# Standardisation of Inland Port Due Foundations

Nederlandse Vereniging van Binnenhavens

Centraal Bureau voor de Rijn- & Binnenvaart

KONINKLIJKE BLN-SCHUTTEVAER

# ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

Master Thesis Urban, Port & Transport Economics

Name student: Koen de Korte

Student ID number: 498842kk

Supervisor: Bart Kuipers

Second assessor: Martijn Streng

Date final version: 30/09/2019



## Acknowledgement:

I want to give a special thanks to the following persons with, without whom this thesis would not have been possible:

Dr. Bart Kuipers. As my supervisor he provided me with the right feedback, contacts, and support whenever I needed it. His endless enthusiasm for everything that has to do with ports and transport made him a very enjoyable person to work with.

Lijdia Pater – de Groot. As my direct supervisor from the NVB, she always challenged me to think critical and supported me where necessary, without taken over the project or making decisions for me. By doing this, she provided me with confidence to carry out my research

Robert Kasteel, Freya Brands – Diepeveen & Leny van Toorenburg. With their knowledge, they provided me honest and clear feedback on my research, conclusions and writing. Realising that this sometimes was a painful (but necessary) process, I am very thankful for their feedback. The quality of this thesis would not have been the same without their support.

# Table of contents

# 1 Introduction

Main ports like Rotterdam are important hubs for the world economy. However, without adequate hinterland connections seaports would not be able to flourish. It is not surprising that changes in the Dutch economy are especially visible at important economical nodes in the hinterland. In the coming years, the Netherlands are facing a big challenge regarding sustainability, digitalization and connectivity. A smart, sustainable and integrated transport system will be a necessity in solving this and an adequate, future-proof inland port structure will be essential. One of the few knobs that can be turned to influence behaviour are port dues. They can be used to reward desirable behaviour and tax undesirable behaviour. Most inland port dues in the Netherlands however, are based on a variation of historical foundations. This results in a variety of port due structures. Not only is this conflicting with the level of integration of the Dutch inland port structure, it can also be expected that the historical foundation no longer is the optimal for current transport systems.

The historical foundation of port dues dates back to the 1930s. The market in the ‘30s was highly regulated. Shippers using inland transport were obliged to offer their freight on skippers exchanges. These exchanges allocated the available freight fairly over the vacant capacity on barges. A first in, first out system was used: The skipper that had waited the longest, received the next shipment. Next to that, a fixed price was used per unit of freight and a new barge was only allowed to be constructed when another was demolished. This structure maintained a constant level of overcapacity that was needed in times of low water, while offering means of living during the larger part of the year when water levels were not a problem. During the latter, this meant that barges often had to wait 2 or 3 weeks for their next shipment. This translated into port due foundations based on week, or month subscriptions. From the abolition of the skippers exchanges and its regulation in 1997, free market forces have changed the landscape. Now most barges only stay a longer time in a port due to holiday periods (Vavier & Verkade, 2018).

That also inland ports do not deem the current port due foundations optimal is shown by the Dutch Federation of Inland Ports (NVB) (2013). It states that 75% of the inland ports considers modernizing the foundations of their port fees. STC-NESTRA (2015) reports that the current large diversity in port dues foundations results in high costs for operators and form a barrier for especially container logistics. Moreover, during the NVB masterclass of 2018 that covered port sustainability through a smart port due structure, a majority of the participating inland ports expressed the wish to standardise port dues (NVB, 2018). Based on these events, the following research question is formed:

*What are the best foundations for inland port dues in the Netherlands and can those foundations be standardised over all inland ports in the Netherlands?*

# 2 Definitions: What should port dues optimise

To answer the research question, first it should be established what the goals of inland ports and authorities are. Only then a port due model can be created to optimise these goals. To do so, this chapter will first briefly address the definition of port dues. After that, the value of a port is discussed. Then the aims of European and Dutch authorities are discussed. This leads to the formulation of four sub-questions. Finally, an overview is given on the composition of an inland port due structure.

## 2.1 What are port Dues?

The dictionary answer to this question is simple: “the charge for the use of a port”. This leaves a lot of room for interpretation. The World Bank (2003) fortunately has a more complete definition of port dues: “Charges by a port authority to a vessel for each port entry, usually on a per gross tonnage basis, to cover the costs of basic port infrastructure and marine facilities such as buoys, beacons, and vessel traffic management systems.”

Vavier and Verkade (2018) note that port dues are a retribution. This means that the income of port dues cannot be higher than the cost a port inquires to maintain and develop the port. A municipality is not allowed to make a profit with their port. This specification is important defining the goals of a port: regardless of port due optimisation, financial retribution is ruled to be a standalone business model for public ports.

Privately owned ports on the other hand, are allowed to make a profit on direct financial income on their port activities. Several municipalities have put their port activities into an independent company. By doing this, port due foundations are no longer a public regulation and become a private agreement. The stocks of these independent port companies are still owned by the municipality that used to own the port. In some cases neighbouring municipalities, provinces and the national government are also shareholders. (Vavier & Verkade, 2018). By doing this, ports no longer directly depend on decisions of the municipality. On the other hand, ports will create externalities that directly affect the regions they are located in. Municipalities will therefor always maintain a strong influence on their port (Van der Lugt, 2018)

Whether port dues are a retribution based on public regulation on which no profit can be made, or a private agreement on which they can, in practice this does not change a thing. Geest, Quispel & Overweel (2013) show that not a single inland port is able to cover their cost with the collected port dues. Port of Utrecht even has a coverage ratio of just 32%. Municipalities and regional governments

continue to invest in, or at least maintain their ports. Therefor they must have another value proposition than the direct financial retribution of port dues alone.

## 2.2 The value (function) of inland ports

Already in 1766 Bentley, Wedgewood and Withworth wrote about the benefits of inland navigation. They state that inland navigation increases the wealth of nations by facilitating and increasing commerce, creating cost advantage over road transport and ease communication with distant parts of the country. Inland navigation, they concluded, strengthens a nation's superiority in commerce, since they will be able to sell manufactured products for a lower price than competitors. Although this was written in a time in which horse-drawn barges were being used, their conclusions still correlate considerably with the situation today.

### 2.2.1 Economic value

According to Van den Bosch, Hollen & Volberda (2017) ports have an economic value and a strategic value. They state the economic value of a port "consists of value added, employment, size of investments and other quantified indicators of what has been economically realized in the country". Ports add value by attracting port-related business, creating cluster synergies and increasing the logistic value of the region (Nijdam & Van der Horst, 2017). For inland ports in the Netherlands these effects count up to 12.6 billion euros from direct-, and indirect value added. Next to that, they are responsible for the direct employment of 66,900 persons (Streng & Kuipers, 2016). To provide a comparison: The proceeds of all Dutch inland port dues count up to around 45 to 50 million euro (Geest, Quispel & Overweel, 2013). This is not even 0.5% of the total added value of inland ports to the economy. Economic growth can therefore be considered a main goal of a port. This leads to the following sub-question:

*How can inland port due foundations optimise economic development and how does standardisation of those foundations contribute to that?*

### 2.2.2 Strategic value

The strategic value of ports are their economic value combined with the difficult-to-copy contribution to the sustainable international competitiveness of firms in its country (Van den Bosch, Hollen & Volberda, 2017). For a port to contribute to the international competitiveness, it needs to have difficult-to-copy attributes that contribute to the economic development stage of their country. According to the Global Competitiveness Index of the World Economic Forum the Netherlands are ranked 4$^{th}$ and can therefore be expected to only benefit from innovation-driven economy factors to increase their international competitive position. Whereas an inland port separately does not contribute much to the international competitiveness of the Netherlands, a

large amount of strategic value is created through national strategic connectivity of the inland port network in the Netherlands (Van den Bosch et al., 2011).

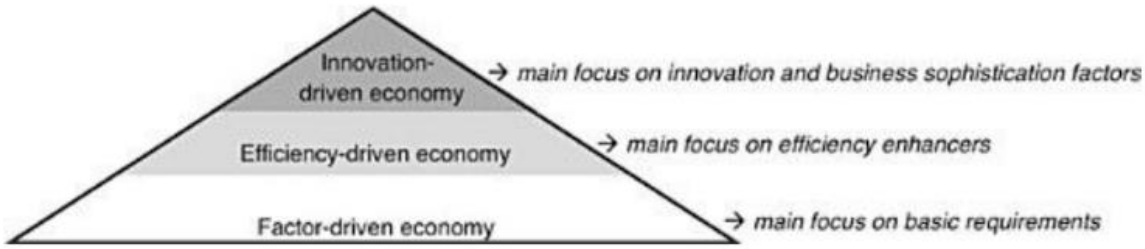



Figure 1: Levels of international competitiveness (van den Bosch et al., 2011)

An important view on this topic is that of Witte et al. (2014). They state that the current outside-in focus on maritime transport that centres seaports and focusses on inland ports only as their network is problematic. To facilitate efficient transport and global trade, inland ports have to be acknowledged as crucial linkages. To this end, an inside-out structure that acknowledges inland ports as independent structures is warranted. They conclude that research should consider not only transport, but also spatial, economic and institutional dimensions of inland ports.

This notion is important for this research: standardisation of port dues foundations can have a different effect on the national level than on the regional level. On a national level standardisation might have a positive effect, while the performance of inland ports in some regions might be negatively affected. Next to that, the externalities standardisation creates – both negative and positive – can differ largely between regions. Also the strategic value of inland ports can vary on national and regional level. As stated above, to contribute to the international competitiveness of the country, inland ports need to add value to the innovation driven economy level. To increase regional competitiveness, it might be more beneficial to add value on efficiency-factor-driven level. For instance the Regional Innovation Index of ING ( 2018) shows that the Randstad (Noth-Holland, South-Holland and Utrecht) leads significantly on innovation in the Netherlands. This regions represents the majority of the lions share of the Tech, Fintech, ICT and start-ups in the Netherlands. Clearly those industries will only benefit from innovation driven economy factor. After the Randstad, the provinces of North-Brabant, Flevoland, Gelderland, Overijssel and Groningen have either universities with a high reputation for research in high-tech industry and agricultural/life science, or strong business environment. These regions also are likely to benefit innovation driven economy factors.  Zeeland, Friesland, Drenthe and Limburg on the other hand have a large focus on industry and agriculture itself compared to the other regions. For these regions, a focus on efficiency driven enhancers might be beneficial.

The standardisation of port dues can be seen as a software measure to improve the interconnectivity of inland ports and the port networks. A software measure optimizes the flow between existing hardware by avoiding bottlenecks and maximising utilities (Corman & Negenborn, 2017). Whereas standardisation might have a positive effect on the Dutch port system, some regions might experience a negative impact. To create full participation, it is important that a system is created that all ports benefit from. Moreover, Geest, Quispel & Overweel (2013) conclude that the modernisation and standardisation of port dues result in a more efficient and fair structure for port users. These findings leads to the following two sub-questions:

*How can standardisation of Dutch inland port dues be implement with maximum fairness for all Dutch ports?*

*How can inland port due foundations optimise fairness for ports users and how does standardisation of those foundations contribute to that?*

## 2.3 Governmental policy: environmental sustainability

From a policy perspective – both national and European – environmental sustainability has become a major objective. The European Commission (2011) published a white paper urging Europe to become a frontrunner in the use of low-carbon fuels. A goal has been set to reach the 2050 target of a 60% reduction in carbon emissions. The Paris Agreements (2015) put these goals in practise. A total 195 countries signed a binding agreement and committed to the goal of a decreasing global warming to 1.5 degrees Celsius. One of the flaws of the above named paper and agreement is the negligence of measures for air and maritime transport. The need for action by ports is stressed by Acciaro et al. (2014) who state that: "Port authorities are required to engage in energy management in order to diversify and respond to environmental pressure" and that they "can promote energy management by coordinating power generation, energy use and the uptake of renewables." The Green Deal (Ministerie van Infrastructuur en Waterstaat, 2019), signed by a wide party of actors in waterborne transport, has shown the acknowledgement and the willingness to change also in the maritime sector. The goals set for inland transport are at least a 20% reduction of CO2, and a 10% reduction of SO2, NO2 and PM by 2024. The ambition is to be fully emission free and climate neutral by 2050. To achieve this the following targets are set for inland ports:

1. Creating more uniformity in the systematics of discounts used for increased sustainability in ports and aiming to make them correspond to the targets of the Green Deal as much as possible.
2. Stimulating logistical chain optimisation in inland navigation, through for instance logistical platforms.

3. Creating uniform inland port due foundations in order to decrease barriers within the logistical process.
4. Expanding the shore-power facilities within inland ports and creating locations to switch battery packs as well as preparing infrastructure for the use of alternative fuels.

These goals show that environmental sustainability is an important aim for this research. Moreover, that standardisation of port due foundations on itself is stated as one of the measures to increase environmental sustainability, reinforce the case for creating a uniform system. This leads to the following sub-question:

*How can inland port due foundations increase environmental sustainability and how does standardisation of those foundations contribute to that?*

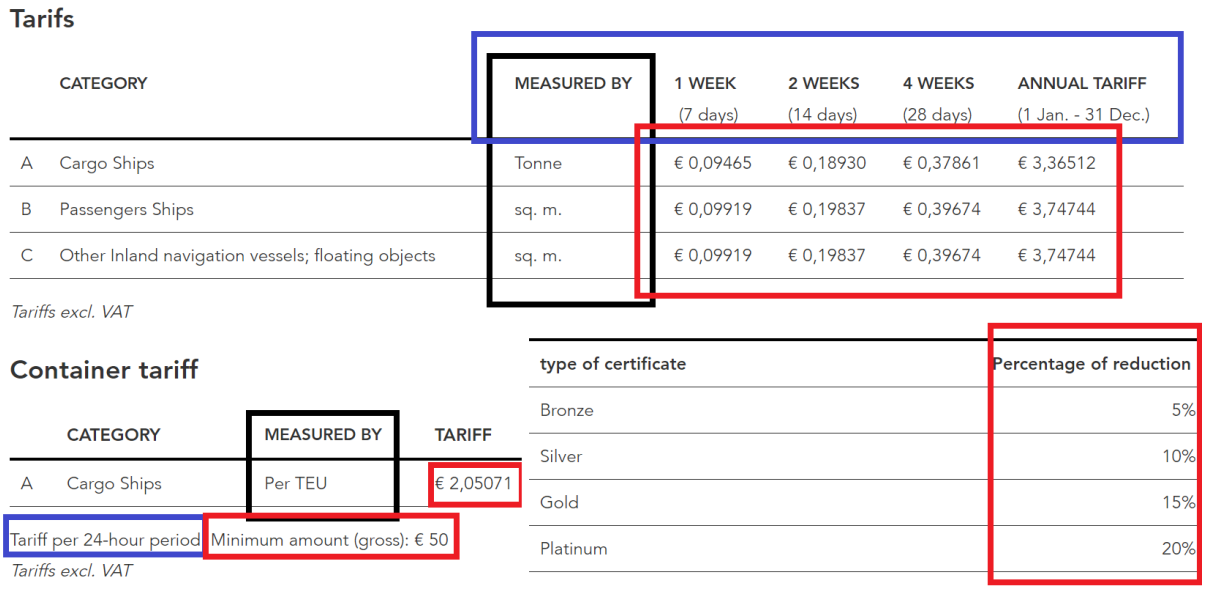
## 2.4 Composition of the inland port due structure

The inland port due structure has three levels: foundations, pricing and operations. The grounding of the structure is based on the foundations. They create the rulebook on which the port dues are charged. These are the assumptions this thesis will mainly focus on. Most Dutch inland ports use a quantity-based foundation and a time-based foundation. Figure 2 provides an example of a port due structure. First, the black boxes mark the port due foundations that are quantity based. Different foundations can be used depending on the type of vessel. The foundation of cargo ships is based on the amount of tonnes the vessel can transport. If the cargo ship is a container barge, it can also choose a foundation based on the amount of containers transhipped. This results in a cut-off point depending on the size of the barge and the amount of containers it needs to tranship. When a barge just needs to tranship a few containers, it is likely use the foundations based on the containers transhipped. When it however is going to tranship the full capacity, it is cheaper to use the foundations based on the maximum loading capacity. Next to that there are different versions of these ‘container tariffs’ in place. Some are based on the total amount of containers transhipped, others on the total amount of TEU or even on the amount of full containers. Passenger ships and other vessels pay port dues based on the amount of square meter of the vessel. The blue boxes mark the time-based foundations. This port either offers a week, 2-week, 4-week or annual tariff. Container barges that use the container rate can choose to pay a 24-hour tariff.

Then, on the middle level, there is pricing. Pricing is a tactical tool that can be used to influence users of the port within the boundaries of the foundations. The red boxes mark the pricing of the foundations. An example of how pricing is used to influence users is the differentiation in the price of the annual tariff. Buying the annual tariff costs approximately 32% less than the other options. This makes it a more valuable proposition for port users. The trade-off is that it binds the user to the

port for a year. Another example is the minimum amount for the container tariff. This pushes the user to tranship at least 24 TEU. Next to that, this specific port also provides a discount on barges that are relatively environmental sustainable. These are based on the measures of the Green Award foundations. They provide a label on how sustainable a barge is. When a barge complies to CCR 1 standards it receives a bronze awarded, for CCR 2 compliance a silver award is granted. Complying to EU stage V results in a golden award. Finally, experimental barges such as electric powered barges receive a platinum award.

Finally, there are the operations. These consist of the measures used by ports to manage port operations. An example is port users have to report their arrival in port or how port dues are collected.



**Tarifs**

| | CATEGORY | MEASURED BY | 1 WEEK (7 days) | 2 WEEKS (14 days) | 4 WEEKS (28 days) | ANNUAL TARIFF (1 Jan. - 31 Dec.) |
|---|---|---|---|---|---|---|
| A | Cargo Ships | Tonne | € 0,09465 | € 0,18930 | € 0,37861 | € 3,36512 |
| B | Passengers Ships | sq. m. | € 0,09919 | € 0,19837 | € 0,39674 | € 3,74744 |
| C | Other Inland navigation vessels; floating objects | sq. m. | € 0,09919 | € 0,19837 | € 0,39674 | € 3,74744 |

*Tariffs excl. VAT*

**Container tariff**

| | CATEGORY | MEASURED BY | TARIFF |
|---|---|---|---|
| A | Cargo Ships | Per TEU | € 2,05071 |

Tariff per 24-hour period: Minimum amount (gross): € 50

*Tariffs excl. VAT*

| type of certificate | Percentage of reduction |
|---|---|
| Bronze | 5% |
| Silver | 10% |
| Gold | 15% |
| Platinum | 20% |

Figure 2: Port due structure build up

# 3 Theory on Port Due Foundations

This chapter provides an overview of the theoretical optimal port due foundations for inland ports. As stated in the previous chapter, port due foundations should strive to increase economic development, environmental sustainability and fairness of the port due system. First, the best foundation for economic development is discussed. Next, environmental sustainability is addressed. Then, Fairness of the port due system is addressed. Finally, a model for port due foundations is suggested based on the academic theory discussed.

In chapter 2.1 it was discussed that direct financial income from port dues cannot be a driver for inland ports. However, during the interviews with inland ports it was often mentioned as important. To that end, after every suggestion for a foundation the financial feasibility of that foundation is discussed. Due to this format, not only a academically grounded suggestion for port due foundations is created. Also, the feasibility of ports implementing it is discussed.

A final remark is warranted before reading. Given the small amount of research done in the subject of standardisation of inland port dues and the effect of inland port dues in general, often theory is used that relies on neighbouring fields of research. In both chapter 3 and 4 it will be indicated if this is the case. The 3 main neighbouring fields used are: Seaport and sea shipping, supply chains and transport streams in general and standardisation in general. Although these papers provide an interesting inside in port activities and the possible effect of inland port due standardisation, it results in limitations. The theory cannot be translated directly to that of inland ports. Next to that, sea shipping and supply chains have drastically the last decades. An example is the increasing size of ships and the decreasing number of parties involved. results find by authors 10-15 years ago might not be relevant anymore. This should be constantly considered when interpreting the theoretical framework presented in this thesis.

## 3.1 Economic development of a single port

This chapter first addresses some recent reports that do suggestions for inland port due foundations. Together with some economic theory they create an argument for the best port due foundation to promote economic development. Furthermore, the financial feasibility of these findings is addressed. Finally, it is concluded with a statement on the best inland pot due foundation option.

### 3.1.1 Best foundation for economic development

Considering the three goals of this thesis, the theoretical argument for economic development is most grounded. Panteia (2013) published an extensive report on port dues. They found that current port due foundation based on the maximum loading capacity of a barge create a financial barrier.

This especially true for solutions that make container transport more efficient. They suggested that a container rate should be used to these barriers. With a container rate, port dues are charged based on the amount of actual transhipped containers.

