and a discussion of the restrictions that were encountered during this research.

1.5 List of chapters

The remainder of this report will be divided into four chapters. After this introduction, a literature review has been performed in chapter two to introduce the reader to the topic. The way the sector works and the differences in cargo segments has been discussed. For example, the sub question '*What is the role of innovation and technology in the demand for revised regulations?*' has been partly answered with the literature review, as the importance of innovation will be discussed there. This question is also discussed later in the analysis of the interviews and the survey.

In chapter three, the background of the regulations, the establishing of the regulations and the current situation have been discussed. Also, different results are used to sketch an image of the modes of exploitation in the IWT sector. This has been used to compare the results of the survey with. The sub question '*What are the manning regulations?*' is answered in this chapter. '*What is the frequency distribution of the modes of exploitation?*' is also part of chapter three, but also features in chapter four.

Chapter four is about the interviews and the survey that have been conducted for this research. The decision for these two types of research are motivated, followed by an explanation of how both are planned to be performed. The results and conclusions of both types of research are also discussed in this chapter.

In chapter five, the main conclusions are drawn. The chapter both summarizes the earlier chapters and draws conclusions from them. Also, this chapter gives recommendations for future research and possible changes in the regulations. Restrictions and limitations of this research are discussed in this chapter.

Additional information is found in the appendix at the end of this report.

2. Inland waterway transportation: Characteristics

2.1 Introduction

Inland waterway transportation (IWT) is the transport of goods and people over inland waterways by motor ships and convoys (see chapter 2.3.5). Over the years, this sector has become more and more complex. Therefore, some of the most important aspects and details for this research need to be discussed to understand the issues.

In this chapter, the basic elements of the sector will be discussed. It includes information about the different segments of IWT and the role IWT plays in supply chains. The chapter ends with the segmentation of IWT based on the size of the vessels that is used in the current regulations and the role of innovation in the sector.

For this research, the passenger transport segment is excluded. The main reason is that the passenger segment follows a different structure for the manning requirements and is therefore difficult to compare.

2.2 Role of IWT in supply chain

In figure 1, the basic chain for (container) barging is shown. It is comparable to the chain of other cargo types, because most steps are the same. Initially, the shipper wants goods to be transported and contacts parties in the chain to do this. The shipper is the most important party in the chain, as he is the owner of the cargo that needs to be transported. He could organize the whole procedure by himself or outsource it to a forwarder. These forwarders often have a lot of knowledge about the market and have access to a large network of barge operators, shipping lines and (inland) terminal operators. Because these forwarders have a contract with many different parties in the chain (black arrows in figure 1), they make it easier for shippers to come into contact with e.g. a shipping line.

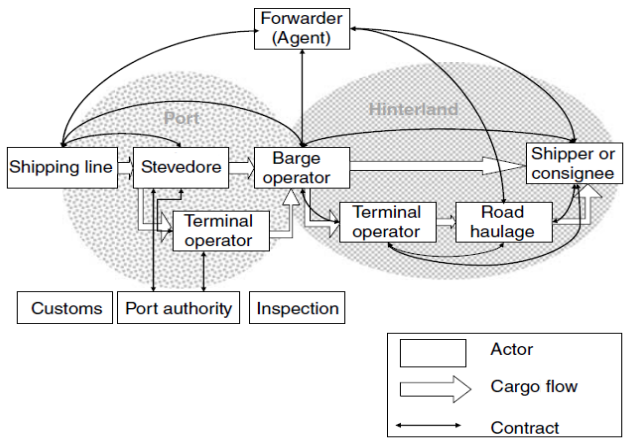

Figure 1: Role of IWT in physical part of supply chain (source:(Van Der Horst & De Langen, 2008)**; modified by author)**

The deep sea shipping line brings the cargo into the seaport, in which it is handled by the stevedore. The shipping lines are the only client of the stevedore company. The stevedore keeps the goods in storage or directly transfers the goods to the modality that is responsible for the inland transportation. After the cargo enters the port and is put on the inland transporting mode, in our case the barge, it has two possibilities. First, it could be transported directly to the consignee. Second, it could first be transported to an inland terminal, in case the consignee can't be reached directly by waterway. Road transport is then often used for the final transport to the consignee. Although inland terminals are often located close to large consignees who regularly have large orders, smaller consignees located further away from the terminal may also make use of the services of these terminals (A&S, 2003).

Vertical integration and service providers make supply chain more complex

In reality, additional service providers make the chain a bit more complex than described above. In figure 1, three parties are shown that are not active in the transport of goods, but in controlling the goods and the course of business: customs, the port authority and inspection. These independent (governmental) parties play an important role in the chain. They are responsible for safety on the waterways and control the cargo. Another reason why the supply chain can be more complex is because some companies perform multiple parts in the chain. For example, terminal operators are nowadays more and more often the leading companies in the supply chain, e.g. by also performing the inland transportation by barge and setting up inland terminals (see example ECT later on in chapter 2.3.1 and appendix A1). This way, the terminal operator is more in charge of the transportation process and is thus able to organize the transportation in a more efficient way (Geerlings et al., 2012).

Role of barge operator

The barge operator has both a physical and an informative role. It arranges the transport between the terminal in the port and the shipper or inland terminal. The operator tries to acquire cargo and distribute it over multiple barges. In many cases, the barge operator (also) uses barges that are not owned by himself, but has contracts with private barge owners who will perform the actual transportation from A to B. However, most operators own their own vessels. The barge operators also have to maintain contact with shippers, shipping lines and (inland) terminal operators to increase the efficiency in the chain (A&S, 2003).

Synchromodality to increase flexibility

Synchromodality, a way to make optimal use of the different modalities, is a developing trend of which the implementation by ECT is an early example. The idea is to choose the most efficient mode of transport just before the transport is needed. This way, it is possible to adapt to the current

situation. It increases the role of IWT, because traffic jams on the road that just emerged can be avoided by using other modalities. More information about synchromodality can be found in appendix A1.

2.3 Segments in IWT market

In inland waterway transportation, different types of cargo require (or benefit from) more specialized transportation vessels. The vessels differ in the way in which they charge, hold and discharge cargo, cover different markets (also geographically) and perform in different supply chains. Therefore, the operators in the IWT sector are divided into smaller segments. Hubens (2011) divided the waterway transportation sector into six different segments, as shown in table 1 (ordered by share in total transport). These are the segments that will be discussed in the coming sub chapters.

Cargo segment	Details about operator	%
Rhine dry bulk transportation	Transports all sorts of dry bulk over the Rhine, its tributaries and the Danube.	39%
Sand and gravel transportation	Mainly transporting sand and gravel.	17%
National/North-South dry bulk transportation	Transports all sorts of dry bulk inside the Netherlands and in Belgium and France.	16%
Tanker transportation	Transport of one or more forms of liquid cargo.	13%
Container transportation	Transport of containers with specialized vessels and dry bulk vessels.	9%
Other	Other, smaller segments together, e.g. ro-ro transport.	6%

Table 1: Segmentation of Northwestern European IWT market. Percentage belongs to sample of 845 businesses (source: (Hubens, 2011)**).**

Shares of cargo segments change

According to Hubens (2011), the shares of container transport and tanker transport both increased with 4 and 9 percentage points respectively, compared to 2004. Simultaneously, the transport of dry bulk through the Rhine, on other (Dutch) rivers and sand and gravel decreased with 9, 2 and 1 percentage points respectively. It is clear that there is a shift from dry bulk to other types of cargo.

Size of the Western European IWT fleet

At the moment, the total cargo-transporting fleet of Western Europe consists of approx. 16,100 vessels (IVR, 2013). The Netherlands has the largest fleet, with approximately 7,500 vessels. These are owned 3,000 to 3,500 different companies, of which 75% are family businesses (BVB, 2013a). The fleet sizes per company in the Netherlands in 2002 are shown in table 2 to give an indication of the current fleet sizes. However the number of companies is somewhat outdated, it still shows that a large number of companies work with only one or two vessels. Approximately 61% of all vessels of

Dutch companies are in hands of single-vessel companies. Five percent of all vessels is part of a company with twenty or more vessels. Due to upscaling of activities, this percentage is likely to have become a bit higher.

In the following part, this number of companies will be divided into smaller segments.

Number of vessels per company	Number of companies	%	Number of vessels	%
1	2,930	87%	2,930	61%
2	230	7%	460	10%
3	73	2%	219	5%
4	35	1%	140	3%
5	21	1%	105	2%
6-9	39	1%	301	6%
10-19	28	1%	371	8%
20+	9	0%	245	5%
Total	**3,365**	**100%**	**4,771**	**100%**

Table 2: Size of Dutch IWT companies in terms of fleet size, in 2002 (source: (CBS, 2002)**).**

2.3.1 Rhine- and National/North-South dry bulk and containers

The first segment consists of dry bulk movers. Later on, this segment will be separated in two parts, namely a segment covering the Rhine area (the largest and most important segment) and the one covering the Dutch, Belgian and France markets. Transport of dry bulk and especially containers between the ports of Amsterdam, Rotterdam and Antwerp (transport in the so-called ARA-area) is also included in this second sub segment of the dry bulk segment. In the dry bulk segment, barges are able to transport all sorts of dry cargo, e.g. grain, ore and containers. A problem with containers is that the cargo hold of these traditional dry bulk barges are not designed to store containers, which especially makes the smaller vessels not the most efficient means of transportation for containers. Therefore, also the container segment will be discussed here.

Vessel types

Dry bulk vessels are the most common vessels in IWT. All different goods that belong to dry bulk transportation are shipped with these vessels. They are able to transport goods like grain, gravel and ore, but also general cargo in the form of steel plates and machines. As said above, the vessels are also used for the transportation of containers. A further segmentation of vessel types is mainly based on the size of the ships. A specialized dry bulk vessel is the container vessel. The cargo area of these barges is specifically designed to keep containers.

Fleet size

As of April 2013, in Western Europe, approx. 9,780 dry bulk barges are active (IVR, 2013). However, only two-thirds are self-powered. The Dutch fleet consists of 4,000 motor ships and 1,150 push barges used to transport dry bulk (BVB, 2013a).

The average fleet size in the dry bulk segment is quite diverse. Many small businesses, like family companies, are operating in this sector. Therefore, many businesses consist of only one ship. Vessels owned by family businesses are generally older than average. Because the owners of these companies are often strongly attached to their personalized vessels and are not always able to afford a new vessel, the average age becomes quite high.

The dry bulk fleet (figure 2) shows a clear pattern. The older ships are clearly the majority, ships constructed in the past eight years are in the smallest group.

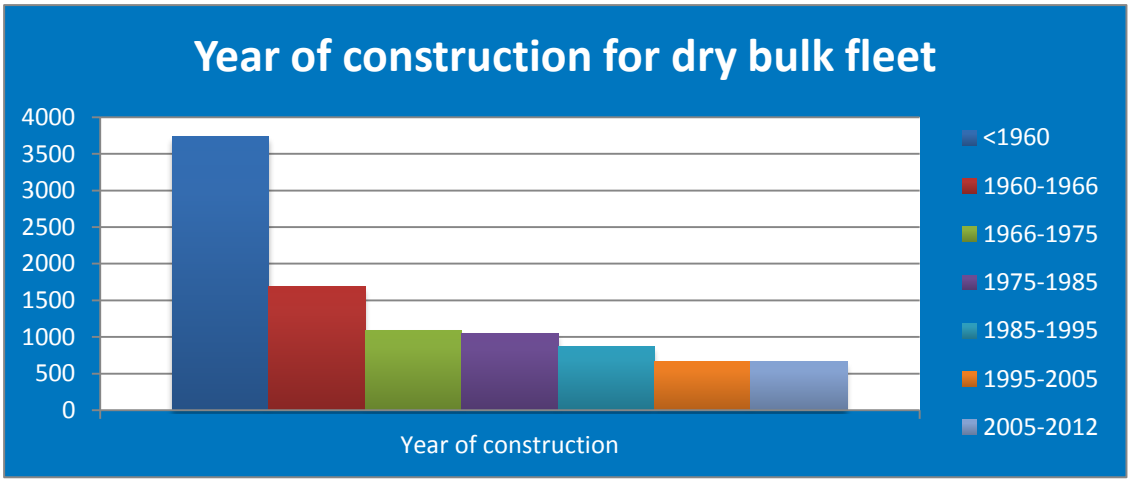

Figure 2: Year of construction for IWT dry bulk vessels in Western Europe, measured in April 2013 (source:(IVR, 2013)**).**

For transportation of dry bulk over the Rhine, most vessels are able to carry at least 1,500 tons. The vessels deployed for transport in the Netherlands, Belgium and France are somewhat smaller, mainly able to carry less than 1,500 tons (Hubens, 2011).

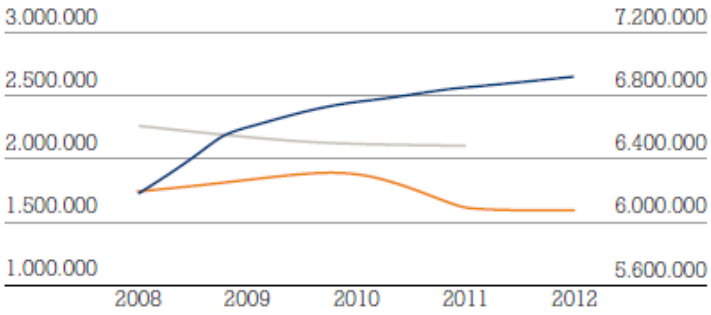

Figure 3: Development of the capacity of dry bulk fleet in tonnage in Belgium (orange), Germany (grey) and the Netherlands (blue, right axis) between 2008 and 2012 (source: (ING Economisch Bureau, 2013)**).**

The total size of the dry bulk fleet in terms of tonnage in the Netherlands clearly increased between 2008 and 2012, with a remarkable increase in 2008 (figure 3). On the contrary, the fleet sizes of Belgium and Germany show a decreasing trend. The increase of the Dutch fleet isn't necessarily an optimistic observation, as the cargo volume is quite disappointing (ING Economisch Bureau, 2013). Therefore, the increase in capacity is rather useless and only creates overcapacity.

Exact number of container transporting vessels is unknown

The exact number of vessels transporting containers is not clear. According to Hubens (2011), only 1% of the IWT entrepreneurs have a container vessel as their first ship. This could have multiple reasons. First, again, dry bulk barges are also used for container transportation. Secondly, container transportation experienced its strong growth after many family businesses already had their first (and for many also their current) vessel. In figure 2, it is shown that a large part of the Western European dry bulk fleet consists of vessels built before 1960, while transport of containers in and to Europe wasn't a large market in and before the sixties (ECT, 2013). Therefore, companies with one or more container vessels may already have had a vessel for a different cargo segment.

Market for dry bulk

The most important transport corridor for transport in the Netherlands is the Rhine corridor, as some of the most important destinations of the goods coming in through the port of Rotterdam are situated in the German Ruhr-area. The largest part of transport over the Rhine is iron, steel and scrap transport. The largest customer is the steel industry in Germany. Another large market is the transport for solid fuels (e.g. coal) over the Rhine (CCNR, 2012).

Other flows of ore and scrap belong in the North-South segment of dry bulk transportation. The transport of solid fuels is more important for this region (CCNR, 2010). However, for the waterways in France and Belgium, soil and building materials is the most important group with approx. 39% of the total cargo. On the Main-Danube Channel in Germany, agricultural and food products are the major part of the transport.

There are only few final destinations for dry bulk when it is compared to containers. Main clients are e.g. blast furnaces. However, because these companies need large quantities of input resources, there is also a lot of demand for IWT. The newer ships in general are much larger than the older ships. Besides its advantages, it also lowers the number of waterways that are accessible. It therefore lowers the number of locations that are accessible (ING Economisch Bureau, 2013).

Market for containers

Compared to dry (and liquid) inland waterway transportation, the container segment is less limited to the amount of origins and destinations. As containers can contain more different types of goods,

they also have many different consignees. The final destinations for the goods in the containers are very scattered (Geerlings et al., 2012).

Because this market is relatively new and growing, the market is more popular under new entrepreneurs (Hubens, 2004). The quite low share of specialized container vessels makes this market more interesting to invest in as there is still some efficiency to gain. Until it is not lucrative anymore for standard dry bulk vessels to transport containers, there is a possibility to gain a good position in the market.

The increased use of inland terminals is, and will be, a large driver of IWT container transport. The construction of inland terminals close to large entry ports, like the container transferium in Alblasserdam[1], boosts the use of inland barges for short distances. Together with the transport on larger distances, it increases the volumes transported by inland barges (ING Economisch Bureau, 2013). However, simultaneously, too many motor ships were added to the total fleet. This resulted in overcapacity in multiple cargo segments, including container transport (Geerlings et al., 2012).

2.3.2 Tankers

The second segment is the tanker segment. Tankers generally move liquid bulk, consisting of all different kinds of oils (petrol, edible oils) and (dangerous) chemicals. Edible oils are part of the liquid agribulk sub segment. Liquid agribulk consists of liquids used and mostly produced by agricultural companies. An example is palm oil.

Because some tankers must be able to transport dangerous toxic substances, higher safety regulations are applied. IWT has a market share of approx. 80% in this cargo segment, because it is much safer to transport flammable substances by barge than by truck or by train, because the latter two modalities are often closer to people and residential areas specifically (BVB, 2013a). Also, it is the segment with the highest number of highly educated people (Geerlings et al., 2012).

Double-hulled tankers increase safety, but create temporary overcapacity

For the coming years, ADN[2] stipulated a transition from single- to double-hulled tankers, in three steps, between the end of 2012 and the end of 2018. Because many companies started preparing themselves for these changes quite early (the majority approx. since 2008, but also earlier), at the moment, the total capacity in this segment lies far above the demand for transport. Additionally, operators try to sail 24 hours per day to earn back the investment costs as quickly as possible,

[1] The container transferium in Alblasserdam helps reducing the pressure on the busy entry road into and from the port of Rotterdam. By using barges directly from the port area, large quantities of containers can be transported out of the port without congestion problems (Rijksoverheid, 2009).
[2] The European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways.

increasing the capacity even further (CCNR, 2012). In the coming years, the single-hulled tankers are supposed to leave the European market, therefore gradually decreasing the total capacity of tankers and restoring the balance.

Vessel types

Several specific vessel types are used in tanker transportation, as the cargo is rather diverse. Four types are the most common. The standard tanker (type N) is used for the cargo that is not very dangerous, e.g. car fuel. At the moment, most of these are still single-hulled and thus need to be replaced. The second tanker type is the chemicals tanker (type C). These tankers have the strongest safety regulations, because more dangerous substances are carried. To prevent chemicals to escape the tanker, e.g. after a collision, these tankers are already double-hulled and therefore don't need to be replaced. Some tankers are designed for more specific acids, but generally belong to this type of vessel. A third type is the gas tanker (type G), which transports all sorts of gas. These gasses are liquefied for transport. Their rounded construction is very strong and therefore particularly suitable for the transportation of gas. The last type contains tankers that are specialized in transporting powders, because these powders behave like liquids when they are under a certain pressure (BVB, 2013b). In addition to these general types, tanker transportation also makes use of push boats and barges. These boats are, depending on their specifications, allowed to push one to six barges.

Fleet size

The total Western European tank fleet consists of 2,197 vessels (April 2013), of which 964 are double-hulled and 1,233 are still single-hulled. About 1,450 vessels are type N-vessels, around 670 are transporting chemicals. The remainder is used for transportation of gas and powders. Approximately 1,300 vessels are part of the total Dutch fleet (BVB, 2013a). In general, the fleet size per company is relatively large. Because the investments in this sector are rather large, there are mostly larger companies. To increase efficiency, the scale of operations is increased.

The high number of new double-hulled vessels in the segment is a reason why the age of the tanker fleet in Western Europe is slightly biased. However, also without that policy, it is clearly different from the figure for dry bulk vessels. The difference between the periods 1966-1975 and 1975-1985 are large (figure 4). The figure for dry bulk vessels (figure 2) shows a more clear pattern.

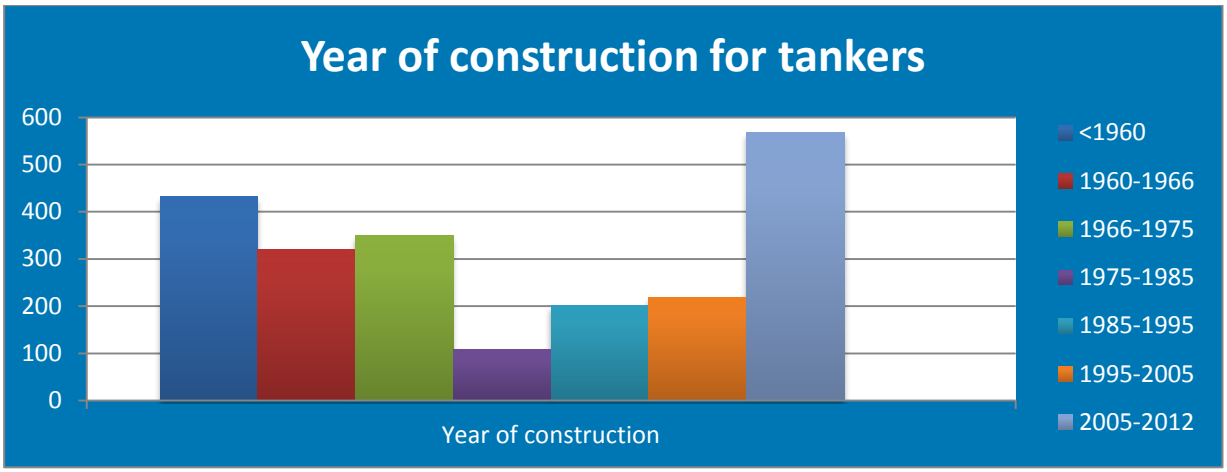

Figure 4: Year of construction for IWT tankers in Western Europe, measured in April 2013 (source: (IVR, 2013)**).**

In figure 5, it is shown that the total capacity of the national tanker fleets of Belgium, Germany and the Netherlands increased in each of these countries over the last four years. The overcapacity due to the stricter regulations has a strong effect on the market. The excess capacity is estimated at 25 to 30 percent at the beginning of 2013. Also, larger vessels are being used where sometimes smaller vessels would be more efficient (ING Economisch Bureau, 2013).

