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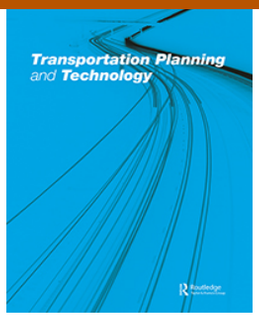

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Coordination problems in container barging in the port of Rotterdam: an institutional analysis

Martijn van der Horst[a], Michiel Kort[b], Bart Kuipers[a] and Harry Geerlings[b]

[a]Department of Urban, Port and Transport Economics, Erasmus School of Social and Behavioural Sciences, Erasmus Universiteit Rotterdam, Rotterdam, Netherlands; [b]Department of Public Administration, Erasmus School of Social and Behavioural Sciences, Erasmus Universiteit Rotterdam, Rotterdam, Netherlands

ABSTRACT

Container barging has gained in importance in port-related transport along with the need for sustainable transport. Nevertheless, coordination problems between terminal operator and barge operator exist, and performance lags behind. This paper analyses factors that may hinder or stimulate a better future performance of container barging in the port of Rotterdam. A case study is accomplished and guided by a framework rooted in Institutional Economics. Despite favourable conditions set by governments and the port authority, the share of container barging has hardly grown. The container barging sector in Rotterdam is embedded in a history with many alliances, a high degree of organisation, and a good track record in the development of institutional arrangements to solve coordination problems. However, the present contractual relations in the transport chain form an inadequate condition. From a theoretical perspective, the paper shows the value of studying port-related transport chains by acknowledging their institutional context.

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Introduction

Containerisation has led to an increase in international trade of manufactured goods. It has also increased competition between ports (Slack 1993) and put pressure on the use of scarce hinterland infrastructure. Having efficient port-related transport, including infrastructural access to the hinterland and the availability of transport services, is considered to be crucial in today's competition between ports (cf. Tongzon 2009). Moreover, the use of rail transport and Inland Waterway Transport is seen as a keystone for sustainable development of transport and ports. However, in these intermodal transport chains, efficiency does not always develop spontaneously, because it is characterised by sequential interdependencies, multiple transport modes, different industrial practices and organisational arrangements (Jaffee 2016).

CONTACT Martijn van der Horst martijnvdhorst@hotmail.com Department of Urban, Port and Transport Economics, Erasmus School of Economics, Erasmus Universiteit Rotterdam, Rotterdam 3000 DR, Netherlands

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This paper focuses on port-related container transport by barge in the port of Rotterdam, the largest container port in northwest Europe. Because of the favourable environmental performance of Inland Waterway Transport (IWT) and the almost unlimited capacity of infrastructure, the policy of the Dutch government and the Rotterdam Port Authority is to realise a 'modal shift' in favour of IWT (Port of Rotterdam 2011; Ministry of Infrastructure and the Environment 2015). Despite these policy goals, the share of container barging hardly grows. At the same time, it is observed that the performance of container barging in Rotterdam is quite inefficient. Earlier research showed that a major critical interdependency is between the deep-sea terminal operators and the hinterland transportation company (Van der Horst and De Langen 2015; Jaffee 2016). Coordination problems between both lead to long turnaround times of barges and inefficient terminal planning. In reality, it seems difficult to improve these coordination problems.

The goal of this research is to analyse factors that may hinder or stimulate a better future performance of container barging in the port of Rotterdam. The next section describes the research methodology guided by a framework rooted in New Institutional Economics (Williamson 1998) that offers a starting point to discuss contextual variables related to the informal and formal institutional environment, market organisation and institutional arrangements. Section 3 provides the results. The last section synthesises the results of the study.

Research methodology and framework

In this research, a single case study approach was adopted. A case study is relevant because it aims at an in-depth understanding of the 'why' of a contemporary phenomenon. In this paper, we investigate why the performance of container barging sector in the port of Rotterdam is inefficient and which contextual factors (causes) hinder or stimulate its performance. Furthermore, a single case study is relevant because the issue is local (Rotterdam-based) and unique. The literature on IWT of containers is limited and good learning experiences are hard to find. This can be explained by the small number of ports where container barging has an important market share. In Europe, for instance, container barging is only well developed in the ports of Antwerp and Rotterdam (cf. Konings 2007 or Caris, Macharis, and Janssens 2011). Also learning experiences can be gained from France (Frémont, Franc, and Slack 2009) or China (Notteboom 2007).