Table 3.1.1 provides a clear overview on the effects of using a container rate. The table shows how port due cost increase for transhipping 20 TEU, when the maximum container load is used compared to a container rate. During the research of Panteia, the inland ports of Kampen, Cuijk, and Utrecht used a container rate. Regardless of barge size, port due cost remain equal for the amount of TEU transhipped. The other inland ports charged their dues based on maximum loading capacity. These ports have an increasing proposition for the size of a barge. A Jowi-class barge can carry between 400 and 500 TEU. In a port that bases their port due foundations on maximum loading capacity of a barge, a Jowi-class barge pays up to 15 times more per TEU than in a port that has foundations based on a container rate .

| *Haven* | *Kempenaar* | *1000 ton* | *Europaschip* | *110 meter* | *Jowi* | *KPV* |
|---|---|---|---|---|---|---|
| Moerdijk | 6,9% | 28,3% | 33,7% | 81,8% | 136,5% | 64,0% |
| Kampen | 0,0% | 0,0% | 0,0% | 0,0% | 0,0% | 0,0% |
| Meppel | -3,4% | 93,2% | 262,3% | 721,3% | | |
| Venlo | 13,4% | 13,4% | 13,4% | 13,4% | | |
| Cuijk | 0,0% | 0,0% | 0,0% | 0,0% | | |
| Utrecht | 0,0% | 0,0% | 0,0% | 0,0% | 0,0% | 0,0% |
| Vlissingen | -3,4% | 93,2% | 262,3% | 721,3% | 1502,3% | 1381,6% |
| Terneuzen | -3,4% | 93,2% | 262,3% | 721,3% | 1502,3% | 1381,6% |
| Amsterdam | -3,4% | 93,2% | 262,3% | 721,3% | 1502,3% | 1381,6% |

Figure 3: Port due cost when transhipping 20 TEU based on maximum loading capacity compared to a container rate. (Panteia, 2013)

According to Haralambides (2002) high prices for the use of a seaport, damages the trade it is supposed to serve. Baier and Bergstrand's (2001) state that increasing world trade is explained for 25% by tariff-rate reductions and for 8% by transport cost declines. Combined with the widely supported assumption that world trade increases economic growth (Singh, 2010), this presents a clear case for using port dues based on a container rate.

This argumentation fully rests on the assumption that barges on average are not using their maximum loading capacity or if they do, they do not transhipp their full capacity every port. If barge always do transhipp their full capacity in port, either foundation would result in the same cost per TEU. Van Rooy (2010) analysed several network types and showed that barge utilisation varies between 40% and 85%. Port dues based on a container rate are therefore expected to increase economic development.

This argument is fully build on container barging. However, the same line of reasoning can be applied on all types of freight barging. If 20 TEU is translated to 20 tons of freight, dry bulk barges, Liquid bulk barges, and push barges have the same negative effects of port dues based on maximum loading capacity. A suitable base for port due foundation to increase economic development can therefore be formulated as: 'Actual transhipped goods'. This can either be tons or containers.

### 3.1.2 Financial feasibility of best foundation for economic development

Haralambides (2002) does not only find that high prices for the use of seaport facilities damage the trade the port is supposed to serve, but also actually deprives a seaport of its users. Moreover, he states that low port prices may bring a certain amount of patronage to the seaport, increasing clientele. Both Ng (2006) and Nazemzadeh and Vanelslander (2015) add that this also applies to seaport competition. They state that port costs are considered the most important factor for shippers, ship operators and freight forwarders in determining the attractiveness of ports. Geographical location, quality of hinterland connections, productivity and capacity of ports are found to be less important. These results are surprising, since Port of Rotterdam is the largest port in the region. Rotterdam does not have the cheapest port, but does have a good geographical location compared to especially Antwerp and Amsterdam. Regardless of this remark, this stresses the importance of port due tariffs on the attractiveness of a port.

Also, Ishii et al. (2013) show that to remain competitive, ports should set lower rates when price elasticity of demand high, and port expansion activities are both high and almost simultaneously undertaken by competing ports. Applying these findings to the situation in the Netherlands – a country with nearly 400 ports that are continuously expanding – it can be assumed that this is the case. More importantly, Suykens and Van de Voorde (1998) indicate that lowering port dues is not only important to maintain market share. It is also be used as an incentive to attract business due to the lower costs for using the seaport. They state that "inadequate connections may provide ports with an incentive to reduce port dues or offer financial compensations to try and maintain or increase their market share."

It should be noted that above researches are all based on seaports. As noted in chapter 2.2.2, Witte et al. (2014) indicated that inland ports should be considered researched as independent structures. The level of correlation of these results with the Dutch inland port structure cannot be stated. Unfortunately, due the lack of research focussed on inland ports no other academic argumentation can be provided. However, these results do sketch an image that can be expected to correlate on some level to the case of inland waterborne transport.

On the other hand, a lower tariff increases the risk that investment costs are not recovered in the long-run (Haralambides, 2002). When the suggested port due foundation based on actual transhipped goods is applied, this is a valid concern. Ports that used to charge for the maximum loading capacity of a barge, now on average will receive payment for a smaller part of it, decreasing direct income for their services. However, STC Nestra (2015) shows that instating port due foundations that are based on transhipped goods not only benefit inland port users, but also the terminal itself. They state that through quantity increases, the investment-, and operational cost per move decrease. This results in port dues covering a higher share of operation costs per move when a container rate is installed. Since this foundation is expected to increase the amount of goods transhipped, the risk of lower prices is offset by the increase in quantity.

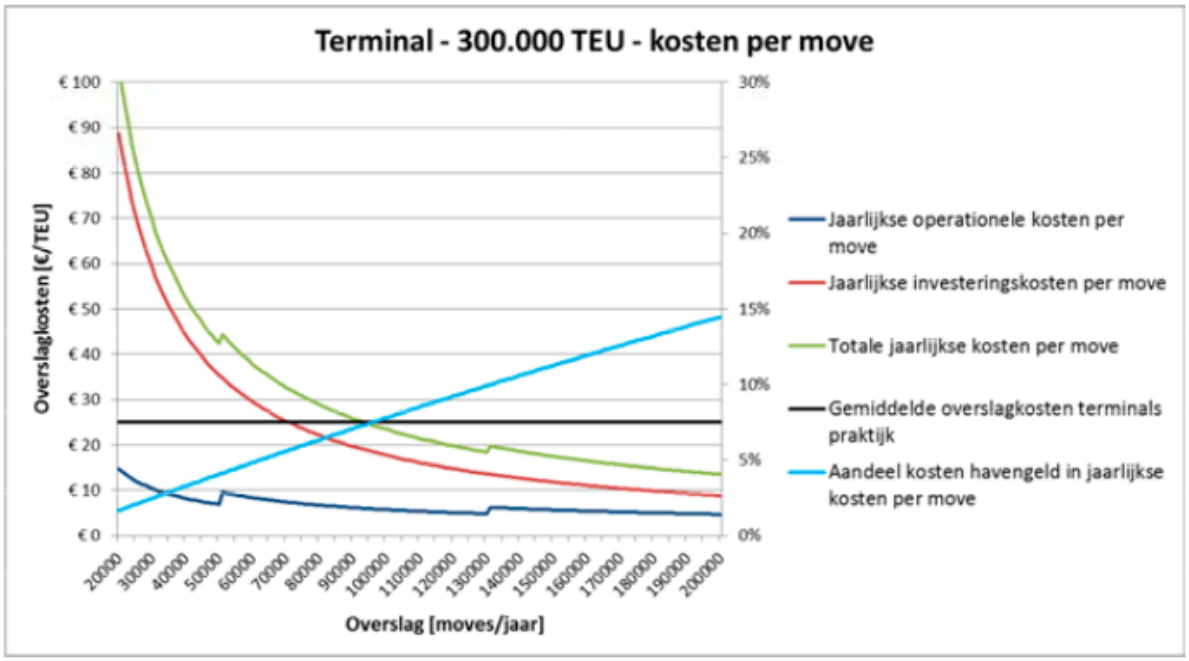



Figure 4: Terminal cost per moved TEU (STC Nestra, 2015)

The above findings show that a port due system based on actual transhipped goods, instead of the maximum loading capacity of a barge can be considered a win-win situation. Not only will it reduce operation-cost for port users, it actually results in a better coverage of the financial income for a port.

## 3.2 Environmental sustainability of a single port

The targets set by European Commission (2011) and the Green Deal (Ministerie van Infrastructuur en Waterstaat, 2019) are set more on cooperation and standardisation itself. Whereas economic environments can be researched on a scope as small as a port region on itself, environmental issues are cross-border phenomena. Chapter 4.3 will focus the benefits of standardisation of port due foundations for environmental sustainability. Acknowledging the international nature of this goal,

this chapter aims to formulate a port due foundation that can increase the environmental sustainability of a single port.

Egels-Zandén and Berggvist (2012) show that the use of green port dues can significantly decrease the environmental impact of hinterland transport. First of all, they state that this is due to the increased modal shift to more environmental friendly modes of transport. This will be discussed in chapter 3.2.1. 'Green port dues', result in specific pricing for the level of environmental sustainability of barges. Chapter 3.2.2 addresses the effect of incentives. Finally, in chapter 3.2.3 the financial feasibility of inland ports instating green port dues is discussed.

### 3.2.1 Sustainability through modal shift

CO2-Emissiefactoren (2017) provides a clear overview of the emission per ton/km for different types of transport within,- and between modalities by using an extensive list of academic research. They show that rail-transport on a Well-to-Wheel basis emits by far the least CO2 emissions per ton/km. However all forms of waterborne transport are still cleaner than road transport.

Den Boer et al. (2008) raise two important remarks to these findings. First, they agree that rail-transport on itself can be considered the cleanest form of transport. They state however, that also the emission cost for construction, maintenance and demolition of infrastructure and vehicles should be taken into account. Trucks have a short lifespan compared to rail and barge transport. This causes a relatively high environmental construction, maintenance and demolition costs of vehicles. The rail transportation network needed for trains on the other hand, produce relatively high environmental construction, maintenance and demolition cost of infrastructure. Therefor compared to truck and train, barging is a cleaner alternative than sketch by CO2-Emissiefactoren. Barges have a long lifespan and the transport network construction and maintenance have relatively low environmental cost.

On the other hand, they state that the long lifespan of barges and trains result in slow adaption of new technologies and innovation compared to road transport. This results in more vehicles that use older technology. It is likely that those vehicles emitting more than is desirable. Still they conclude that both trains and barges as a modality emit less CO2 per ton/km than trucks. Following these findings, a port due that results in the reduction of a single good being shipped per truck results in an increase in environmental sustainability.

Moreover, Bloemhof et al. (2011) write that the utilisation rate of barges and trains is considerably smaller than that of trucks. Given the current rates, trains and barges use 2 to 3 times less energy per ton of goods transported than road transport. However, if a port due foundation is used that

would result in increased use of barges, it can be expected that the utilisation rate of barges increases. This causes on average less energy consumption per ton . Furthermore they address the positive effect increased use of barging would have on road congestion. Of course, certain ports also have congestion problem for barging. However, keep in mind this paper addresses energy consumption. Congestion on waterways is causes by waiting times at the terminal, but doesn't result in physical lines of barges waiting in port. It does not cause the wasteful energy consumption road congestion does. Every container that is loaded on a barge instead of a truck, does not only result in a higher utilisation rate of barging, but also less congestion on the road.

To increase the environmental sustainability of a port, it should use a port due that encourages the use of barges as shipping method. In chapter 3.1.1 is shown that using port dues based on actual transhipped goods increase the quantity of freight shipped by barge. Through reducing operation,- and transport cost in general, choosing waterborne transport becomes a more attractive choice and available for smaller batches of goods. Therefore they also increase environmental sustainability. Also, chapter 3.1.2 presented an argument for the financial feasibility of using a foundation based on actual transhipped goods. There is therefore no barrier for implementing this port due foundation.

The Port of Amsterdam (2017) confirms the success of changing their inland port dues foundations to a container rate. They state that the switch to a container rate results in four benefits: One, it decreases the turnover time in of containers on terminals. Improving the service to clients in the hinterland. Two, it increases the amount of containers transported per barge. Three, it increases the possibilities to bundle shipments and the cooperation between terminal. Four, it decreases the transport of containers by truck, decreasing CO2 emissions and road transport in general.

### 3.2.2 Environmental sustainability through incentives

To quote a part of McCloskey's (1999) speech regarding environmentally responsible business: "We need to create a system that encourages improvement and progress toward good performance -- ideally "Green Excellence." For this system to work, there must be incentives to improve and to reach toward excellence, and disincentives for the laggards and poor performers. Both "carrots and sticks" are needed. Poor performers need to be prodded to improve; when they do, their improvement needs to be acknowledged."

Applying this logic on port dues foundations would result on a discount for environmental sustainable users and a tax for environmentally poor performing users. Both taxing and incentives are found to be effective for increasing sustainability. Stabler & Goodall (1997) find that the cost-cutting opportunities are the most important incentive to be environmentally responsible. This is especially true when combined with reduced taxes, operating subsidies and capital grants. De Mooij

& Bovenberg (1997) show that taxing pollution results in a lower aggregate pollution on the productivity of capital.

An interesting insight in the behavioural impacts is given by Carver & White (1994). They show that negative incentives (punishment) are stronger for behavioural change than positive incentives (reward). Moreover Gneezy et al. (2011) state that incentives can break social norms of trust, frame social interactions and affect social norms and reduce image motivation. In short, they indicate that an incentive establishes the expectation that for doing something desirable a reward should be received. Whereas before instating the incentive, it was part of the social norm. Although both should be instated, increasing port dues for bad performing port users can be expected to be more effective than decreasing port dues for strong performing port users.

### 3.2.3 Sustainability discounts and tax: financial feasibility

Providing discount to be green might be effect, however they also result in decreasing direct financial income of ports. This might be used as a reason for ports not to offer these incentives. However when other industries are researched, an argument can be raised for providing incentives on being green.

In the academic literature arguments are made for several sectors that investing in being green actually results in value creation. Hustvedt & Bernard (2008) show that people are willing to pay a considerable premium of $1.86 for socks that are labelled organic. Furthermore, Ha-Brookshire & Norum (2011) indicate the same for organic, sustainable, and US-grown cotton shirts, Kang et al (2012) find proof for green initiatives of luxury and mid-priced hotels and Schäufele & Hamm (2017) for wine. It is therefore not surprising that Laszlo & Cescau (2017) find that societal challenges such as climate change do not only produce risks for firms, but also offer large potential opportunities for value creation.

These arguments are however all based on consumer products. More closely related is research on aviation. Chen, Chang & Lin (2012) indicate that social responsibility has a marginally significant and positive effect on customer loyalty with airlines. Moreover, Hagmann et al. (2015) show by surveying passengers that the green image of airlines influences the choice of airline during booking. Furthermore, Balcombe et al. (2009) find that airline passengers are willing to pay a relatively large amount for better service quality. When environmentally friendliness is considered a service, this may results in a premium. Finally, Schniederjans & Starkey (2014) state that the current strong consumer attitude and peer pressure for environmental sustainability, increases the willingness to pay for green freight transportation initiatives.

Unfortunately all these arguments are based on consumer experience and perception, whereas ports deal with business Proof cannot be provided on the financial gains of being perceived a "green" port. Bergqvist and Egels-Zandén (2012) however are clear about what inland ports should do should be done however: They should be concerned with the total costs for society. This consists of the business cost and external cost. External costs include costs such as pollution, congestion, vibration, noise, and land-use. The business cost of green port dues are marginal, but it greatly decreases the external cost. Overall, this results in a positive effect for society. Therefore, they should be valid used. The professional magazine Havenlocaties (2019) – a magazine to promote port locations for industry – does indicate that this is the direction ports are taking. Most inland ports marketed themselves as sustainable in it.

Taxation presents its own problems. Many firms fear that instating a pollution tax or environmental regulation, industry located in the area will leave for a location that is more tolerant causing decreased financial income and economic growth. Such a pollution haven effect is widely debated. Whereas older literature find that this effect is insignificant (Barik, 1988; McConnel et al, 1990), more recent studies find that there is some reason for concern. When panel data is controlled for unobserved heterogeneity and instruments are used to control for endogeneity, evidence is found for a pollution haven effect (Brunnermeier & Levinson, 2004). They state that this effect is observable across all studies, regardless of their scope. Mulatu et al. (2009) temper these findings by showing that in Europe this only is the case for highly polluting industries.

## 3.3 Fairness of port dues in a single port

The final goal of this thesis is to establish a suggest a port due foundation that is fair for the users of the port. For this, the question 'when is a port due fair?' needs to be asked. An interesting perspective is that of law philosopher Radbruch (2003). He states that laws can only be legitimate if they are based on just principles and that without justice there is no law. According to Happé (2011) The aim to create a fair share of contribution is a part of the legitimacy of laws. Most inland ports are either publicly owned or a private company with stocks that are publicly owned. This means local municipalities decide on the structure of port dues. These are hammer pieces, making their payment a tax and their foundations a law. Port dues can therefor only be legitimate if the create fair allocation of cost for port users. If they do not, they are not legitimate.

This is something that is already argued by Heggie in 1974. He states that: "A tariff of dues and charges should be based on the social opportunity cost of providing each service. Subsidies should be made explicit and should only be offered to selected users on non-discriminatory national policy grounds. Discriminatory subsidies inevitably lead to some users pay more than their fair share of the

costs in order that other users may enjoy these services at less than cost." Moreover, Anshelevich et al. (2008) find that dividing cost based on fair allocation results in useful mechanism for inducing strategic behaviour. According to this a fair-policy should be pursued. The European Commission (1998) writes just that in their White paper on "principles of fair payment for transport infrastructure", acknowledging that the user must pay for the use of the infrastructure.

Table 3.1.1 by Panteia (2013) clearly shows that the current system does not provide a fair allocation of costs. Both larger barges and port users that ship small quantities are punished. After the economic and the environmental argument, this further builds the case for charging port dues based on a transhipped goods instead of the maximum loading capacity. By doing this, the user is charged for their actual use and pays their fair share. Also, this provides an argument for the abolishment of weekly,- monthly,- quarterly or yearly subscriptions and an argument for a port due foundation based on the actual time stayed in port. These subscriptions can be seen as discriminatory subsidies that discount cost of large users of the port and transfer them to small consumers.

Finally, continue this train of thought leads to an argument for quality-based policy: Users pay for the desirability of the services they consume. Examples are for instance berth location, berth facilities and speed of service. If fairness is strived for, these all should be accounted for. The question should be raised to what level this reasonable and achievable to implement these kind of policy. Moreover, to what extend desirable and beneficial?

## 3.4 Conclusion: A theoretical port due model

These findings all provide the argument for a model based on actual use, with a discount on being green and a tax on emitting. This decreases the barrier of entering a port and the cost of using a port in general through charging only for the actual use. It motivates port users to be green and punishes those who are not through incentives. Next to that, it results in fair port dues that do not subsidise certain user by charging others. To conclude: the theoretical model presented in figure 3 should be instated.

| | Policy | Bulk | Container |
|---|---|---|---|
| Foundation | Time-based | Actual time of stay | Actual time of stay |
| | Quantity-based | Actual transhipped ton | Actual transhipped container |
| Pricing | Environmental | Discounts & taxes | Discounts & taxes |
| Operations | | | |

Table 1: Theoretical measures for optimal port due structures

# 4 Theoretical benefits of standardised port dues

After having established a theoretical model for port due foundations for a single port, this chapter focuses on the benefits of standardising port dues. Blind (2004) offers a clear overview on what actually is the effect of those standards. He presents a model that distinguishes four types of standardisation and their economic functions: compatibility/interoperability, minimum quality/safety, variety reduction and information. Although standardisation has both, all types of standardisation have more positive effects than negative effects.

| Type of Standardisation | Positive Effects | Negative Effects |
|---|---|---|
| **Compatibility / Interoperability** | Network Externalities | Monopoly power |
| | Avoiding lock-in | |
| | Increasing variety | |
| | Efficiency in supply chains | |
| **Minimum Quality / Safety** | Avoiding adverse selection | Raising rival's costs |
| | Reducing transaction cost | |
| **Variety Reduction** | Economy of scale | Reducing choice |
| | Critical mass in starting industries | Market concentration |
| **Information** | Facilitating trade | Raising rival's costs |
| | Reducing transaction cost | |

Figure 5: The effects of standardisation. (Blind, 2004)

Researching academic theory leaded to the identification of three functions that benefit from the standardisation of port dues: the intermodal system, innovation and technology, and green policy. For all three functions, first is discussed how standardisation benefits them. Then it is shown that the function actually benefits economic development, environmental sustainability and fairness of port due foundations. After analysing these three categories, it is discussed what is needed to standardise port due foundations and whether the model created in chapter 3 is still applicable given the results.

## 4.1 Intermodal system

The Collins English Dictionary (2014) defines intermodal transportation as: “Intermodal transportation is the use of two or more modes, or carriers, to transport goods (freight) from shipper to consignee.” In chapter 4.1.1 is addressed how port due standardisation affects the intermodal system. Following, in the benefits of the intermodal system are discussed in chapter 4.1.2.