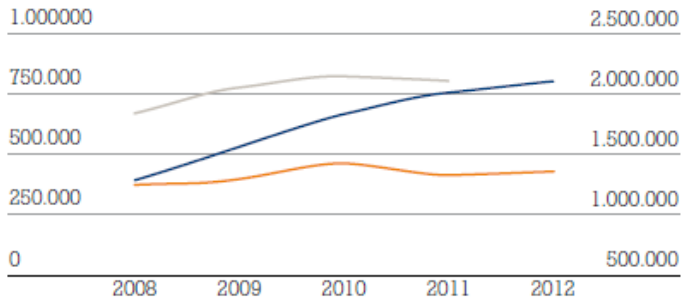

Figure 5: Development of the capacity of liquid cargo fleet in Belgium (orange), Germany (grey) and the Netherlands (blue, right axis) between 2008 and 2012 (source: (ING Economisch Bureau, 2013)**).**

Market

Many locations that the tankers need to call are located directly next to a waterway. This makes the transport fairly direct. It also increases the speed in which a delivery can be completed. The group of clients making use of tanker transportation consists of e.g. oil refineries and the chemical industry, which are located all over Western Europe (Netherlands, Belgium, Northern France, Switzerland and Germany). It is also expected that the transport of alternative fuels like biodiesel will help the IWT transportation with tankers to stay on a high level, as both share the sustainable character. However, it is not so sure whether this will help this segment enough (CCNR, 2012).

A reason why the market for tanker transportation has relatively few problems is because companies in this segment work with fixed, rather long lasting contracts. Because of the stronger safety

regulations in this segment and the need for safety certificates, tanker operators generally ask higher tariffs (ING Economisch Bureau, 2013).

2.3.3 Sand and gravel

Vessel types

The transportation of sand and gravel requires a barge that is able to release all the water that has entered the cargo area during the loading process. This must happen without losing large quantities of sand or gravel and without bringing the vessel in danger. Therefore, these barges are double-hulled: it increases the floatability of the barge (BVB, 2013b).

Fleet size

Sand and gravel is another sector in which family companies have a large share. About 89% of the companies only has one vessel. The vessels used in this segment are generally only able to carry cargo up to 1,500 tons.

Market

The market for sand and gravel is for a large part played out in the national (Dutch) and North-South sailing area (Hubens, 2004). Besides, as mentioned in 2.3.1, this transport has a large share in Belgium and France, with the Elzas region as an important location where large shares of the sand and gravel are gained. A large part of the cargo is used for the first phase of infrastructural projects. Especially for the construction of large railway projects at the beginning of this century, a lot of transport was needed to get all the sand and gravel on the right place (Willems, 2006). Because this type of cargo is rather heavy, there is little to no competition from road transport for the longer distances.

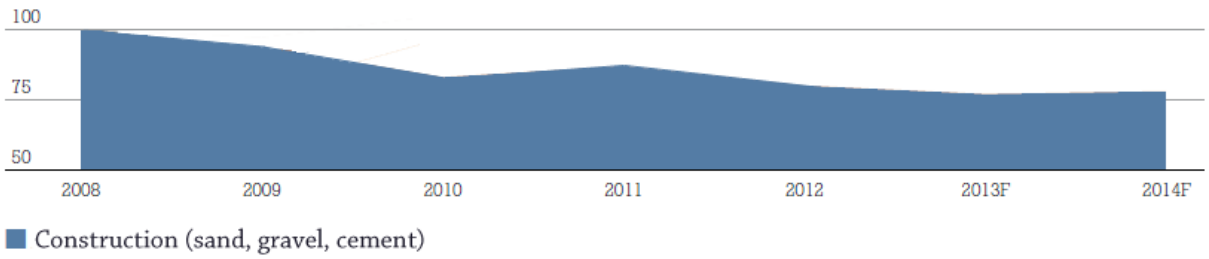

Figure 6: Development of volumes for domestic shippers (index, 2008=100) (source: (ING Economisch Bureau, 2013)**; modified by author).**

Because construction is also rather strongly linked to the state of the economy, there is a decrease in volumes in this segment (figure 6). A small increase in 2011 was directly followed by a decline in 2012. In five years, volumes decreased by approx. 25%.

2.3.4 Other

The last segment consists of several smaller segments. Hubens (2011) mentioned tugboats, pushers, crane barges and vessels for specialized transport. This last group also contains e.g. ro-ro transportation. The pushers are used in the (previously mentioned) larger segments, but will be discussed briefly here. This segment is only a small part of the sector and will receive less attention in the remainder of this research.

Vessel types

This segment consists of various vessel types, some differing a lot from each other. The first type is the pusher (or push boat). It basically is the engine room of a regular vessel without the cargo area. It still has a crew area. It is possible and allowed to push up to six push barges, but two or four is mostly common. The push barges are able and allowed to transport any type of cargo, which puts this vessel type basically in any of the previous segments. Together with push barges, they form the convoys that are mentioned in the regulations. These regulations are further discussed in chapter 3.

The second type is the tugboat. Tugboats are used to drag all sorts of floating objects, such as floating cranes and platforms. These boats can also assist large ships navigating and mooring in the port area. Crane barges are specialized in heavy lifting, which makes them ideal for offshore construction.

A third vessel type is the roll-on-roll-off-ship (ro-ro-ship). Ro-ro transportation stands for 'roll on-roll off' and is used for the transportation of large amounts of cars and trucks.

Fleet size

As vessel types like tugboats don't really offer any cargo space, the largest group of vessels has less than 1,500 tons of space. Most companies, approx. 76%, operate only one ship. The Western European fleet of push boats and tugboats contains 1,959 vessels in 2013. The Netherlands has the largest fleet with about 1,200 of these vessels. In total, there are 795 tugboats, 627 push boats and 537 push tugs (IVR, 2013).

Market

The share of roll on/roll off in the cargo throughput in the ports of Antwerp, Rotterdam and Amsterdam is around 3%. This type of transport is mainly performed on the Danube and on a smaller scale on the Rhine. It is a way for trucking companies to avoid the roads in Eastern Europe which are not always of high quality (NEA, 2011). This sub segment will still be a part of the research, but will not be thoroughly analyzed, as its role in the sector is too small.

The markets for pushers are generally the same as for the segments in the previous sub chapters. The convoys in the dry bulk segments compete with self-propelled vessels to obtain cargo.

2.3.5 Segmentation on size

Next to the segmentation based on cargo type, it is also possible to divide the ships in terms of length and the number of push barges that are part of the convoy. The segmentation is designed by the Central Commission for the Navigation of the Rhine. A more complete backstory on the establishment of this commission and setting up the regulations is given in chapter 3.

Self-propelled vessels and convoys

The first segment is related to vessels that are self-propelled. For the manning regulations discussed later on, the vessels are divided into three groups. The first group consists of the smaller vessels, which are at least 20 meters long and not longer than 70 meters. The second group has a smaller range, as it contains vessels longer than 70 meters, but not longer than 86 meters. The last group consists of every vessel longer than 86 meters.

This division does not include the vessels that are shorter than 55 meters and thus belong to the 'alleenvaart'[3] ('solo-navigation'). The possibility to navigate a vessel alone is only available in a select number of regions in the Netherlands and Belgium. These waterways do not belong to the waterway network of the Rhine. Therefore, these waterways are not linked to the regulations of the CCNR. Other, separate regulations are set for these waterway networks.

Not all operations make use of just one vessel that is self-propelled. Therefore, the regulations also make use of a distinction for 'convoys', which consist of at least two vessels linked to each other.

	Segmentation of self-propelled vessels	Segmentation of convoys
1	Length =< 70 m	C.L. =< 37 m, Width =< 15 m
2	70 m < Length =< 86 m	37 m < C.L. =< 86 m, Width =< 15 m
3	86 m < Length	Push boat + one push barge longer than 86 m, or 86 m < C.L. =< 116.5 m
4		Push boat + two push barges, or motor ship + one push barge
5		Push boat + three/four push barges, or motor ship + two/three push barges
6		Push boat + more than four push barges

Table 3: Segmentation of self-propelled vessels and connections by length (C.L. = convoy length) (source: (CCNR, n.d.)**).**

Segmentation based on the size of ships is also found in the CEMT-class division, established in 1992, which makes clear on which part of the waterway infrastructure certain vessel types are able (or

[3] Vessels in this class are allowed to have only one person on board and don't require extra crew.

allowed) to navigate (table 4). The smaller the vessel is, the larger is the amount of waterways the vessel is able to sail through.

A further distinction in IWT segments is based on the number of hours barges navigate per day and is part of the manning regulations. This distinction will be discussed in chapter 3.2, where the manning regulations will be discussed.

CEMT-classification	Name	Length (m)	Breadth (m)	Draught (m)	Air draft (m)	Tonnage (t)
0	'Other'	<= 38	<= 5			1-250
I	'Péniche'	38.50	5.05	1.8-2.2	4	250-400
II	'Euro-barge'	50-55	6.6	2.5	4-5	400-650
III	'Gustav Koenigs'	67-80	8.2	2.5	4-5	650-1,000
IV	'Johann Welker'	80-85	9.5	2.5	5.25-7	1,000-1,500
Va	'Large Rhine'	95-110	11.4	2.5-4.5	5.25-7	1,500-3,000
Vb	1×2 convoy	172-185	11.4	2.5-4.5	9.1	3,200-6,000
VIa	2×1 convoy	95-110	22.8	2.5-4.5	7-9.1	3,200-6,000
VIb	2×2 convoy	185-195	22.8	2.5-4.5	7-9.1	6,400-12,000
VIc	3×2 convoy	193-200	34.2	2.5-4.5	9.1	9,600-18,000
VII	3×3 convoy	195 or 285	34.2	2.5-4.5	9.1	14,500-27,000

Table 4: Definition of CEMT-classes (source: (EICB, 2010)**).**

2.4 Innovation

The IWT companies are represented in several sector organizations. 'Koninklijke Schuttevaer' is the organization for the nautical part of the sector since 1849. The social-economical part of the sector has been a fragmented landscape for many years (Hubens, 2011). In the large network of IWT interest groups, there is sufficient focus on innovation. It is remarkable that inland waterway transport is gradually being overtaken by other modalities in terms of emissions (Kul, 2008). The IWT sector is innovating and becoming cleaner, but other modalities are doing this faster (Kansen, Wouters, & Kolkman, 2011). There are several factors that explain why innovation in this transport sector gets adopted slower than in other transport sectors.

Long depreciation times hinder modernization

The long depreciation times of inland barges, which are often 20 to 30 years, are much longer than those of trucks (ING Economisch Bureau, 2009). Therefore, truck transportation companies are more able to react to new engine developments than barge owners. Because there isn't a sufficient policy regarding the emission standards for the long-term future, barge owners don't know which types of

engines are allowed to be used in the coming 20-30 years. This long depreciation period makes it difficult to implement policies for the long term which are still realistic and strict enough at the moment they are applied (Kul, 2008). For this reason, innovation in terms of emissions is adopted faster by individual companies and diffused faster in the market in the truck market than in the market for inland barging.

Incentives by EU try to stimulate modernization

To increase innovation and the level of sustainability, there must be an incentive for the barge owners to reduce emissions. The EU introduced a guideline in which is defined which engines and emission standards are allowed from certain dates. For example, in 2016, engines need to satisfy the requirements of phase IV[4] (Ten Broeke, 2007). Another new innovation concerns more efficient propulsion by using multiple propellers, or a type of propulsion called 'the whale's tail'. Propulsion has the power to increase the efficiency enormously and is a large part of the investments in this sector. However, it is also quite costly and thus risky in economically difficult times and not always affordable for IWT companies (Kul, 2008).

The role of ICT in innovation

Innovation also aims on ICT. Trends like synchromodality make use of advanced ICT systems to increase the efficiency of planning and communication. Systems become more complex and are therefore difficult to implement for smaller companies with less technical proficiency. More efficient operations lead to lower fuel use and emissions. It is therefore important to invest in improved ICT systems. A problem with ICT technologies is the high number of failures in mountainous areas (Kul, 2008).

2.5 Conclusions

The aim of this chapter was to provide background information on the IWT sector in general by performing a literature review.

Segmentation of the IWT sector

The first sub question '*What are the characteristics of the different IWT segments?*' was answered in this chapter. The sector was grouped into smaller segments. The first division was based on the cargo type that is transported by the vessel. This results into five cargo segments: dry bulk (in this chapter also divided into transport of dry bulk on the Rhine and on other waterways in the Netherlands, Belgium and France), liquid bulk (tanker transport), containers, sand & gravel and other (small) segments. Two other segmentations are based on the size of the vessels, of which the most important segmentation divided motor ships and convoys in three and six groups respectively. This

[4] Phase IV implies a maximum of 0.4 g/kWh of NOx and 0.025 g/kWh of PM.

segmentation is used in the manning regulations discussed later this report. The other segmentation on size is the CEMT-classification. This division indicates on which waterways a certain vessel type (characterized by inter alia, length, breadth, and tonnage) is allowed to sail.

The importance of innovation in IWT

The second sub question ('*What is the role of innovation and technology in the demand for revised regulations?*') was also partly discussed in this chapter. Long depreciation times of the vessels make it more difficult for policymakers to implement engine policies that are both achievable and inciting. Policies must therefore aim on the long term. Innovation also aims on ICT and other technologies on board which can have a great effect on the efficiency. This sub question will be further discussed later on in this report.

3. Modes of exploitation and manning regulations on the Rhine

3.1 Background of legislation

Early history of legislation

The sailing area of the Rhine is the most important waterway network for trade in Europe. For example, the traffic between the Port of Rotterdam and Germany makes use of this river. Therefore, this area receives a lot of attention. Regulations for inland waterway transportation in the Rhine area have a history that goes back to the 19th century. In 1804, the first treaty was signed by the German and French empires. The treaty's goal was to centralize the charging of various tolls, so the development and maintenance of waterways could be financed from one source. This made it more focused and efficient. It was forbidden for other instances to levy taxes on the Rhine. It is a way to increase efficiency and enlarge budgets for specific, large projects. The foundation for the later 'Central Commission for the Navigation of the Rhine' (CCNR) was laid in 1815, which was the beginning of a period of open use for navigation on the Rhine river in a larger area. The principle for open use of inland waterways and a central commission was developed, but still had to be signed by all involved states. In 1831, the treaty of Mainz was signed. Since then, the act makes sure that the waterways are open to be used for free, but have certain restrictions and requirements implemented by the authority. This was followed by the Act of Mannheim in 1868, which was a revised version of the earlier treaty. It included rules for e.g. the transport of dangerous substances. Also, it was determined that it was no longer allowed to levy any taxes on the Rhine (CCNR, 2011).

Current (main) regulations were implemented in 1988

The current version of the regulations for the modes of exploitation was implemented in 1988, after which the regulations were updated by adding exceptions and additional laws for certain states and parts of the waterway network. This act applies to the parts of the Rhine and its tributaries in Belgium, Germany, the Netherlands, France, Luxemburg and Switzerland. Currently, the CCNR generally focuses on simplifying formalities that came with the unification of Europe (CCNR, 2011).

Framework of CCNR used for many other sailing areas

The regulations by the CCNR for the Rhine area are not fully adopted by the other sailing areas in Europe. However, in many cases, the regulations are strongly influenced by the situation in the Rhine area. Member states of the CCNR are free to determine the policy for other waterway networks in their country that do not belong to the Rhine network, but the regulations by the CCNR are used as a guideline in most cases. It is often easier to make use of a similar framework of regulations.

3.2 Current modes of exploitation on the Rhine

The basic rules for inland waterway transport operations, set up by the CCNR, are as follows. Barge owners can choose between three basic different modes of exploitation, which involve the number of hours per day a ship is allowed to sail (table 5). Each mode has its own required minimum composition of crew.

Mode of exploitation	Allowed sailing time	Minimum rest hours for crew members
A1	Allows to sail up to 14 hours per day.	Eight uninterrupted hours of rest outside sailing hours.
A2	Allows to sail up to 18 hours per day.	Eight hours of rest, of which six uninterrupted outside sailing hours.
B	Allows to sail continuously.	24 Hours of rest per 48 hours, of which at least two times six hours are uninterrupted.

Table 5: Three modes of exploitation for Rhine area (source: (CCNR, n.d.)**).**

Mode of exploitation A1 is the most limited mode

A1 allows vessels to navigate a maximum of 14 hours in a time span of 24 hours. The crew is obliged to have at least eight hours of uninterrupted resting time outside the sailing hours. During these rest hours, the crew members are not allowed to be put on stand-by. It is mandatory to interrupt sailing from 22:00 to 6:00. For smaller family companies, this is a very common mode of exploitation, because less additional crew members are needed.

A2 offers more sailing time, but also demands more requirements

A2 gives the possibility to navigate for 18 hours on one day, but the resting times are a bit more complicated. The crew is obliged to rest for a minimum of eight hours per day, of which six are outside sailing hours. Therefore, two hours of rest may be during sailing. Sailing must be interrupted from 23:00 to 5:00. For this mode of exploitation, companies make use of shiftwork to continue while a part of the crew is resting during sailing.

Tachograph

When a tachograph is linked to the propeller of the ship, the barge owner is allowed to operate mode A1 and A2 in a more flexible way. For mode of exploitation A1, barge owners are allowed to sail 16 hours in one day once a week. For both A1 and A2, the tachograph allows the barge owner to choose during which part of the day he does not sail, instead of the fixed periods mentioned before.

Mode of exploitation B allows maximum sailing time

Mode B allows vessels to sail for 24 hours a day, but requires a more extensive crew. The crew members are entitled to have 24 hours of rest per 48 hours. This means that two complete crews are used to work shifts.

Crew requirements for each mode relate to vessel length

The crew requirements depend on different vessel lengths. These lengths correspond to those in table 3. Switching between the modes of exploitation is possible, as long as the crew had the minimum amount of resting hours or is completely replaced.

Monitoring instruments

A required piece of 'equipment' that must be on board is the logbook. In this book, skippers must note the sailing times and resting hours, the number of crew members on board and their functions on board (SAB, 2012a). Each function has its own requirements in terms of minimum age, permits and experience. A summary of the different functions in IWT is given in table 6 below. Compliance with the regulations is controlled by the logbook. Every member state has its own authority which controls the logbooks and issues new logbooks to barge owners. These are e.g. ministries and the administrations of provinces and municipalities through which the waterway network of the Rhine flows.

Function	Description of requirements
Deckhand	Minimum age of 16 years.
Ordinary boatman	Minimum age of 15 years, proof of subscription at vocational school.
Boatman	Minimum age of 17 years, passed exams at vocational school or minimum age of 19 years and three years of experience on board.
Boatman-operator	Meets the requirements for seaman and passed exams for engine operator or worked for at least one year on a motorized vessel as a seaman.
Able-bodied boatman	One year experience on a ship as a seaman and passed exams on vocational school, or two years without exams, or finished three-year course.
Helmsman	Experience as able-bodied seaman for one year or as seaman for three years, or owning a boatmaster's license*, or experience for at least four years and a license similar to the large Rhine-patent**.
Skipper	Owning a Rhine-patent or a similar license.
Engineer	Minimum age of 18 years and passed exams for engine-related education, or minimum age of 19 years and two years of experience as engine operator.

Table 6: Summary of crew members in IWT. * = following Directive 96/50/EG or 91/672/EEG; ** = allows person to navigate all vessel types and sizes (source: (CCNR, n.d.)**).**

Every crew member, except for patent holders, must also be in the possession of a 'service record book', used to identify crew members. It contains inter alia the functions these members are allowed to perform, where they are allowed to sail and the sailing days of the crew members (SAB, 2012b).