The study contained four research steps. Firstly, 15 interviews were held with actors active in the container barge hinterland chain (barge operator, deep-sea terminal operator, and inland terminal operator). In addition, representatives of the sector associations as well as experts and academics in the field of ship finance, business history, (inland) transport law, and port management contributed and were interviewed. During the interviews, the following working hypothesis provided the basis for discussion: 'The container barging sector in the port of Rotterdam is unable to pick-up the expected future role, namely providing efficient hinterland transport for maritime containers in 2030.' The interviews were helpful to make a set of subjects related to reasons behind coordination problems in container barging. In other words, the interviews set the boundaries between phenomena and contextual factors which are not clearly evident in case study research (Yin 2008). The interviews also guided the selection of the data sources. Thirdly, desk research was executed and, simultaneously, a multi-disciplinary framework was devised (shown in Figure 1). Finally, the results were reviewed by an external committee, including

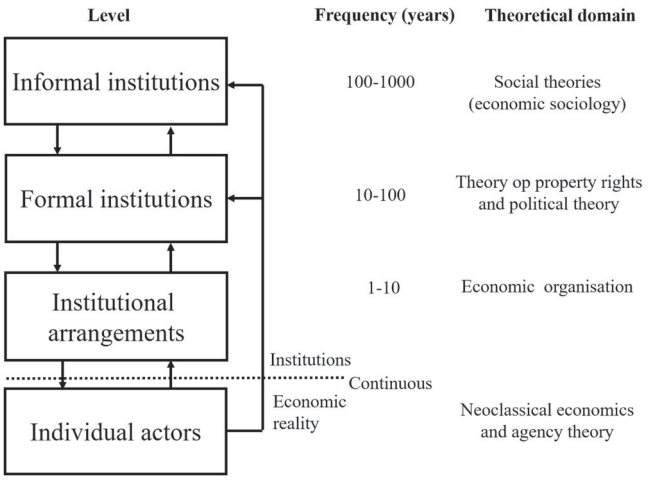

Figure 1 Framework. Source: adapted from Williamson (1998).

representatives from the Ministry of Infrastructure and the Environment, Rotterdam Port Authority and the National Institute for Advanced Logistics.

In this qualitative 'process of inquiry', the combination of triangulation is important (Patton 1987). Four common forms of triangulation (Yin 2008) can be justified. We used multiple methods (methodological triangulation) such as interviews, workshops with experts, and desk research to achieve greater accuracy and a more coherent interpretation. By using a review group evaluator triangulation is justified. By using different data sources from different research fields, we can validate the theory and data triangulation.

For the framework, consideration of New Institutional Economics (Williamson 1998) formed the starting point. Williamson's work has its origin in Transaction Cost Economics (TCE), dealing with matching categories of transactions with categories of efficient governance structures (Williamson 1981). Later, Williamson (1993) suggested that governance does not operate in isolation, but categorical context factors (causes) play a role. The framework aims at identifying causes for the inefficient performance of container barging in the port of Rotterdam. Possible causes for this 'economic reality' (on layer 4) lie in the institutions on layers 1, 2, and 3. Following the influential definition of North (2005), institutions may be seen as humanly devised *constraints* that structure political, economic and social interactions. A comparable institutional approach was earlier applied in port research (De Langen and Chouly 2004), and other infrastructure markets like electricity (Künneke and Fens 2007), and wireless infrastructure (WiFi) (Lemstra, Hayes, and Groenewegen 2010). The framework distinguishes between different types of institution inspired by different theoretical approaches. This multi-disciplinary perspective is the first important value of the framework. Borrowing other suitable theoretical lenses is a rather common practise in transport and logistics research (cf. Stock 1997). Secondly, the framework gives coherence to empirical inquiry. Figure 1 shows that institutions are not developing randomly but are interrelated with certain logic with a hypothetical time period for change. At level 1 of the framework, we find informal institutions which are based on broad beliefs, values and norms that influence the behaviour of economic actors. These informal institutions are assumed to be deeply rooted in society