### 4.1.1 Benefits of standardization for the Intermodal system

Van Klink & van den Berg (1998) state that one of the barriers of intermodal transport is the extra transhipment that is needed. This causes monetary-costs in the form of terminal handling charges, time-costs in the form of delays and risk-costs due to potential damages during transhipment. A uniform port due system can be seen as a software measure to improve accessibility of a port network. A software measure optimizes the flow between existing hardware by avoiding bottlenecks and maximising utilities (Corman & Negenborn, 2018). Standardising port due foundations does just that: It establishes a standard cost structure, resulting in clear measures that ports users can anticipate on. This will save both time-cost and monetary-cost.

Moreover, one of the important bottlenecks in logistic networks is a lack of contracts between actors in the chain (Zhang & Pei, 2016). The standardisation of port dues is a form of contract between ports, terminals and their users. Decreasing this barrier results in an environment where all users can adjust their operations to the same standard. The most vivid proof of the benefits of standardisation in the successful intermodal transport is the shipping container that caused a sharp fall in transportation costs through providing a standardized freight size that could be used for all modalities (Levinson, 2016). Kuipers (2014) even goes a far as stating that the standardized container has done more for world trade than all the trade agreements of the last 50 years. Where standardizing port dues might not be as fundamental, it certainly paints a picture of how the intermodal system might benefit from it.

This is confirmed by Tsamboulas and proven by Langen. Tsamboulas et al. (2007) researched the potential for intermodal mode-shift on a European scale. They found that one of the barriers for intermodal mode-shift was the freight pricing system not being harmonised within, and between countries in Europe. De Langen (2007) discusses that, after the opening of the Rhine-Main-Donau canal, it took a decade for the new potential of inland shipping to be used. According to him, this was due to difficulties with switching cargo within the barging sector itself. A standardized port dues system could have helped in this case. As shown in table 3.1.1, a uniform container rate would have resulted in decreasing the barrier to drop of the containers that would optimally be transported by barge via the Rhine-Main-Donau canal. Instead, those containers were often transported via a less efficient route (De Langen, 2007).

For the intermodal system, standardisation of port dues foundations presents two of the functions of Blinds (2004) model: first it results in variety reduction. This facilitates economy of scale and critical mass in starting industries. It decreases the barriers to use ports and tranship containers.

Second, it provides information for the users through harmonisation. This facilitates trade and reduces transaction costs.

### 4.1.2 Benefits of Intermodal system

Quoting Tavasszy et al. (2017): “Intermodal transport allows access to large-scale modalities like inland waterways and rail, from areas that have only access to the road network… …allowing the bundling of freight flows from several origins and destinations.” Yevdokimov (2000) lists four benefits resulting from this: an increase in the quantity of transportation within a network, reduced logistic cost of current operations, economies of scale through network expansion and better accessibility to markets. Given these findings it can safely be stated that optimisation of the intermodal system increases economic growth through efficiency and cost advantages. This is just what Memedovic et al. (2008) conclude. They state that the benefits arising from global value chains’ spreading could not be realised without co-developments of innovations such as containerisation and intermodal transport.

Already over 20 years ago, Koopman (1997) argued that existing transport policy instruments would be deficient to manage the European Union’s switch in focus to congestion, $CO_2$ emissions and, air quality problems. Chapter 3.2.1 showed that both trains and barges emit les CO2 than trucks. It is therefore not surprising that one of the goals of the European Commission to fight these problems, is to increase the share of those modalities in the modal split. They expect that optimising the intermodal system eases the possibility to use another mode than road transport (EC, 2011). Moreover, as stated by Yevdokimov (2000), intermodal transport causes economies of scale and increased accessibility. Just as increasing economic development, this increase in efficiency can be expected to reduce emissions through aggregating supply chains. Pan, Ballot and Fontane (2013) confirm this. They show that supply network pooling is an efficient approach to reduce $CO_2$ emissions. Easing intermodal mode shift can therefore be expected to have a positive effect on environmental sustainability through efficiency and modal advantages.

On the other hand, Bouchery & Fransoo (2015) state that maximizing the share of inland waterway transport and rail in the modal split is actually harmful, both for cost advantages and carbon emissions. The optimal modal split level depends on distance of terminals. When distance to the terminal is small, fixed financial and environmental cost involved for rail and barge are larger than for road use. However also for longer distances, modal shift does not have to be better. It might results in longer overall routing. Trains and barges have to follow rail and waterways. Afterwards, these shipments have to be picked up by trucks that also have to cover extra distance. Bouchery & Fransoo (2015) therefor state that the optimal modal shift level should be analysed per route.

Although this warning is noted, they also state that the current modal shift level of 25% is not the optimal level yet. Therefore the port due standardisation that aims to increase modal shift toward rail and inland waterway transport is expected to increase both economic growth and environmental sustainability.

## 4.2 Innovation and Technology

Many academic papers are devoted to the effects of standardisation on innovation and technology. In section 4.1.2 the benefits of standardisation of port dues is discussed

### 4.1.2 Benefits of standardisation for innovation and technology

Evenagelista and Sweeney (2006) state that due to the current lack of compatibility of standards, the development of systems for the entire transport chain and their operations is negatively affected. This does not only cause major challenges with implementation of innovation. It also increases the cost for installing and integrating new technology (Pokharel, 2005). Standardisation results in innovation being more effective. By having common processes, innovations are applicable over the whole horizon (Blind, 2016).

Moreover, standards affect R&D, production, and market penetration. Therefore, they have a significant collective effect on innovation and productivity (Tassey, 2000). Standard port due foundations result in all ports benefitting from information gathered from research. This increases the likeliness of ports to cooperate in R&D and increase the total investment. Using standardised port due foundations can therefore be expected to make innovations more effective. Next to that, they can be expected to increase innovation drive: shared expenses cause cost reduction per port. Shared interests will result in a more specialised focus of innovation.

Panteia (2015) noted the need for several standardisation assumptions to make results comparable. This is one of their major limitation to their research. Already in 1961 Simmons showed that uniform measures create comparability of data. Standardisation of port dues results in the creation of quantitative, comparable data. McCloskey (1999) states that this provides the qualitative data that can compare firms within their industry, and against industry averages. Results according to him, are an overview of industry leaders and laggards. By doing this, better justified decisions can be formed on what should be targeted and how this can be most effective. Bottlenecks can be traced, informed decision made and efficiency of investment maximised. Foundations that produce the largest collection of data, increase this ability.

Applying again Blinds (2004) model, standardisation of port dues has two functions for innovation and technology. One, it provides variety reduction. Since all ports use the same port due foundations

variety in research and innovation is decreased. This results in economies of scale for innovation and critical mass to initiate research. Two, it causes compatibility and interoperability of ports and port data. Resulting in network externalities by connecting to other ports that do the same thing, avoiding lock-in through learning from other ports, increasing variety due to new connections and data comparability between ports and efficiency through doing the same as other ports. Using standardised port due foundations creates the ability to located and bottlenecks and optimise investments through data.

### 4.2.2 Benefits technology and innovation

That technology and innovation are key factors for economic growth is widely accepted. Grossman and Helpman (1994) show that technology can be considered "the real force behind perpetually rising standards of living". Investment in innovation increase the possibility of achieving a higher standard of technology in firms and regions resulting in the introduction of superior products (Bilbao-Osorio & Rodríguez-Pose 2004). Next to that, investment in innovation results in increased productivity and growth (Romer, 1990; Lichtenberg, 1992). It is therefore not surprising that according to Trajtenberg (1990), R&D is one of the key strategies to secure technological potential and economic growth.

What neither is surprising, is that innovation is a driver for environmental sustainability. Technological innovations lead to the reduction of pollutants by ports and barges: multiple low carbon fuel types – such as electric, hydrogen and bio-based – opportunities are cross-developed (Contestabile, 2011). Ports are investing in more innovative technologies such as onshore power supply, alternative fuelling stations and the increasing development of renewable energy installations in the port areas (Acciaro et al., 2014). Both authors do indicate that these technological developments need to be accompanied with non-technical innovations. Port dues standardisation can be considered an example.

## 4.3 Green policy

A practical example for the need for standardisation is the above mentioned research into alternative fuels. Heineken and CCT have just launched the Gouwenaar 2, a (potentially) fully electrical barge. Argos and Shell, combined with several other companies are investing in LNG infrastructure and barges. The TU Delft, Port of Amsterdam and Tata are researching the possibilities for using hydrogen. Given the early stage of research into alternative fuels a broad orientation might still be warranted. When the implementation stage nears, steps need to be taken to ensure a standardised system. Contestabile (2011) argues that it is unlikely that the transition of environmental developments will occur organically. The requirement to ensure an optimal path with

the highest rate of success is the creation of common policy. A common green investment policy would provide the measures needed to achieve this. Moreover Egels-Zandén and Berggvist (2012) state that communicating a clear green strategy would secure the strategic consideration of transport service providers and other stakeholders.

Next to the development of green investment policy, The Green Deal (Ministerie van Infrastructuur en Waterstaat, 2019) indicates the same need for green incentives given by ports. It states the goal of creating more uniformity in the systematics of discounts used for increased sustainability in ports and aims to make them correspond to the targets of the Green Deal. Multiple studies show that eco-labels have considerable effects on the environmental sustainability. Rashid (2009) states that eco-labels play a crucial role of Malaysian consumer purchase decisions. Considering transportation sectors, Baumeister & Onkila (2017) argue that an eco-labelling scheme for the aviation industry would help reduce the environmental impacts of aviation. It would result in behavioural change. However, to do this the eco-label needs to meet 5 criteria: credibility, comparability, clarity, transparency and participation.

For the barging sector the Green Award Foundation offers such a standardisation through an eco-label. Barges are rated by a set of standardised measures and when they perform well enough, they are awarded with either a bronze, silver, gold or platinum label. This structure provides credibility through the acknowledged name of the Green Award Foundation, and comparability, clarity and transparency through the set of standards developed by this foundation. Participation is the last criterium to create behavioural change as stated by Baumeister and Onkila (2017).

Egels-Zandén and Berggvist (2012) state that, although “most large shippers and transport service providers are salient and likely negative towards green port dues, they are unlikely to resist its introduction. This is due to the attempts of shippers and transport service providers during the last two decades to portray themselves as environmentally and socially responsible.” Publicly criticising green port dues would damage that reputation. Bansal and Roth (2000) add that transport service providers ‘go green’ to gain legitimacy by portraying themselves as sustainable. A Green Award certificate provides this legitimisation. Standardised green policy can therefore be expected to cause both to efficient green investment and behavioural change of port users.

## 4.4 Needs for standardising port due foundations

The chapter shortly addresses what is needed for the participation of inland ports when standardisation of port dues is aimed for. Several studies are devoted to the implementation of standardisation. Besen and Johnson (1986) stress five point that should be met to facilitate standardisation:

1. All major industry parties must be willing to participate in standardization processes
2. The industry group has to overcome potential antitrust objections
3. A narrow range of choices should be presented
4. Objective technical means must be developed to overcome subjective disputes
5. Firms that suffer cost from standardization should be offered a royalty fee to reduce these costs.

Gudmundsson et al (2004) list four key elements that need to be jointly considered by firms before the implementation of standardisation:

1. Current and future needs and wants of customers
2. Organisation's own core competencies
3. Effects on the supply chain of suppliers and distributors
4. Dominant technologies built into the products.

Ramakumar and Cooper (2004) state that process standardisation is critical if operational excellence and optimal flexibility is to be achieved in a value chain. According to them, critical features to achieve standardisation are:

1. Common definitions of metrics
2. Common language
3. Common business rules
4. Process logic and data
5. The flexibility to rapidly change.

More lists on the subject are created by different studies, however two main themes are found to be important in all of them. First the quality, understandability and ease of use of the proposed model for standardisation. Second, the willingness and ability of firms that implement and accept the model. The solution for the standardisation of inland port due foundations presented in this paper is fairly simple. It suggests a pay-for-use model. Based on the amount of transhipped goods and the actual time of stay. It has been shown that this model not only has benefits for the ports alone, but also benefits for the whole port system through standardisation. Also, to an extent it has been proven that this model does is not expected to result in financial cost for ports implementing it. Therefore it is likely that firms are willing to implement and accept the model as presented in chapter 4.

However, when the situation occurs that standardisation does result in cost for certain ports, Besen and Johnson (1986) indicate that they should be compensated by ports that receive benefit from the

standardisation. This aligns with the findings in chapter 3.3 on the fair allocation of cost. Only when this is accounted for, fairness of port due standardisation for the implementing ports is achieved

## 4.5 A theoretical port due model

Standardisation of port dues results in a more efficient intermodal system, more investment in, and a higher effectiveness of innovation and increased effectiveness and focus of green policy. The findings of this chapter on standardisation reinforces the suggested modal presented in chapter 3. Foundations based on the actual transhipped quantity and actual time of stay minimise the barrier for transhipment. Also, they maximise the amount of data that can be gathered. Furthermore, the use of the Green Award structure as the foundation for green policy results in credibility, comparability, clarity, transparency for environmental sustainability and legitimisation for certificate owners. The Green Award certificate should therefore be added as a third foundation.

Next to that, standardisation of port dues will result in negative or positive effects for different ports. If fairness and participation is to be achieved, ports that inquire costs due to the standardisation of port dues should be compensated by the ports that profit from it.

| | **Policy** | **Bulk** | **Container** |
|---|---|---|---|
| Foundation | Time-based | Actual time of stay | Actual time of stay |
| | Quantity-based | Actual transhipped ton | Actual transhipped container |
| | Environmental | Green Award | Green Award |
| Pricing | Environmental | Discounts & taxes | Discounts & taxes |
| Operations | | | |

Table 2: Theoretical measures for optimal port due structures

# 5 METHODOLOGY

To research the possibilities for standardising port due foundations in the Netherlands, qualitative interviews are done with carefully selected partners. These can be divided in 4 different groups:

- Interviews with inland ports
- Interviews with shipping companies
- Port user survey
- Subject specific interviews

## 5.1 Interviews with inland ports

The list of interviewed ports can be found in appendix A1. The ports are selected because they either indicated to be a frontrunner of innovation or standardisation, recently made changes to their port or port due structure, or have an exceptional port situation. The base of the questions can be found in appendix A2. However the nature of the interviews – qualitative and port specific – results in port specific questions and subjects. The questions focus on port structure, their bottlenecks, and if port dues can be used for improvement.

## 5.2 Interviews with shipping companies

The list of interviewed shipping companies can be found in appendix A3. The goals of these interviews are to get an inside in the effectiveness of incentives suggested by ports. Next to that, and maybe more important: finding what shipping companies are triggered by and what they want to change when it comes to port dues. In short, do the goals of inland ports align with the demands of shipping companies? Companies that perform different types of transport are selected: liquid bulk-, dry bulk-, container-, push barging and passenger transport. This result in an extensive view on the consequences of actions taken by ports. The questions asked can be found in appendix A4. Just as the interviews with inland ports, the interviews are qualitative and company specific. This results in company specific questions and subjects.

## 5.3 Port users survey

The interviews with shipping companies are qualitative. The survey aimed at port users provides a more quantitative insight in the effectiveness of incentives given by ports and port due preferences. The survey is sent to all members of Koninklijke BLN Schuttevaer and the CBRB. The survey can be found at appendix A5. Appendix A6 contains an overview of the results of the survey. Table A6.1 shows how the respondents are scattered.

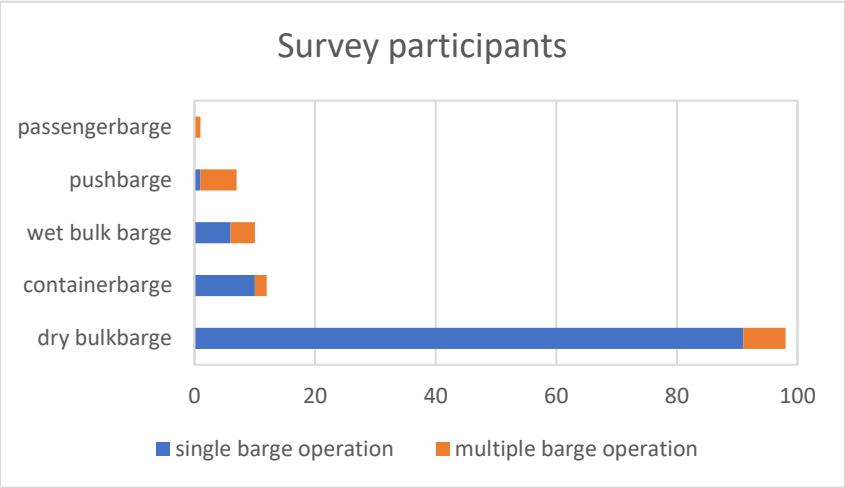



Figure 6: Survey participants descriptions

## 5.4 Subject specific interviews

To put this in perspective several other interviews are conducted. First, Port Solutions Rotterdam is interviewed. They are specialised in innovative solutions for port development and logistics. More important, when it comes to port dues they are a neutral party. They are expected to have no conflict of interests when arguing for, or against port due foundations and the possibilities for standardising them.

Second, the Green Award Foundation is interviewed. Their efforts to contribute globally to sustainable waterborne transport is discussed. This is especially valuable to provide an inside on how port dues can be structured to promote environmental sustainability.

Third, the European Federation of Inland Ports (EFIP) and the Bundesverband Öffentlicher Binnenhäfen (BÖB) – the German Federal Association of Inland Ports – are approached. The aim is to discuss differences and similarities in port due policy in the Netherlands and other Western-European countries. This could provide information on the performance of port due structures that might not be used in the Netherlands. Unfortunately both parties stated that they could not provide any information. They stated this is only disclosed upon request at the port itself. Fortunately some information on this topic is gathered at during other interviews.

## 5.5 Quantitative data limitations

It would have been valuable to use quantitative data to further reinforce the findings from interviews and the survey. Unfortunately there is no open source data on inland port dues available. Inland ports themselves either do not have any data, or are not willing to disclose it. An interesting remark of Port of Rotterdam was the notion that if port dues where altered, they would be able to gather data, creating some form of paradox. The findings of this thesis are therefor based on the opinions of a limited amount of actors in the field. Next to that, the survey had 133 complete responses, whereas it had been send to all members of KBLNS and the CBRB. The survey has a total response of 5-6% of their combined members. Since the data survey is fully anonymous, not statements can be made on the percentages of replies from KBLNS and the CBRB. Bulk barge skippers that operate a single barge are very well represented as shown in figure X. Whether this is representable in the real world is debatable. It can be imagined that especially the groups with a strong opinion responded, causing polarised results.

# 6 Results

In this chapter the findings from interviews and the survey are discussed. The interviews resulted to a wide area of remarks on the current port due structures. Some arguments directly addressed port due foundations, others were more related to the pricing of port facilities or touched upon their operations. This chapter is divided accordingly: foundations, pricing and operations.

The reason that not only port due foundations are discussed, but also their pricing and operations, is that they are correlated. Some pricing issues can only be solved by using certain port due foundations. Some theoretical port due foundations are criticised to be unlikely to be put in operation. This structure provides a complete overview off the effects of port dues. All findings on pricing and operations are however focussed on how they relate to optimising port due foundations or their standardisation.

First, the view of inland ports on their value and the definition of port dues is discussed. Then, the port due foundations are addressed. Both the current situation and the vision of interviewees. This is followed by some cases regarding port due pricing and the vision of port users what fair allocation actually is. Next, the current port due operations are discussed and special attention is given to the major frustrations these provide. Finally, a standardised port due model is presented.

## 6.1 The value of an inland port

All interviewed ports agreed on the purpose of inland ports in their municipality: economic development. They acknowledge that inland port dues cannot be used to create a revenue to result in break-even financial result. When this would be pursued, port dues would have to be tripled. If a single port would do this, it would lose its competitive position to other inland ports in the region. Moreover, when this would be jointly pursued by all inland ports in the Netherlands, it would negatively affect the competitive position of the Netherlands as a whole. Transport price for barging would increase, deteriorating its competitive position to other modalities and the competitive positions of Dutch ports – both inland and sea – to ports outside the country.

The drive to maintain an inland port can be found in the spin-off effect and their externalities. Inland ports have a positive effect on land value and on attracting investment, such as production or logistics operations. This results in more earnings on land lease, sale of land and industry taxes. Next to that, the newly attracted firms provide extra jobs. This increases earnings on income taxes and decreases spending on unemployment benefits. Moreover, the increased salary of the now employed inhabitants results in an extra economic spin-off through spending in the local economy. This is where the value of an inland port is found, not in the direct financial profit of port dues. An

example is the investment of the municipality of Waalwijk in a new, larger port. They state that the cost of investment is expected to be 35 million. A considerable investment for a municipality of not even 50,000 inhabitant. They do not expect to regain the investment and consider it sunk cost. It is however, a necessary investment to remain competitive in the future and an interesting location for industry.

On the other hand, it has been noted that attracting more investment and expanding the port also has an increasing negative effect. At first, newly attracted business has a large positive effect on job creation for unemployed inhabitants in the region. There is however a tipping point. After a certain amount of logistics industry locates in the region, the region cannot supply the demand for labour. Firms therefor try to attract labour from outside the region. This mostly results in a stream of low-skilled labour into the region, which might not be desirable. An increased pressure on low-priced housing is named as one of the consequences. Next to that, some forms of investment have a negative effect on the environment and liveability of a region. Both in terms of health by worsening air quality and in terms of visual environment. Port of Venlo pointed out an increase group of inhabitants complaining of what they call “boxification of the area” because of the arrival of XXL-warehouses.