Technical standards ease crew requirements for more modern vessels

Concluding, there are regulations regarding the technical equipment of the barges. The technical requirements are divided into two standards, namely S1 and S2. Of these two, S2 is a more comprehensive standard and thus requires a slightly smaller or lower-qualified crew. These requirements are linked to the required crew members on a vessel: some modes of exploitation are not allowed to be used when the technical requirements and the corresponding crew requirements are not met. For example, when a barge operator wants to navigate his vessel for 24 hours a day (mode B), but does not have enough crew members available to meet S1, a possibility then is to deploy more crew to meet the requirement for S1 or make sure his vessel satisfies the requirements for technical standard S2 (and additionally deploy more crew in case these crew requirements are also not met). For every vessel class, the technical standards require applicable sets of crew members. The minimum manning requirements for self-propelled vessels are as follows:

Length	Crew	A1			A2		B		
		S1		S2	S1	S2	S1		S2
L =< 70 m	Skipper	1			2		2		2
	Helmsman	-			-		-		-
	Able-bodied boatman	-			-		-		-
	Boatman	1			-		1		-
	Ordinary boatman	-			-		1*		2*/***
70 m < L	Skipper	1	1	1	2		2		2
L =< 86 m	Helmsman	-	-	-	-		-		-
	Able-bodied boatman	1	-	-	-		-		-
	Boatman	-	1	1	-		2		1
	Ordinary boatman	-	1	1*	1		-		1
86 m < L	Skipper	1	1	1	2	2	2	2	2
	Helmsman	1	1	1	-	-	1	1**	1
	Able-bodied boatman	-	-	-	-	-	-	-	-
	Boatman	1	-	-	1*	-	2	1	1
	Ordinary boatman	-	2	1	1	2*	-	-	1

Table 7: Minimum crew requirements for self-propelled vessels. *= One ordinary boatman may be replaced by a deckhand. **= The helmsman must own boatmaster's license. *= At least one must be 18 years or older (source:** (CCNR, n.d.)**).**

All modes of exploitation have additional rules and exceptions, e.g. regarding the minimum number of hours that the crew is entitled to rest, or the different functions that have to be fulfilled on board. For example, in 2011, the required crew on barges shorter than 86 meters was eased slightly. However, it only applies to the traffic in the Netherlands on the rivers Rhine, Waal and Lek, that does not cross the border with Germany (CBRB, 2011).

3.3 Frequency of modes

The fourth sub question of the report is: 'What is the frequency distribution of the modes of exploitation?'. This distribution will be further divided into the segments previously discussed in chapter 2.3 and the CEMT-classes of 2.3.5. In combination with the results of the interviews and survey, the goal is to gain insight into the way IWT entrepreneurs choose the exploitation mode that fits their business the best way and to discover the opinion on the regulations in the sector.

Research by Panteia used for analysis frequency of modes

The data used for the following part of the report comes from a research by NEA, a division of research company Panteia that focuses on transport and logistics. By means of a survey, the use of the modes of exploitation on 505 self-propelled vessels[5] in the different segments is shown. It could be that the results contain more than one vessel of one firm, but this is not indicated. It doesn't affect the results.

Below, a number of tables will show the complete use of the modes. More tables with the results of the research regarding the frequency can be found in the appendix (B1). The complete tables will show a more clear representation with the 505 vessels divided by CEMT-class. In this case, the dry bulk segment is not divided into the two sub segments discussed in chapter 2.3. Also, we still see only a small amount of container transporting vessels. It is unclear in the results whether a part of the respondents in the dry bulk segment also operate in the container segment.

Analysis of results

It is notable that the transport of sand & gravel is rather small, compared to the numbers in table 1.

	A1	A2	B	Total
Dry Bulk	*193*	111	22	326
Tanker	33	23	*34*	90
Container	7	10	*27*	44
Sand & Gravel	*26*	8	4	38
Other	*3*	*3*	1	7
Total	*262*	155	88	505

Table 8: Frequency of modes of exploitation, by cargo segment (source: (Geest, 2013)**).**

[5] Original research had 535 respondents. The passenger segment, which contained 30 vessels, is left out of this research. The original research shows a division in AVV-classes M0 to M8, which doesn't include convoys.

Table 8 shows the total number of respondents, divided by segment. In figure 7, the distribution in percentages is shown. It gives a more clear representation of the differences between the IWT segments.

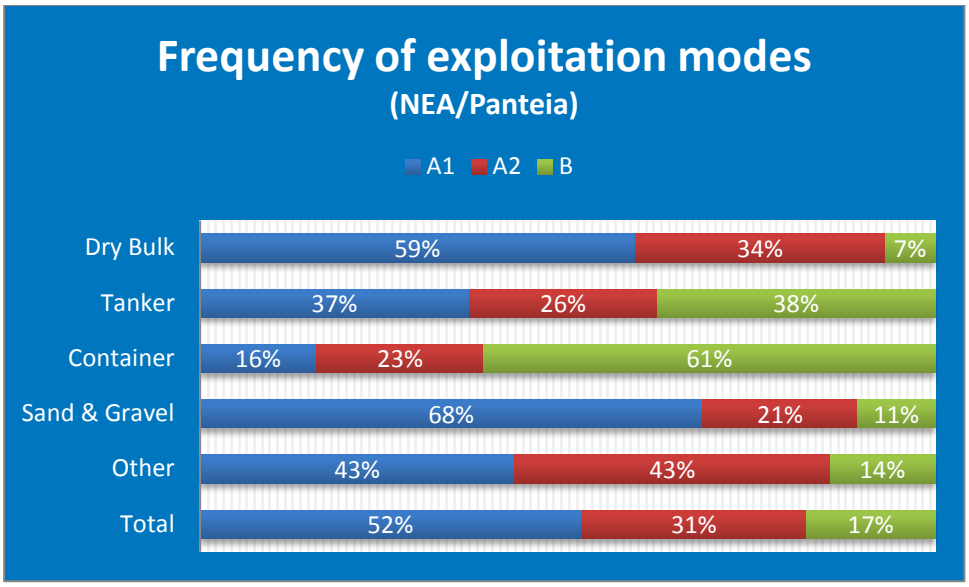

Figure 7: Frequency of exploitation modes, shown in percentages, by segment (source: (Geest, 2013)**).**

Percentage-wise, container vessels are used in continuous transport most frequently (61%). The majority of operations in the dry bulk segment and the sand & gravel-segment follow the A1 exploitation mode in which it is allowed to sail for a maximum of 14 hours per day.

Not every segment is linked to the modes of exploitation the same way

The tanker segment is the one with the most equal distribution of modes, as no mode is used in more than 38% of the cases. It has a relatively high share of exploitation mode B (38%). A reason could be that most tanker companies are quite large, in contrast to the dry bulk sector which consists of many small family businesses. These tanker companies have less problems with employing enough crew to operate 24 hours per day, compared to dry bulk transporters, because tanker companies are in general larger companies thus have more capital (Hubens, 2011). Dry bulk has by far the largest number of respondents and therefore looks a lot like the total. 59% Of the operations follows mode A1. An important reason could be the lower amount of capital which the relatively small dry bulk companies have at their disposal. Mode A1 has lower costs, because the total labor costs and fuel costs are lower, and could therefore be more interesting for these smaller companies.

Frequency of modes for different length groups

> 70 m	A1	A2	B	Total
Dry Bulk	36	32	0	68
Tanker	4	1	0	5
Container	0	3	0	3
Sand & Gravel	5	3	1	9
Other	3	1	1	5
Total	48	40	2	90

Table 9: Choice of exploitation mode for vessels up to 70 meters (source: (Geest, 2013)**).**

In table 9, the distribution for vessels not longer than 70 meters is shown. There are only two cases (2.2%) in which exploitation mode B is chosen. Only a few tankers are active in this group. Sand and gravel, the smallest main segment overall, is the second largest segment in this length group.

70 to 86 m	A1	A2	B	Total
Dry Bulk	90	30	0	120
Tanker	11	3	0	14
Container	5	3	2	10
Sand & Gravel	18	4	1	23
Other	0	1	0	1
Total	124	41	3	168

Table 10: Choice of exploitation mode for vessels up to 86 meters (source: (Geest, 2013)**).**

In contrast to the results in the previous table, A1 is used in far more cases than A2 in the vessel length group 70-86 meters (table 10). None of the cargo segments with more than five respondents has a majority in A2. Therefore, it seems that operating with mode A1 in this length group has more advantages than A2, despite the lower number of hours in which vessels are allowed to sail. Again, exploitation mode B is used in only a few cases.

86 m <	A1	A2	B	Total
Dry Bulk	67	49	22	138
Tanker	18	19	34	71
Container	2	4	25	31
Sand & Gravel	3	1	2	6
Other	0	1	0	1
Total	90	74	83	247

Table 11: Choice of exploitation mode for vessels longer than 86 meters (source: (Geest, 2013)**).**

Compared to the first two length categories, the vessels longer than 86 meters are used in exploitation mode B far more often. While for the dry bulk segment, mode B is still the least chosen mode, container- and tanker vessels more often use mode B than one of the other two modes. It probably has the same reason as discussed earlier: dry bulk companies are often family companies with smaller vessels and a low amount of capital at their disposal. This in contrast to the owners of

tankers and probably also container vessels, which are more often part of larger companies which don't function the same as small family companies do. Also, the container vessels and tankers are newer in general, triggering the owners to choose mode B to accelerate the recovery of the investment costs.

Next, it is important to see which factors are influencing the decision-making process of barge operators in choosing their mode of exploitation.

3.4 Conclusions

The aim of chapter three was to provide information about the modes of exploitation and the manning regulations. First, the origin of the CCNR is covered, which started with the idea to centralize the charging of tolls. Later, it developed into open use of the Rhine river, as long as the skipper made sure the vessel and the crew meet the requirements set by the CCNR.

Manning regulations

The first sub question that is answered in chapter three is '*What are the manning regulations?*'. The manning regulations determine which crew composition is required on various vessel sizes in different modes of exploitation. These (three) modes of exploitation define how long a vessel may be navigated through the waterways (14, 18 or 24 hours) and when the crew members must rest from their work. The regulations include requirements for each function on board (in terms of experience and certificates) and monitoring instruments to control the skipper. Technical standards S1 and S2 were introduced to implement a small advantage for owners of more well-equipped vessels by lowering the crew requirements for these vessels.

Frequency of different modes of exploitation

A research by NEA, part of research institute Panteia, about the frequencies of the modes of exploitation showed the use of the different modes by the different cargo segments and vessel types in the CEMT-classification[6]. It showed that dry bulk (and sand and gravel) vessels are generally used in combination with mode A1 (14 hours). For tankers, the use of the different modes is much more even. Container vessels are for a large part used for 24 hours a day. According to these results, mode B1 is almost only used with vessels of at least 86 meters long. This answers sub question four, 'What is the frequency distribution of the modes of exploitation?'.

[6] Originally, the AVV-classification was used, but this was converted into the CEMT-classification.

4. Interviews and survey

In the following part of the report, the interviews with experts and survey will be discussed. First, it will be motivated why these two types of research are chosen. In 4.2 and 4.3, the approach for both types will be motivated. The results are then discussed and concluded.

4.1 Research approach

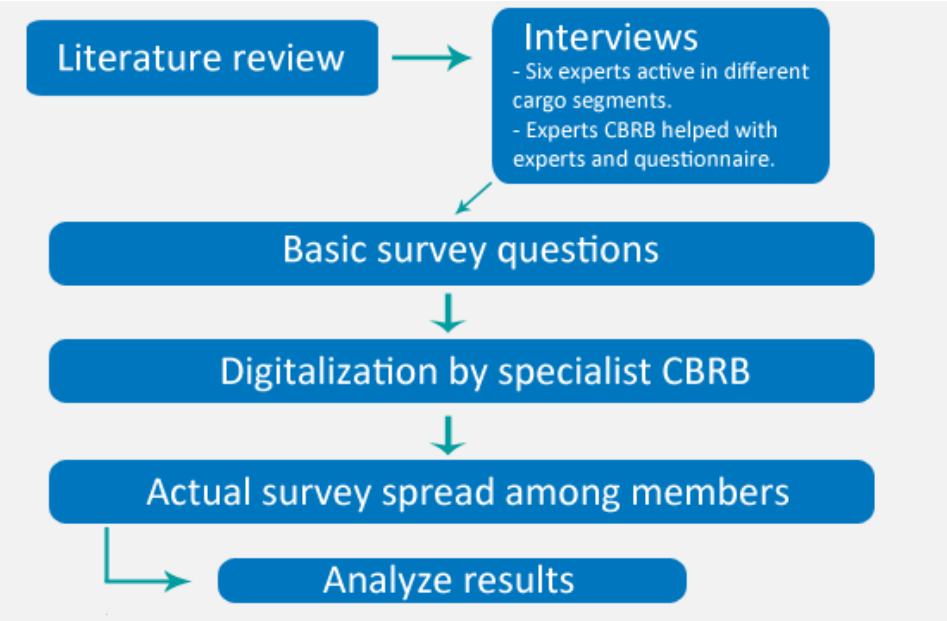

Figure 8: Visualization of research approach.

The best way to determine how companies choose the modes of exploitation is by asking the people in charge directly. It is important to discover why these people choose to operate this way, which factors are crucial in determining which mode of exploitation is ideal for their situation. Therefore, for this research, multiple interviews and a survey are used to gain more insight into the use of the modes of exploitation and the accompanying manning regulations. The survey is complementary to the interviews: the interviews are qualitative research, the survey is more of a quantitative approach.

Survey complements interviews

After the interviews, a digital survey is conducted. The interviews are used to gain a detailed insight into how the companies work. This information is used for setting up the survey. In case new aspects and perceptions are learned through interviewing, these aspects can still be used in the survey. Therefore, the interviews will lead to answers to questions that were already known, but also to new questions.

Qualitative versus quantitative research

The survey is distributed over a larger group of companies, which are members of the CBRB. As a form of quantitative research, the survey is used to sketch a more general image. In case the interviews give a distorted image due to the small sample size, the survey could shape a more

accurate representation. It could be that important information is missed during interviewing and only comes to light during the survey. A survey is a good instrument to acquire a large group of respondents, but it is more difficult to ask open-ended questions than during interviews. Therefore, the information gained from the interviews is so important, as it can be used for setting up multiple choice options.

4.1.1 Approach of the interviews

For this research, six interviews were conducted. Six experts of different cargo segments were contacted by the CBRB to be interviewed. In these interviews, the experts gave background information with respect to the use certain types of vessels, exploiting principles for these vessels and strengths and weaknesses related to the current regulations. The names of the experts and related companies are confidential. First, the decision to use interviews is motivated. Then, an overview of the differences and similarities between the statements of these experts, categorized by subject, is given.

Expertise

The interviews are used to obtain more information from parties that work with the regulations on a daily basis. They will be referred to as experts from here on. These experts are capable of giving well-supported explanations why a specific mode of exploitation is chosen and what problems are encountered. Because the experts work in the sector, they are more aware of the benefits and downsides that come with different modes of exploitation. Also, their professional experience could improve the argumentation behind their answers.

Different perspectives on the regulations

With these interviews, the goal is to look at the subject from different perspectives. The experts have been selected according to three important criteria:

1- The cargo segment in IWT. Because not every segment reacts to economic situations in the same way, not every segment demands changes to any legislation to increase competitiveness compared to the other modalities as much as another segment does. Besides, some differences between the segments don't have anything to do with the market circumstances. For example, tankers have a stricter safety policy which may influence the perception of parties working in this segment about the manning regulations,

2- Propulsion characteristics of the vessels. The differences between companies working with convoys and self-propelled vessels are distinguished. Convoys require specific proceedings,

3- Size of the company. Different company sizes may have different problems, because different possibilities are encountered and different business ideas are set.

Topics during the interviews

The main subject of the interviews is how the companies decide which exploitation mode to use. This choice might be related to the demands of their clients, market circumstances, the additional restrictions that come with the modes of exploitation or different reasons. The experts are also asked whether they have concerns with the current regulations. As, besides the manning regulations, the regulations concerning the technical aspects are also a point of discussion, this is also discussed during the interviews.

Every interview for this research is conducted after finishing the literature review. This way, all interviews are performed with the same amount of background information. It minimizes the danger of completing an interview and afterwards finding information that could have been useful during that interview.

The advantage of face-to-face interviews

All interviews are face-to-face interviews. This has several advantages. First, this type of interviewing has an advantage over the survey, because it is easier to ask for more extensive answers in case the answer was unclear (Verschuren & Doorewaard, 2000). The face-to-face interview was preferred over a telephone interview, because it makes it easier to share additional information, like a list of used modes of exploitation. With face-to-face interviews, sharing this (and similar) information is easier.

The interviews are recorded, unless the expert wishes the interviewer to write notes instead. Recording the interviews is preferred from the interviewer's perspective, because it makes it easier to make accurate quotes and to remain focused on the answers of the expert during the interview. This again makes it easier to respond to these answers in case something is not clear.

Same list of questions used for every interview

Before starting with the first interview, a list of questions is established with the help of experts of the CBRB. This initial list of questions is prepared for all interviews, but could be altered slightly in case a question turns out to be irrelevant or a question is missing. A different list of questions decreases the number of corresponding questions and thus the comparability of the interviews. This makes it easier and more useful to compare the interviews. The complete initial questionnaire can be found in appendix C1.

Topics during the interviews

The interviews start with open questions to introduce the companies. In which segment(s) do the companies operate? What vessel types are used? How large are the companies? With the answers to these questions, it must be possible to discover certain patterns in choosing the mode of exploitation

after also the survey has been conducted. After that, the way companies cope with the manning regulations is discussed. Which modes of exploitation are used? Which factors are important in deciding which mode to use? In the end, a report of all interviews is written and only shared with the CBRB. Each report is first shared with the expert to make sure none of the statements was interpreted in the wrong way.

Comparing and analyzing the results

Next, the results of the interviews are discussed. The results are clustered into three topics: mode of exploitation, manning regulations and innovation. The first one is mainly about which modes are chosen and why. Which factors are the most important? And what are problems that occur most? The second part looks at the minimum crew requirements on board, but also the requirements the employees have to meet before they are allowed to come on board. The last part, about innovation, looks at the innovation in the sector and the perceptions of the experts on modernization.

4.1.2 Approach of the survey

To sketch a representative picture of the use of exploitation modes in the inland waterway transportation sector, a survey has been conducted. The information gathered during the interviews and the conclusions that were drawn afterwards were used to create the survey. Although the interviewed experts already give a lot of information, the survey is used to gain more information from the individual skippers and operators. Furthermore, the statements of the experts must be tested. Because during the interviews certain factors may not have been mentioned, the survey still gives the participants an opportunity to share new perceptions. However, from a statistical point of view, it is preferred to use a selection list.

Structuring the survey with in-house expertise

The questions and structure of the survey were made in close cooperation with the in-house expertise of the CBRB on both the subject as the construction of survey. Their experience with establishing questions helped to create a coherent survey with a logical order and to include all topics in a concise survey.

Participants of the survey

The survey is distributed among all members of the CBRB that belong to at least one of the cargo segments mentioned in chapter 2.3. These are the only requirements the companies had to meet. In total, 261 companies were invited to take part in the survey. More extensive details of the division of these companies into cargo segments is given in chapter 4.3. To stimulate the response rate of the survey, the participants are asked to answer the questions for a maximum of three vessels. Otherwise, in case a participant has to complete the survey for many more vessels, there is a larger chance there will be no response. The participants are asked to choose the vessels that represent the

company's fleet as accurate as possible. Therefore, it is important to look at the results in percentages and not in real numbers, because the results may not be comparable with reality for the full 100%. The downside of this approach is that the number of vessels in the survey results is lower than the number of vessels in reality. This affects the fleet composition in the results and must be taken into account during the analysis.

Types of questions in the survey

The first questions are about e.g. the sailing area, the cargo segment and the exploitation mode. Both open questions (building year) and multiple-choice questions (sailing area, cargo segment) are used. Then, the defining factors in deciding which mode of exploitation to use are asked. A list of factors is set up, including an open option in case not every important factor is listed. Together with the frequency distribution of the modes of exploitation, this is the main part of the research. What are the most important reasons to select or change the mode of exploitation? This is an essential question for understanding why a certain mode of exploitation is chosen. In the last two parts of the survey, the participants are asked to share their opinion on the manning regulations and the role of innovation in the sector. These questions aim on the standpoints of the participants on the regulations that are central in this research. Do the regulations still fit in the modern day economy? In what way do the regulations influence the modes of exploitation? For these subjects, participants are asked to share (e.g. on a scale from one to five) to which extent they agree with statements or whether the statements are important at all. The complete survey can be found in appendix D1.

4.2 Interviews and survey results

In the following chapter, the results of the interviews and the survey will be discussed. First, a few details about the results of the survey. After that, for every topic discussed in the interviews and survey, the results will be debated. In this chapter, the most important graphs and tables will be placed. The remaining graphs and tables can be found in appendix E1.

4.2.1 Survey response rate

For the survey, 261 companies were invited to participate. Before the results of the survey are discussed, the response rate and its influence will be talked over.

Complete and incomplete responses

The survey was filled in 82 times. This number includes a significant amount of incomplete responses (29). Of these 29 incomplete responses, the respondents that answered at least all questions until the important factors influencing the mode of exploitation choice (question 9) are included in the results. The following questions ask for the opinion of the respondent on the manning regulations and innovation. The answers of the first questions about the vessels and the mode of exploitation

choice are not affected by not answering the second part of the questionnaire. Therefore, it was decided to include the incomplete responses that at least answered the first questions.

In the end, 62 responses were used for the analysis, representing 62 companies belonging to one of the CBRB member groups. Of these respondents, 53 have produced a complete response and 9 did not fully complete the survey. These nine respondents filled in the survey for 11 vessels.

Segment	Dry Bulk	Tanker	Container	Sand & Gravel	Other	Total
Invited	70	89	29	56	17	261
Responded	16	28	8	6	4	62

Table 12: Number of companies invited for and that responded to survey per cargo segment.