and only change over a very long period of time (according to Williamson, between 100 and 1000 years). They emerge spontaneously within the social context and stay in the domain of economic historians and economic sociologists. Level 2 refers to formal or legal embeddedness. Here, according to Williamson (1998), the laws regarding property rights – their definition and enforcement – are prominently featured. Moreover, it includes the area of formal governmental policy, and property and decision rights. Periods of change at this level are between 10 and 100 years. The third level concerns market organisation, firms and other institutional arrangements. The relevant theoretical lens here is Transaction Cost Economics. Periods of change are quite short, namely between 1 and 10 years. Resource allocation, behaviour and performance by the market actors are described at the fourth level. The arrows connecting higher levels with lower levels mean that the higher level imposes constraints on the level immediately below. Although Williamson recognises that the system is fully interconnected, he tends to neglect the feedback links. While the purpose of this study is to find causes of a 'market reality', we consider the feedback arrows in the framework from level 4 to 1. In this respect, we see institutions as constraints as well as instruments to provide a structure for human interaction that regulates the behaviour of actors.

Results of case study: application of the framework

In this section, the framework will be applied to container barging in the port of Rotterdam. The following section introduces the market actors and their interactions. The second section presents some key data to illustrate the performance of container barging in the port of Rotterdam. Next, we discuss the most relevant elements in the context of the container barge sector, namely the informal institutions, formal institutions, and the institutional arrangements.

Market actors in the container barge transport chain

Figure 2 shows the main market actors involved in container barge transport. There are three actors on the demand side of the transport chain, namely the shipper, freight forwarder or the carrier. Primarily, a shipper is the owner of the goods and creates the demand for transport. Commissioned by the shipper, freight forwarders could arrange hinterland transport; they do not own vessels or terminals but purchase transport and terminal services from third parties. Although deep-sea carriers are traditionally responsible for seaborne transport, they could also be involved in organising hinterland transport of the container by barge (carrier haulage).

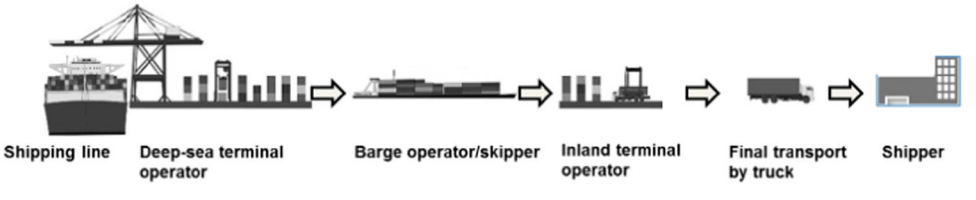

Figure 2 Hinterland transport chain of container barging.

On the supply side, three actors play a role in the provision of container barging, namely: the barge operator, the private barge company or skipper, and inland terminal operator. The core business of the barge operator is organising container barge transport by providing frequent shuttle services between the deep-sea and inland terminals. In Rotterdam, 70% of container barge transport is organised by barge operators (Port of Rotterdam 2016). The inland terminal operators handle the container flows arriving by barge, offer storage capacity and transfer the containers to trucks for final transport to the shipper. An inland terminal operator can also act as a barge operator; they organise barge transport and contract with skippers. Both the barge operator and the inland terminal hire ship capacity from skippers with short- or long-term contracts. The skippers offer barge capacity (including crew) for a fixed period; the barge and inland terminal operator offer the logistics management.