These findings align with academic theory. Ports that are successful in creating a good business environment, have an increasing negative effect on the liveability in a region. They are likely to lose support of the community, indicating a thin line between economic and social development of a municipality.

## 6.2 What are port dues: a tax, a compensation or a tool?

What then, is the role of ports dues, if it is not the business model of inland ports? This question resulted in several answers that can be divided into 3 groups:

- Port dues are a possibility for municipalities to levy tax within their own tax regime.
- Port dues are a compensation to facilitated management and maintenance of the port
- Port dues are a tool to give (dis)incentives to optimise port efficiency

When ports only consider port dues to be a possibility to levy tax, the revenue is detached from the activities it is gained from. It is no longer linked to the port, but part of the budget of the municipality. Increasing activities in the port provides more income for the municipality, however does not automatically result in more investment or funding for the port. For the increased income to benefit the port, the municipality has to decide to increase the budget assigned to the port. Multiple ports state that this is problematic. Municipalities prefer to spend their money on facilities

for inhabitants rather than industrial investments. Results are negligence of maintenance in the port. This mostly goes hand-in-hand with a port due structure that does not account for any facilities and uses a flat rate for all barges based on maximum load capacities. Shipping companies indicate to feel unfairly charged and used as a 'cash cow' in those ports.

In ports that consider port dues as a compensation for management and maintenance, increases in port activities do result in extra financing for the port. The income of a port is directly linked to its performance. Still, this presents a problem. As stated before, the value of a port is economic development, not direct financial gain. When port dues are considered a compensation however, it focusses on financial gain and is therefore likely to result in wrong incentives.

Finally, ports that consider port dues a tool for giving (dis)incentives to optimize port efficiency use a different approach. They do not mainly considered port dues a form of income, but a measure for managing transport streams. This approach focusses on taxing scarcity, pushing out unwanted activity, and awarding desired behaviour. On one side, this might result in a small decrease in financial benefits: more incentives are given than (dis)incentives. On the other hand, this results in the optimisation of the supply-chain and empowers economic growth for the industry ports serve. The economic potential of this approach correlates most with the goals of economic development.

## 6.3 Port due foundations

Although there are many differences in port due foundations, they are always based on two constant factors: a time-based foundation and a quantity-based foundation. The time-based foundation establishes a time-period that the port due payment is valid. The quantity-based foundation states the measurement on which the price of the port due is calculated. A clear divide can be made between two types of ports: ports that use historical foundation and ports that have reformed their foundations. These are discussed in chapter 6.3.1 and 6.3.2. Following this, a view from the perspective of shipping companies is given on how port due foundations affect their business. Finally, it is discussed how port dues should be structured to be fair according to port users. Chapter 6.3.4 focusses on time-based foundations. Chapter 6.3.5 addresses quantity-based foundations.

### 6.3.1 Historical foundation

Most interviewed ports still base their port dues on historical foundations. This combines two foundations:

- Time-based: a subscription that allows a barge to be in port for a fixed time period, e.g. a week.

- Quantity-based: a rate based on the maximum loading capacity of a barge.

Several variations on this system are applied in every port. For the time-based foundation also monthly, quarterly, and yearly subscriptions are common. Furthermore, this subscription can be offered for a single journey or multiple entry. In the case of single journey the remaining time of the subscription expires after leaving the port. With multiple entry a barge can enter the port as often as desired for the full duration of the subscription. Also, in some ports the time-based subscription pays for the use of facilities such as quays, shore-power and/or drive-off facilities, whereas in other ports it is a fee that solely facilitates port entry and the use of the terminal.

Also the quantity-based part has some variations. First of all, the measure for the maximum loading capacity can be based on several perspectives. This can either be based on cubic water displacement, square meter surface, cubic meter content, or cubic meter of storage capacity of a barge. However, most ports use the letter of measurement that provides information on the maximum capacity of a barge. Next to that, several ports have started to offer a half-full charge for barges that are loaded less than 50% of their capacity. This shows not only awareness of ports that the system is outdated, but also indicates that they are able to measure the actual capacity of a barge to some extent.

Nearly all ports acknowledge that this port due structure is obsolete and should be changed. Two reasons where named for not having changed the foundations yet: One, they do not know what would be the appropriate structure to change it to. Moreover, they want to agree on a uniform structure with all ports before changing it. Awaiting the results of this research for that purpose was not uncommon.

Two, the municipal council has to decide on it. Not only does it take time to change things by the council, also they expect the direct income from port dues to decrease. This results in a negative impact on the municipal budget. To compensate this, less money can be spent on other projects. An inland port simply is not the most popular thing to spend money on. This is again an argument based on direct financial gain, whereas the value of inland ports is economic development.

### 6.3.2 Reformed foundation

This is a smaller, but growing group of ports. They decided to change their port due foundations to fit better to the current demand for transport. Both the foundations they did, and did not change provide an interesting view in this demand. The changes particularly focus on container shipping.

These ports all instated a container rate instead of a foundation based on maximum loading capacity. This is exactly the structure suggested by academic theory. Just as the ports with historical

foundations, the exact reformed foundations differ per port. It can either be based on total quantity of transhipped containers, total quantity of transhipped full containers or total transhipped TEU. None of the interviewed representatives could provide a clear argumentation for their specific choice though. Next to that, some ports implemented a minimum charge for container barges to cover basic cost. Also, in most of these ports the container barges do not need to acquire a time-based subscription for a week or longer. In some ports they can buy a day subscription. In others they do not have to buy a subscription at all, unless they want to make use of the berthing facilities. All ports provided a clear argument for switching to a container rate: the nature of container shipping. Container barges are often 24/7 operations, preferable hopping from port to port, picking up and dropping of small batches of containers. Historical foundations formed a barrier. To be competitive, optimise efficiency and maximise use of barges were necessary changes.

Port dues foundations for bulk transport on the other hand, are not adjusted. A common argument for this is the lack of need in practice. This conclusion is drawn from analysing the differences between bulk and container barge transport. A bulk barge normally transports the shipment of one client from a pickup location directly to the destination. The port dues, both at pick-up and destination location are cost inquired in service of that one client. Container barges however serve many clients at the same time and visit multiple ports with the goods of those clients. This results in multiplying the cost per client.

These specific characteristics of container barging lead to two systematic problems for time rates based on weekly subscriptions or longer, and quantity rates based on the maximum loading capacity. First, it affects the cost for container barging as a whole, due to the amount of ports that have to be visited to fill the full capacity of a barge. Second, it leads to the unfair allocation of cost to the several clients of container barges: barges filled with large shipments per client reduce the total port due cost. This is both conflicting with the nature of container barging, and with the aims of economic development, environmental sustainability and fairness.

Although according to inland port representatives changing port due foundations for bulk transport might not be as pressing, just as well as for container barging, a pay-for-use structure would optimise the port due foundations. Also a bulk barge is not always fully loaded. When it is not, it would pay a larger due than it should if the maximum loading capacity is used as a foundation. An example is the case of low water the summer and fall of 2018. The capacity of barges was decreased up to 80% due to accessibility problems on the Rhine. Port due based on a maximum loading capacity are in this case unfair, uneconomical and result in more road transport, decreasing environmental sustainability. Moreover, just as container barges, bulk barges rarely stay in port

longer than a day. Charging for a week or more does not result in the fair allocation of cost. Moreover, it encouraged barges to stay longer in ports, which in most ports is not desired.

### 6.3.3 The effect of current foundations according to shipping companies

Although in theory many arguments can be provided for different types of foundations, the first answer of shipping companies on the question of what would be best the best due foundation is discouraging: 'It does not matter'. They state that port due foundations, or port dues in general, do not affect their business decisions Port dues count up to 2 or 3 percent of the total cost of operations. A common remark is that 'changes in port due foundations will result in some profits at one part of the operation and some losses at another. When the cost are added up however, it is still likely to be 2 or 3 percent of the operation cost'. This has to do with the nature of the sector. Deep sea ships that transport goods to North-Western Europe can decide to call on several ports within the Hamburg-Le Havre range. Inland barges have to pick up these goods at the location they are dropped off and deliver them to a specific location. In other words, the luxury of choosing a port depending on its port due foundations is barely existent.

#### *Container barges*

Container barge operators were able to build a case where port dues and their foundations do have an impact. This occurs when a relatively small batch of containers has to be picked up. When port dues are based on the maximum loading capacity of a barge, in most ports this results in a fee of around 300 euro. The profit of a container lies around 40 euro. Historical foundations based on maximum loading capacity therefore create a barrier to pick up smaller shipments. When the shipment is to small, more costs are allocated per container, pushing down to and below the break-even point for container barge operators. Below the break-even point, it is not interesting anymore to pick up containers. A transhipment based foundation would solve this. This case aligns with the goals of the ports that reformed their port due foundations.

Moreover, container barge operators confirm that the foundations of port dues therefor effect the modal split. Shipments that are too small to be picked up are most likely transported by truck. This results in unnecessary pressure on road infrastructure and increased emission of CO2.

#### *Bulk barges*

The size of bulk shipments ensures that no such barrier exists in this sector. Most of the shipments are at least half the capacity of a barge. In general, modal competition neither is an issue due to the size and value of barge shipments. Barges can carry on average between 1500 and 3000 ton. Trucks can transport a maximum of 40 or 50 tons (depending on country norms). For the quantity that one barge transports, 30 to 75 trucks are needed. For push barging this can even be multiplied by 6

barges, resulting in the need for as much as 450 trucks to compensate for 1 skippers operation. Even freight trains that use their maximum of 46 wagons carrying over 4500 ton are not able to compensate for this. Moreover, the goods transported by bulk barges are often of relatively low value per ton, making it nearly impossible to be competitive when another mode of transport is used.

One exception was named: High value specialised chemicals. The shipments of these chemicals are smaller, sometimes as small as 500 tons. Their higher value and the smaller competition within this niche market allows for some modal competition: 10 to 13 trucks, or 5 wagons on a freight train could also transport this freight shipment. Since in this case only a part of the barge capacity is used, a port due foundation based on the actually transhipped goods might be beneficial for the modal split. Realistically however, the cost of port dues remains marginal. More important for shippers in these cases is the reliability, speed and cost of transport.

### 6.3.4 Fair foundations according to port users: Time-based

What port users did state to be important is fairness. This both touches on the time-based, as the quantity-based foundation. Fair allocation of time-based foundations is the easier of the two. A barge skipper that aims to be only in the port for transhipment purposes is in the port for the shortest amount of time possible. When a skipper wants to be in port for other purposes such as social occasions or spending the weekend, it is longer in the port. The prevailing weekly subscription allocates cost from those who stay longer in port to those who leave after necessities are done.

Implementing port dues based on actual time of stay in ports does facilitated a fair allocation of cost. Staying longer in this case equals to higher dues. It should be taken into account that economic development is served by decreasing cost for supply chain operations. Instating a time-based port due that only initiates after transhipment purposes are done would facilitate that. Such a structure is fair, since all port users are generally in the port for transhipment purposes. This can be done by charging a barge for their time in port only when it is using a berth.

Although this touches on the pricing of port does, it is important note that ports will aim to retain their revenue. When a barge is staying 24 hours in a port that uses port dues based on actual time in port, it unlikely to pay $1/7^{th}$ of the charge of ports that use week subscriptions. The fairest measure would be calculating the average duration of the stay in the port. This duration should be charged the same amount as was charged for the week subscription. For example, when the average duration of stay in a port is 3 days, staying 1 day in port will be equal to $1/3^{th}$ of the charge for the historical week subscription. On the other hand, staying a week in port will result in $7/3^{th}$ of what it

used to cost. Implementing a model where transhipment time is not charged for, results in an even faster increasing port due.

An important note is the clear division of interest between shipping companies and private barge skippers. Barges of shipping companies often work 24/7 and do not stay in port longer than necessary. Berth dues based on a pay for actual use structure instead of a week subscription in their perspectives increases the fairness of the price. On the other hand, skippers often live on their barge and feel pushed out of the city and unwelcome. Not only does it become increasingly expensive to be in a port area for a longer period of time, also there is a lack of decent alternative resting places. The berths that are available outside of the port area often do not have the facilitated means to leave the barge. Even if they do, the nearest village is often far away.

This results in a difficult to solve situation where the social aspect of shipping is sacrificed for an optimised transport chain. Unfortunately, when economic development, environmental sustainability, but also the fairness of the port due system are considered, port dues tend to shift to the logistical, rather than social optimisation. A discouraging example can be taken from seaports: sea shipping has been pushed out of the city and become detached from social life. Although this was not necessarily caused by port dues but by more demand for space by both the city and ports, it does provide an inside in the possible future. Cities will want to use their waterfront for a more valuable industry such as tourism. Logistic driven companies also demand more space. Port dues that enforce this logistic drive automatically have a negative affect on the social aspect of shipping. Whether this is desirable and what the cost for inland port is, might be interesting for future research.

The figure A6.8 below indicates there is indeed an unfair allocation of cost when a week-subscription is used. A total of 39% of the respondents answered to stay longer in a port with a week rate. This would only occur when there is an unfair allocation of cost. Otherwise, the respondents would be indifferent. Moreover, ports that want to decrease berth occupancy can positively effect this by switching to a day rate. It can be imagined that an hour or minute rate is even more effective.

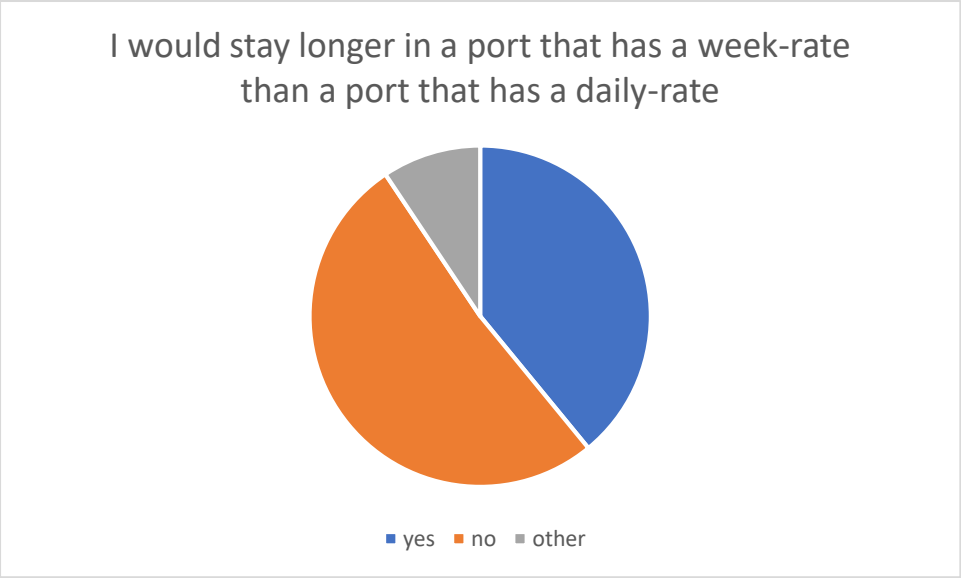



Figure 7: Time of stay depending on time-based foundations

As figure A6.3 shows nearly half of the peer group (49%) answered they preferred actual time in port as basis for port dues. Comments stated that this is most fair. One of them compared it to parking a car. 'Parking your car also goes by the minute, why isn't this possible for barging?' Having to pay for an hour if a car only needs to be parked for 5 minutes causes frustration and the feeling of being unfairly treated.

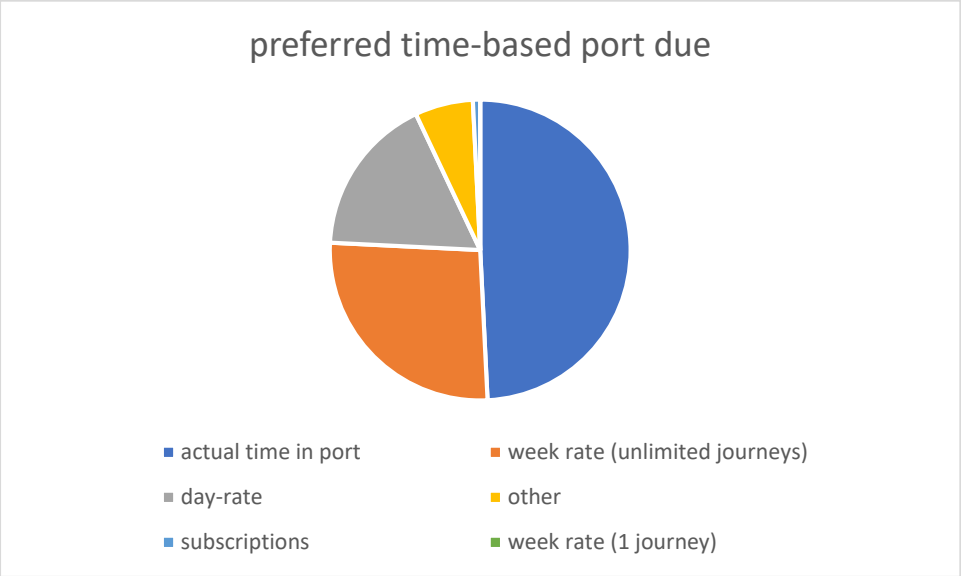



Figure 8: Preferred time-based port due

Still a little over a quarter (27%) answered to prefer the week rate. They commented that this was easy, and used in most ports. Changing everything costs a lot of effort. They doubted whether that effort would actually change something. Note that these are all votes for a week rate with unlimited access to the port. None of the questioned preferred the week rate with a single journey. The single journey is argued to be not only unfair, but also no valid reasoning can be presented to defend it.

Then, 22% stated they preferred a day rate. The comments indicated that they also based their decision on fairness. They argued however that a day rate is something that can be implemented fairly easy, whereas actual time in port probably cannot.

Analysing this argumentation distinguishes two important decision factors: the fairness of port due foundations on one side, and the ease operation on the other side. It is therefore likely that port users prefer time-based port due foundations based on actual time in the port, provided that operations for using it are easy. These operational measure will be addressed in chapter 6.5.

### 6.3.5 Fair foundations according to port users: Quantity-based

Providing fair allocation of the quantity-based part of port due foundations is more difficult. It can be viewed from different perspectives, resulting in varying arguments. First of all, the measure that uses maximum loading capacity is argued to result in fair allocation of cost for the consumption of space a barge uses. Moreover, advocates argue it is an appropriate measure when the possible maintenance it provides for a port is considered: a large barge is likely to have a large engine and is therefore likely to do more damage in port.

More parties state that this is not a correct measure: if fairness of port dues is really about the consumption of space, it should either be measured on the square footage of a barge, or the actual loaded capacity. The maximum loading capacity only accounts for the theoretical consumption of space. But more important, often barges do not use their full capacity. The actual loaded capacity would therefore be better. Not only does it account for the actual consumption of space, it also accounts for a more fair allocation of port dues for the amount of goods a barge transports. Moreover, it account for ports, waterways and situations where barges are physically unable to use their maximum loading capacity – for instance during the earlier named low water level. In some cases barges could only load up for 20% of their capacity. Port dues based on maximum loading capacity were therefore at least 5 times as high per ton/container as normal. With an actual loaded capacity rate the port dues per ton/container would have remained the same.

Most fair is a port due foundation based on actual transhipped goods. Proponents agree that the maximum loading capacity is not the correct measure. However according to them, the actual loaded capacity neither is the solution. They state that there is an increasing demand of multiple shipments per barge. With multiple pick-up and delivery ports, barges have to pay multiple dues for the same shipment. Port dues based on actual transhipped goods would solve this, paying only for the amount of goods that is meant for the port. On the other hand, this does not account for the consumption of space. Moreover, opponents state it is difficult and costly to implement.

This leads to a debate that is clearly expressed in the survey. The results of the survey question regarding quantity-based port dues are represented in figure 6.2. Although it looks less pronounced than table A6.3, it shows a comparable trend: Ease of use versus fairness.