In table 12, the number of companies invited for the survey and the number of respondents per cargo segment are shown. This translates in the percentages shown in figure 9.

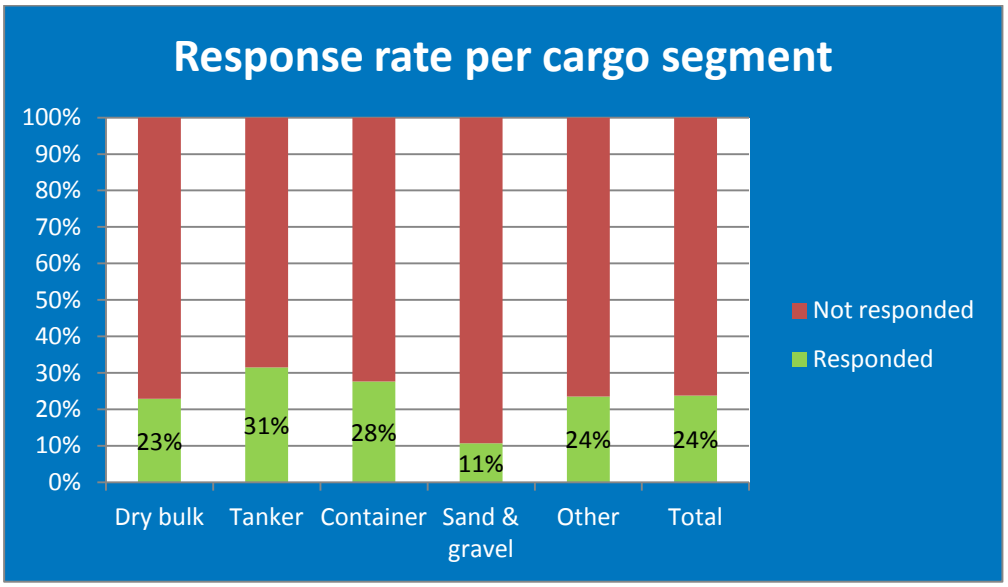

Figure 9: Percentage of responding companies for survey per cargo segment.

Response rate rather low, number of respondents for some segments too low

In figure 9 above, the response rates are shown. In total, approx. 24% of the invited companies responded. The response rate of sand & gravel companies is the lowest response rate, with 11%. The highest response rate is found at the tanker segment, of which 31% of the invited companies responded. Percentage-wise, these response rates are not disappointing per se. However, as shown in table 13 below, the real number of vessels that is a part of the results is quite low. Compared to the total Dutch fleet (approx. 7,500 vessels), this amount is very small. Especially for the smaller segments (sand & gravel, other and even container transport), this must be taken into account during the analysis of the results.

Segment	Dry bulk	Tanker	Container	Sand & gravel	Other	Total
#vessels	26	51	14	6	7	104
#complete	24	45	12	5	7	93

Table 13: Number of vessels filled in for survey per cargo segment.

In total, the survey was completed for 104 vessels. Of these 104 vessels, 93 are motor ships and 11 are push boats. 93 of the 104 vessels are part of a complete response. When all vessels from the companies with a fleet larger than three vessels are included, there is a total of 318 vessels. This is around 4% of the total Dutch fleet. In this survey, the tanker segment is the largest segment, instead of the dry bulk segment, which is the largest segment according to the survey in chapter 3.3 and chapter 2.3. This must be taken into account when conclusions are drawn.

Consequences of response rate for results

With these numbers, it is possible to already draw a conclusion about the results. The results regarding the frequencies of the modes of exploitation are more part of an exploratory research. The results will not exactly show how many companies of a certain cargo segment will use a certain mode of exploitation. To research this more accurately, the shares of the different cargo segments must be more close to reality. For that question, the research of Panteia will probably give a more accurate representation of the real situation. The results of the statements and the factors influencing the decision which mode of exploitation to choose will still be useful, because it is important to learn about why companies choose a certain mode of exploitation. Which modes are chosen doesn't say much about the problems IWT companies have with the manning regulations. More information will be given in the coming sub chapters.

4.2.2 Basic survey results

Fleet sizes of the companies

One vessel	Two vessels	Three or more vessels	Statistics	
37 (59.7%)	8 (12.9%)	17 (27.4%)	Minimum size: 1	Maximum size: 45
			Mean: 5.13	Median: 1

Table 14: Statistics of company sizes of respondents.

Of all respondents, 59.7% only exploits one vessel for inland waterway transport use. 12.9% of the companies makes use of two ships, the remaining 27.4% has three or more vessels in the sector. The company sizes of the respondents vary from one vessel up to 45 vessels. The average fleet contains more or less five motor ships and/or push boats. The average fleet size of the companies in this survey (5.13) is strongly influenced by the larger companies, because 18% of the companies uses more than three vessels (in contrary to the 4% in chapter 2.2). Therefore, the average is higher.

Reasons for this higher percentage may be that the member groups of the CBRB have a different composition, compared to the complete group of barge operators in the Netherlands. Also, it could be that larger companies are more willing to respond to a survey, for example because they feel they have more influence. Another reason could be that they can bundle more opinions, because they have more skippers who experience (different) problems with the regulations. At last, a skipper for a single vessel-company may not find time to respond to the survey, while larger companies could have more people that are willing to fill in the questionnaire.

For these statistics, push barges were not included, only push boats. In table 2 (chapter 2.3), the numbers are quite different. With those numbers, the average fleet size is just above one.

Largest number of vessels belongs to longest vessel group

#	Group specifications motor ships	% Motor ships	Group specifications convoys	% Convoys
	Of total	89.4%		10.6%
1	Length ≤ 70m	24.73%	Dimensions L ≤ 37 m, B ≤ 15 m	0%
2	70m < Length ≤ 86m	29.03%	Dimensions 37 m < L ≤ 86 m, B ≤ 15 m	0%
3	Length > 86m	46.24%	Pusher + 1 barge L > 86 m, or dimensions 86 m < L ≤ 116,5 m, B ≤ 15 m	9.09%
4			Pusher + 2 barges, or motor ship + 1 barge	45.45%
5			Pusher + 3 or 4 barges, or motor ship + 2 or 3 barges	9.09%
			Pusher + more than 4 barges	36.36%

Table 15: Statistics of vessels and vessel groups.

89.4% of the vessels is a regular motor ship, active in one of the several cargo segments. Of these vessels, the largest group belongs to group 3, vessels longer than 86 meters. These are the longest motor ships in the fleet. Most vessel owners choose to increase the internal economies of scale. This means that the companies try to decrease their average costs per unit transported (e.g. one container or one ton of coal) by increasing the total amount of cargo transported by one vessel. In the case of IWT, economies of scale are gained by using larger ships, because fuel costs are divided over a larger amount of cargo. Also other costs, like the cost of maintenance, are most likely lower. Vessels of 135 meters long do not necessarily need more personnel to clean the vessel than vessels of 120 meters, but it transports more cargo.

Year of construction	%
-1960	14%
1960-1966	6%
1966-1975	8%
1975-1985	6%
1985-1995	4%
1995-2005	28%
2005-2013	34%

Table 16: Year of construction of IWT vessels.

On average, the motor ships that belong to group 3 (the longest vessels) are the youngest vessels. It shows that the barge owners want to gain economies of scale by buying larger vessels.

The other 10.6% consists of pusher boats that use barges to hold the cargo. Of these convoys, the largest group belongs to group 4[7]. However, because only eleven push boats were found in the results, one extra push boat could have changed the percentages significantly. Therefore, these percentages aren't even as solid as the ones for motor ships.

Building years of IWT vessels

When we look to the building years in the whole group of companies, we see that the majority was built after 1995 (62%). The oldest vessels are from 1930, the latest is completed in 2014. The segment with the (on average) oldest vessels is 'sand and gravel', with an average building year of 1968. For dry bulk, this is 1984. On average, tankers are built in 1995. The container fleet is the most modern fleet, with an average building year of 2004. The container segment is the youngest cargo segment in IWT. Containers are still transported by vessels originally built for transporting dry bulk. Because these vessels can't be used as efficiently as container vessel (e.g. because of the not-specific cargo hold), there is still a possibility to increase the efficiency. This makes it interesting to invest in container vessels. Besides, a strong growth of the container market (until the crisis of 2008) and a positive perspective towards the future made it interesting to invest in the sector. Also, this made it more interesting for banks to finance the construction of new vessels and therefore easy for entrepreneurs to construct new vessels (CCNR, 2013). For these reasons, the average building year is rather 'recent'.

[7] Push boat + two push barges, or motor ship + one push barge (see chapter 2.3.5)

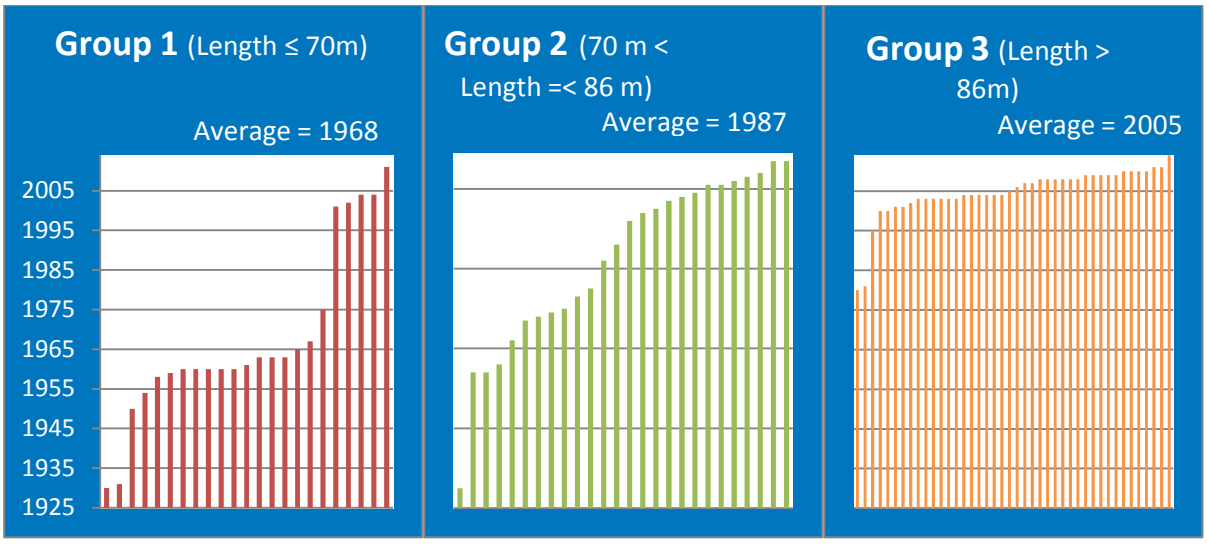

Figure 10: Building years per motor ship length group. Every bar represents an individual vessel.

Figure 10 shows that construction of motor ships in group 1 lags behind the construction of motor ships in the other two groups. However, this was more of a problem during the 1970's, 1980's and 1990's. Especially ships in group 3 are rather young. Outside of the large percentage of ships longer than 86 meters already measured (table 15), these ships are also the ones being constructed most. The averages for group 2 and 3 are in the middle of the graphs. For group 1, the average is a bit more to the right. The vessels built after 1995 increase the average rather much. This percentage is therefore likely to grow in the coming years. It is important to keep this trend in mind, because larger ships can't navigate on every waterway. It has and will have a strong influence on the structure of the supply chains.

Cargo segments and the size of the fleet

					Adjusted to real company size	
Cargo segment	**One vessel**	**Two vessels**	**Three+ vessels**	**Of total no. vessels**	**Three+ vessels**	**Of total no. vessels**
Dry bulk	27.03%	25%	22.81%	25%	32.45%	31.14%
Tanker	40.54%	50%	50.88%	49.04%	48.43%	47.70%
Container	10.81%	12.5%	21.05%	13.46%	17.99%	16.67%
Sand & gravel	16.22%	0%	0%	5.77%	0%	1.80%
Other	5.41%	12.5%	5.26%	6.73%	1.13%	2.69%

Table 17: Statistics of different cargo segments.

In table 17, the different company sizes and the cargo segments the companies are active in, are shown. Companies with only one vessel are slightly more often active in the dry bulk segment than the larger companies. This was also discussed in earlier parts of the report: smaller companies are

more often family companies which have been active in the dry bulk segment for a longer time. This type of companies is often characterized by owning older vessels which are not fully suited for container transport. Still, a large part of these larger companies works in other segments, of which tanker transport is the most important. Most vessels filled in by the respondents (around 49%) are active in the tanker segment. As mentioned earlier, because this differs from the characteristics of the sector, this must be taken into account when analyzing the other results of the survey. Of the larger companies (three or more vessels), almost 51% of the vessels transports chemicals and other liquid goods. Transportation of containers is more often performed by larger companies. Of the single vessel-companies, only 10% is active in the container cargo segment. Simultaneously, of the companies with three or more vessels, 21.05% of the vessels is active in the container segment. The only transporters of sand and gravel are small companies with only one vessel.

The real company sizes slightly influence shares of the cargo segments

When we take the total fleet sizes of the companies into account, we see some differences in the frequencies for cargo segments. The share of dry bulk vessels becomes more important. The share of the smaller segments (other and sand & gravel) becomes even smaller. The percentage of container vessels becomes smaller when we only look to the companies with three or more vessels (17.99%). However, when we look to the total number of vessels, the percentage is larger (16.67% instead of 13.46%). For this group of respondents, the tanker segment is still the largest segment with approx. 48% of the vessels.

The participants were asked to answer the questions based on their total fleet and therefore chose a maximum of three vessels that represent their company in the best way. For choosing the vessels that represent the cargo segments the companies are active in, this is still feasible. To do the same for the modes of exploitation and the other questions in the survey and do this all for the same vessels is much more difficult and maybe even impossible. Therefore, the real company sizes will not be taken into account for the rest of the results, unless this is indicated.

Most companies are active on the Rhine and the (other) Dutch waterways

Rhine	Netherlands	Belgium	France	Germany (other)	Other
47 (75.81%)	49 (79.03%)	33 (53.23%)	4 (6.45%)	12 (19.35%)	2 (3.23%)

Table 18: Sailing areas of survey respondents. Total number of companies active in area.

Table 18 shows the sailing areas in which the respondents are active. The percentage between brackets indicates the percentage of respondents being active in that sailing area. The question gave the opportunity to give more than one answer. Therefore, it is impossible to see how intensive a

company sails through e.g. France. We can say that most traffic is concentrated around the Rhine and probably on and around the part of the Rhine flowing through the Netherlands. The open option 'other' was used two times for the ARA-area. These were added up to Belgium, as there is some overlap with those two answers. Many of the respondents who answered 'Belgium' could have meant participation in the ARA-traffic, as the origin of most companies is the Netherlands. Transport on the Danube, in Western Europe and to other parts of Europe were also mentioned once.

4.2.3 Modes of exploitation

The statements of the experts and the questions of the survey about the modes of exploitation will be discussed in this sub chapter. First, the visions of the experts are shared. Then, the results of the survey on this subject will be discussed.

The supply of cargo is the most important factor

Deciding which mode of exploitation to use is mainly influenced by the supply of cargo. Most companies change the mode of exploitation when there is less or more cargo to be transported. Especially in the transport of chemicals and containers, where the supply of cargo is relatively stable, there is less reason to shift between exploitation modes. These are large companies which have good contact with their clients. There is often a fixed scheme, at least for a part of the fleet. Also parts of the specialized transport markets are relatively stable, because there are long-term contracts. For example, the ro-ro ships almost always follow exploitation mode B and never change that. It is a market with only a few participants and therefore low competition levels. When total supply remains rather stable, there is not much need to change the mode of exploitation.

Only few changes in which mode of exploitation is used

Over the years, mode of exploitation patterns didn't change much. Most experts say that the patterns of exploitation modes used on each vessel have been more or less the same for many years. An exception is the container segment, because this segment experienced a growth of the market. While in the early years of the segment, vessel owners had to combine container cargo with other cargo at the same time to fully load their vessels, their focus is now on the transport of containers 24 hours a day. The supply of containers became more stable. This development made it more efficient to use exploitation mode B. In general, in container transport, this seems to be the most used mode of exploitation. In the other segments, there haven't been many changes over the years.

The importance of the route a vessel follows

Another strong factor is the route a vessel is following to transport the cargo. When a vessel is used to sail on the same route regularly, there often is no reason to change the exploitation mode. This is in line with one of the previous arguments: when a skipper has a long-term contract with one or more clients, there is not much need to change the mode of exploitation. When you deliver the same

amount of cargo to the same client over and over again, you'll most likely need more or less the same amount of time for each time you deliver the goods. Also, if it costs 13 hours for a skipper and his crew to reach its destination for the day, there is no reason to follow exploitation mode A2 or B. That would only increase the costs.

The size of the vessel is not a defining factor

A factor that does not appear to be a main direct factor in deciding which mode of exploitation to use, is the size (or, more specifically, the length) of the vessel. At least, it was not mentioned as one of the defining factors during these interviews. However, it is possible to conclude that the size of the vessel influences the possible sailing areas and thus how much time is needed. Obviously, the length of the vessel influences the way a barge owner is allowed to sail for a specific number of hours, but it doesn't directly influence the number of hours a barge owner wants or needs to sail. The external factors mentioned above, which the operator can't influence, have a stronger effect.

Flexibility

One of the major concerns the experts have with the current regulations, is the lack of flexibility. In general, the experts say that the way the ship is exploited (number of sailing hours, the crew requirements) should depend on the following factors:

1- The destination(s), and more specifically the waterways chosen to reach the destination(s),
2- The obstacles (locks, bridges) that are ran into during the transport. A high number of obstacles increases the duration and the number of proceedings that need to be performed. When you don't come across a lot of locks and bridges, the crew members do not always have a lot to do. Therefore, this is seen as an important factor. It could have a strong influence on the business of a company.
3- The different types of chemicals and gasses that are transported need different treatments in terms of cleaning and safety. More dangerous substances require more precautions and must be handled with more care. This requires more time and proceedings, which means that more time and manpower is needed in these situations.

Some experts have a problem with the regulations, because the three factors mentioned above are not implemented in the current regulations. It does not matter whether your crew is very busy or hasn't got much to do, the regulations are the same for both. This makes the crew requirements not suitable for all different situations.

Loading and unloading cargo complicates decision

Differences between the cargo segments that could influence the decision which mode to choose are found in the process of loading and unloading the cargo. The number of terminals a ship has to call,

or the time a vessel has to wait in the port to load the cargo could affect the way an IWT entrepreneur wants to operate. For example, thanks to the use of pumps to load and unload tankers, the loading and unloading processes of chemicals are less time-consuming than the same processes in the dry bulk segment. If the loading times are very irregular and waiting times at the terminal are long, an option is to choose mode B to have enough time to respond to irregularities any possible way. On the other hand, to not let the hours allowed to sail go to waste while waiting at the terminal until his vessel is (un)loaded, it is also possible to use a mode of exploitation with less hours. However, the costs for exploitation mode B are significantly higher because of higher labor costs. Therefore, this factor has a potential influence, or it gives the owner of the vessel at least another reason to think about the chosen mode.

Short waiting times in ro-ro segment

Where the experts of most segments say the waiting times at terminals have a rather strong influence on their activities, the ro-ro segment has very short waiting times. This means that the transport is more intensive. The waiting times here influence the activities in a different way. Because they are less important in the time schedule of these vessels, it is easier for ro-ro vessels to plan the resting periods and the crew exchange for exploitation mode B. In other segments, you can plan the resting times during the waiting times, but the irregularity of the waiting times makes it difficult.

Frequency of mode A2 versus A1 and B

There are differing opinions about the differences in frequency between exploitation mode A2 and A1 and B. In chapter 3.3, it appeared that exploitation mode A2 was used less frequently than A1, especially in the transport of dry bulk. A reason given is that the step between A1 and A2 is not very interesting, because the extra costs outweigh the extra sailing hours. However, some experts state that A2 is ideal for their routes and activities. The most evident reason is that small family businesses, which are often working in the dry bulk segment, want to work with as few additional crew members as possible. In the other segments, especially the tanker segment, A2 is used very frequently. The differences in frequencies are mostly attributed to the different demands desired by the IWT companies of different cargo segments and different company sizes.

Survey: The use of modes of exploitation in different segments and company sizes

In table 19, with survey results, it is shown that mode B becomes more popular when you go down the first part of the table. For this table, it is of importance that all vessels in a company may use a different mode of exploitation. Therefore, the table shows percentages for each vessel instead of per company size. The third vessel most frequently uses mode B. This could be interpreted the following way: The larger the company, the more the company makes use of exploitation mode B. The

differences between the modes of exploitation for the first and second vessel in this table are quite large. This means that the business idea for companies with multiple vessels differs a lot from the companies with one vessel.

Mode of exploitation	A1	A2	B
First vessel	*43.54%*	27.42%	29.03%
Second vessel	24%	36%	*40%*
Third vessel	17.65%	35.29%	*47.06%*
Dry bulk	*42.31%*	19.23%	38.46%
Tanker	31.37%	*41.18%*	27.45%
Container	0%	28.57%	*71.43%*
Sand and gravel	*66.67%*	33.33%	0%
Other	*71.43%*	0%	28.57%
Total	*34.62%*	30.77%	*34.62%*

Table 19: Frequency distribution of modes of exploitation per vessel and per cargo segment.