Performance of container barging in port of Rotterdam

Rotterdam is the largest container port in Europe. In 2015, the container throughput was 12.2 million TEU (the twenty-foot equivalent unit). About 70% of the containers handled (8.5 million TEU) have an origin or destination in the hinterland of Rotterdam. The remaining 30% are for sea-sea transhipment (Port of Rotterdam 2016). In 2013, the Port of Rotterdam completed the Maasvlakte 2 Project. This port extension project enlarged the port area with roughly 1000 hectares, of which 600 hectares is used by container terminals. The Maasvlakte area is situated directly on the North Sea and is the ideal location to accommodate the largest container ships. Most containers are currently handled in the Maasvlakte area. In the hinterland transport of containers, road transport has a dominant position. To be able to transport the growing volumes of containers in an efficient and sustainable way, the Port Authority states that it is necessary that IWT will be making up a larger share in the transport system. In their strategic plan 'Port Vision 2030' (Port of Rotterdam 2011), a desired modal split is formulated in favour of container transport by barge and train of 65% for the total Maasvlakte port area in 2030. The ambition for container barging is to realise a modal split of 45%. This change in the modal split was contractually agreed upon with the new terminal operators on the Maasvlakte: APM Terminals and Rotterdam World Gateway.

Although Rotterdam has good natural conditions, such as the location of the port at the estuary of the river Rhine (the most important inland waterway for freight transport in Europe), and container volumes handled in the port are increasing, the development of IWT remains stable (Table 1). A core reason for the inability to make container barging more efficient and let its modal split share increase is related to coordination problems in the port operations. Two coordination problems are particularly relevant.

Table 1. Development of modal split in Maasvlakte area for selected years (%).

	2002	2006	2010	2012	2013	2015[a]	2030 Ambition
Barge	41.1	38.3	39.9	42.9	42.3	41.6	65
Rail	12.5	13.2	12.9	12.8	12.4	12.2	
Truck	46.4	48.5	47.2	44.3	45.3	46.2	35
Total	100.0	100.0	100.0	100.0	100		

Source: Port of Rotterdam (2011, 2015).
[a]Only Q1 and Q2.

The long duration of (un)loading cargo in the port, caused by the many calls and the small call sizes per terminal, is the first coordination problem. All barge operators call at a variety of terminals in the port and load or unload limited numbers of containers per terminal. The so-called call size in Rotterdam is relatively small, with an average of 33.3 containers per terminal. There is an important difference in the call size between terminals active in the Maasvlakte area and the rest of the terminal, mainly active in the Waal/Eemhaven area (40 km from the sea). In general, the average call size is higher in the Maasvlakte port area, namely 41.3 containers, although there are large differences between the lowest call size (24 containers) and the highest call size (51 containers) (Port of Rotterdam 2013). The average call size in Waal/Eemhaven is 19.4 containers. These findings correspond to the fact that the average rotation time of a barge is long and varies from 21 h for smaller vessels [<85 m) to 36 h (larger vessels) (Port of Rotterdam 2013)].

The second coordination problem is related to the relationship between the barge operator and the deep-sea terminal operator and deals with inadequate terminal and quay planning for barge handling. Tighter operational planning could reduce rotation times but barges frequently cannot be handled as planned. In the port of Rotterdam, for 41% of the calls by barging, the actual handling at the deep-sea terminal deviated by less than 2 h from the planned start time; 59% of barges are therefore handled outside −2/+2 h of the start time (Port of Rotterdam 2013).

Informal institutions

In the analytical framework shown in Figure 1, the informal institutions are positioned at the highest level. Institutional economists believe that informal institutions emerge spontaneously and endogenously. Once adopted by society or a sector they may 'lock in' over generations and become a part of the set of broad beliefs, values and norms. In our study, we found that the IWT sector can be characterised as individualistic, where cooperation and coordination are not manifest. Sector associations or socioeconomic interest groups can be mentioned as a way to enable large groups of actors.

The socioeconomic representation in IWT in the Netherlands has fragmented over the years – from the 1920s, a wide range of socioeconomic interest groups exist. From this early period, the mentality of about 10,000 private skippers was characterised as highly individualistic and limping between two opinions: a skipper felt they were neither a 'worker' nor a 'patron' (Van Zuuren 1992). Following the Great War in 1918, socioeconomic interest groups were formed based on ideology or religion. A crisis in 1929 led to the Act of Proportional Freight Distribution in 1933. The aim of this Act was to spread the available cargo amongst skippers on a rotation list. The ship registered the longest was assigned to the first suitable trip. Despite industrial growth and modernisation of the fleet, this Act led to the further division of socioeconomic interest groups.