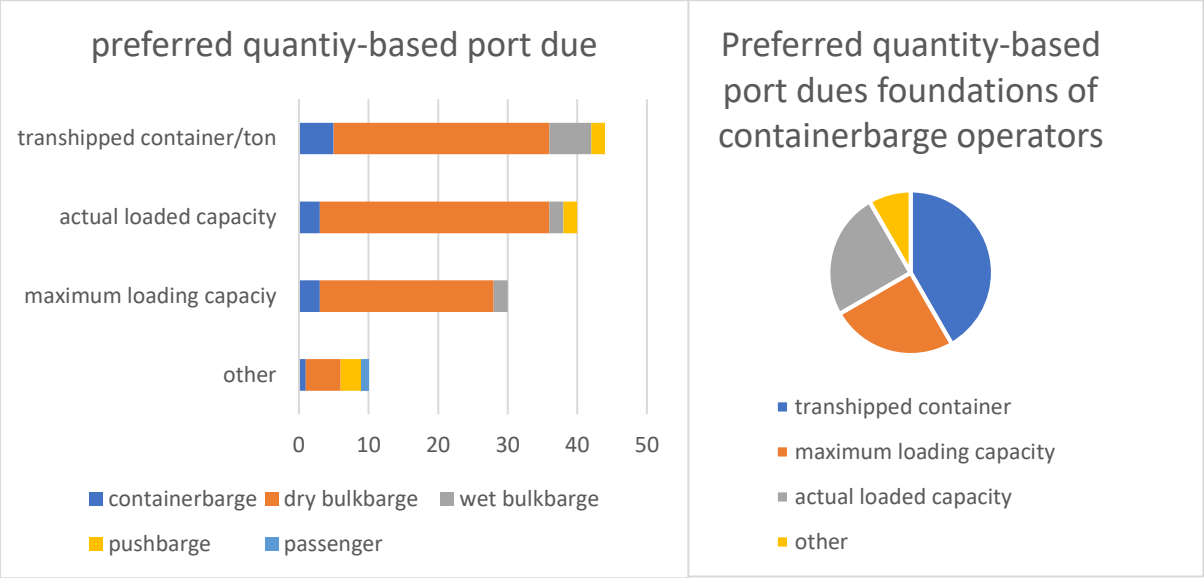



Figure 9 & 10: Number responses for suggested quantity-based port dues, split by barge type of the respondents. (hoover over data to see amount)

Port due foundations based on transhipped ton or container are most preferred. Especially among parties operating container-, and liquid bulk barges. According to them it is not only most fair, but also very possible to put this in practice. Next to the arguments made above, a surveyed person comments that 'If we can work with actual amounts when we pick up shipments, why would that not be possible when it comes down to port dues'. They also point to the unfairness regarding multiple shipments. This is not surprising given the nature of container transport.

The proponents of using the actual loaded capacity are also quoting fairness, but again state that charging per transhipped ton or container is either unmeasurable or will result in large amounts administrative work. The ones who voted for the maximum loading capacity quote, just as for the time-based weekly subscription, ease of use and that most ports use this system.

Another interesting remark is that pushbarge operators mostly state they consider square meter of a barge a fair and good foundation. An explanation was not left in the comment section. The fact that push barges have more storage capacity per square meter than other barges leads to the impression that fairness in this case is not the agenda.

Again, analysing the argumentation distinguishes two important decision factors are located: The fairness of port due foundations on one side, and the ease operation on the other side. The operational measures are addressed in chapter 6.5. Different than for time-based foundations,

quantity based foundation depend on the point of view. Are port dues charged on the consumption of space in port, or should they be based on what a barge is doing in that port? For the economic and environmental argument is clear what is best, however fairness depends on perception and behaviour. Most respondents however indicate that foundation based on actual transhipped container/ton is fairest. This is the foundation that is also best for economic development and environmental growth according to the interviewed stakeholders and the literature.

## 6.4 Port due pricing

Although creating a structure for port due pricing is not the aim of this thesis, it has been found to be important during interviews. There are significant differences between inland ports, that demand specific port due structures. Since port due foundations are aimed to be standardised, competition and differentiation of inland ports in port dues will have to depend largely on pricing. This section creates a framework to indicate that the different demands can still be facilitated, safeguarding the participation of inland ports in the standardisation of port dues.

As mentioned before: port dues should be used as tool to give (dis)incentives to optimise port efficiency and economic growth by taxing scarcity, push out unwanted activity and award desired behaviour. 'Optimizing efficiency and economic growth' has a different meaning in every port, leading to different port due pricing structures. Other way around, the need for competition and differentiation within the pricing structure also demands certain port due foundations. This section sketches an image of the demands of ports in their pricing structure.

During the interviews different issues have been found to be important for ports, affecting the optimal port due pricing structure. Three port specific characteristics and their consequences are highlighted below to present an argument for port due pricing: berth usage & time in port, locks and green policy.

### 6.4.1 Berths

An important issue named by most ports is the scarcity and availability of berths. The number of berths in ports is often not large enough to facilitate the demand of port-users. Many ports find it frustrating and undesirable that preferred spots in ports are used as storage on water by push barges, blocking the facilities for actual manned barges.

### *Duration of stay*

For ports that have a lack of berths, the most efficient pricing structure would cause a minimal time of stay at a berth. Ports that have excess supply of berths on the other hand, want to use a pricing structure that invites barges to stay in port. Ports that offer a variation of subscription such as a weekly, monthly, quarterly, and yearly subscriptions often combine this with a discount when a longer subscription is chosen. Ports want to lure users into spending more by offering a discount if quantity increases. This is a valid approach when demand is scarce. However in most ports supply is scarce. It would be more fitting to have an exponentially increasing price rather than a decreasing one. Moreover, it might even be more effective to offer a discount when barges stay less than a certain period of time.

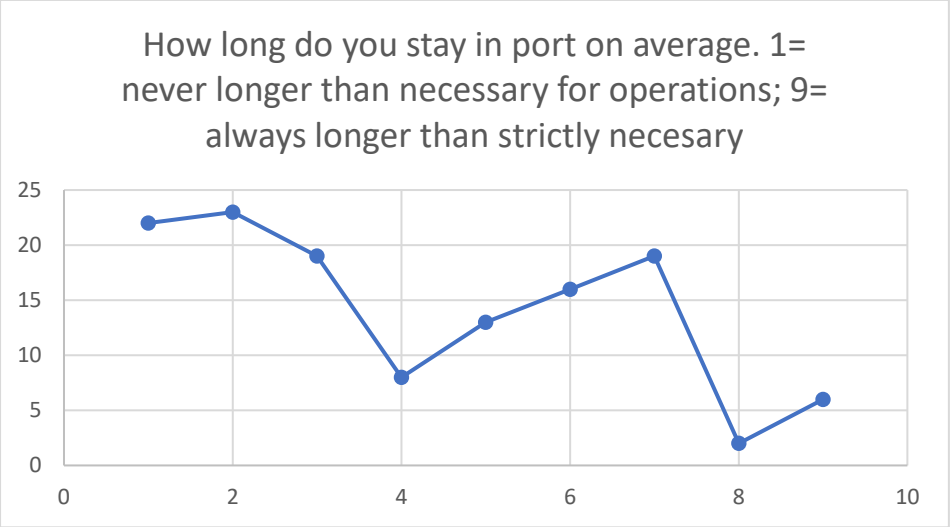



Figure 10: Time in port

Figure A6.7 provides a clear overview. Most port users do not stay longer in port than strictly necessary. There is however also a considerable part that does. By giving an incentive to stay longer in ports that desire long-term stay, and provide a disincentive on ports that want to decrease the duration of stay of barges, efficiencies can be gained.

### *Location of stay*

Another berth related issue is the location of stay. Port of Deventer provided a good example. They stated they have around 10 berths behind the locks. Deventer is a popular place to stay, so most of the time the berths are occupied. At least 2 of those spots are used as storage on water. In their opinion this is a shame since those places could be used by manned barges who would benefit more from the utilities. On the other hand, there are 6 berths outside the locks at the IJssel that are mostly empty. It would be desirable to have barges use those locations, especially the push barges that are used as storage on water. At the moment there is no incentive to do so. A distinction can be made between 2 camps.

On one hand there is the push barging sector. They state that given the current system, they are unfairly allocated for cost for amenities they do not use. A push barge does not need any of those facilities. Still they are charged the same amount as motorised and manned barges. A location-based incentive results in a system where users that demand less amenities move to less desirable spots. This can be push barges, but also unmanned normal barges that are not in operation due to holidays of the crew. This creates room for barges that do want to make use of amenities.

On the other hand, port users that do want to use amenities feel unfairly treated when they are not facilitated in port. In their opinion, this is something that should be provided by a port when they are asking for port dues. Several times the comparison with road transport and the free availability of resting places along the road is used. This is however, a poor argument. Berths are provided along waterways by the government for free. On roads this is financed by taxes on gas and road use. Taxing waterways is not allowed by the act of Mannheim. Berths within ports can in this framework be compared with parking spaces within cities, which are neither free.

Since in most ports there is a lack of berths, this is not an easy solved problem. Port dues can however make sure each type of consumer locates in the best available place. This can be done by valuing berths. Several examples are named, such as booking.com for berths: The desirability of a berth is awarded 1 to 5 stars depending on location and amenities. More stars means a higher price.

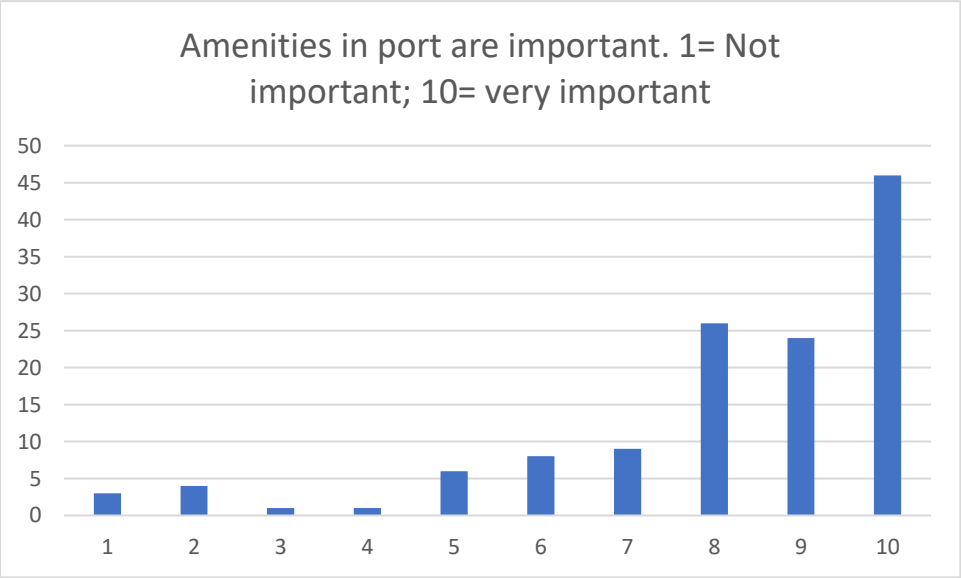



Figure 11: Importance of port amenities

Survey findings indicate that this might have a result. Most port users – except for push barge operators – value amenities highly. Of the few users that filled in they did not value them, some stated that there are barely any facilities and therefor there is nothing to value. These comments imply that they also value amenities, but have become sceptical.

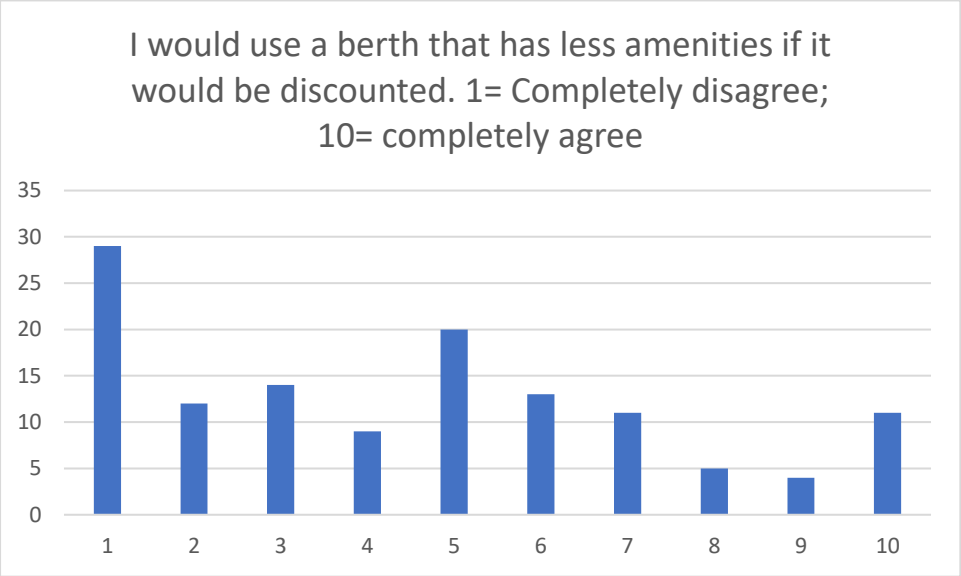



Figure 12: Effectiveness of berth quality pricing

Without a rating system, everyone would locate in the highest value location. Using the booking.com example: When a person could choose to stay in a road side motel or a city centre boutique hotel for the same price, the choice would be obvious. By instating price differences, quality demanding consumers will move to the hotel. Consumers looking for a cheap stay will move to the motel. Figure A6.11 shows that around 15% of the respondents would relocate when such an incentive is given. Whether this is effect is large enough to be significant should be further researched

### 6.4.2 Locks

Another interesting case is related to the presence of locks. They provide a physical barrier that barges have to pass. It results in extra cost, waiting times, and a limited possible passages a day. The optimal port due foundation of a port with a lock, can depend on the utilisation of it. When a lock is not fully utilised, providing a more competitive price would be a solution. However when the lock is operating at maximum capacity, port dues should be arranged in a way that it drives maximum utilisation of every barge for a port. Driving up the size of a port call can be the solution. By instating a minimum fee, results in incentives for a higher quantity transhipped in port.

### 6.4.3 Green Policy

It is debated whether incentives processed in port dues for being 'green' actually stimulate environmental sustainability. Shipping companies are clear on the matter: they do not. They state that no-one is going to make drastic alterations to their barge such as swapping the engine for a more sustainable type, unless it is physically necessary, or financially attractive. The financial gain of having a Green Award is not even close to compensating for a new engine. Moreover, they state that the price of a certification is barely regained by the benefits the Green Award certificate offers. According to them, quantity and efficiency based targets such as corridors and just-in-time management would be more beneficial. This is reflected by the finding of the survey. Although nearly a quarter (24%) of the respondents have got a Green Award certificate, less than 6% indicated that it played any role in the consideration for modifying their barge. Moreover, several respondents commented that they would qualify for a green award, but that they simply do not perceive it valuable.

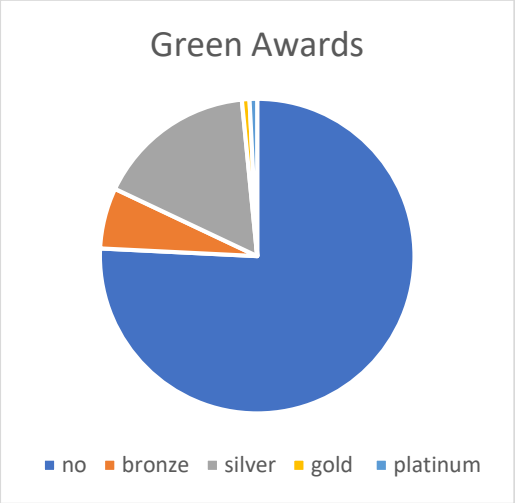



Figure 13: The split in Green Awards


Figure 14: The reason your barge qualifies for a Green Award

The Green Award Foundation on the other hand is clear: it does work. They state that they realise they cannot provide an incentive to swap an engine immediately. What it does offer, is a clear and easy framework that can be used to make the right decision when maintenance is due. This results in the creation of awareness. Next to that, Green Awards go further than discounts on port dues. Also discounts on the certification cost itself and rent on loans of the EICB are offered. According to them this should make it increasingly attractive to participate in the program and invest in being green. Moreover, the goal for environmental sustainability by firms and governments can be expected to drive their demand to exclusively use barges that have a Green Award. When this is the case, The Award system is going to be an important influencer for environmental sustainability.

What is needed is to increase both horizontal and vertical integration of the Green Award system. The more firms join the initiative, the larger the incentive is to make a green investment. The award will cost a marginal part of the income of firms, but can be expected to also attract business and provide good publicity. It is therefore beneficial both for economic development and environmental sustainability that all ports instate a Green Award.

Moreover, as stated by McCloskey (1999): “poor performers need to be prodded to improve; when they do, their improvement needs to be acknowledged.” Most ports that provide a discount at the moment use a single measure: Green Award certificate or not. Newly constructed barges are often directly able to claim a bronze Green Award. This means there is no financial incentive to improve anymore, unless ports are going to use a progressive system; different discounts for the different levels of Green Awards: Bronze, Silver, Gold & Platinum. By doing this, reward is provided for the effort put in environmental sustainability.

Then, there is the part where poor performers need to be prodded to improve. The theory shows that negative incentives have a stronger effect. It is debated however if that effect is to adapt or to move. Rotterdam is the one port in the Netherlands that provides such a negative incentive. According to them, this does not do any damage to their supply chain.

What should be instated is the progressive system of Bronze, Silver, Gold and Platinum. Whether this is combined with a negative incentive and what the size of this incentive is, should be decided per port depending on the port characteristics.

### 6.4.4 Fair pricing according to port users

Lastly, a major complained is given by nearly all port users: the large differences in prices for port facilities in general. Some ports that provide the same facilities as others charge up to double the amount. Moreover, there are ports that offer no facilities at all, and still are more expensive than ports that have a variety of amenities. Changing port dues foundation is unfortunately not going to change this. Whether the foundation is based on the maximum loading capacity or on actual usage, the pricing of the services offered remains a part of the competitive position of ports. What the social optimal price for port facilities is, is interesting for future research.

## 6.5 Port due operations

The most pressing demand from port users however, has to do with port due operations. Large differences occur between the methods of reporting a port visit and the manner of collecting the required port dues. This causes frustration, non-transparency and high administration cost. First, the current types of port due operation structures are discussed. Then, remarks from the industry are

addressed. Furthermore, an overview is given on the AIS and digitisation debate. Finally, port due congestion and operational solutions are discussed.

### 6.5.1 Current port due operation systems

Although they cannot be considered foundations, large differences occur between the methods of reporting a port visit and the manner of collecting the required port dues. Depending on the port announcing your arrival should either be done by transceiver upon arrival, by online form or by count of the port master. Some ports give a discount for announcing arrival beforehand or a penalty if it is announced late. To make it more confusing, several ports expect to receive information on paper regarding weight and duration of stay, whereas other ports save barge specifics and can process this themselves once a barge has announced itself.

Collection of port dues is also done in different ways. First of all several ports charge per visit, whereas others charge after a month for the total amount of visits that month. Then, these charges are accounted to either the barge that visits the port, the shipping company the barge works for or the industry that the shipment is meant for.

### 6.5.2 Standardisation of operations

The large differences between port due reporting and collection operations cause frustration for port users. It creates confusion, is prone to mistakes and most importantly creates a large amount of administrative work. Especially the latter is named as a costly and unnecessary affair. Many shipping companies call for the creation of a platform that facilitates reporting and collection at one location for all ports.

Multiple initiatives are aiming to create such a platform. It can be described as a ‘parking app for barges’. In the front end of such a platform, the users would only have to fill in the specifics of their barge once into their account. On the back end, it is fit neatly on the different structures of all ports. This would create a seamless experience. Administration would be done automatically, saving operational cost.

### 6.5.3 AIS and digitisation

For the best experience possible, sharing of barge location would be necessary. By doing this, arrival in port and departure from port does not need to be manually inputted. Such a platform could result in potential optimal use of port facilities. A good example how such a platform would work, is the PRONTO app. This is an app created by Port of Rotterdam to optimise port calls. It works as a sort of route planner. All parties involved in port activities share their data. By doing this, the optimal route can be planned through port activities. Of course, the complexities of a seaport as Rotterdam cannot

be compared to the average inland port. On the other hand, it could therefore be seen as an easy environment to implement such a platform compared to seaports. By sharing data, an estimated time of arrival can be suggested. Peak hours can be predicted. Berth availability can be monitored. Delays can be indicated.

An issue has been the unwillingness to share data, locations or AIS by skippers. It is either seen as an invasion of their privacy or as an undesirable strategical insight in their operations. Figure A6.12 shows a divide between port users. A total of 31% responded not to be willing to share AIS. They either argued that this has to do with privacy reasons, are mistrusting sharing data in general or that AIS is not meant for these purposes.

On the other end of the spectrum, 28% answered they are willing to share AIS. Most of them argued that it would help port optimisation and therefor help anyone involved. The 18% that answered they wanted personal benefits mostly argued that they expected to be helped findings the best available berth. The 7% who opted for “other” argued that AIS at this point is not precise enough. If it would be optimized, they would be willing to share it for optimisation purposes. This group of 53% of the respondents can be seen as the population that is willing to share AIS if used in purpose of optimisation and technologically stable. Whether 53% coverage is enough to optimise port activities should be researched. However it can be expected that if sharing AIS in practice results in benefits for those who do, the more sceptical respondents will follow.

The 16% remaining expects financial benefits. They mostly argued that ports also charge for everything, so it is fair that they would receive compensation for valuable data. Whether this group can be convinced to share AIS, depends on how ports value this data. If they can be convinced in sharing data, over 2/3th of barge owners would be sharing their AIS. Indicating that the argument for privacy is less represented than the argument for optimisation.