Even though the row of 'First vessel' also includes vessels from larger companies, the differences are still notable. A reason for this could be that smaller (family) companies generally have more problems with having a large crew on board and being active 24 hours a day. Couples often prefer to navigate a vessel as a couple to retain some privacy. For larger companies, this is less of a problem, because these have a different motivation to be active in this sector.

Container vessels in most cases part of company with three or more vessels

Company size	%
One vessel	28.57%
Two vessels	14.29%
Three or more	57.14%

Table 20: Statistics of in which company sizes the container vessels are used.

Especially in the container segment, this seems to be the case. The container segment is the youngest cargo segment in IWT and simultaneously has the highest percentage of vessels being used in mode of exploitation B. As shown in table 20, 57.14% of the container vessels is used in companies that have three or more vessels active in the IWT sector. The larger companies focus more on the business aspect and less on having a nice and enjoyable life on board. A reason for the rather large percentage of one vessel-companies with containers could be that the sector is rather popular under new, still growing companies.

Mode A1 is only occasionally used by large companies

What's striking is that mode A1 becomes less in use the more you go down the first part of table 19. Mode B is the most frequently used mode for the second and third vessels. Also mode A2 is used a

bit more often than A1, but this mode of exploitation doesn't show that much change between the three groups.

Cargo segments and modes of exploitation

In the second part of the table, the frequency distribution is shown per cargo segment. It shows which modes of exploitation are used more or less often in each cargo segment. In the dry bulk segment, mode A1 is used most often (42.31%). The most outstanding result is mode of exploitation B being used in 38% of the cases. This is more than expected. A1 being the most frequently used mode in this segment was expected. For the tanker segment, the modes of exploitation are rather equally distributed. The most frequently used mode (A2) is chosen 41.18% of the time, the least frequently chosen mode of exploitation (B) 27.45% of the time. Therefore, there is no clear pattern in this segment when we look at it this way.

Differences between overall frequencies modes of exploitation quite small

Overall, there isn't much difference between the frequencies of the modes of exploitation (last row table 19). Modes A1 and B are used for most vessels (both 34.62%), but also A2 is still used in 30.77% of the cases. These results show a different image than the research by Panteia presented earlier in this report. The main reason is probably the composition of the cargo segments. In this research, the tanker segment is represented with the largest amount of vessels. In the research by Panteia, most vessels belong to the dry bulk segment. This probably has a strong effect on the frequency of especially mode A1, as this is the most frequently used mode of exploitation in the dry bulk segment.

Mode of exploitation B most strongly linked to largest vessel group

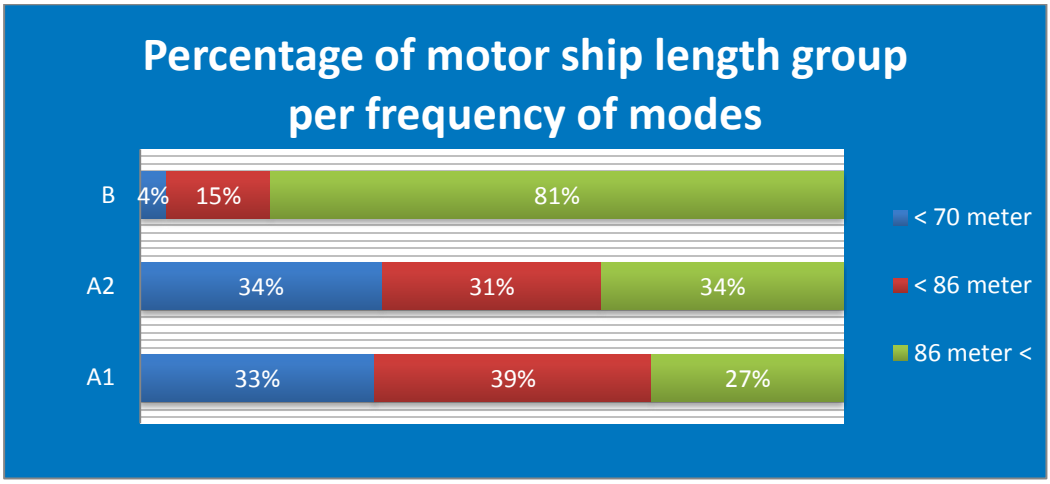

Figure 11: Percentage of frequencies for motor ship length groups per mode of exploitation.

In figure 11 above, it is shown that mode B is most frequently used with motor ships in length group 3, vessels longer than 86 meters. In 81% of the cases, exploitation mode B is used in combination with a vessel of at least 86 meters. The other two modes aren't that strongly linked to one of the

length groups. For mode A2, the distribution is rather equal. In none of the length groups, it is used in more than 34% of the cases. Exploitation mode A1 is used most frequently by vessels in group 2 (between 70 meters and 86 meters long). Again, the differences are much smaller than for mode B.

Size of motor ships in IWT

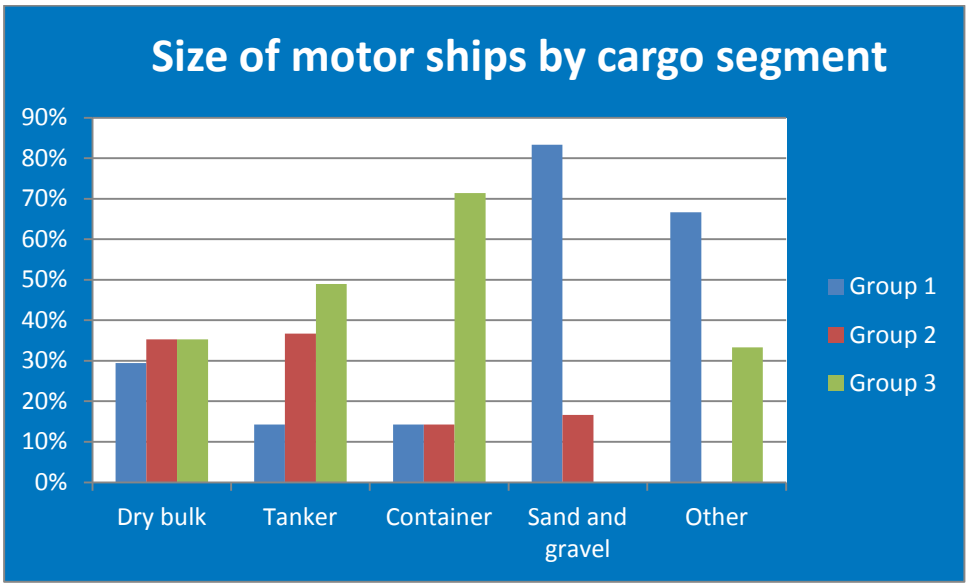

Figure 12: Number of vessels per motor ship length group in survey, divided by cargo segment.

In figure 12 above, a visual representation of the frequencies of the different length groups of vessels are given. It shows clearly that vessels longer than 86 meters (group 3) form the largest group in the tanker segment. For the dry bulk segment, the distribution over the three groups is rather equal. Most container vessels are at least 86 meters long, because approx. 71% of the container vessels in this survey belongs to group 3. The smaller segments (sand and gravel and 'other') generally consist of vessels in group 1 (83.33% and 66.67% respectively). For the convoys, there were too few convoys (twelve in total) to make a good representable graph. Nine of these convoys (75%) are used for the transport of dry bulk, of which five convoys (41.67%) belong to group 4 (a push boat with two push barges, or a motor ship with one push barge) and four convoys (33.33%) to group 6 (a push boat with more than four push barges).

Companies generally never change their mode of exploitation weekly, or else never

Vessel	Daily	Weekly	Monthly	Half-yearly	Yearly	Never
One vessel	2.78%	27.78%	13.89%	2.78%	0%	52.78%
Two vessels	12.5%	31.25%	0%	6.25%	0%	50%
Three or more vessels	9.80%	27.45%	9.80%	0%	7.84%	45.10%
Total # of vessels	7.77%	28.16%	9.71%	1.94%	3.88%	48.54%

Table 21: Statistics of how often companies change the mode of exploitation, per vessel.

In table 21 above, it is shown how often companies change the mode of exploitation used. The most frequent answers are 'weekly' and 'never' with 28.16% and 48.54% respectively. In many cases, the barge operator or barge owner decides which exploitation mode to use every week. This was also revealed a few times during the interviews. Some experts decide which mode of exploitation to use every one or two weeks. However, even more often, the mode of exploitation (almost) never changes. An explanation for this could be that every week, companies decide to hold on to the current mode of exploitation or choose a different one, but that in the end, the companies stay with the initially chosen mode. For example, companies assess whether the supply of cargo is sufficient enough to stay with a certain mode of exploitation. In case of having long-term contracts with suppliers of cargo, companies don't have to change the mode very often. Another argument is that many companies have a certain pattern, dependent on the supply of cargo. It could be that these patterns stay the same for a very long period and therefore the companies answered 'never'. When the average supply of cargo for a certain company is very close to a point where the owner needs to make a consideration whether he uses one or another mode of exploitation, a small change in the supply could already change the ideal mode of exploitation for that moment. When the owner knows this and forms this into a pattern, he may perceive that pattern as his mode of exploitation and thus not for instance chose 'weekly', but 'never'.

The differences between the company sizes and how often the mode of exploitation is changed aren't very large. The group of companies with two vessels is relatively small (see table 14) and therefore may not be represented that well. The other two groups (one vessel and three or more vessels) show many similarities. This shows that the size of the company's fleet doesn't have a lot of influence on this decision to change the mode.

Changing the mode every day is hindered by regulations

Changing the mode of exploitation every day is chosen in only 7.77% of the time. A reason for this may be that barge owners would lose a lot of time with getting their crew fully rested before working again is allowed. The experts shared that this rule is hindering the way they work. In case this rule was eased, changing or reconsidering the mode on a daily basis could be more 'popular' because it makes the business more efficient. In the container segment, where 64.29% changes (almost) never changes its mode of exploitation, changing the mode daily is also chosen remarkably often (21.43%). Apparently, in this segment, the companies can be divided into two groups: those who almost never change the mode of exploitation and those who change it at least once a week.

Changing the mode monthly, half-yearly or yearly

Changing the mode of exploitation every month is also not a very often chosen answer, with 9.71% for all vessels. Half-yearly or yearly are both mentioned less than 4% of the time. Both depend on the

state of the economy and the associated level of the supply. Such changes in the economy can also make the firms working with long-term contracts change the mode of exploitation now and then. Currently, companies that have long-term contracts with their clients have no reason to reconsider so often.

Changing mode of exploitation per cargo segment

During the interviews, the experts from the (large) tanker companies often said that the rather stable supply of cargo means that there often isn't a good reason to change the mode of exploitation. Therefore, a last reason could be that there just is a strong difference between the companies in the different cargo segments and that some companies never have any reason to change the mode of exploitation and some do.

The results in table 22 show that the tanker companies change the mode of exploitation weekly most often. This is a rather surprising result, because the supply is quite stable and the tanker vessels are most often the largest vessels (figure 12). Normally, an important factor here could be the size of the crew and the labour costs. When the labour costs are rather large, the companies ideally want to use this crew as efficiently as possible. If the number of sailing hours is lowered, the crew is often paid for idle hours. Therefore, it is surprising that the tanker companies change their mode of exploitation so often. In the other two main segments, dry bulk and container transport, most of the companies almost never change the mode of exploitation.

	Daily	Weekly	Monthly	Half-yearly	Yearly	Never
Dry bulk	-	11.54%	15.38%	3.85%	7.69%	61.54%
Tanker	5.88%	45.10%	7.84%	1.96%	3.92%	35.29%
Container	21.43%	14.29%	-	-	-	64.29%
Sand & gravel	-	16.67%	33.33%	-	-	50.00%
Other	33.33%	-	-	-	-	66.67%

Table 22: Statistics of how often companies change the mode of exploitation, per cargo segment.

Factors influencing the mode of exploitation decision process

The barge operators were asked which factors are the most important ones in deciding which mode of exploitation to use. Sixteen options were given, including an open option where the participants could fill in their own suggestions in case an important factor wasn't yet included (see appendix D1, question 9). The participants were asked to choose the three factors that are the most important for their company. In table 23 below, the factors are shown.

Rank	Factor	% of respondents
1	Size of the ship	48.39%
2	Cost control	33.87%
3	Minimum crew requirements of other modes don't fit the business idea	32.26%
4	Supply of cargo	30.65%
5	Mode of exploitation fits best to the (fixed) route	27.42%
6	Loading- and unloading times at the terminal	25.81%
7	Demands of the client	24.19%
8	Characteristics of the vessel	20.97%
9	Mandatory downtime of vessel	14.52%
10	Workload of crew	12.90%
11	Characteristics of the sailing area	9.68%
-	Natural conditions	9.68%
13	Technical developments	8.06%
14	Fast recovery of investments	4.84%
15	Open option: weather conditions	1.61%
-	Open option: efficiency	1.61%
17	Type of cargo	0%

Table 23: Most important factors for deciding mode of exploitation, (survey).

What's striking is that none of the answers is mentioned by more than 50% of the respondents. Apparently, there is not one factor that (almost) all barge operator and barge owners find the most important one.

Size of the ship most frequently chosen factor

Remarkable is the high ranking of the size of the ship; 48.39% of the respondents answered this option). Earlier, during the interviews, the size of the ship wasn't always mentioned as a factor that should influence the mode of exploitation. In fact, the size was seen as unimportant by a few experts. An important reason is that with the current regulations, the size of the ship is important because the current regulations are based on this factor. Therefore, the decision which mode of exploitation to use is strongly influenced by the size of the ship. Another reason for the high ranking could be that the results don't show which option a specific respondent would rank as the single most important factor. Therefore, it is impossible to say whether the option ranked highest is also seen as the most important factor by the respondents or just chosen as number two or three very often. A small effect

on the results could be that the option 'size of the ship' was mentioned on top of the list in the survey and was therefore the first answer people read and were thinking about when the options were read. However, the other factors on top of table 23 were not all mentioned on top of the list, but were placed all over the list.

Cost control important during difficult times

The second most important option is cost control (33.87%). Fuelled by the recent economic crises, IWT entrepreneurs try to minimize their costs as much as possible. Among other costs, labor costs are a large part of the total costs. Therefore, the companies want to optimize the deployment of their crew members. In addition, the companies don't want their vessels to be manned for 24 hours of work when there is only work for 18 hours. Because this would make the costs needlessly high, the costs are attempted to be controlled by minimizing idle hours.

Crew requirements influence the choice of modes.

'Minimum crew requirements of other modes don't fit the business idea' is mentioned third (32.26%). It is somewhat related to the cost control. Companies try to decide which composition of crew is ideal for the way they work. If the barge owner would like to sail 24 hours a day, but there isn't enough work for all crew members, one of the other two modes will probably be considered.

Differing opinions on importance supply of cargo

The supply of cargo (30.65%) is a factor that was given much importance during the interviews. As long as clients keep supplying the same amount of cargo, there is no reason to change the mode of exploitation. If the supply of cargo is volatile, the company will probably reconsider its decision very regularly. In these results, the supply of cargo is not as important as expected beforehand. Besides having its influence on deciding which mode fits e.g. a new vessel, the supply of cargo can change this decision over the years thereafter. The influence of the size of the ship is mainly important at the beginning, as it doesn't change over time.

Route to navigate on mentioned as fifth most important factor

The route on which the vessel is navigated is the fifth most important factor (27.42%). This factor was also mentioned multiple times by the experts during the interviews. For example, when it takes 14 hours to complete all the work for one day, choosing for mode A1 is perfect. In that case, there is no need to choose A2 or B, even though a barge owner might wish to work with one of these two modes. If a barge owner knows that the duration of a trip on its standard route is rather volatile, he may anticipate on this by choosing a mode of exploitation that gives him a more comfortable period of time to complete the transport. 'Characteristics of the sailing area' (9.68%) is very much related to this factor. For instance, a high number of locks bridges intensifies the trip through a certain

waterway and thus requires more manpower and also more time. Especially more time needed for the route influences the decision which mode of exploitation to choose.

Volatility of waiting times at the terminal complicates mode of exploitation choice.

The time spent at terminals for loading and unloading cargo is the sixth most important factor of the list, with 25.81% of the respondents choosing it as one of the three most important factors. Because waiting times at the terminal to (un)load cargo can be rather long and volatile, it therefore is difficult to make a good planning. It is ideal to plan the resting time or maintenance during these downtimes, but this is not always foreseeable. However, companies need to take these waiting times into account for deciding which mode of exploitation is ideal for their business. Past experiences must be used to predict the future waiting times.

Remaining factors

Demands of the client as a factor was mentioned by 24.19% of the respondents. Characteristics of the vessel, for example the size of the cargo area or the equipment on board, was chosen by 20.97% of the respondents. The mandatory downtimes that is part of each mode of exploitation is was chosen by 14.52% of the responding skippers and operators. Characteristics of the sailing area, which was mentioned a couple of times during the interviews, is mentioned by only 9.68%, but probably was also referred to with factor 5 (Mode of exploitation fits best to the (fixed) route). The type of cargo was mentioned by none of the respondents.

Factors mentioned in the open option are efficiency and the weather conditions. Especially the first one can be seen as a combination of the answers that were already given (cost control, (un)loading times at the terminal, etc.).

4.2.4 Manning regulations

Number of required licenses on board an unnecessary burden

The manning regulations are generally seen as outdated and inefficient. A major concern is the lack of revision in the regulations, which leads to a situation where the presence of certain crew members is required by law while these members would be abundant on modern ships. For example, the requirement to have three boatmaster's licenses on board for vessels longer than 86 meters in exploitation mode B is criticized by almost all experts. Some opt for a situation where two licenses is the standard. Working alone, which is allowed on small vessels in certain regions, is dangerous, because there is nobody to take over the vessel when, e.g., the skipper loses consciousness or somehow cannot navigate the vessel anymore. Three licenses is often seen as a burden during the process of finding enough crew. Finding enough adequately qualified crew members is, in some cases, difficult enough. Finding crew members with a license is even more difficult. Besides, people

with a license demand a higher salary and thus increase the total labor costs. It is therefore also a financial burden. Simultaneously, most experts don't see why that third license is required at all. According to some of the experts, with the current technologies, navigating a vessel for a short period of time to bring it back to shore safely is not so difficult that you necessarily need a license for it.

Flexibility demanded to increase efficiency in the sector

The experts also say that it is impossible to adjust all the manning requirements to a level based on situations where the vessels meet few obstacles and thus need only a few proceedings. This would leave the more intensive routes undermanned, which is too dangerous. Therefore, flexibility is demanded by most experts. A good example of this is the mixed reaction by experts in the tanker segment on the minimum crew size on ships. These are not always perceived as appropriate, but also not always as outdated. Factors influencing this could be how well-equipped a vessel is, or the route a vessel follows. The transport of liquid cargo is in general a more intensive type of transport. It demands more and different proceedings, compared to e.g. container and dry bulk transport. Cleaning requires more time and specified knowledge from the crew. Therefore, the crew is supposed to meet more strict requirements. For these reasons, the experts working in the tanker segment generally have less complaints about the manning regulations. Although it could be more difficult to find the right employees, the minimum requirements for the crew fit a lot better in this cargo segment than they do in the other large segments. It is also safer to have some more crew on board, because of the dangerous properties of certain gasses. To make sure there are no mistakes made, overworked crew is not quite desirable. Flexibility is also a key argument here, because there are also situations in this segment where some crew is redundant.

Educational requirements complicate hiring process

Besides the complaints about the manning regulations above, the experts are also against the current requirements which crew members themselves need to satisfy. For example, while boatmen need three years of experience on board of an IWT vessel, they often already know how to perform most of the jobs after a couple of months. The remaining years are a problem for the skipper, because he cannot deploy a person as a boatman before those years have ended. For the skipper, this means there are more than enough crew members to execute all the jobs that need to be done on board. However, according to the regulations, the skipper still needs to find a boatman to satisfy the manning regulations. Therefore, an extra person must be deployed to meet the legally required manning. The supply of adequately qualified workers is rather low. This is one of the reasons why some companies hire personnel from Eastern Europe. The salary isn't the main reason for this, but the low supply of adequately qualified workers in the Rhine states.

Redundant crew member differs per situation

Besides these complaints about the manning regulations, the experts cannot say there is a specific requirement that should be changed. However, the minimum required crew composition should be more flexible. Which manning requirement should be changed can't be said, because that could differ per situation. The experts in the convoy segment don't have any complaints about the minimum size of the crew at all. Only the requirements these employees need to fulfill themselves are perceived as too strict. In general, this is the largest problem with the manning regulations, as it is mentioned by companies in all segments.

Required resting time for shifting between modes

Shifting between different modes of exploitation and the associated required resting time for the crew is a problem for some companies. It costs a lot of time, while it is perceived as useless. A given remark was: 'If a completely rested crew comes on board and during the first hours most of them have nothing to do but sitting and waiting until the vessel reached its destination, why do they need to be fully rested? Why can't we let them rest during that period of time?'. Again, this is a rule that is seen as too rigid and could use some more flexibility.