In the early 1970s, the European Commission wanted to abolish the Act on Proportional Freight Distribution. This divided the skippers in the Federation of Skippers Union, who wanted to adopt a more commercial market approach, and the group of Independent Dutch Skippers Union. The 1980s were characterised by many shifts in membership among the two Unions: socioeconomic interest groups that stepped in and out. In the early 1990s, there were two socioeconomic organisations: the so-called 'Kantoor Binnenvaart' (literally translated as Office Inland Shipping) and the Dutch Central Bureau for

Rhine and Inland Navigation, the entrepreneurs' and employers' association representing owners and operators of inland vessels. In 1995, attempts were made to form one umbrella organisation by assembling three organisations: Schuttevaer, Kantoor Binnenvaart and the Dutch Central Bureau for Rhine and Inland Navigation. This initiative collapsed when the subsidy from the national government stopped in 1999. The result was that there were 10 socioeconomic interest groups at the beginning of the twentieth century. From 2013 onwards two socioeconomic organisations exist: the Dutch Central Bureau for Rhine and Inland Navigation and Royal BLN-Schuttevaer.

From the perspective of interest groups, it can be concluded that collaboration between individual skippers in the Netherlands is fragmented and shows a history of 'trial and error'. Although collective action is not obvious, the sector is embedded in a long tradition of horizontal and vertical coordination. Whether a skipper chooses horizontal and vertical coordination varies considerably according to (geographic) market segments, motives, and different time periods. The question of whether a skipper chooses the vertical or horizontal way has depended on several factors and varied greatly per period. Verrips (1991) concludes that this behaviour shows a 'chameleonic ability' of the sector. In general, the horizontal strategy took place in economically difficult times when prices were low and the bargaining power of shippers and charterers was too high. By working together, skippers formed a united front against shippers and charterers. In the vertical strategy, skippers tried to be on good terms with charterers and shippers, after economic recovery.

Most of the interviewees agreed that the container barge sector became a mature transport sector because of horizontal cooperation. Van Driel (2000) notes that the initial phase of container shipping in the 1970s was strongly characterised by horizontal cooperation as a response to two factors: high investment in new vessels and the establishment of scheduled services in a new market being risky. Many of the first barge operators in Rotterdam participated in the so-called Fahrgemeinschaften in the mid-1980s and early 1990s. A Fahrgemeinschaft is a form of horizontal cooperation between barge operators with a joint sailing schedule combined with a profit pool. Despite the ability of the sector as a whole to adapt well to changes in the environment (an illustration of its chameleonic ability), most of the interviewees and market studies (e.g. STC-NESTRA 2015) note that on the level of individual entrepreneurs, the IWT sector demonstrates conservative entrepreneurial behaviour. The sector has a long tradition of family businesses. The vessel serves not only as an asset but also as a home. On the one hand, family businesses are financially vulnerable, caused mainly by the fact that families own one ship with high fixed costs and less variable costs, and where only the fuel costs can be treated as a variable cost (between 10% and 25%). On the other hand, the presence of family businesses is also positive in their daily operations with respect to working hours and their ability to adapt to trends such as information and communications technology (Hubens 2004). This adaptability and flexibility are very important in modern logistics practice (Naim et al. 2006).

Formal institutions

The next level of analysis is the legal embeddedness of the sector. In our study, two important conditions related to the formal institutional environment were stressed by interviewees and further analysed, namely the formal governmental policy by the European Union (EU) and the Dutch government, and the division of the property and decision rights between actors