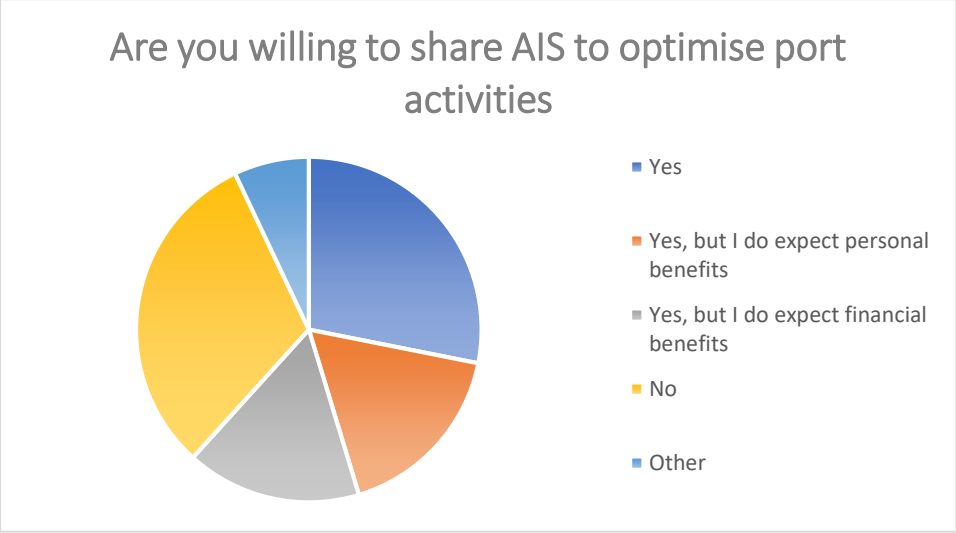



Figure 15: Willingness to share AIS

### 6.5.4 Corridors

The establishment of corridors means that ports along a route cooperate in bundling goods before entering the deep sea terminal. Instead of many barges dropping of a few containers, the call size at the terminal can now be increased up to 200 containers per barge. This results in a more efficient use of barges and less port calls needed. By most ports this is seen as an optimal use of barging. The establishment of a corridor is expected to provide significant improvements in the performance of inland transport. Reliability, efficiency optimisation and CO2 reduction were named as the result. In other words, they increase economic development and environmental sustainability. For this reason, corridors are something inland transport should strive for.

First and foremost, an efficient corridor operation demands port due foundations that that facilitates hopping of container barges. As shown previous chapters, these are foundations based on actual time and actual quantity transhipped. Only when this is instated, an optimal operations structures can be installed.

The bundling process of the corridor results in an extra port of call (at the bundling port) and extra transhipment of goods (transhipping goods with same destination on single barge). Whereas every party values, and is willing to facilitate corridors, it leads to a debate on the allocation of the extra cost it provides. On the one hand, inland ports that compete on price see the corridors extra cost result in a deterioration of their position, both within and between modalities. Moreover, the corridor according to them results in a better established position for the bundling port, since it provides them a better business environment.

On the other hand, bundling ports have extra cost for the transhipment of goods, which they want to have reimbursed. Moreover, Port of Moerdijk stated the amount of containers handled did not increase, only the amount of moves did. They therefor conclude that the corridors do not provide them with extra business, only more transhipment to manage corridors. Not asking port dues for containers in the corridor would therefore not only increase their cost, but actually decrease the income compared to the income without corridors.

There is a third party involved: the seaport. This party reaps the benefits of the corridor. The larger call-sizes at deep sea terminals and decrease pressure at their facilities. Moreover, less barges in port also results in more availability of/less need for all the facilities they use. Looking back at chapter 4.4: to create a fair system that all parties want to participate in, allocation of cost and benefits should be fair, and firms that suffer cost should be offered compensation to reduce them. Following this logic, seaports should partly compensate bundling ports minimise transhipment, since

the cost made at bundling ports is partly made in the benefit of the seaport. How this should be constructed, is interesting for future research.

### 6.5.5 Timeslots

Another measure that could optimise port operations are timeslots. With a timeslot, a port provides a fixed window for a barge to tranship its goods. When a timeslot is booked, a barge operator can plan its operations around it instead of having to wait its turn in port. Especially combined with corridors – resulting in large size port calls – it provides a high efficiency measure. Next to that, a guaranteed time-slot provides reliability, which has been named one of the barriers to use barge transport as a mode of transport. ECT acted on this by asking a fee for using a timeslot. Pricing time slot seems like a perverse incentive, since it drives-up the cost of a reliability. However container barge operators stated that they did not mind the fee, since it provided them with a mandate of service.

Figure 16 shows that most of the respondents would not use a timeslot if they could use one. They mostly stated that reservation is of no use due to the unreliability of barging. However 31% of the respondents stated that it could be helpful. By reserving a berth, they would know directly where to go and what to expect. This shows that it might upgrade the operational structure of ports.

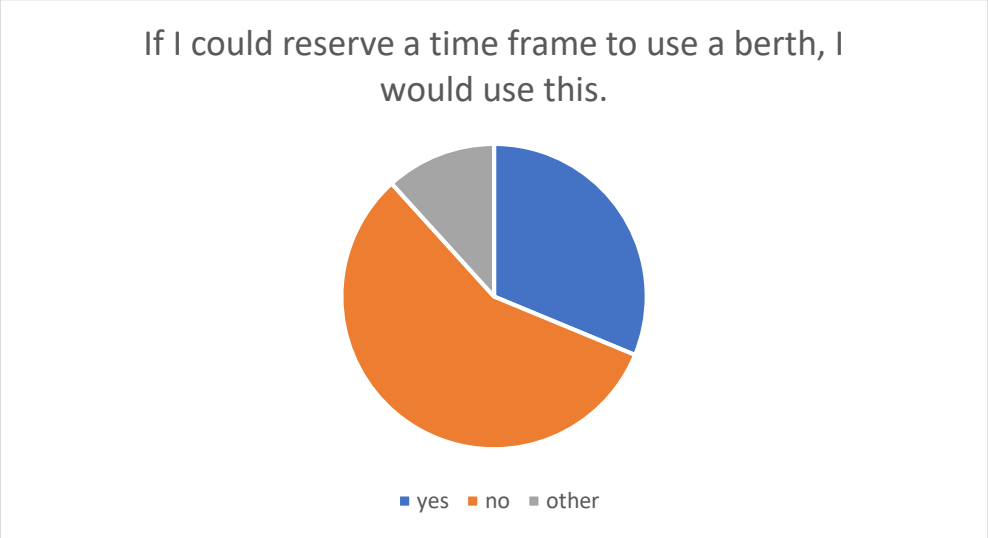



Figure 16: Reserving time slots when available

## 6.6 Inland port due model

The results from the interviews and survey lead to table 3. The findings not only correspond to the theoretical findings, but further expand on them. A more complete framework for inland port due foundations, inland port due pricing and inland port due operations is created. This framework provides an overview how inland ports should build their port due structure.

| | Policy | Bulk | Container |
|---|---|---|---|
| **Foundation** | Time-based | Actual time of stay | Actual time of stay |
| | Quantity-based | Actual transhipped ton | Actual transhipped container |
| | Environmental | Green Award | Green Award |
| **Pricing** | Time-based | Scarcity | Scarcity |
| | Quantity-based | Competitive position | Competitive position |
| | Location-based | Quality of amenities | Quality of amenities |
| | Barriers | Utilisation | Utilisation |
| | Environmental | Tax laggards + stepped reward | Tax laggards + stepped reward |
| **Operations** | Reporting & collecting | Standardisation of operations | Standardisation of operations |
| | | Digitisation op operations | Digitisation of operations |

Table 3: Final suggested inland port due model

All ports should base their port due structure on three foundations: a time-based foundation, a quantity-based foundation, and an environmental foundation. The time-based foundation should be based on actual time of stay. This has been found to optimise fairness and is also desired by port users. Especially barges that are just in a port for logistical operations will benefit from this, since they are in port the shortest amount of time. It is therefore also expected that a foundation based on actual time of stay is going to increase economic development and will result in modal shift.

The quantity-based foundations should be based on actual transhipped goods. This can either be based on tonnage for bulk transport or containers for container transport. Especially for container transport this is important. It decreases the barrier to tranship small amounts, which increases economic development and environmental sustainability. Next to that, it increases the fairness of the port due structure. Although there is less need in the sector, for bulk transport the same arguments hold.

An environmental port due foundation should be based on the Green Award structure. The standardised eco-label the Green Award Foundation provides, results in s credibility, comparability, clarity, transparency and legitimacy. By using their measures, environmental sustainability is positively affected.

Pricing of port dues depends on the wants and needs of a port. Time-based pricing should be focussed on taxing scarcity. If a port wants to decrease the time a barge is in the port it should use an increasing price, whereas ports that want to increase the time a barge is in port should use a decreasing price. Quantity-based pricing depends on the competitive position of a port. It should tax if they want to discourage something, and put incentives on what they want to encourage. Location-

based pricing should be based on quality of amenities. When a location offers better amenities, it should have a higher price. Barriers should be priced based on the utilisation level. When a barrier limiting performance and it is not fully utilised, prices should be decreased. If it is, a minimum fee should be instated. Finally, the environmental price should focus both on taxing laggards and rewarding frontrunners. The stepped system of the Green Award Foundation should be instated to maintain incentives to improve. These port due pricing structures all aim to optimise port activities, increasing economic development and environmental sustainability. They do however not necessarily create fairness of the port due structure.

On operational level, inland ports should be focussed on the standardisation and digitisation of their port due structure. The lack of standardisation between different inland ports drive up cost and cause frustrations for port users. Digitising port due operations through apps, platforms and by using AIS can solve these problems. Moreover, digitisation creates ease of use and results in a straight forward implementation of port due foundations that are based on actual use.

## 6.7 An example of historical foundations vs actual use

To better visualise the effects of changing port due foundations, the only part that can be calculated by a hypothetical example is the financial effect of changing port dues. As stated this is less relevant than the economic effect, environmental effect and the effect on the fairness of port dues. However, it is still interesting to see. The example shows how port due cost and port due cost per container variate for different port dues. Three barge types are used for the comparison:

- Container Kempenaar (class 3):
    - Dimensions in meters: L63, W7, D2.5
    - Capacity: 32 TEU / 1000 ton
- Standard container barge (class 5a):
    - Dimensions in meters: L110, W11.4, D3
    - Capacity: 200 TEU / 2750 ton
- Large container barge (class 5b):
    - Dimensions in meters: L135, W17, D3.5
    - Capacity: 500 TEU / 6000 ton

Those barges follow the newly established North-Brabant Corridor:

| | Rotterdam | Moerdijk | Waalwijk | Den Bosch | Wanssum | Venlo |
|---|---|---|---|---|---|---|
| **Container/ FEU rate** | 3* | 2,79 | 1 | 3* | 3,0116 | 3,14 |
| **ton tariff** | 0,095 | 0,084 | 0,09 | 0,12 | 0,15374 | 0,14 |

**Rotterdam and Den Bosch do not have a container rate. The 3 euro rate is based on the other rates, however fictional*

In Rotterdam they are loaded for 100%, 75% or 50% at a deep sea terminal with 40-foot containers. Then they sail to the bundling port of Moerdijk, where in some cases the special situation occurs that more than the full capacity of the barge is transhipped. In total 75% of the containers are loaded of the barge, and the same amount is received back. After having done this, they hop via Waalwijk, Den Bosch, Wanssum to Venlo, transhipping containers along the way. Table 5 below shows how much more expensive the use of historical port dues is compared to port dues based on container rates for this journey.

| | Rotterdam | Moerdijk | Waalwijk | Den Bosch | Wanssum | Venlo | cost difference | |
|---|---|---|---|---|---|---|---|---|
| **Class\|FEU** | Pick-up | 75% | 10 | 20 | 30 | 40 | | |
| **3: 100% loaded** | 98% | 25% | 800% | 100% | 70% | - | € 267,43 | 97% |
| **3: 75% loaded** | 164% | 67% | 800% | 100% | 70% | - | € 296,17 | 120% |
| **3: 50% loaded** | 296% | 151% | 800% | 100% | 70% | - | € 324,91 | 149% |
| **5a: 100% loaded** | -13% | -45% | 2375% | 450% | 368% | 207% | € 873,09 | 87% |
| **5a: 75% loaded** | 16% | -26% | 2375% | 450% | 368% | 207% | € 1.052,71 | 128% |
| **5a: 50% loaded** | 74% | 10% | 2375% | 450% | 368% | 207% | € 1.232,34 | 191% |
| **5b: 100% loaded** | -24% | -52% | 5300% | 1100% | 921% | 569% | € 2.014,24 | 97% |
| **5b: 75% loaded** | 1% | -36% | 5300% | 1100% | 921% | 569% | € 2.463,30 | 151% |
| **5b: 50% loaded** | 52% | -4% | 5300% | 1100% | 921% | 569% | € 2.912,37 | 246% |

Table 5: Price difference between maximum loading capacity and container tariff

It shows that this system is relatively fair: When a small amount of containers is transhipped, it is much cheaper. However when a large amount of containers is transhipped – such as in Moerdijk, where more than 100% of the capacity is transhipped – it results in more cost than using the maximum loading capacity. The cost now no longer depend on the dimensions of the barge, but on what the barge is actually doing in the port. The overall cost when maximum loading capacity is used, are 87% to 246% higher than when a container rate is used.

Although reasons for fairness and barge operators are clear, the benefit for inland ports to switch to a container rate are less obvious. They seem to lose a large part of their revenue from inland port dues. In the most extreme case of this example however, the cost for using the maximum loading capacity are 53 times as high. In this case it is valid to reason that inland ports do not loose nearly all of their revenue, but that a new market is tapped into: the port used to be too expensive for this market. When this is the case, it actually results in extra business and revenue for the inland ports.

# 7 Conclusion

This thesis has researched new foundations based on current practices in inland shipping foundations for inland port dues in the Netherlands and if those foundations can be standardised. The foundations proposed would maximise economic development, environmental sustainability and fairness. It is shown that the use of three inland port due foundations achieves this: (1) a time-based foundation based on actual time in port, (2) a quantity-based foundation based on actual quantity transhipped and (3) an environmental foundation based on the measures of the Green Award Foundations.

Standardisation of those foundations has been found not to be an issue. Inland ports do have major differences. To optimise port activities, these demand varying port due structures. Even though standardisation means this can no longer be achieved on port due foundations level, on port due pricing level this is still very possible. Ports maintain the opportunity to price time, quantity, location, barriers and emission as they like, resulting in a port due structure that works for every port regardless of standardised foundations.

Although this is a big issue for port users, the standardisation of inland port due foundations does therefor not eradicate price differences between ports. That is still for ports to decide. Standardisation based on the three foundations does however result in legitimacy: port users are charged for what they are actually doing, not for what they could potentially do. Cost are not allocated from inefficient users to efficient ones, driving economic activities and resulting in fair allocation of cost. Next to that, environmental laggards are punished and front runners rewarded. This results in a system where environmental sustainability is rewarded. Moreover, due to standardisation of port due foundations the performance of inland ports can be compared without having to make assumptions. A clear overview can therefore be created to optimise the focus in R&D and increase effectiveness of investments.

Although this sound promising, two fair questions are raised: one, is it actually possible to implement port due foundations based on actual use? Based on the results of this study, it is considered feasible. To make this work, port due operations need to be standardised and digitised. The use of AIS, and platforms and apps that are being developed provide software for this. Although a third of the port users is not willing to share their AIS, two thirds is willing to share AIS data. If sharing AIS has a positive effect for those who do, it can be expected that others follow. Next to that, digitisation has the added benefit that port dues can be charged fully automatic. This results in a decrease in administration for both ports and port users.

Two, how large is the impact of changing port due foundations going to be? In other words, is it worth our while? The example of chapter 6.7 shows that a change in port due foundations does result in a more fair distribution of cost and is likely to cause new markets to be tapped into. Also survey results show that incentives are likely to have some effects. However the size and significance of these changes can only be measured after instating those new ports dues. One thing can be stated: Changing them will not have a negative effect. Therefor there is no reason not to at least try it.

# 8 Weaknesses, strengths & future research

Two major limitations arise during this research. First of all, the lack of academic research focused on inland ports and port dues. Therefor creating a theoretical framework not only inland port dues, but specifically on the foundations of inland port dues relied on a wide area of research. This research often touched only minor parts of the subject. Although together they build a decent case for inland port due foundations, it depends heavily on assumptions from other fields. An important part of these difficulties is that a large part relies on academic research on sea ports. Not only can this research not directly be translated to inland ports, seaports have also changed drastically during the last 10 years. Resulting in the use of possibly outdated conclusions.

Second, there is an absence of quantitative data when it comes to inland barging. Data is either nonexistent or not made available by those who have it. This weakness has an impact on the foundation of the conclusions drawn. No real examples can be given, only financial calculation and qualitative assumptions.

The strength of this thesis is founded on its weaknesses. Given the lack of data and academic theory, this research has been conducted from multiple approaches to create a decent foundation where this was lacking before. Not only a large group of inland ports is interviewed, but also their users. Both the visions and dilemmas of inland ports and the frustrations and wishes of their users are documented. This resulted in a completed overview of the effectiveness and correlation of goals of those parties that next to each other formed a relatively complete overview of opinions and viewing points. Moreover, the survey distributed under port users created a small quantifiable amount of data to serve as measure for qualitative opinions.

Next to that, the advice for not only inland port due foundations, but also for its pricing and operations presents a complete format that does not leave a lot of questions. It is therefore very implementable.

Two future suggestions for further research flow from these findings. Once the suggested port dues foundations are implemented, data can be gathered. With that data, it can finally be tested what the actual bottlenecks in the complete inland port due structure are. Where are the bottlenecks? Which ports are under-, or overperforming, and why is that? Is this the best port due, or should it again be adjusted now actual data is created?

During the interviews another interesting perspective on port dues popped up regularly: if decreasing port dues results in optimisation, why not abolish them. Moreover, the municipality of Zwijndrecht stated that before their port became part of the port due structure of Port of

Rotterdam, the cost of collecting port dues was higher than what they received. So why would they actually do the effort of charging a fee? Now a framework has been created for standardised port due foundations, following research should focus on the optimisation of pricing of inland port dues.

# 8 References

Acciaro, M., Ghiara, H., & Cusano, M. I. (2014). Energy management in seaports: A new role for port authorities. *Energy Policy*, 71, 4-12.

Anshelevich, E., Dasgupta, A., Kleinberg, J., Tardos, E., Wexler, T., & Roughgarden, T. (2008). The price of stability for network design with fair cost allocation. *SIAM Journal on Computing*, *38*(4), 1602-1623.

Baier, S. L., & Bergstrand, J. H. (2001). The growth of world trade: tariffs, transport costs, and income similarity. *Journal of international Economics*, *53*(1), 1-27.

Balcombe, K., Fraser, I., & Harris, L. (2009). Consumer willingness to pay for in-flight service and comfort levels: A choice experiment. *Journal of Air Transport Management*, *15*(5), 221-226.

Bansal, P., & Roth, K. (2000). Why companies go green: A model of ecological responsiveness. *Academy of Management Journal*, 43(4), 717–736.

Bartik, T. J. (1988). The effects of environmental regulation on business location in the United States. *Growth and Change*, *19*(3), 22-44.

Baumeister, S., & Onkila, T. (2017). An eco-label for the airline industry?. *Journal of cleaner production*, *142*, 1368-1376.

Bentley, T., Wedgwood, J., & Whitworth, R. (1766). *A view of the advantages of inland navigations : With a plan of a navigable canal, intended for a communication between the ports of liverpool and hull*(2nd ed., Eighteenth century collections online) [2nd ed.]. London: Printed for Becket and 6 others. (1766).

Bergqvist, R., & Egels-Zandén, N. (2012). Green port dues—The case of hinterland transport. *Research in Transportation Business & Management*, *5*, 85-91.

Besen, Stanley M. and Leland L. Johnson (1986). *Compatibility Standards, Competition, and Innovation in the Broadcasting Industry*. Santa Monica, California: The RAND Corporation, November.

Bilbao-Osorio, B., & Rodríguez-Pose, A. (2004). From R&D to innovation and economic growth in the EU. *Growth and Change*, *35*(4), 434-455.

Blind, K. (2004): The Economics of Standards – Theory, Evidence, Policy: Edward Elgar.

Blind, K. (2016). The impact of standardisation and standards on innovation. In *Handbook of Innovation Policy Impact*. Edward Elgar Publishing.

Bloemhof, J. M., Van der Laan, E. A., & Beijer, C. (2011). Sustainable Inland Transportation. *International Journal of Business Insights & Transformation*, *3*.

Bouchery, Y., & Fransoo, J. (2015). Cost, carbon emissions and modal shift in intermodal network design decisions. *International Journal of Production Economics*, *164*, 388-399.

Brunnermeier, S. B., & Levinson, A. (2004). Examining the evidence on environmental regulations and industry location. *The Journal of Environment & Development*, *13*(1), 6-41.

Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: the BIS/BAS scales. *Journal of personality and social psychology*, 67(2), 319.

Closs D.J., Goldsby T.J. & Clinton, S.R. (1997). Information technology influences on world-class logistics capability. *International Journal of Physical Distribution and Logistics Management*, 27 (1), pp. 4-17

Co2emissfactoren.nl (2017). *Lijst emissiefactoren*. Retrieved from: https://www.co2emissiefactoren.nl/lijst-emissiefactoren/#goederenvervoer"

Contestabile, M., Offer, G. J., Slade, R., Jaeger, F., & Thoennes, M. (2011). Battery electric vehicles, hydrogen fuel cells and biofuels. Which will be the winner?. *Energy & Environmental Science*, *4*(10), 3754-3772.