Opinions about personnel from outside Rhine states differ a lot

Problems with finding qualified personnel also differ. While one expert says that they find it difficult to find adequately qualified crew members to fulfill the minimum requirements and therefore needs to find these in Eastern Europe instead of in the Rhine states, another expert claims there are, with some periods as an exception, very few problems with finding adequately qualified employees in the Rhine states. The opinion about crew from outside the Rhine states is also quite diverse. On one side, there are experts who see that their willingness to gain a higher position on board is smaller than for the other crew members. These crew members want to find work here and only seldom try to gain a higher position on board. However, most of the time, they don't want to have any large responsibilities. Therefore, they are often satisfied with a lower-ranked function. Also, it is sometimes difficult to determine what a good composition on board is, because some cultures differ too much. This could make it less pleasant on board. Furthermore, because of the language barrier, there could be extra problems. In case they would be the skipper, there could be misunderstanding when contact with other parties on land has to be made. On the other side, some experts tell that there is almost no difference between foreign and domestic employees and their desire to gain a higher position on board, for example the will to become skipper. These experts may have contracted more people from the Rhine states, but the way they work isn't any different. Overall, there isn't a definite general opinion.

Survey: Eight statements about the manning regulations

In the survey, the participants were asked about their opinion on the manning regulations. Eight statements were given. The set of statements was defined after the interviews with the experts. All statements aim at a different aspect (or problem) of the manning regulations that was mentioned during the six sessions with the experts. In conjunction with the CBRB, these aspects were formed into statements. The results are shown in tables 24 to 33 below. For the results divided per cargo segment, tables are found in appendix E1 (table A11 to A18).

Minimum required crew

Statement one is about the minimum crew requirements set by the CCNR. The question is whether these requirements match up with the minimum needs in practice. According to this survey, the opinions are rather divided but leaning towards disagreeing. Around 43% of the participants disagrees with the first statement and thinks that the theoretical requirements don't match with the practical needs on board. Of this 43%, 24% strongly disagrees with the statement. On the other side, 38% of the respondents says the minimum requirements do match with the current needs. Disagreeing with this statement could mean two things: the respondent thinks the theoretical requirements are too low or too high. The second possibility is more likely in this case, because too low requirements don't prohibit a barge owner to employ more people. It is possible that a respondent thinks the low requirements lead to unsafe operations. However, during the interviews, the other possibility was the only one coming up.

Statement 1	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The minimum required crew matches with the practical needs on board.	**24.14%**	18.97%	18.97%	22.41%	15.52%

Table 24: Results of first manning regulations statement.

On this statement, there aren't large differences between the cargo segments. Among companies in one cargo segment, there are still different opinions on this statement. The differences between the length groups are giving more information. The group with the longest vessels (group 3) strongly disagrees with the statement far more often than the other two groups. An explanation for this observation is that the vessels constructed most recently are often vessels of group 3. Therefore, it is likely that these vessels are more modern. With more modern vessels, there is often less need for crew members to execute certain proceedings. It's an extra motive to disagree with the statements.

Statement 1	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Group 1	4.76%	**38.10%**	14.29%	33.33%	9.52%
Group 2	3.85%	26.92%	23.08%	**30.77%**	15.38%
Group 3	**36.59%**	14.63%	29.27%	7.32%	12.20%

Table 25: Results of first manning regulations statement, per motor ship length group.

Required minimum amount of licenses on board

Statement two (table 26) focuses on the required number of licenses on board. During the interviews, it was mentioned that for vessels longer than 86 meters in mode of exploitation B[8], the regulations require to have at least three people on board who are allowed to navigate a vessel. Many experts find the requirement of three licenses an unnecessary burden. Again, there is no unanimous result on this statement. About 40% disagrees with the statement. 38% agrees with the same statement and thus says there is no reason to change the required number of licenses on board of IWT vessels. Among the explanations given by the participants for question 13 further on, the regulation for three licenses is also brought up. Most respondents agree that the number of three licenses should be brought back to two licenses. A common suggestion is replacing one license (the helmsman) for a boatman.

Statement 2	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The requirements concerning the required amount of licenses on board are sufficient.	**22.41%**	17.24%	**22.41%**	20.69%	17.24%

Table 26: Results of second manning regulations statement.

There are some small differences between the cargo segments (appendix E1, table A12). Especially the dry bulk companies often strongly disagree with the statement. 40% Strongly disagrees with the statement, a total of 60% disagrees. The companies with tankers and/or container vessels are also rather negative about the required number of licenses, but also tend to react a bit more neutral. On the contrary, the smaller segments, including sand and gravel transport, are much more positive and generally agree with the statement. The differences between the length groups are also notable. The groups with smaller vessels agree much more with statements and thus are more satisfied with the current required number of licenses than barge operators with vessels in group 2 (neutral) and group 3 (negative).

[8] For convoys, this means using mode of exploitation B with convoys belonging to group 3-6.

Statement 2	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Group 1	4.76%	9.52%	23.81%	**47.62%**	14.29%
Group 2	11.54%	23.08%	**26.92%**	23.08%	15.38%
Group 3	**31.71%**	24.39%	24.39%	4.88%	14.63%

Table 27: Results of second manning regulations statement, per motor ship length group.

Finding and hiring new crew members

The third statement of the survey looks to the hiring process of new crew members. During the interviews, there were some comments on the strictness of the current requirements crew members need to satisfy. It increased the problems for companies to find adequately qualified crew members, because these educational requirements made the total supply of labour smaller. In this survey, the largest group agrees with the statement that the requirements make it difficult to find the right personnel (38%). However, this is not a majority. Almost 26% is neutral and doesn't have problems with the regulations during the search for personnel. About 36% disagrees with the statement and has no problem with finding new crew members.

The experts shared reasons from both sides. Some said it was difficult to find new crew members, especially in Western Europe. Other experts said that the minimum requirements their own company has set often match or even exceed the requirements in the general regulations. Therefore, if there are problems with finding adequate employees, the regulations are not the reason.

Statement 3	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I find it difficult to find suitable employees due to the minimum educational requirements for crew members.	15.52%	20.69%	**25.86%**	17.24%	20.69%

Table 28: Results of third manning regulations statement.

Looking at the cargo segments separately, it appears that the dry and liquid bulk transporters, in general, tend to disagree with the statement. However, there is again no unanimity. In the container segment, 50% agrees with the statement and thus has problems finding personnel. The length groups also do not offer many explanations. Group 2 and 3 are, in general, a bit more negative about finding suitable employees, but the differences are quite small.

Statement 3	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Group 1	19.05%	14.29%	**23.81%**	**23.81%**	19.05%
Group 2	**23.08%**	**23.08%**	19.23%	11.54%	**23.08%**
Group 3	12.20%	**31.71%**	19.51%	17.07%	19.51%

Table 29: Results of third manning regulations statement, per motor ship length group.

Manning regulations and the characteristics of the vessel

The fourth statement asks the question whether the manning regulations take the characteristics of the vessels into account well enough. Currently, the composition of crew mainly depends on the number of hours the company wants or needs to sail and the length of the vessel. About 43% disagrees with the statement that the regulations do take the characteristics into account sufficiently, of which 30.4% disagrees strongly (table 30). About 30.4% is neutral and 27% agrees with the statement. This statement is the first to show a more clear opinion. The largest group disagrees with the statement and thus thinks the regulations don't match up with the characteristics of the vessel enough. A reason is that while the length of the vessel is of some importance, the breadth of the vessel or the size of the cargo area isn't having much influence on the minimum composition of crew required. Therefore, there could be a significant difference between vessels and their characteristics, but the requirements set by the CCNR only distinguish between different vessel lengths.

Statement 4	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The manning regulations take the characteristics of the vessel into account sufficiently.	**30.36%**	12.5%	**30.36%**	12.5%	14.29%

Table 30: Results of fourth manning regulations statement.

The cargo segments don't give many extra answers (table A14). The motor ship length groups also differ some from each other. Group 1 is quite neutral, but also has quite a lot of respondents disagreeing strongly. Group two is also quite neutral, but has quite some respondents agreeing strongly with the statement. The participants in group 3 strongly disagree most often and overall disagree with the statement. They do not think the characteristics of the vessel are taken into account enough.

Statement 4	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Group 1	23.81%	4.76%	**52.38%**	14.29%	4.76%
Group 2	11.54%	11.54%	**34.62%**	11.54%	23.08%
Group 3	**43.90%**	14.63%	21.95%	7.32%	12.20%

Table 31: Results of fourth manning regulations statement, per motor ship length group.

Manning regulations and the characteristics of the cargo segment

The fifth statement aims on the importance of the cargo type. 32.14% says the role of the cargo type in the manning regulations isn't of enough importance yet and therefore strongly disagrees with the statement. In their opinion, there are differences between the transport of certain types of cargo which are not taken into account by the current regulations. The second largest group responds neutral on the statement. For example, certain types of cargo require more cleaning and safety measures. This means that the companies transporting these goods could use more manpower on board than when other, 'easy' types of cargo are transported. They don't mind that the manning regulations are too strict for other companies, but they can imagine that it isn't ideal for all cargo segments. For their business, the requirements are appropriate. Another reason could be that the suitability of the crew requirements differs per situation and is therefore both good and bad, depending on the each situation. They could live with a change in the regulations, but don't desire it very much and thus stand neutral.

At question 9 in the survey, the respondents were asked which factors are most important for deciding which mode of exploitation to use. The type of cargo was mentioned by 0% of the respondents. Therefore, it is striking that 32.14% demands more influence for this factor in the regulations. A possible interpretation is that there is no reason yet for skippers and operators to take the type of cargo into account for deciding which mode to use because it isn't implemented in the regulations sufficiently.

Statement 5	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The manning regulations take the type of cargo into account sufficiently.	**32.14%**	3.57%	28.57%	25%	10.71%

Table 32: Results of fifth manning regulations statement.

The tanker segment and the container segment (strongly) disagree most with the statement and therefore are not satisfied with the role of the cargo type in the regulations. The opinions in the dry bulk segment are very divided. It is not very surprising that the tanker segment disagrees with the

statement, because the way this type of cargo is treated during transport differs for specific types of liquid cargo.

The minimum educational requirements for the different functions

The last three statements are about the educational requirements for becoming a skipper, helmsman or boatman. During the interviews, the experts stated that it was difficult to find adequately qualified personnel in the Netherlands due to the structure of the educational program. According to the survey, this especially counts for the program to become a boatman. 51.79% of the respondents agrees to this statement (table 33). This was also the function that was mentioned most during the interviews. Experts earlier shared the opinion that the three years of experience needed to become a boatman was far too long for the proceedings he is supposed to be able to perform. The years of experience are seen as a large burden for many companies, because the crew member can't be deployed as a boatman while he is able to perform all proceedings related to his function after just a couple of months.

Opinions about requirements for skippers and helmsmen more positive

The opinions about the requirements to become a helmsman are a more positive, but also receive some criticism. For the requirements to become a skipper, there isn't much negative response. Skippers carry a lot of responsibility, need to be well-trained and must have everything under control. For this reason, having a license to navigate a vessel is an obvious requirement.

For the requirements to become a skipper, the container segment is a bit more neutral than the other two large cargo segments. However, the percentage of respondents agreeing with the statement is still very low. The tanker segment is the segment that disagrees with the seventh statement most and is quite positive about the requirements to become a helmsman.

Statement 6-8	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The minimum educational requirements for the following function are too high:	-	-	-	-	-
• Skipper	26.79%	**37.5%**	19.64%	16.07%	0%
• Helmsman	19.64%	26.79%	**33.93%**	16.07%	3.57%
• Boatman	16.07%	10.71%	21.43%	21.43%	**30.36%**

Table 33: Results of sixth, seventh and eighth manning regulations statement.

Especially the container segment and the sand and gravel transporters strongly agree with eighth statement and demand a change in the requirements to become a boatman. The tanker segment

and dry bulk segment are rather neutral. This is quite noteworthy, because many experts had complaints about the requirements crew members have to meet to work as a boatman.

Working with less or lower-qualified personnel

With question 13, participants were asked whether work could be done safely with less or lower-qualified personnel. The question was asked separately for each of the three modes of exploitation, because the companies may have different opinions for each mode of exploitation. In table 34, the results are shown. Subsequently, the participants were asked to explain their answer.

Could you safely work with less or lower-qualified crew members?	Yes	No
A1	44.90%	**55.10%**
A2	**57.14%**	42.86%
B	**56.52%**	43.47%

Table 34: Results of question whether respondents think work can be done safely with less or lower-qualified personnel.

For none of the modes of exploitation, there is a clear answer. For A1, the majority responds negative to the question. For the other two modes, the majority thinks working with less or lower-qualified personnel could be safe enough. In the explanations to this question, the opinions are also rather diverse. A lot of complaints are about the composition of the crew. Three licenses for vessels and convoys longer than 86 meters using exploitation mode B is very often seen as a burden, which was already discussed at one of the statements earlier this report (table 26). This is the main point of criticism about this mode of exploitation. The different types of boatmen are also problematic, because they don't differ as much in practice as implied in the regulations. For example, one participant says: ,,At the moment, I must work with at least one boatman. I think that this would also work with one ordinary boatman. In four to six weeks, it is possible to see whether he is eligible or not to become a boatman". The problem is not per se that the different types of boatmen create confusion, but that the required education and experience do not always correspond to the required skill set.

Many agree that current required composition is outdated, but solutions differ

The common part in most explanations is that the composition of the required crew is not appropriate, but the solutions differ a lot. It depends on the type of cargo and the sailing area, which was stated during the interviews. Where one respondent says his crew must work hard to get everything done, the other one says that they could succeed with less or lower-qualified crew. In short, the most important point given is that the third license is very often seen as unnecessary and that the crew requirements in practice heavily depend on the sailing area and cargo type.

4.2.5 Innovation and modernization

Introduction of classification system or similar measures to modernize the fleet

A recurring opinion during the interviews was about the lack of modernization in the whole IWT sector. One of the opinions is that the current regulations are in favor of the owners of older vessels. Older vessels sometimes receive dispensation in case they don't fulfill the technical requirements anymore. This is a thorn in the side of companies that are willing to modernize their fleet, because it keeps old material in business. It influences the competitiveness of the sector. Simultaneously, this has an effect on the volumes that are transported in IWT and therefore also the exploitation modes used. If the competitive position of IWT gets worse and the image of the sector gets damaged, the total volumes will also decrease. A solution mentioned during the interviews is the introduction of a classification system. In such a scenario, a classification system is set up in which all vessels in inland waterway transport are categorized. The newest, modern ships are found in class I, the old ships for example in class VI. This way, if a ship doesn't match the requirements of a certain class, it will shift down a class. This could have consequences, like a reduced number of hours per day it is allowed to sail, or higher port dues. It could be an extra incentive for the owners of older vessels to invest in newer material.

Advantages and disadvantages of modernization policies

On the one hand, a group of experts looks at the competitiveness of the sector, compared with the other modalities. These experts say that the regulations protect the old vessels too much and don't stimulate companies to invest in new, modern vessels. However, on the other hand, there are the experts who like the way work is done now and don't want any big changes in the regulations which will make the old vessels worthless. New regulations could mean that the fleet declines in size or large investments must be made to maintain the fleet's size. In the first situation, people would lose their jobs. In the end, you could argue that the modernization, on the longer term, would lead to more work in the IWT sector. If the modernization does not occur, supply of cargo for the IWT sector may decrease due to the worsening of the competitive position in the transport sector. However, the perceptions of the experts about this point differ quite a lot.

Borders of vessel length groups often perceived as illogical

Overall, the borders between the (motor ship) vessel length groups (-70 meters, -86 meters and longer than 86 meters) and the technical standards (S1 and S2) are perceived too outdated. Many respondents think the use of three strict length groups is somewhat outdated. Also, the fact that only the length and no other characteristics of the vessel (and its cargo hold specifically) play an important role in the regulations, is criticized more than once.

Survey: The current regulations and innovation

Two questions of the survey (of which one consists of four statements) aim at the role of innovation in the regulations. For the first question, the question structure of question 13 (whether companies could safely work with less or lower-qualified personnel or not) was used for question 14. The question is whether the regulations take innovation and technical improvements into account sufficiently. Again, this was asked for each mode of exploitation separately. The possibility to support the answer with an explanation was also given.

Do the current regulations take innovation and modernization into account sufficiently?	Yes	No
A1	27.66%	**72.34%**
A2	23.81%	**76.19%**
B	25.58%	**74.42%**

Table 35: Results of question whether respondents think the regulations take innovation into account sufficiently.

These results (table 35)are rather convincing, but also what was expected. During the interviews, the lack of space for innovation to flourish in the IWT sector was mentioned multiple times. Therefore, the results are what was expected. None of the current modes of exploitation are aligned to innovation enough. More than 70% of the respondents thinks that the current regulations don't give companies enough opportunities to adopt technical developments and support the development of new projects. This is rather problematic for the sector. A low level of modernization and adoption of new technologies affects the competitiveness of the sector drastically, as it often lowers the costs on the longer term.

Proponents of more modernization in IWT

Again, respondents were given the opportunity to explain their answer. Participants answering 'no' say that the modern vessels are modern enough to be navigated with less crew on board. An important perspective shared is that during the educational programs, crew members need to become familiar with modern technologies before the regulations will be aligned with those technologies. It could lead to unsafe situations when these crew members only learn to work with new technologies when they start working on a vessel. Other perspectives look at other industries and think it is strange that inland waterway transport is one of the only transport sectors in which technological development gets such little support. At last, some mention that in practice the length of the vessel has become less important thanks to the modernization of vessels, because more parts of the vessel can be controlled from the cabin.

Opponents of more modernization in IWT

Participants answering 'yes' on the question whether the regulations take innovation into account sufficiently state that the new technologies do not increase safety when they replace manpower. It is not always wise to trust technology when small mistakes could have rather large consequences. The idea that the training should be adjusted is also given as a reason to not rely on technology that much. Not every crew member will be ready to work with modern technologies unless additional training is done. However, what speaks in favor of the group that disagrees is that it seems abnormal to put barge owners on large extra costs by forcing them to deploy personnel while any extra crew members aren't really needed in practice.

Technical standards

The last survey question focuses on the opinion of the respondents about the technical standards, which are set in the regulations. The technical standards S1 and S2 split each mode of exploitation in two sets of manning requirements. A less strict requirement is set for more modernly equipped vessels complying with standard S2. Four statements were given and the participants were asked to choose the statements that are agreed with. There was also a possibility for the participants to share their own vision on the technical standards through an open option, in case this vision wasn't represented in one of the statements.

Statement	Yes	No
The standards are not flexible enough.	30.19%	**69.81%**
The standards are unnecessary.	26.42%	**73.58%**
None of the standards is sufficiently linked to modern technologies.	32.08%	**67.92%**
The degree it influences the manning regulations does not fit.	30.19%	**69.81%**

Table 36: Results of statements about technical standards S1 and S2.

What was first noticed after these results (table 36) is that 64.5% (40 out of 62) of the respondents who answered this question agreed with only one of the statements. This may have affected the results, because it could be that some participants assumed it was only possible to choose one statement. However, by comparing the percentages, we can see which statements are perceived as more important. Only looking at the results of respondents agreeing with just one statement, statement one was agreed with most (30%). However, differences are not very large (22.5%, 27.5%, 20% for statement two, three and four respectively).

'The standards are not flexible enough'

The first statement questions whether the standards are flexible enough. Although the two standards increase the flexibility of the complete system of regulations, 30% of the respondents state that the standards are not flexible enough.

'The standards are unnecessary'

The second statement has the lowest percentage of agreeing participants. The idea of having no technical standards at all is not very popular. Apparently, while the current standards are often perceived as outdated, the idea behind the standards is still agreed with by most of the IWT entrepreneurs.

'None of the standards is sufficiently linked to modern technologies'

The third statement, about the standards not being sufficiently linked to modern technologies, is the statement with the highest percentage of followers. While most do not want the idea behind the standards to go, the way the standards are structured now is not ideal for a significant group of IWT companies. Vessels that are equipped with modern technologies don't have a technical standard that gives them a specific manning requirement.

'The degree the standards influence the manning regulations does not fit'

The last statement, 'The degree it influences the manning regulations does not fit', focuses on whether the technical standards have the right effect on the required crew. In table 36, it got 30.19% of the respondents to agree with the statement. From the respondents agreeing to only one statement, it got the lowest percentage of votes (20%). The respondents are not entirely negative about the effect on the manning regulations.

The open option was used three times to share the general opinion of these IWT entrepreneurs. It was once used to mention that the technical standards are alright and this respondent has no problems with how the standards work now. Another respondent shared that the standards are outdated. The last respondent using this option thinks that the use of technics in IWT is overrated and that there should be less focus on that aspect.

Looking only at the percentages in table 36, it seems like the respondents are rather satisfied with the current technical standards S1 and S2. However, the results of table 35 spoke for itself: the current regulations didn't take new innovations into account enough. A conclusion that could be drawn from these results is that the idea of technical standards on itself is important and works well in this system of regulations, but the standards need to be updated to not obstruct the companies that want to innovate and modernize in this sector in a negative way.

4.3 Analysis

4.3.1 Interviews

Factors influencing mode of exploitation choice

There are a lot of similarities found in the answers given during the six interviews that were conducted for this research. Especially the factors that determine the chosen exploitation mode, which only seldom change over time, are often identified as the same by the interviewed experts. The supply of cargo and the route on which a ship is sailing (and the accompanying characteristics of the waterway) are the most frequently mentioned factors. On the other hand, the size of the ship seems not of much importance. In chapter 3.3, it is shown that exploitation mode B is more often chosen by the larger ships, compared to the smaller ships. However, it could also be concluded that these larger ships are more often used in different segments, segments in which this mode of exploitation is more useful. This could be a defining factor here.