in the port and its hinterland. The European Commission sees ITW as an energy-efficient mode of transport. Therefore, Inland Waterway Transport should receive a larger share in the distribution of transport modes. According to the White Paper (European Commission 2011), 30% of all goods transported by road over more than 300 km should be transported by rail or Inland Waterway Transport by 2030. In 2050 it is expected that the share increases to 50%. Compared to earlier European policies, recent policymaking pays more attention to the potential of IWT. Europe also wants to create an integrated transport network by using the instrument of regulation. In 2011, a new proposal for regulation was introduced: the Trans-European Networks – Transport (TEN-T) guidelines based on proposals from individual Member States. To date 30 infrastructural projects have been identified. These so-called Priority Projects were chosen according to both their 'European added value' and their contribution to the sustainable development of transport. The 30 key projects consist of 18 railway projects, three mixed rail-road projects, two IWT projects, and one short-sea shipping project. This choice reflects a high priority towards more environmentally friendly transport modes. Also at the level of the national government, growth in the share of inland shipping is seen as important for the well-functioning transport system for the Dutch economy. In this context, the government together with local authorities and businesses will improve the utilisation of the main (inter) national hinterland connections, and thus achieve more efficient use of multi-modal terminals and surrounding business parks. Policy objectives focus on the elimination of maintenance backlogs and bottlenecks in inland waterway infrastructure, better use of existing infrastructure, sustainable transport, safety, reliable travel times, and reducing the administrative burden by ensuring better-quality information. In

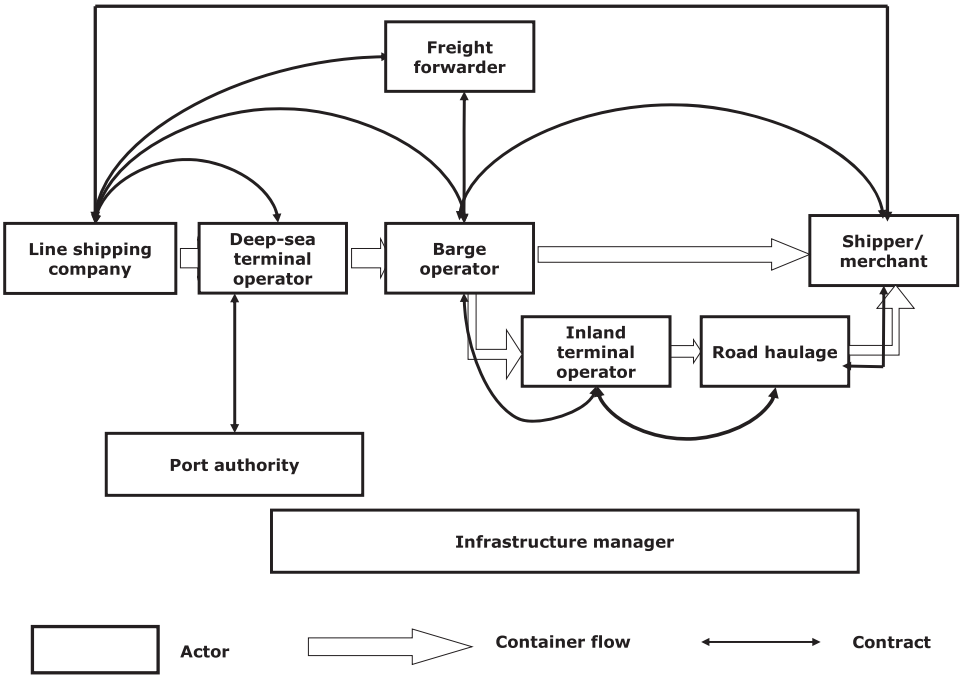

Figure 3 Actors and contractual relations in container barging chain. Adapted from: Van der Horst and De Langen (2015).

addition, innovation has a prominent position on the policy agenda (Ministry of Infrastructure and the Environment 2015).