Corman, F., & Negenborn, R. R. (2017). Accessibility of Ports and Networks. In *Ports and Networks* (pp. 127-145). Routledge.

David, P. A., & Greenstein, S. (1990). The economics of compatibility standards: An introduction to recent research. *Economics of innovation and new technology*, 1(1-2), 3-41.

De Martino, M., Errichiello, L., Marasco, A., & Morvillo, A. (2013). Logistics innovation in seaports: An inter-organizational perspective. *Research in Transportation Business & Management*, *8*, 123-133.

Den Boer, L. C., Brouwer, F. P. E., & Van Essen, H. P. (2008). STREAM Studie naar transport emissies van alle modaliteiten. *Delft, CE*.

European Comission. Directorate-General for Mobility and Transport. (2011). *White Paper on Transport: Roadmap to a Single European Transport Area: Towards a Competitive and Resource-efficient Transport System.* Publications Office of the European Union.

Evangelista, P., & Sweeney, E. (2006). Technology usage in the supply chain: the case of small 3PLs. *The International Journal of Logistics Management*, 17(1), 55-74.

Farrell, J. V. R., & Saloner, G. (1984). Standardization, compatibility and innovation.

Geest, van der, W., Quispel, M. & Overweel, M. (2013). Hoofdrapport: Haven en kadegelden grondslagen.. Panteia

Geest, van der, W., Quispel, M. & Overweel, M. (2013). Rapport: Historische grondslagen havengelden. Panteia

Gneezy, U., Meier, S., & Rey-Biel, P. (2011). When and why incentives (don't) work to modify behavior. *Journal of Economic Perspectives*, *25*(4), 191-210.

Grossman, G.M., and E. Helpman. 1994. Endogenous innovation in the theory of growth. *Journal of Economic Perspectives* 8: 23-44.

Gudmundsson, A., Boer, H., & Corso, M. (2004). The implementation process of standardisation. *Journal of manufacturing technology Management*, *15*(4), 335-342.

Ha-Brookshire, J. E., & Norum, P. S. (2011). Willingness to pay for socially responsible products: case of cotton apparel. *Journal of consumer Marketing*, *28*(5), 344-353.

Hagmann, C., Semeijn, J., & Vellenga, D. B. (2015). Exploring the green image of airlines: Passenger perceptions and airline choice. *Journal of Air Transport Management*, *43*, 37-45.

Happé, R.H. (2011) '*Belastingethiek: een kwestie van fair share'*, in: Belastingen en ethiek, Geschriften van de Vereniging voor Belastingwetenschap, nr. 243, Deventer, Kluwer, p. 9

Haralambides, H. E. (2002). Competition, excess capacity, and the pricing of port infrastructure. *International journal of maritime economics*, 4(4), 323-347.

Harel, S. (2005). Perception on information and communication technology perspectives in logistics: A study of transportation and warehouses sectors in Singapore. *Journal of Enterprise Information Management*, 18(2), 136-149.

Heggie, I. G. (1974). Charging for port facilities*. Journal of transport economics and Policy*, 3-25.

Ishii, M., Lee, P. T. W., Tezuka, K., & Chang, Y. T. (2013). A game theoretical analysis of port competition. *Transportation Research Part E: Logistics and Transportation Review*, 49(1), 92-106

Kang, K. H., Stein, L., Heo, C. Y., & Lee, S. (2012). Consumers' willingness to pay for green initiatives of the hotel industry. *International Journal of Hospitality Management*, *31*(2), 564-572

Koopman, G.J. (1997). Long-Term Challenges for Inland Transport in the European Union: 1997–2010: consequences for transport fuel economy and use. *Energy Policy*, *25*, 1151-1161.

Kuipers, B. (October 11th, 2014). Ja, de container is uitvinding van de eeuw. *NRC Handelsblad*. Retrieved from: https://www.nrc.nl/nieuws/2014/10/11/ja-de-container-is-uitvinding-van-de-eeuw-1427438-a414958

Langen, P. de (2007). Port competition and selection in contestable hinterlands : the case of Austria. *European Journal of Transport and Infrastructure Research*. 7. 1-14.

Laszlo, C., & Cescau, P. (2017). Sustainable value: How the world's leading companies are doing well by doing good. *Routledge.*

Levinson, M. (2016). *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger-with a new chapter by the author*. Princeton University Press.

Lichtenberg, F.R. 1992. *R&D investment and international productivity differences*. NBER WorkingPaper N. 4161.

McCloskey, M. (1999). Environmentally responsible business. *Vital Speeches of the Day, 65*(17), 534-536.

McConnell, V. D., & Schwab, R. M. (1990). The impact of environmental regulation on industry location. *Land Economics*, *66*(1), 67.

Memedovic, O., Ojala, L., Rodrigue, J. P., & Naula, T. (2008). Fuelling the global value chains: what role for logistics capabilities?. *International Journal of Technological Learning, Innovation and Development*, *1*(3), 353-374.

Ministerie van Infrastructuur en Waterstaat (19-07-2019). Green Deal Zeevaart, Binnenvaart en Havens. *Staatcourant*, 39775

Mulatu, A., Gerlagh, R., Rigby, D., & Wossink, A. (2010). Environmental regulation and industry location in Europe. *Environmental and Resource Economics*, *45*(4), 459-479.

Nazemzadeh, M., & Vanelslander, T. (2015). The container transport system: Selection criteria and business attractiveness for North-European ports. *Maritime Economics & Logistics*, 17(2), 221-245.

Ng, K. Y. (2006). Assessing the attractiveness of ports in the North European container transhipment market: an agenda for future research in port competition. *Maritime Economics & Logistics*, 8, 234-250.

Nederlandse Vereniging van Binnenhavens (2019): *Havenlocaties Nederland 2019.* Jager media.

Nederlandse vereniging van Binnenhavens (April 13th, 2018). *Masterclass 'De duurzame haven van de toekomst' - deel 3.* Retrieved from: https://havens.binnenvaart.nl/duurzamehaven3

Nederlandse Vereniging van Binnenhavens. (October 4th, 2013). *Modernisering havengelden impuls voor efficienter containervervoer over water.* Retrieved from: https://havens.binnenvaart.nl/nieuws/191-modernisering-havengelden-impuls-voor-efficienter-containervervoer-over-water

Nijdam, M., & van der Horst, M. (2017). Port Definition, Concepts and the Role of Ports in Supply Chains: Setting the scene. In *Ports and Networks* (pp. 9-25). Routledge.

Notteboom*, T. E., & Rodrigue, J. P. (2005). Port regionalization: towards a new phase in port development. *Maritime Policy & Management*, 32(3), 297-313.

Ozanne, L. K., & Vlosky, R. P. (1997). Willingness to pay for environmentally certified wood products: A consumer perspective. *Forest products journal*, *47*(6), 39.

Pan, S., Ballot, E., & Fontane, F. (2013). The reduction of greenhouse gas emissions from freight transport by pooling supply chains. *International Journal of Production Economics*, *143*(1), 86-94.

Port of Amsterdam (27-01-2017). *Amsterdam introduceert containertarief binnenhavengeld*. Retrieved from: https://www.portofamsterdam.com/nl/nieuwsbericht/amsterdam-introduceert-containertarief-binnenhavengeld

Public-Private Infrastructure Advisory Facility Staff. (2003). Port reform toolkit. Washington: World Bank Publications. (2003).

Radbruch, G. (2003). *Rechtsphilosophie* (Vol. 2043). CF Müller GmbH.

Ramakumar, A., & Cooper, B. (2004). Process standardization proves profitable. *Quality*, *43*(2), 42.

Rashid, N. R. N. A. (2009). Awareness of eco-label in Malaysia's green marketing initiative. *International Journal of Business and Management*, *4*(8), 132-141.

Romer, P. (1990). Endogenous technological change. *Journal of Political Economy* 98: S71-102.

Schäufele, I., & Hamm, U. (2017). Consumers' perceptions, preferences and willingness-to-pay for wine with sustainability characteristics: A review. *Journal of Cleaner production*, *147*, 379-394.

Schniederjans, D. G., & Starkey, C. M. (2014). Intention and willingness to pay for green freight transportation: An empirical examination. *Transportation Research Part D: Transport and Environment*, 31, 116-125.

Simmons, J. K. (1967). A concept of comparability in financial reporting. *The accounting review*, *42*(4), 680-692.

Singh, T. (2010). Does international trade cause economic growth? A survey. *The World Economy*, *33*(11), 1517-1564.

Stabler, M.J. & Goodall, B. (1997). Environmental awareness, action and performance in the Guernsey hospitality sector. *Tourism Management*, 18 (1) (1997), pp. 19-33

STC-NESTRA (2015). *Kansen voor slimme containerbinnenvaart en de havengelden*. STC-EduPort, Rotterdam

Streng, M. & Kuipers, B. (2016). *Binnenhavenmonitor 2015.* Erasmus University

Suykens, F., & Van de Voorde, E. (1998). A quarter a century of port management in Europe: objectives and tools. *Maritime Policy and management*, 25(3), 251-261.

Tassey, G. (2000). Standardization in technology-based markets. *Research policy*, *29*(4-5), 587-602.

Trajtenberg, M. (1990). Economic analysis of product innovation. Cambridge: Cambridge UniversityPress.

Tavasszy, L., Behdani, B., & Konings, R. (2017). Intermodality and synchromodality. In *Ports and Networks* (pp. 251-266). Routledge.

Tsamboulas, D., Vrenken, H., & Lekka, A. M. (2007). Assessment of a transport policy potential for intermodal mode shift on a European scale. *Transportation Research Part A: Policy and Practice*, *41*(8), 715-733.

Van den Bosch, F. A., Hollen, R. M., & Volberda, H. W. (2017). How Ports Create Strategic Value for their Country. In *Ports and Networks* (pp. 38-53). Routledge.

Van Den Bosch, F. A., Hollen, R., Volberda, H. W., & Baaij, M. G. (2011). The strategic value of the Port of Rotterdam for the international competitiveness of the Netherlands: A first exploration. *Rotterdam School of Management (RSM), Erasmus University Rotterdam*.

Van Klink, H. A., & van Den Berg, G. C. (1998). Gateways and intermodalism. *Journal of transport geography*, *6*(1), 1-9.

Vaccaro, J.J.P. Jansen, F.A.J. Van Den Bosch, H.W. Volberda. (2012) Management innovation and leadership: The moderating role of organizational size. *Journal of Management Studies*, 49 (1), pp. 28-51

Van Rooy, B. (2010). Applying hub-and-spoke networks to inland barge transportation: a quantitative and qualitative analysis for a port terminal operator. *Master's thesis, Eindhoven University of Technology*.

Vavier, M. & Verkade, B. (2018). *Tijd voor actie: modernisering van haventarieven*. Havenlocaties Nederland 2018, 16-18.

Witte, P., Wiegmans, B., van Oort, F., & Spit, T. (2014). Governing inland ports: a multi-dimensional approach to addressing inland port–city challenges in European transport corridors. *Journal of Transport Geography*, *36*, 42-52.

Witten, Ian H. (1983), Welcome to the Standards Jungle: An In-Depth Look at the Confusing World of Computer Connections. Byte, 8(2, February), 146-178.

Yevdokimov, Y. V. (2000). Measuring economic benefits of intermodal transportation. *Transp. LJ*, *27*, 439.

Zhang, M., & Pei, A. J. (2016). *Synchromodal versus intermodal freight transport: The case of rotterdam hinterland container transport* (No. 16-2237).

# 9 Appendix

## A1 Interviewed ports and their stakeholders:

| | |
|---|---|
| • Flevokust haven | Municipality of Lelystad & province of Flevoland |
| • Gemeente Venlo | Municipality of Venlo |
| • Gemeente Waalwijk | Municipality of Waalwijk |
| • Gemeente Zwijndrecht | Municipality of Zwijndrecht |
| • Haven Wanssum | Municipality of Venray |
| • Port of Amsterdam | Municipality of Amsterdam |
| • Port of Deventer | Municipality of Deventer |
| • Port of Moerdijk | Municipality of Moerdijk |
| • Port of Rotterdam | Municipality of Rotterdam |
| • Port of Twente | Municipality of Almelo, Enschede, Hengelo, Hof van Twente & Lochem |
| • Port of Zwolle | Municipality of Zwolle, Kampen & Meppel |

## A2 List of base questions for inland ports:

- What are port dues?
- What is the importance of the port for the municipality?
- Why are these port due foundations used?
- How are the port dues collected?
- What are the bottlenecks of the port and what do you think could be a solution?
- Can port dues be used to overcome those problems?
- Can port dues be used to become more sustainable?
- If both not: Do you think port dues can affect behaviour/situations at all?
- What do you consider the best port due structure?
- Do you think nationally standardised inland port due foundations are feasible?

## A3 Interview shipping companies

| | |
|---|---|
| • Danser | Container transport |
| • Feenstra Rijn Lijn | Passenger transport |
| • ThyssenKrupp Veerhaven | Push barging |
| • Uniworld River Cruises | Passenger transport |
| • Wijgula | Wet bulk transport |
| • ZwaansDelta | Wet bulk transport |

## A4 List of base questions for shipping companies:

- What are port dues for?
- Do port dues have any effect on business decisions?
- Which port has a specifically good/bad port due structure, and why?
- What would be the ideal structure, and why?
- Are you influenced by location-based incentives?
- Are you influenced by sustainability based incentives?
- Are you struggling with modal competition
- Do you think nationally standardised inland port due foundations are feasible?

## A5 Survey questions for port users:

### A5.1 Orientation

- How many barges do you exploit?
    - 0 [if chosen, end of survey]
    - 1
    - More than 1
- Which type of barges do you mainly have?
    - Container barges
    - Dry bulk barges
    - Liquid bulk barges
    - Push barges
    - Passenger barges
- Which port due foundation with regard to quantity do you prefer?
    - Maximum loading capacity
    - Actual loaded capacity
    - Transhipped container/ton
    - Transhipped full container (in case of container transport)
    - Square meterage of the barge
    - Per passenger (in case of passenger transport)
    - Other, namely:
- Can you explain why? Or why specific foundations not?
    - [Room for comments]
- Which port due foundation with regard to time do you prefer?
    - Historical week subscription single entry

  - Historical week subscription multiple entry
  - 24 hour rate
  - Actual time in port
  - Long term subscriptions
  - Other, namely:
- Can you explain why? Or why specific foundations not?
  - [Room for comments]
- Do you pay port dues yourself, or does someone pay this for you?
  - I pay port dues myself
  - I do not pay port dues myself

## A5.2 Environmental sustainability

- Does your barge have a Green Award certificate?
  - No [if chosen, go to last question of section]
  - Yes, bronze
  - Yes, silver
  - Yes, gold
  - Yes, platina
- Did you receive a Green Award due to modernising/renovating/upgrading your barge?
  - No [if chosen, go to last question of section]
  - Yes
- To what extend did the Green Award certificate play a role in this process? The certificate…
  - …Did not play a role
  - …Is nice, however did not play a role
  - …Was part of the reason
  - …Was the main reason
  - Other, namely:
- Statement: The incentives that come with a Green Award Certificate stimulate me to increase the environmental sustainability of my barge.
  - Yes, they play an important role
  - Yes, however only a small role
  - No, however when more/all ports would join it would
  - No, the discounts are nice, however they do not play any role
  - Other, namely:

## A5.3 Amenities and efficiency

- How long do you on average stay in the port area?
    - Scale 1-9: 1 = no longer than necessary for transhipment purposes; 9 = next to transhipment purposes I also stay for non-logistical/social activities.
- Can you extend your answer?
    - [Room for comments]
- Statement: I would stay longer in a port with a historical week subscription than one with a 24hour rate.
    - Yes
    - No
    - Other, namely:
- Can you extend your answer?
    - [Room for comments]
- Statement: If I could reserve a timeslot for a berth in port I would use this feature.
    - Yes
    - No
    - Other, namely:
- Can you extend your answer?
    - [Room for comments]
- Amenities in port such as shore power, Wifi, freshwater, waste dumps, and drive-off facilities are important.
    - Scale 1-10: 1 = fully disagree; 10 = fully agree
- Can you extend your answer?
    - [Room for comments]
- Statement: I would use a berth with less amenities if this is offered for reduced cost
    - Scale 1-10: 1 = fully disagree; 10 = fully agree
- Can you extend your answer?
    - [Room for comments]
- Statement: I stay longer on a location that has better amenities.
    - Scale 1-10: 1 = fully disagree; 10 = fully agree
- Can you extend your answer?
    - [Room for comments]

## A5.4 AIS

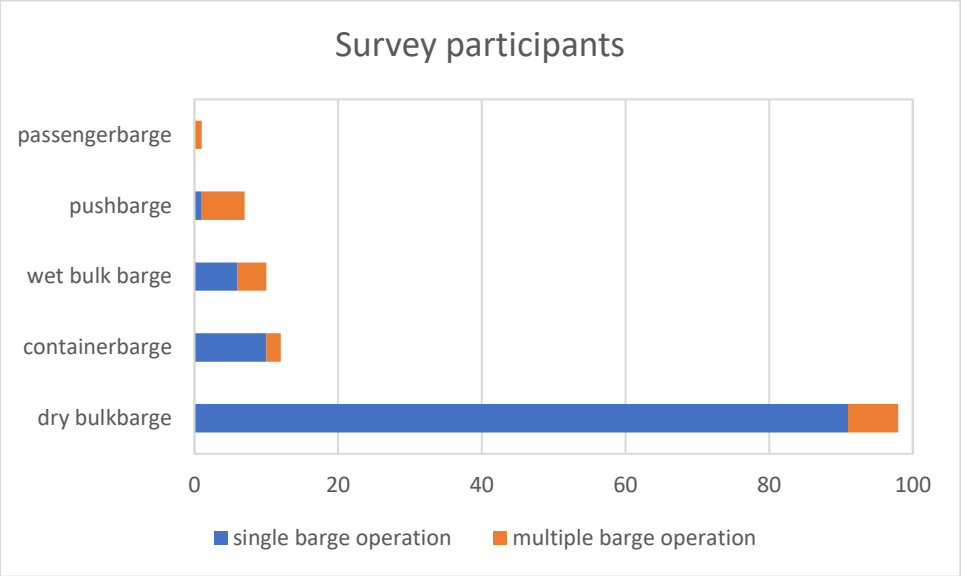
- Statement: I am willing to share AIS to improve port activities.