Flexibility

The most important complaint is the lack of flexibility in the regulations. The exploitation modes are perceived as rigid and outdated. Using the length of the vessel to divide the vessels in classes is often seen as a wrong way to classify the ships, especially the way it is done now. The technical standards S1 and S2 don't fit with the current technical characteristics of modern ships. The important factors mentioned earlier – like the destination and the obstacles crossed to reach that destination - are suggested as factors that should have more influence. With the current regulations, there are not enough factors influencing how vessels are allowed to be navigated.

Manning regulations

Problems with the manning regulations are mainly found in the strict requirements crew members have to fulfill. The experience needed to become a higher ranked crew member, especially in the case of boatmen, is overestimated. Also, the fully rested crew that is mandatory to switch between the modes of exploitation is seen as an unnecessary and hindering rule. Currently, the type of cargo and the sailing area don't make a difference for the required crew on board. In practice, especially the sailing area is seen as a large influence on the workload in practice. The number of licenses required on board is also criticized. The requirement of having three licenses on board of vessels longer than 86 meters and sailing 24 hours per day is a burden for many companies. Revising this rule could improve efficiency, because crew members with a license are relatively expensive.

Possible changes perceived both positively and negatively

Some possible changes, like restrictions for older vessels, are perceived differently by the experts. On the one hand, these changes could contribute to the modernization and the competiveness of the

sector. For example, a classification system could strengthen incentives to modernize. On the other hand, some companies don't like the idea that dismissing employees due to the loss of sailing hours or investing large amounts of money in their vessels is the consequence.

4.3.2 Survey

Composition of cargo segments

The results of the survey generally are as expected or can be rationally explained. It must be said that the composition of vessels from the different cargo segment differs from the compositions in the other researches that were also discussed in this report. The survey by Panteia (chapter 3.3) and the research by Hubens (2011, table 1) show a higher share of dry bulk vessels in the total number of vessels than the results of the survey conducted for this research do. Therefore, this must be remembered when looking at the analysis of the results. Also, some of the different groups in the survey (e.g. convoys and associated sub groups) were to some extent underrepresented. For this reason, it was sometimes not possible to analyze them sufficiently. To draw a conclusion with a low amount of data should be avoided when it won't give an accurate image of reality.

In these results, the largest cargo segment is the transport of liquid cargo by tankers. Of these tankers, the largest group consists of motor ships belonging to group 3 (86 meters or longer). The effect this has on the results is that there is a larger share of companies transporting a product that requires more proceedings (cleaning, safety, etc.) in a relatively stable market. This influences the average opinion of the respondents about the manning regulations and therefore the results. Because during the interviews it appeared that these companies have less problems with the current manning regulations, the average opinion may be a bit more positive than it would be when the real division of the cargo segments also applied to this survey. The same counts for some of the other aspects of the regulations. A more stable market than average could mean that the companies change their mode of exploitation less often. For the average of all these results, this probably means that the frequency of changing the mode of exploitation is also lower than normal.

Frequency of exploitation modes and differences with other research

In figure 13 below, the frequency of modes of the different cargo segments is given. The upper graph is figure 7, used in chapter 3.3 to summarize the results of the research by Panteia. The second graph contains the results of the survey conducted by the CBRB for this report. It shows the difference in results between the two surveys.

There are some interesting differences between these results. First, the frequency of exploitation mode B in the dry bulk segment. In the research by Panteia, this mode of exploitation was mentioned a lot less, compared to the other two modes. Another difference is the use of mode A2 in the tanker

segment. In the first research, this was the less frequently used mode of exploitation for tanker vessels. In the survey conducted for this report, it was the most frequently answered mode of exploitation by tanker operators. The large differences in these two sectors have the strongest effect on the overall distribution of the exploitation modes, because these are the best represented segments in the survey.

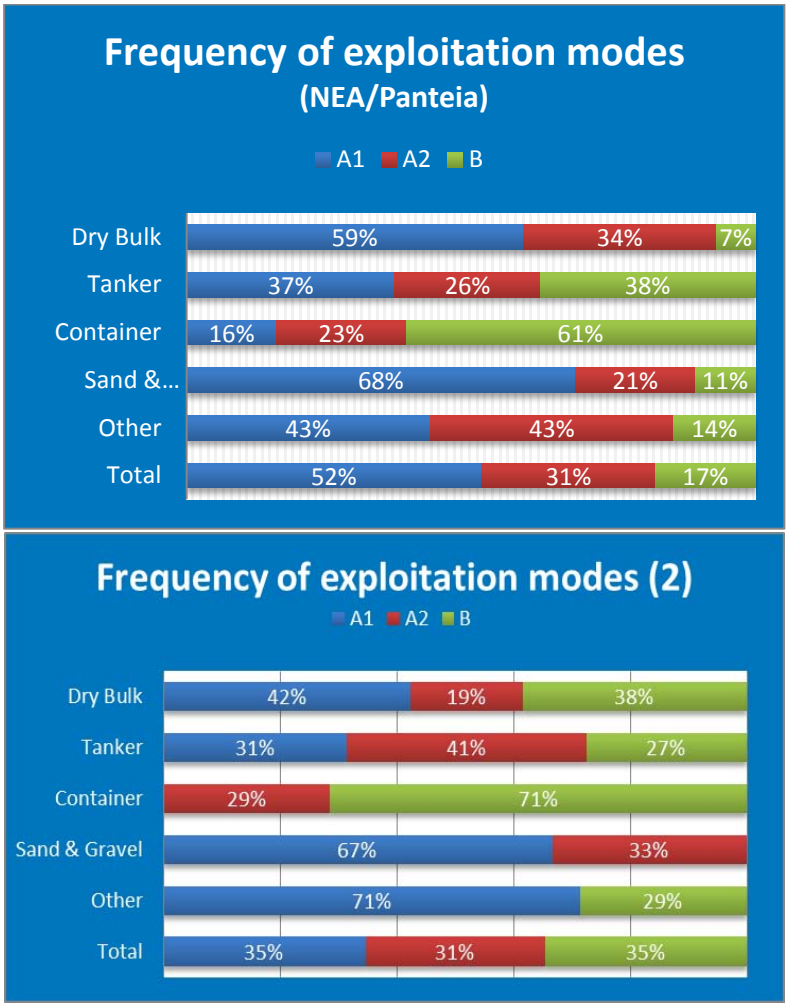

Figure 13: Frequency of exploitation modes, shown in percentages, by segment (source upper graph is Panteia/NEA (figure 7): (Geest, 2013)**). Graph (2) is based on results of own research.**

Factors influencing mode of exploitation choice

The factors which influence choosing the mode of exploitation gave an interesting insight into the decision-making process of companies. The most chosen factor (size of the ship) was chosen by 48.39% of the respondents. This shows that there is not much unanimity about this question. There is not one clear number of factors that has the largest influence on the mode of exploitation choice. While it is by far the most often chosen factor, the majority still did not think this factor is one of the three most important factors. Also, this factor wasn't more frequently mentioned under companies

of one specific cargo segment. In figure 11, it is shown that this factor only has a strong influence for vessels that are used in mode of exploitation B.

Different opinions about the statements

The different opinions observed at the statements, for example at the first eight statements about the manning regulations, are explained by the differences between cargo segments and business ideas. Of course, there is also a division independent from these segments about e.g. the use of more advanced technologies and the implications for safety of these developments, but the differences between the segments also influence these opinions. Earlier mentioned in this concluding part are the market circumstances and the intensiveness of the proceedings on board and the way these influence the frequency of changing the mode of exploitation and the practical crew requirements. The business idea of a company also influences its opinion about the manning regulations. For example, family businesses often prefer navigating a ship with only two persons on board. This could trigger these participants to disagree with the current regulations. For larger companies using the same vessel lengths, the opinion and motivation could be completely different, because focus is probably more on efficiency.

Manning regulations

Problems with the manning regulations are mainly the same as the ones during the interviews. The amount of licenses on board is often seen as an unnecessary burden, because the third license for long vessels sailing all day is sometimes difficult to find and rather expensive.

Especially in the case of boatmen, the experience needed is perceived as too long. The requirement to have a fully rested crew before changing the mode of exploitation is perceived as unnecessary. The different ranks of boatmen and the proceedings they should be able to perform are disproportionate to the requirements that are linked to these ranks. The extra requirements for achieving a higher rank are too much for what they actually need to be able to perform on board. The differences between the ranks are not clear enough.

Because of the inflexible modes of exploitation, especially for modern vessels, many operators need to deploy personnel that is not needed to keep everything running smoothly. The composition of the crew is not tuned to the characteristics of the vessel and the cargo type. This is, besides the two reasons mentioned above, the third reason why the labor costs are higher than needed in some cases.

Innovation

The opinions about technology aren't really different when we look to the different segments. The results in table 35 (chapter 4.2.5) showed that for every mode of exploitation, at least 72% disagrees

with the statement which said current regulations take technical developments into account sufficiently. However, the respondents agreeing with the statement are not found in one specific cargo segment or vessel length group. The reason why these differing opinions appear has a different origin. The answer is the trust in technology as a replacement for manpower and the degree in which IWT companies and their crew members could adjust to technology. These respondents don't believe in replacing one or more members of the current crew by just new technical developments. One of the reasons for this is that the transitional period may be unsafe. The important underlying question in this issue is therefore as follows: is it a problem to let the companies that want to use new technologies actually use these new technologies? In other words, should the regulations be eased to facilitate these companies to replace manpower with new technical developments? What would the implications be for the safety on the waterways, for the environment, for the competion in the sector and for the competitive position of IWT in the whole transport sector?

Technical standards

The opinions of the respondents in the survey about the system of technical standards itself are not very negative. However, the way it is implemented into the legislation is a problem for many respondents. The way modernization of the fleet is facilitated by the manning requirements is not appreciated by a large group of respondents.

4.4 Conclusions

The goal of chapter 4 was to conduct interviews and a survey to answer the remaining sub questions. The research approach was shown. Six interviews with experts of different cargo segments were planned to hear their opinions on the topic. These were used to set up a questionnaire for the survey that was spread under the member groups of the CBRB.

Frequency distribution of the modes of exploitation

The fourth sub question ('What is the frequency distribution of the modes of exploitation?') came back in this chapter. During the survey, another research to the distribution was done. Because the group of respondents is rather small and differs a lot from the sample group of Panteia, this frequency distribution is not a very good overview of the real situation. However, it is useful to be used during the analysis of the remaining questions of the survey.

Defining factors in choosing the mode of exploitation

In addition to this question, another topic was which factors are most important for deciding which mode of exploitation to choose ('How do barge operators choose their mode of exploitation?'). The size of the ship, cost control were mentioned on top of the list. Another important factor is the way other modes fit (or don't fit) with the business idea. Supply of cargo and the route to reach the destination complete the top five factors.

Role of innovation

Sub question two 'What is the role of innovation and technology in the demand for revised regulations?' also came back in this chapter. Both the experts and many respondents stated that innovation is important, but is not supported enough by the regulations.

Problems with the current regulations

At last, sub question six ('What are the problems with the current modes of exploitation?') focused on the difficulties the respondents encounter. The most important problem is that there is a lack of flexibility that makes it difficult to work efficiently. This sometimes burdens companies with abundant crew members. Also, the current regulations don't stimulate companies enough to modernize their vessels.

5. Conclusions and recommendations

5.1 Conclusions

In this report, the goal is to answer the research question: *'What is the opinion on and the effect of the modes of exploitation and its bottlenecks in the current manning regulations under companies in IWT, and are there possibilities to improve their efficiency by revising the manning regulations?'*. To achieve this goal, multiple sub questions were set up. Throughout the report, these questions were answered. The answers will be summarized and concluded below. Afterwards, recommendations are given.

Role of IWT in the supply chain

In the second chapter, the characteristics of the IWT sector were discussed. This is part of the first sub question (*'What are the characteristics of the different IWT segments?')*. In this chapter, the role of inland waterway transport in the supply chain is discussed. The role of barge operators, which are interviewed in a later stage of the report, is explained. The shipper is the most important party in the chain, because this party owns the goods that need to be transported. In recent years, terminal operators tried to gain more power in the chain by getting more influence in the supply chain. The expansion of their power lies in i.a. constructing inland terminals and transporting goods themselves.

What are the characteristics of the different IWT segments?

The different segments (division by cargo type and length of the vessels) were also discussed in the second chapter. The dry bulk segment is the largest segment in IWT, but is less healthy than the transport of e.g. containers (the youngest segment). The transport of sand and gravel heavily depends on the state of the economy and the number of construction projects. The segmentation on size is part of the regulations by the CCNR (Central Commission for the Navigation of the Rhine) and consists of different groups for motor ships and convoys. Another segmentation on size, the CEMT-classification, indicates through which waterways vessels are allowed to sail.

The role of innovation in the sector is small

The second sub question ('*What is the role of innovation and technology in the demand for revised regulations?*') was briefly mentioned in the second chapter. The importance of innovation in the transport sector was discussed. To stay competitive in this sector, it is important to innovate and create advantages compared to the other modalities. What makes it difficult for IWT is that the vessels have a rather long lifetime, which lowers the renewal of vessels in the sector. This makes it challenging to implement engine policies that don't harm the vessel owners too much and still improve the competitive position of IWT. However, innovation can also help the sector in other ways, e.g. with ICT and technologies on board.

Establishment and development of the regulations

In the third chapter, the (establishment of the) manning regulations and the underlying modes of exploitation were discussed. The sub question '*What are the manning regulations?*' is answered.

In the 19th century, the treaties were established to facilitate the open use of the inland waterways in the Rhine area and to centralize the charging of various tolls, which made it more efficient. Later, this organization implemented a system of regulations to increase safety on the waterways and create a more level playing field for IWT companies. This includes that companies must meet the manning requirements to be allowed to navigate the vessel(s). Three modes of exploitation, all defined by a different number of sailing hours per day, were set. Every mode of exploitation requires a different composition of crew to make sure that IWT companies work safely, but also efficiently. Each crew member must satisfy a set of requirements to be allowed to work on board. The three modes of exploitation are again divided by length (three groups for motor ships, six for convoys) and into two technical standards.

Frequency distribution of modes differs per segment

The results of a survey by NEA, part of research institute Panteia, about the frequencies of the modes of exploitation show that mode of exploitation A1 (14 hours per day) is used in more than 50% of the cases, especially by dry bulk vessels. The larger the ships are, the more equal the distribution of the modes of exploitation is. This partly answers sub question four ('*What is the frequency distribution of the modes of exploitation?*'). After six interviews with experts in the different cargo segments, in which decisions by barge operators were explained, a survey was conducted for this research to answer this sub question, along with other questions to describe the position of IWT entrepreneurs in the sector, their working methods and their opinion about the current regulations. Although this survey shows a different composition in terms of cargo segments (e.g., the tanker segment is the largest segment), the results still give information about the decisions made inside these segments. It shows that the three largest segments (dry bulk, tanker and container transport) all have a different most frequently used mode of exploitation (A1, A2 and B respectively). Also, exploitation mode B is mainly used in combination with vessels longer than 86 meters. The other modes aren't as strongly linked to a ship length group.

Factors determining which mode to choose

Sub question five focuses on which factors influence the decision-making process for which mode of exploitation to choose most: '*How do barge operators choose their mode of exploitation?*'. This question is answered by both the interviews and the survey. Some of the most important factors are the ones that define the current manning regulations: the size of the vessel and the discontentment with the crew requirements for other modes of exploitation. Factors that are not that strongly linked

to the regulations yet are cost control (or minimizing the costs), the route (or sailing area) and the supply of cargo. The route and the sailing area were often mentioned during the interviews as factors that should have more influence in the manning regulations.

Interviews and survey increased insight in problems companies

With the interviews and survey, more answers for sub question two (about the role of innovation) were gained. Innovation and technology are important, but don't play an important role in the regulations. Although not every company is convinced by the effectiveness of replacing manpower with technology, a large portion of the companies feels hindered by the (in their opinion) outdated regulations regarding modern technologies.

The main complaints on the current regulations

The last sub question is '*What are the problems with the current modes of exploitation?*'. This question is about the opinions of the experts gained from the statements in the survey and the interviews. The problems with the current modes are rather diverse. The most important and common problems are listed below. More (minor) problems are found especially in chapters 4.2 and 4.3:

- The division of the current modes and the related manning requirements is determined by the size of the ship, the number of hours on one day a vessel is navigated and to a lesser extent by the technical 'level' of the vessel. Missing factors that are mentioned most are the length and characteristics of the sailing route, the characteristics of the vessel (characteristics besides the length of the vessel. This also includes how well-equipped the vessel is) and differences between the cargo segments.

- The lack of flexibility in the regulations affects the effectiveness of these regulations. Aside from the lack of influence of the factors mentioned in the problem above, the system itself is seen as not flexible enough. For this reason, it is difficult to determine which mode of exploitation is most efficient for a certain route or time period. A regulation that is seen as very rigid is that the crew must be fully rested before changing the mode of exploitation. Abolition of this rule would i.a. increase the average frequency of changing the mode of exploitation and improve efficiency.

- The educational requirements for (especially) boatmen are perceived as too strict. The experience requirements are often too long. Therefore, it is difficult to find adequately qualified employees.

- The current technical standards, in combination with the contemporary manning regulations, don't support innovations in such a way that these innovations pull the sector to a higher level. Having a modern vessel does not give advantages regarding the manning requirements. Therefore, it has consequences for the competitive position of IWT in the future.

At last, the research question *'What is the opinion on and the effect of the modes of exploitation and its bottlenecks in the current manning regulations under companies in IWT, and are there possibilities to improve their efficiency by revising the manning regulations?'*. The general opinion is that, although many companies focus on different aspects of the regulations, there is certainly some room for improvement to increase the efficiency. For example, when looking at the four problems mentioned above, but also the other opinions mentioned earlier in this report, this becomes quite clear. The regulations affect the decisions made to such an extent that the best choice for several companies is still not ideal, hence the complaints by many experts and respondents. To increase the efficiency in the sector, there are multiple aspects that could be reviewed. In the next part, recommendations and improvements for the regulations and future research are given.

5.2 Recommendations

Below, recommendations are given. They will include restrictions of the research and points for improvement.

Increasing flexibility

The conclusion that is drawn after many survey questions (e.g. question 13) is that it will be very difficult or even impossible to redefine the modes of exploitation in a way that the number of modes stays the same, but will satisfy a (much) larger part of the barge owners. Lowering the minimum crew requirements to facilitate companies to make more use of innovations has the advantage that it may increase the level of innovation in the sector, but it also may reduce safety. Therefore, many experts and respondents opted for more flexibility. Multiple options to increase the flexibility are possible. First, more factors could be implemented in the regulations. The sailing area was often mentioned during the interviews and adding this factor could make the regulations more flexible. Also other characteristics of the vessels and the cargo type can be implemented to make more distinction between situations. Another way to improve flexibility is by removing or easing the fully rested rule. It would make it easier for companies to shift between modes of exploitation. This would increase the efficiency. What's important is that the crew members must be protected against misuse of this rule. It must not be possible to shift to a more intensive mode of exploitation when this would mean that the crew members will be overstretched.

Implementing more factors into the regulations makes the regulations more complex.

Possibility to increase flexibility

A possibility to increase the flexibility could be an ICT-system that indicates which crew composition is required for a certain vessel size, level of modernization, cargo segment, number of hours of navigation per day and/or sailing area. It would make it possible for a skipper to decide to not use this system. However, this would mean that this skipper must work with one of the crew compositions based on a smaller number of factors, e.g. the ones of the current regulations or a slightly revised version. Installing the system would give more options and thus increase the flexibility for skippers that demand a more flexible system. By making the system optional, the complexity of working with it and installation costs won't be a problem for every company. However, these kinds of possibilities must be examined more thoroughly.

Educational requirements

The requirements to become a boatman must be revised. Currently, the requirements are too strict, which makes it difficult for companies to find adequately qualified crew members. Especially the requirements for the different ranks of boatmen are unclear and sometimes illogical. To increase the flow of boatmen in the sector, it is advised to ease the requirements for this function. Also, the number of boatmaster's licenses on board should be revised. The presence of a third license on a ship of at least 86 meters long in mode of exploitation B is a burden to prevent situations that only occur very rarely.

Increase innovation by implementing extra technical standard and a classification system

To increase the competitiveness of the IWT sector, it is important to keep innovating. Therefore, innovation must be facilitated by the regulations. Because the long depreciation times of vessels make it difficult to have a modern fleet, innovation is maybe even more important. By implementing an extra technical standard with less strict crew requirements for modernly equipped vessels, it becomes more interesting to modernize. Another recommendation is the addition of a classification system in which modern vessels acquire advantages compared to outdated vessels.

To determine whether it is unsafe to make use of modern technologies and whether it is beneficial to innovate more, it should be tested whether a modern vessel with less crew could be navigated safely. Also, it could be researched whether this would really be more efficient than the current system of regulations. The most realistic way is to set up a test project, starting with one vessel and optionally increasing the amount of test vessels.