Figure 3 shows all possible contractual relations that actors in the container barge chain could possibly have with each other. The figure shows that the container stevedore has a contract with the container shipping line. In this contract, the terminal handling charges are agreed. The container shipping line pays the stevedore for three services: (1) the transfer from deep-sea vessel to the container stack, (2) the temporary storage of containers at a stack in the terminal, and (3) the transfer to the hinterland mode (barge, rail or truck). There is no contractual relationship between the barge operator, on the one hand, and the deep-sea terminal operator, on the other. Such a contract would provide an incentive to both parties to better match the quay planning of the container stevedore and the sailing plan of the barge operator. Most of the interviewees and expert opinion mentioned that these missing contractual relations and the fact that stevedores give priorities to container shipping lines hinder the improvement of handling container barges. Some interviewees added that the absence of contractual relations is even worse because container barges are mostly handled along the same quays as deep-sea vessels in the present situation. In addition, between 70% and 80% of container hinterland transport in Rotterdam is organised by what is termed merchant haulage. In this case, transport is organised by a forwarder or shipper. These parties have in the current contract structure a very limited impact on the performance of the container stevedore and barge operator in the port. In the case of carrier haulage, container shipping could encourage stevedore companies or the barge operator to perform better.

The same figure shows that there is no contract between the barge operator and the infrastructure manager. The main reason for the missing contractual relation can be found in the Mannheim Convention on Navigation on the Rhine from 1868. The guiding principles of the Rhine Regime are freedom of navigation for the ships of all estuary nations (Belgium, France, Germany, the Netherlands and Switzerland), equality of treatment of domestic and foreign vessels, uniform administration, and the elimination of all tolls or other fiscal exactions levied solely on the right to navigate (CCR 1868). Due to the principles of the Mannheim Convention, there is no formal relationship between the barge operator or skipper and the owner and infrastructure manager for the use of the waterway at a particular place and a particular time. This limits the guidance of behaviour to achieve more efficient use of the port's infrastructure. In comparison, in rail transport, there is a formalised connection between the rail operator and the rail infrastructure manager. In the so-called access agreement, the contract between an operator and the port's infrastructure manager, there are numerous operational rules, bonuses and penalties that stimulate the efficient use of infrastructure.

Institutional arrangements

A preliminary conclusion from the previous sections is that, on the one hand, there are favourable geographical conditions, stimulating policies by European and Dutch governments and port authority, positive cultural characteristics such as a long tradition in horizontal and vertical cooperation, and entrepreneurs in container barging having a future-oriented and flexible focus. On the other hand, the modal split of inland container transport has remained stable for years, the present contractual relations in the container barge

chain do not support the improvement of coordination, and the sector is embedded in a conservative culture where collective action is not manifest.

Starting from the notion that collective action is not manifest, associations or interest groups are often proposed as a way to enable groups of actors (Olson 2009). Examining barge and inland terminal operators, it is relevant to consider their membership of the Member Group Container Operators of the Dutch Central Bureau for Rhine and Inland Navigation (CBRB) and the Association of Inland Terminal Operators (VITO). According to the first-named association, members of the Group Container Operators Members organise 70% of container transport volumes on the Rhine, between Rotterdam and Antwerp and in the BeNeLux countries (CBRB 2016). About half of the container shuttles from/to the port of Rotterdam are organised by a member of the Group Members Container Operators. The degree of organisation of inland terminal operators is lower than that of the inland operators, namely 23%. This low percentage can be explained by the fact that VITO is a Dutch association; inland terminal operators from Belgium, France or Germany cannot become a member. Almost all Dutch terminal operators are members of VITO. In total, 70% of the container shuttles in Rotterdam are organised by members of these two interest groups (Port of Rotterdam 2013).

A second general observation is that the container barge sector in the port of Rotterdam has a good track record in the development of institutional arrangements to increase the efficiency of container barging in the port. There is high involvement of barge operators, but also non-barging actors like deep-sea terminal operators and the port authority are involved in improving coordination. The barge operators are mainly involved in alliances. A recent example is the alliance between the barge operators H&S Container Line, Danser Containerline and Ultra-Brag in 2016 (via mutual Vessel Sharing Agreements), where barge operators bundle volumes of container traffic from several inland ports along the Upper Rhine and optimise both utilisation of their barges and, because of larger call sizes, they improve the port turnaround time.