- Yes
- Yes, but I expect personal incentives in return
- Yes, but I expect financial incentives in return
- No
- Other, namely:

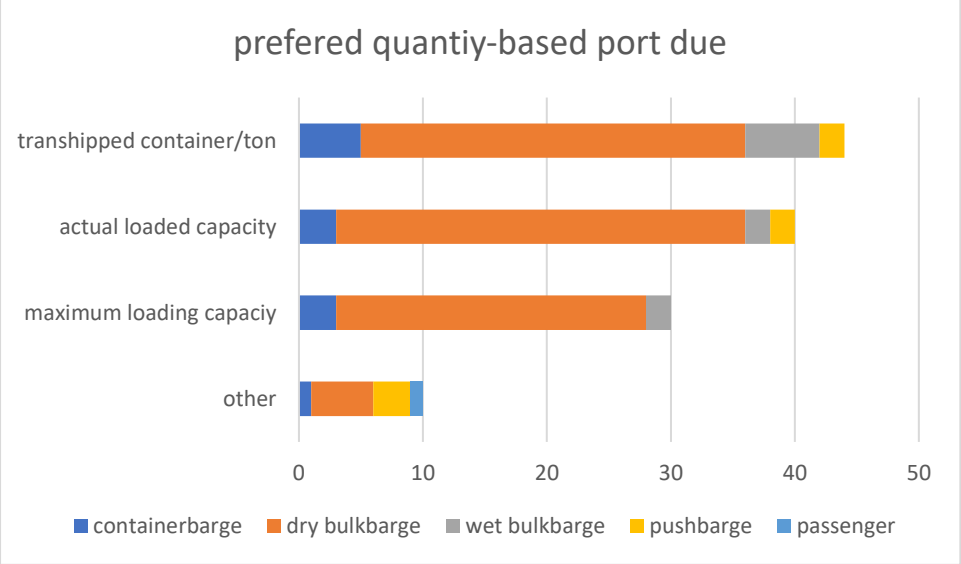
- Can you extend your answer?
  - [Room for comments]

## A6 Survey results

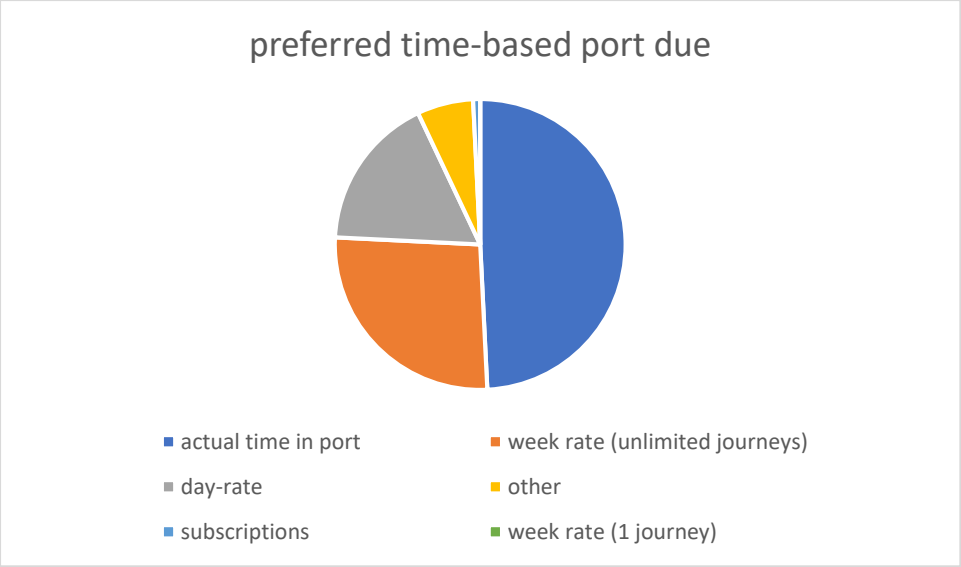
### A6.1 Survey participants



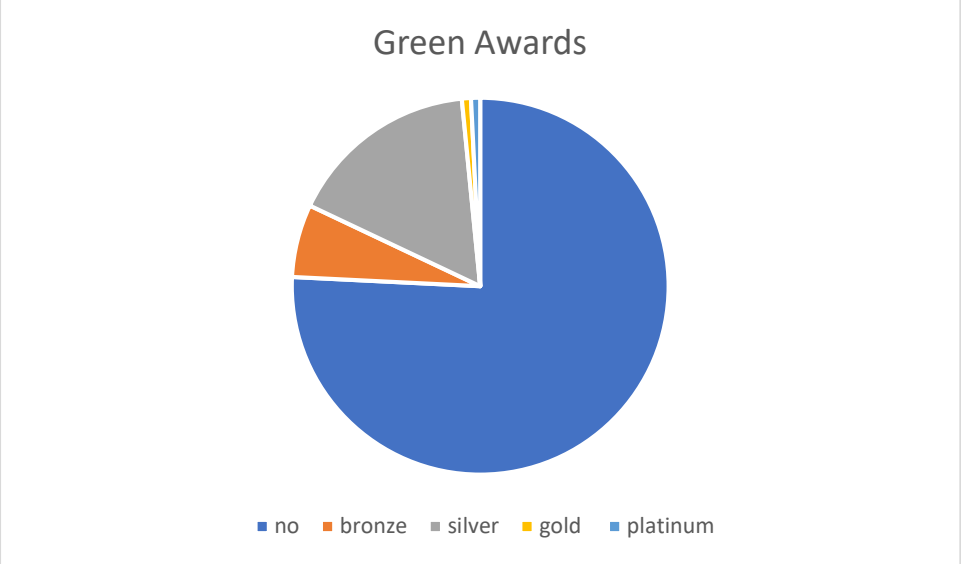

### A6.2 Preferred port due: Quantity-based



## A6.3 Preferred port due: Time-based

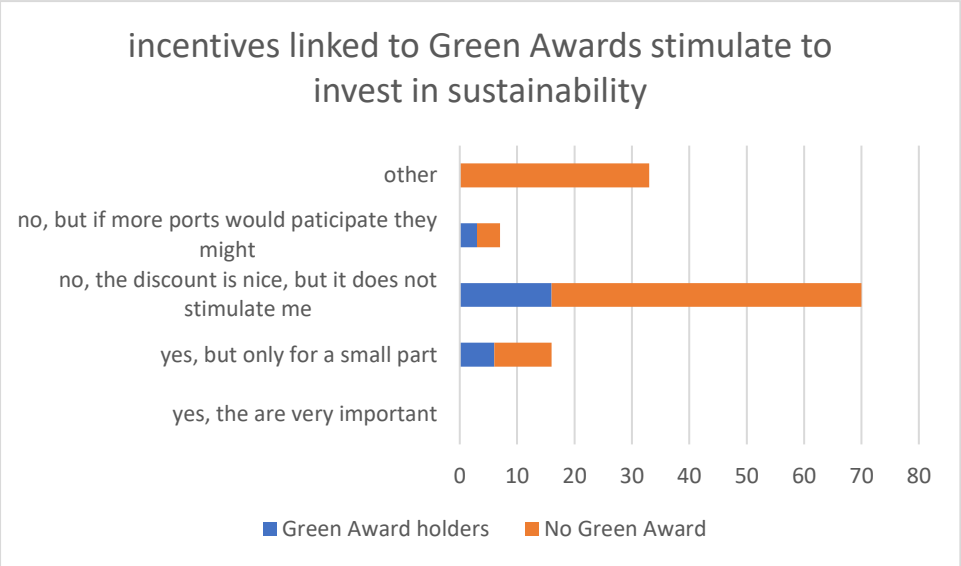



## A6.4 Green Award certification

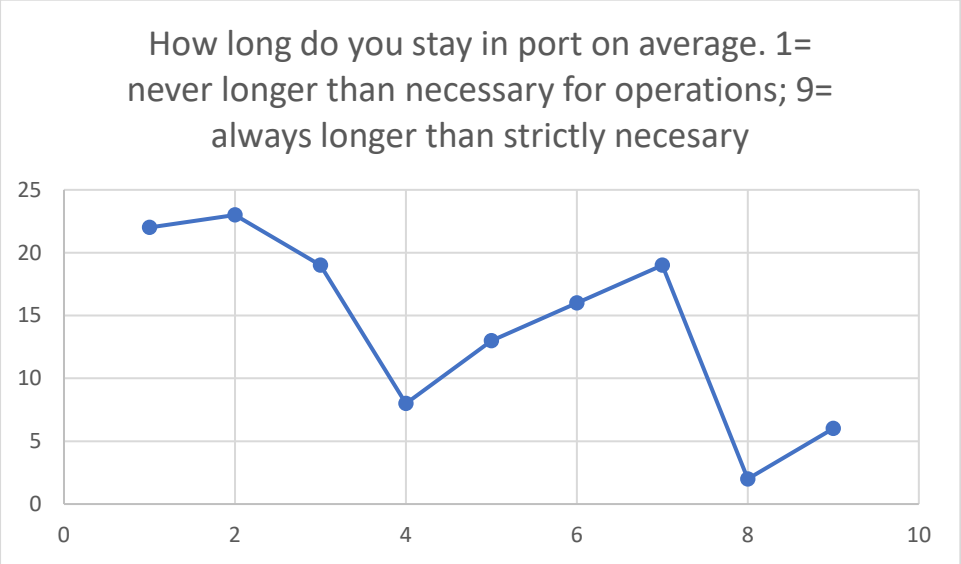



## A6.5 Reason for Green Award

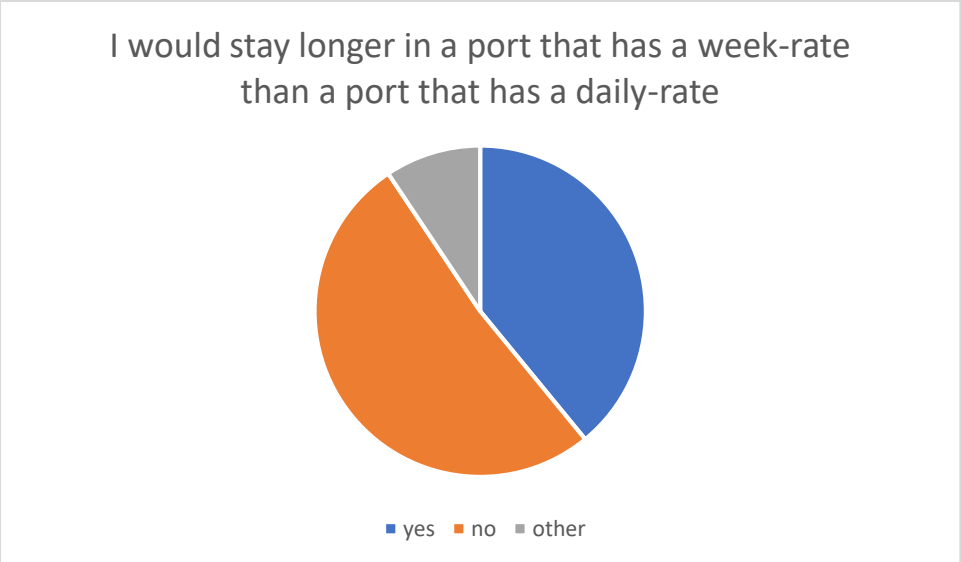
## A6.6 Effect of Green Award on environmental sustainability



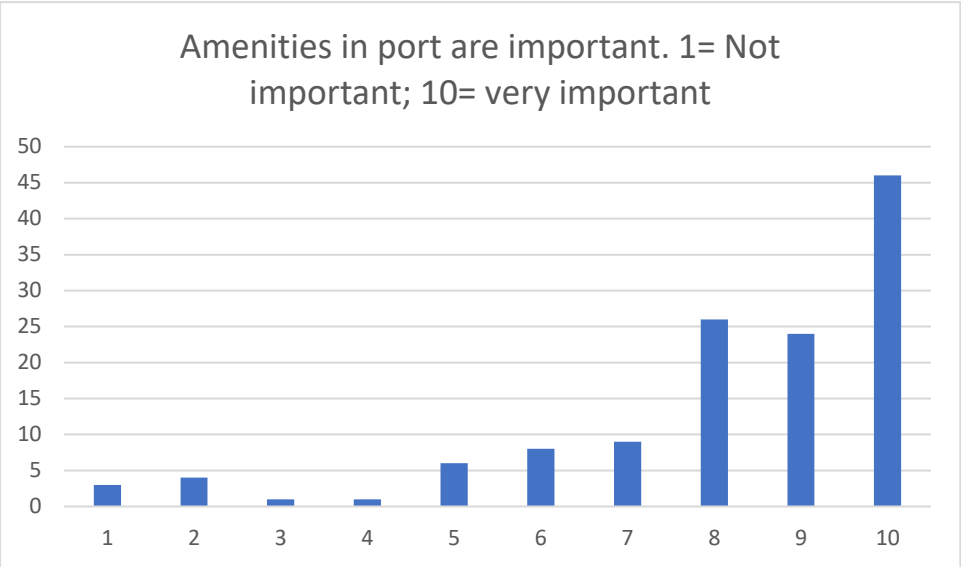

## A6.7 Time in port: strictly business or longer



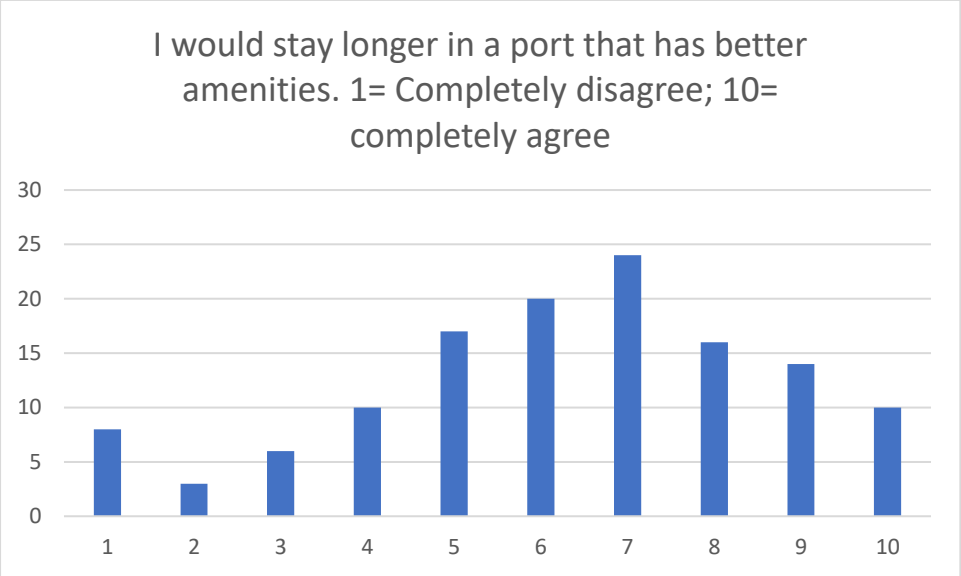

## A6.8 Time in port: depending on time-based foundation.



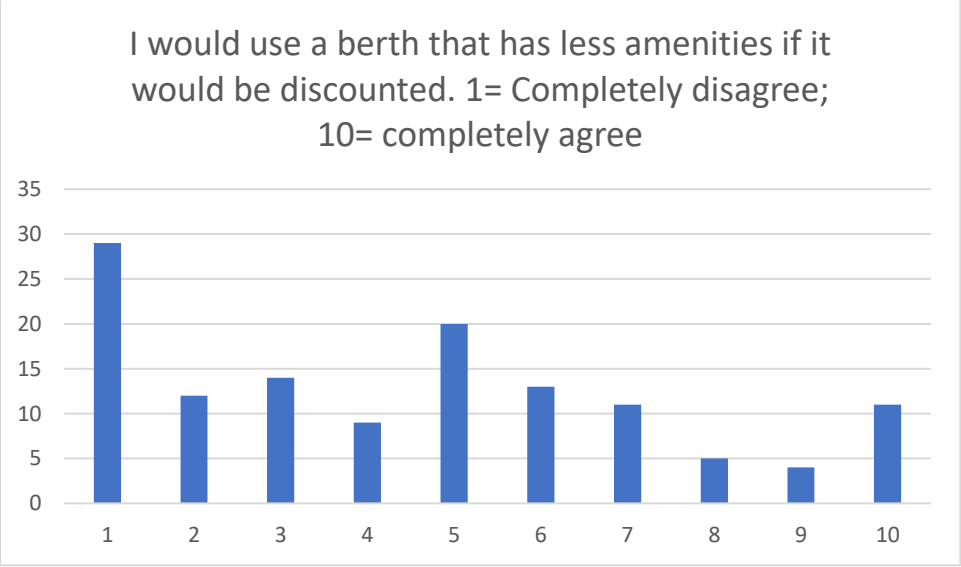
## A6.9 Importance of amenities



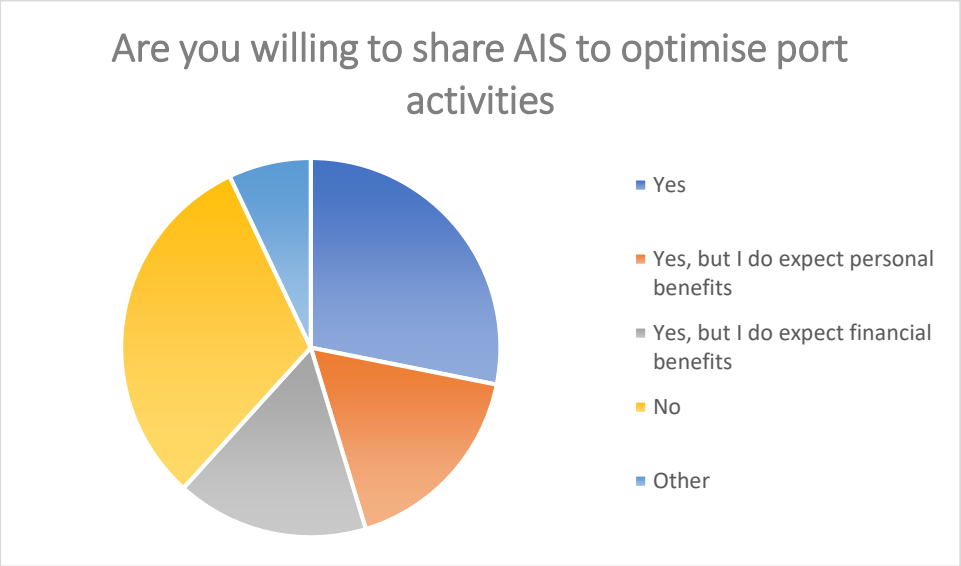

## A6.10 Time in port: depending on amenities



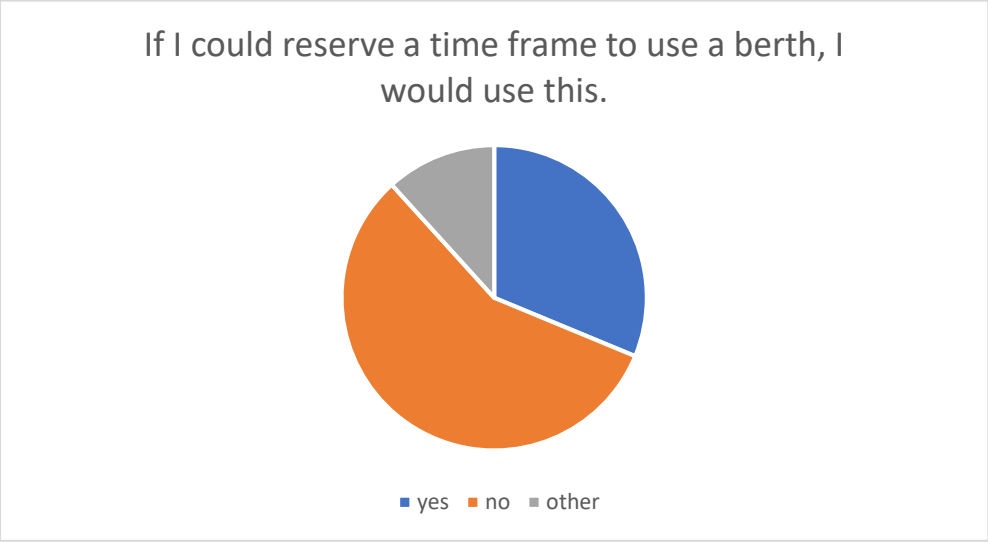

## A6.11 Location in port: depending on Amenities



## A6.12 AIS sharing




## A6.13 Berth reservation




## A6.14 Port due model: Based on port optimisation theory

| | Policy | Bulk | Container |
|---|---|---|---|
| Foundation | Time-based | Actual time of stay | Actual time of stay |
| | Quantity-based | Actual transhipped ton | Actual transhipped container |
| Pricing | Environmental | Discounts & taxes | Discounts & taxes |
| Operations | | | |

## A6.15 Port due model: Based on port optimisation & standardisation theory

| | Policy | Bulk | Container |
|---|---|---|---|
| Foundation | Time-based | Actual time of stay | Actual time of stay |
| | Quantity-based | Actual transhipped ton | Actual transhipped container |
| | Environmental | Green Award | Green Award |
| Pricing | Environmental | Discounts & taxes | Discounts & taxes |
| Operations | | | |

## A6.16 Port due model: Based on theory & results

| | Policy | Bulk | Container |
|---|---|---|---|
| **Foundation** | Time-based | Actual time of stay | Actual time of stay |
| | Quantity-based | Actual transhipped ton | Actual transhipped container |
| | Environmental | Green Award | Green Award |
| **Pricing** | Time-based | Scarcity | Scarcity |
| | Quantity-based | Competitive position | Competitive position |
| | Location-based | Quality of amenities | Quality of amenities |
| | Barriers | Utilisation | Utilisation |
| | Environmental | Tax laggards + stepped reward | Tax laggards + stepped reward |
| **Operations** | Reporting & collecting | Standardisation of operations | Standardisation of operations |
| | | Digitisation op operations | Digitisation of operations |

## A6.17 Price differences between foundations

| | Rotterdam | Moerdijk | Waalwijk | Den Bosch | Wanssum | Venlo | cost difference | |
|---|---|---|---|---|---|---|---|---|
| **Class\|FEU** | Pick-up | 75% | 10 | 20 | 30 | 40 | | |
| **3: 100% loaded** | 98% | 25% | 800% | 100% | 70% | - | € 267,43 | 97% |
| **3: 75% loaded** | 164% | 67% | 800% | 100% | 70% | - | € 296,17 | 120% |
| **3: 50% loaded** | 296% | 151% | 800% | 100% | 70% | - | € 324,91 | 149% |
| **5a: 100% loaded** | -13% | -45% | 2375% | 450% | 368% | 207% | € 873,09 | 87% |
| **5a: 75% loaded** | 16% | -26% | 2375% | 450% | 368% | 207% | € 1.052,71 | 128% |
| **5a: 50% loaded** | 74% | 10% | 2375% | 450% | 368% | 207% | € 1.232,34 | 191% |
| **5b: 100% loaded** | -24% | -52% | 5300% | 1100% | 921% | 569% | € 2.014,24 | 97% |
| **5b: 75% loaded** | 1% | -36% | 5300% | 1100% | 921% | 569% | € 2.463,30 | 151% |
| **5b: 50% loaded** | 52% | -4% | 5300% | 1100% | 921% | 569% | € 2.912,37 | 246% |


Nederlandse Vereniging van Binnenhavens

CBRB
CBDB

Centraal Bureau voor de
Rijn- & Binnenvaart

KONINKLIJKE
BLN-SCHUTTEVAER