Improvements for questioning

In addition, there are also aspects of this research that could be learned from for future research. In retrospect, some questionings could have been improved. For example, the order of the possible factors (appendix D1, question 9) may have influenced the results. Although the first factor mentioned (size of the vessel) is indeed important, the positioning may have increased the number of voters. Another example is group of statements about the technical standards, for which it may have not been clear enough whether the respondents were allowed to choose 'yes' for more than one statement.

Which characteristics of the vessel should be more important?

The largest group of respondents disagrees with statement four of the survey (table 30) and thus thinks the regulations don't match up with the characteristics of the vessel enough. However, which characteristics should have more influence? Is it the size of the cargo area, the degree of modern technologies that is available, or something that wasn't thought of during this research? These factors should be examined more closely in order to determine their relevance for a review of the regulations.

How often do companies transport for a specific client?

When looking at how often the companies change the mode of exploitation, the tanker companies appear to change weekly. This was not what was expected, because the supply of cargo is more stable than for example the supply of dry bulk. Therefore, it could be important to see how often these companies, on average, transport cargo for one specific client. If transport for one client is carried out every week, this could have a different effect on how often a company shifts between the modes of exploitation than when cargo is transported for that client only once a month.

References

A&S. (2003). Basisdocument Containerbinnenvaart.

BVB. (2013a). Waardevol Transport. Rotterdam: Bureau Voorlichting Binnenvaart.

BVB. (2013b). Soorten schepen. *Bureau Voorlichting Binnenvaart*. Retrieved from http://www.bureauvoorlichtingbinnenvaart.nl/over/basiskennis/soort-schepen

CBRB. (2011). Versoepeling bemanningssterkte kleine schepen. *Centraal Bureau voor de Rijn- & Binnenvaart*. Rotterdam. Retrieved from http://www.cbrb.nl/nieuws/nieuwsbrieven/2011/431-nieuwsbrief-2011-04#110401

CBS. (2002). *Nederland en de scheepvaart op de binnenwateren* (p. 144).

CCNR. (n.d.). Herziene Rijnvaartakte. *Centrale Commissie voor de Rijnvaart*. Retrieved from http://www.ccr-zkr.org/files/conventions/convrev_nl.pdf

CCNR. (2010). Marktobservatie in de Europese binnenvaart, 1–6.

CCNR. (2011). Wordingsgeschiedenis. *Centrale Commissie voor de Rijnvaart*. Retrieved from http://www.ccr-zkr.org/11010100-nl.html

CCNR. (2012). *Europese Binnenvaart: Marktobservatie 2012-1*. Straatsburg.

CCNR. (2013). Analyse en evaluatie van structurele markttrends in de binnenvaart.

ECT. (2011). The future of freight transport De toekomst van het goederenvervoer. Rotterdam.

ECT. (2013). Geschiedenis container. *ECT*. Retrieved from http://myservices.ect.nl/ectdocuments/EducationalInformation/DeContainer/Pages/Geschiedeniscontainer.aspx

EICB. (2010). Vaarwegklassen (CEMT). *Expertise- en Innovatiecentrum Binnenvaart*. Retrieved from http://www.informatie.binnenvaart.nl/schepen/scheepscategorien/473-vaarwegklassen-cemt.html

Geerlings, H., Van der Horst, M., Kort, M., & Kuipers, B. (2012). Beschrijving huidige binnenvaart en eerste probleemanalyse. Rotterdam, Zoetermeer: Rijkswaterstaat.

Geest, W. van der. (2013). Verdeling exploitatiewijzen per segment. Zoetermeer: NEA/Panteia.

Hubens, A. C. C. (2004). Continuïteit en ambitie: Onderzoek naar de toekomst van gezinsbedrijven in de binnenvaart. AHA Data.

Hubens, A. C. C. (2011). Organiseren en communiceren: Een onderzoek naar de organisatiegraad in de binnenvaart. Den Bosch.

ING Economisch Bureau. (2009). Binnenvaart ondervindt onverwacht sterke tegenstroom: Nu stabilisatie een feit is , zal de balans moeten terugkeren.

ING Economisch Bureau. (2013). Herstel binnenvaart uit zicht: Wacht de droge ladingvaart een warme of koude sanering ?

IVR. (2013). Statistieken. *Internationale Vereniging het Rijnschepenregister*. Retrieved from http://www.ivr.nl/statistieken

Kansen, M., Wouters, P., & Kolkman, J. (2011). *De rol van het ministerie van Infrastructuur en Milieu bij innovatie in de maritieme sector*. Den Haag.

Kul, H. (2008). *Transumo A15 project Van Maasvlakte naar Achterland; duurzaam vervoer als uitdaging: Duurzame binnenvaart* (p. 62). Rotterdam.

Macharis, C. (2000). Hybrid Modeling: System Dynamics combined with Multi-criteria Analysis. *submitted for publication*. Retrieved from http://www.researchgate.net/publication/228800843_Hybrid_Modeling_System_Dynamics_combined_with_Multi-criteria_Analysis/file/d912f5135ffd5861cf.pdf

NEA. (2011). Medium and Long Term Perspectives of IWT in the European Union. Zoetermeer: Panteia.

Port of Rotterdam. (2011). Port Compass 2030. *Port of Rotterdam*. Retrieved May 31, 2013, from http://www.portofrotterdam.com/en/Port/port-in-general/port-vision-2030/Documents/Port-Vision-2030.pdf

Rijksoverheid. (2009). Containertransferium Alblasserdam stap dichterbij. *Rijksoverheid*. Retrieved from http://www.rijksoverheid.nl/nieuws/2009/06/18/containertransferium-alblasserdam-stap-dichterbij.html

SAB. (2012a). Vaartijdenboek. *Stichting Afvalstoffen Vaardocumenten Binnenvaart*. Retrieved from http://www.sabni.nl/sabvaardocs/index.php/vaartijdenboek

SAB. (2012b). Informatie diensboekje. *Stichting Afvalstoffen Vaardocumenten Binnenvaart*. Retrieved from http://www.sabni.nl/sabvaardocs/index.php/dienstboekje?id=12

Ten Broeke, I. (2007). Op weg naar een zwavelarme brandstof voor de binnenvaart. Retrieved from http://www.ccr-zkr.org/temp/rndtbl030507/tenbroeke.pdf

Van Der Horst, M. R., & De Langen, P. W. (2008). Coordination in Hinterland Transport Chains: A Major Challenge for the Seaport Community. *Maritime Economics & Logistics*, *10*(1-2), 108–129. doi:10.1057/palgrave.mel.9100194

Verschuren, P., & Doorewaard, H. (2000). *Het Ontwerpen Van Een Onderzoek* (p. 223). Boom Lemma.

Willems, R. (2006). Meer containers en minder zand via binnenwater. *CBS*. Retrieved from http://www.cbs.nl/nl-NL/menu/themas/verkeer-vervoer/publicaties/artikelen/archief/2006/2006-2004-wm.htm

Appendix

Appendix A1

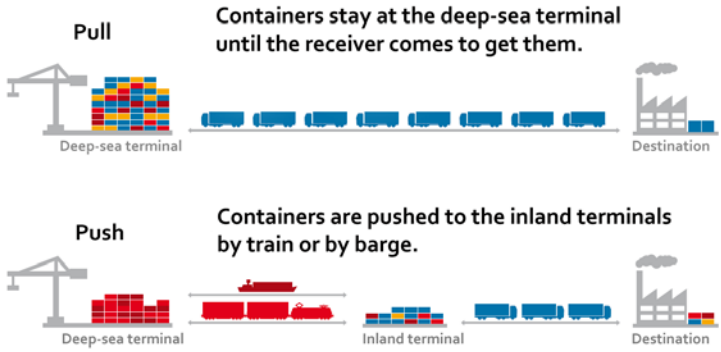

Figure A 1: Push strategy versus pull strategy for inland shipping (source: (ECT, 2011)**).**

This synchromodality concept goes together with a push-strategy instead of pull (figure A1): The containers are pushed towards the inland terminals ('extended gates'). As large quantities of containers go to an inland terminal first, it is more efficient to transport these by train or barge. Therefore, there is an extra role for IWT as its use is preferred above trucking. However, a condition is that it requires a lot of flexibility for both the terminal and the different transporters, as the modality can be chosen last minute. This means that a barge operator can be called and cancelled on short notice. Terminal operators like ECT nowadays more often start to manage the transport between their terminals in the port and the inland terminals on their own (ECT, 2011).

Appendix B1

Frequencies of exploitation modes by CEMT-class (Geest, 2013).

0	A1	A2	B	Total
Dry Bulk	3	-	-	3
Sand & Gravel	-	-	1	1
Other	2	1	-	3
Total	5	1	1	7

Table A 1: Frequencies of exploitation modes for CEMT-class 0

I	A1	A2	B	Total
Dry Bulk	6	6	-	12
Sand & Gravel	1	-	-	1
Other	1	-	-	1
Total	8	6	-	14

Table A 2: Frequencies of exploitation modes for CEMT-class I

II	A1	A2	B	Total
Dry Bulk	12	16	-	28
Tanker	2	1	-	3
Sand & Gravel	2	1	-	3
Total	16	18	-	34

Table A 3: Frequencies of exploitation modes for CEMT-class II

III	A1	A2	B	Total
Dry Bulk	69	25	-	94
Tanker	9	1	-	10
Container	-	3	-	3
Sand & Gravel	16	6	1	23
Total	94	35	1	130

Table A 4: Frequencies of exploitation modes for CEMT-class III

IV	A1	A2	B	Total
Dry Bulk	48	20	1	69
Tanker	5	3	-	8
Container	2	3	-	5
Sand & Gravel	4	-	-	4
Other	-	1	-	1
Total	59	27	1	87

Table A 5: Frequencies of exploitation modes for CEMT-class IV

Va	A1	A2	B	Total
Dry Bulk	55	41	19	115
Tanker	10	15	31	56
Container	2	4	15	21
Sand & Gravel	3	1	2	6
Total	70	61	67	198

Table A 6: Frequencies of exploitation modes for CEMT-class Va

VIa	A1	A2	B	Total
Dry Bulk	-	3	2	5
Tanker	7	3	3	13
Container	3	-	12	15
Sand & Gravel	-	-	-	0
Total	10	6	17	33

Table A 7: Frequencies of exploitation modes for CEMT-class VIa

Appendix C1

The initial questionnaire for the interviews:

Introductory questions

1) How much experience do you have in the IWT sector?
2) Did you always work in the same segments or did you also shift?
3) How many vessels does your company own?
4) In which groups of the division by length do these vessels belong?
5) In which year were the vessels built?

Modes of exploitation

6) Which mode of exploitation did you choose for the vessels? And how often do you change this?
7) Is there a specific reason why you chose for this mode of exploitation?
8) **In case of multiple vessels:** Are there patterns in your decisions for choosing the mode of exploitation? Do you want to keep it varied, or as many vessels as possible with the same mode?
9) Do these patterns change over the years?
10) Are there any aspects specific for the segment(s) you operate in that you have to think about before you determine what is the ideal mode of exploitation for your vessels?
11) Mode A2 seems less popular than A1 and B. What could be a explanation for this?

Changing the mode of exploitation

12) Which circumstances make you change the mode of exploitation for your vessel?
13) Which technical or social-economic changes influence which mode you choose?
14) What are new trends, now or in the future, that could influence the decision-making process for choosing the mode of exploitation?
15) What would you like to change about the current regulations?
    a. What are (potential) benefits and drawbacks (e.g. for safety)?

Manning regulations

16) What is your opinion about the manning regulations?
17) Are there any bottlenecks in the regulations that make it difficult to comply with the regulations? How could these be solved?

    If yes: Do these bottlenecks have to do with a specific function? What is the importance of this function for your business?
18) What is the general opinion of the crew members themselves about the regulations?

Appendix D1

Because it is a digital survey, the survey was slightly adjusted to show all aspects correctly.

Modes of exploitation and the manning regulations for inland waterway transportation

We would like to invite you to participate in a research on deciding which mode of exploitation to choose and the manning regulations in IWT. The goal is to sketch an image of how companies decide which mode of exploitation fits best for their vessel(s) and what their opinion is about the regulations.

This survey is conducted by the CBRB and is also part of the thesis project of Tim van Kester, student of the Erasmus University Rotterdam. The goal is to gain a clear, sound overview of the decisions by IWT entrepreneurs and the problems that come with these decisions. All answers will be treated fully anonymous. It takes about five to ten minutes to complete the survey. Questions marked with a star are mandatory and need to be filled in before you can complete the next questions.

*The survey consists of **fifteen** questions.*

*** 1 How many IWT vessels do you exploit?**

Choose one of the following answers.

- 1 vessels
- 2 vessels
- 3 or more vessels

1a You exploit more than three vessels. Could you share how many vessels in total?

- Open question

*** 2 Are they motor ships or convoys?**

	Motor ship	Convoy
First vessel	•	•
Second vessel	•	•
Third vessel	•	•

In case you exploit more than three vessels, try to give an average view.

*** 3 a1-3 In which group does the motor ship belong?**

Choose one of the following answers.

- Group 1 (L ≤ 70m)
- Group 2 (70m < L ≤ 86m)
- Group 3 (L > 86m)

*** 3 b1-3 In which group does the convoy belong?**

Choose one of the following answers.

- Group 1 (dimensions convoy L ≤ 37 m, B ≤ 15 m)
- Group 2 (dimensions convoy 37 m < L ≤ 86 m, B ≤ 15 m)
- Group 3 (pusher + 1 barge L > 86 m, or dimensions convoy 86 m < L ≤ 116,5 m, B ≤ 15 m)
- Group 4 (pusher + 2 barges, or motor ship + 1 barge)
- Group 5 (pusher + 3 or 4 barges, or motor ship + 2 or 3 barges)
- Group 6 (pusher + more than 4 barges)

4 What is the building year of the vessels?

- Year built first vessel/pusher:
- Year built second vessel/pusher:
- Year built third vessel/pusher:

*** 5 In which market segment are the vessels deployed?**

	Dry bulk	Tanker	Containers	Sand and gravel	Other
First vessel	•	•	•	•	•
Second vessel	•	•	•	•	•
Third vessel	•	•	•	•	•

6 Which mode of exploitation do you generally use?

	A1	A2	B	No answer
First vessel	•	•	•	•
Second vessel	•	•	•	•
Third vessel	•	•	•	•

Based on the mode you used most frequently in the past months.

7 How often do you change your mode of exploitation?

	Daily	Weekly	Monthly	Half-yearly	Yearly	Never	No answer
First vessel	•	•	•	•	•	•	•
Second vessel	•	•	•	•	•	•	•
Third vessel	•	•	•	•	•	•	•

8 In which sailing areas do you operate usually?

Multiple answers possible.

- Rhine
- Netherlands
- Belgium
- France
- Germany (other)
- Other, namely:

*** 9 Which of the following factors are of importance for deciding which mode of exploitation to use?**

Pick the three most important options.

- Size of the vessel
- Characteristics of the vessel
- Type of cargo

- Supply of cargo
- Demands of the client
- Fast recovery of investments
- Cost management
- Mode of exploitation fits best to the (fixed) route
- Characteristics of the sailing area
- Natural conditions (e.g. water level)
- Workload of crew
- Minimum crew requirements of other modes don't fit the business idea
- Mandatory downtime of vessel
- Loading- and unloading times at the terminal
- Technical developments
- Other:

*** 10 To which extent do you agree with the following statements about the manning regulations?**

1=Strongly disagree , 2= Disagree , 3=Neutral , 4=Agree , 5=Strongly agree

- The minimum required crew match with the practical needs on board.
- The requirements concerning the required amount of licenses on board are sufficient.
- I find it difficult to find suitable employees due to the minimum educational requirements for crew members.

*** 11 The manning regulations take the characteristics of the vessels and the type of cargo into account sufficiently:**

1=Strongly disagree , 2= Disagree , 3=Neutral , 4=Agree , 5=Strongly agree

- The manning regulations take the characteristics of the vessel into account sufficiently.
- The manning regulations take the type of cargo into account sufficiently.

*** 12 I find the minimum educational requirements for the crew:**

1=Strongly disagree , 2= Disagree , 3=Neutral , 4=Agree , 5=Strongly agree

- The minimum educational requirements for the function 'skipper' are too high.
- The minimum educational requirements for the function 'helmsman' are too high.
- The minimum educational requirements for the function 'boatman' are too high.

*** 13 Could you safely work with less or lower-qualified crew members?**

	Yes	No	n/a
A1	•	•	•
A2	•	•	•
B	•	•	•

Could you clarify your answer on question 13?

*** 14 Do the current regulations take innovation and modernization into account sufficiently?**

	Yes	No	n/a
A1	•	•	•
A2	•	•	•
B	•	•	•

Could you clarify your answer on question 14?

*** 15 What do you think about the current technical standards (S1 and S2)?**

Multiple answers possible

- The standards are not flexible enough.
- The standards are unnecessary.
- None of the standards sufficiently linked to modern technologies.
- The degree it influences the manning regulations does not fit.
- Other, namely:

End of survey

Appendix E1

Statement	Mean	Standard deviation	N (total respondents)
1	2.86	1.42	58
2	2.93	1.41	58
3	3.07	1.36	58
4	2.68	1.40	56
5	2.79	1.41	56
6a	2.25	1.03	56
6b	2.57	1.09	56
6c	3.39	1.44	56

Table A 8: Additional statistics on seven statements about the manning regulations.

Cargo segment	Building year
Dry bulk	1984
Tanker	1996
Container	2005
Sand and gravel	1968
Other	1975

Table A 9: Average vessel building year per segment.

Statement 1	1	2	3	4	5
Dry bulk	36.00%	16.00%	16.00%	20.00%	12.00%
Tanker	16.33%	28.57%	22.45%	20.41%	12.24%
Container	35.71%	28.57%	21.43%	7.14%	7.14%
Sand & gravel	20.00%	40.00%	0.00%	20.00%	20.00%
Other	28.57%	0.00%	42.86%	28.57%	0.00%

Table A 10: Results of first manning regulations statement, per cargo segment.

Statement 2	1	2	3	4	5
Dry bulk	40.00%	20.00%	4.00%	24.00%	12.00%
Tanker	14.29%	26.53%	24.49%	20.41%	14.29%
Container	14.29%	14.29%	57.14%	7.14%	7.14%
Sand & gravel	20.00%	0.00%	20.00%	20.00%	40.00%
Other	28.57%	0.00%	0.00%	71.43%	0.00%

Table A 11: Results of second manning regulations statement, per cargo segment.

Statement 3	1	2	3	4	5
Dry bulk	12.00%	40.00%	28.00%	0.00%	20.00%
Tanker	18.37%	26.53%	20.41%	20.41%	14.29%
Container	21.43%	14.29%	14.29%	0.00%	50.00%
Sand & gravel	0.00%	20.00%	20.00%	20.00%	40.00%
Other	0.00%	0.00%	28.57%	71.43%	0.00%

Table A 12: Results of third manning regulations statement, per cargo segment.

Statement 4	1	2	3	4	5
Dry bulk	44.00%	16.00%	32.00%	0.00%	8.00%
Tanker	23.40%	14.89%	27.66%	19.15%	14.89%
Container	28.57%	28.57%	28.57%	0.00%	14.29%
Sand & gravel	60.00%	0.00%	0.00%	20.00%	20.00%
Other	28.57%	0.00%	57.14%	14.29%	0.00%

Table A 13: Results of fourth manning regulations statement, per cargo segment.

Statement 5	1	2	3	4	5
Dry bulk	20.00%	4.00%	40.00%	20.00%	16.00%
Tanker	31.91%	4.26%	21.28%	36.17%	6.38%
Container	42.86%	0.00%	42.86%	0.00%	14.29%
Sand & gravel	60.00%	0.00%	0.00%	20.00%	20.00%
Other	0.00%	0.00%	85.71%	14.29%	0.00%

Table A 14: Results of fifth manning regulations statement, per cargo segment.

Statement 6	1	2	3	4	5
Dry bulk	32.00%	40.00%	16.00%	12.00%	0.00%
Tanker	34.04%	42.55%	12.77%	10.64%	0.00%
Container	7.14%	42.86%	42.86%	7.14%	0.00%
Sand & gravel	0.00%	20.00%	20.00%	60.00%	0.00%
Other	28.57%	28.57%	0.00%	42.86%	0.00%

Table A 15: Results of sixth manning regulations statement, per cargo segment.

Statement 7	1	2	3	4	5
Dry bulk	20.00%	32.00%	24.00%	16.00%	8.00%
Tanker	34.04%	27.66%	25.53%	10.64%	2.13%
Container	0.00%	28.57%	28.57%	28.57%	14.29%
Sand & gravel	0.00%	40.00%	20.00%	40.00%	0.00%
Other	14.29%	14.29%	71.43%	0.00%	0.00%

Table A 16: Results of seventh manning regulations statement, per cargo segment.

Statement 8	1	2	3	4	5
Dry bulk	16.00%	8.00%	44.00%	16.00%	16.00%
Tanker	29.79%	19.15%	14.89%	8.51%	27.66%
Container	0.00%	0.00%	7.14%	7.14%	85.71%
Sand & gravel	20.00%	0.00%	0.00%	80.00%	0.00%
Other	14.29%	42.86%	0.00%	14.29%	28.57%

Table A 17: Results of eighth manning regulations statement, per cargo segment.