We observe that the earlier observed long tradition in horizontal cooperation is still deeply rooted in the sector. Initiatives in which barge operators integrate vertically within the chain are hardly seen. Vertical integration in the container barge chain is only seen by deep-sea terminal operators. In Rotterdam, two institutional arrangements were established in which the deep-sea terminal operator, as the 'unusual party', takes the lead in organising container barge transport. In 2010, the Rotterdam container stevedore ECT introduced a new concept called the 'Extended Gate Model'. In this concept, ECT tries to extend the gate of its deep-sea terminal to inland terminals by offering both container handling and hinterland transport services to their own hinterland terminals. From 2011, APM Terminals has organised a daily barge service to the Delta Marine Terminal (DMT) in Moerdijk. In these two examples, one might speak of 'terminal haulage'. Vertical integration by the deep-sea terminal operator is regarded as positive for improving coordination. In this case container cargo for one destination is bundled within the firm (the deep-sea terminal operator), which helps to decrease the call size.

Whereas we noticed vertical integration by deep-sea terminal operators, we also see a prominent role for inland terminal operators in organising container transport. About 40% of the container shuttles from and to Rotterdam are organised by inland terminal operators (Port of Rotterdam 2013). This number increased during recent years. The increased involvement of inland terminal operators is positive because they are well

embedded in the region and are able to bundle cargo in that region which benefits the call size in the port. Secondly, we observe that there is a strong focus on hardware solutions. Some new concepts require efficient use of an appropriate organisational structure ('orgware') and a supporting information system ('software'). Mainly hardware solutions tend to fail. The underlying reasons are the necessary investments in terminal equipment or vessels or the additional storage and handling time, resulting in higher operating costs. The failing factor is that these costs are not fairly allocated to the parties in the transport chain. Many initiatives have failed because there was a temporary necessity to improve coordination. Such initiatives are mainly taken in time periods with above-average growth in container throughput and scarcity of handling capacity at the deep-sea terminal. When container growth declines or handling capacity increases, the necessity disappears and initiatives are halted.

Conclusion

The goal of this research has been to analyse factors that may hinder or stimulate a better future performance of container barging by using a framework rooted in Institutional Economics. The value of this research is that the performance of the container barge sector in the port of Rotterdam, and the possibility to improve it, has not been studied as an isolated issue, but is related to the context of the sector. In recent years, the container barging's lagging performance has meant that it has been unable to play the dominant role in hinterland transport foreseen. The market share of barging in the supply and transport of containers to the Maasvlakte area has, at best, remained stable for years.

The performance of container barging in Rotterdam is inefficient due to the long turn-around times of barges and inefficient terminal planning. Given the long period of time in which the share of container barging has been stable, it seems hard to improve coordination. We observe a paradox: on the one hand, many interdependent actors are undertaking a range of institutional arrangements to improve coordination in container barging, but at the same time, by a non-existing sense of urgency among the main stakeholders and their unwillingness to cooperate, the sector's market share is weakening. The sector's performance and the interaction between actors take place continuously; the informal and formal institutions and institutional arrangements are changing with different time periods. Informal institutions are deeply rooted in the container barging sector and they only change over a very long period. The actors in the Rotterdam container barging sector are embedded in history with many vertical and horizontal alliances. Although the sector can be characterised as conservative and individualistic, operating container barges in the context of family businesses acts with an entrepreneurial and future-focused spirit. Moreover, the container barging sector in the port of Rotterdam operates in a tradition of adapting to changes in the market environment. We observe that this so-called chameleonic behaviour influences, to a large extent, the current market organisation. IWT in Rotterdam has a long tradition of trial and error in collective action. Nevertheless, there is today a high degree of organisation among barge operators and inland terminal operators. This reflects a high level of ability to work on improved coordination in the future. The present market organisation in container barging is characterised by a long track record of initiatives to solve existing coordination problems.

There is considerable discussion on what is needed to give an impetus to container barging in Rotterdam. It seems that the current policy is lacking or formulated by means of the traditional government approach. Not all stakeholders are aware that new roles and new approaches are needed to benefit from opportunities for IWT. The need for an efficient, sustainable and functioning IWT sector is acknowledged on different levels such as local, regional, national and even European level, but manifests most directly in the performance of the port(s). This case study concludes that the present division of property and decision rights in container barging in seaports is a damaging condition for future improvement. Firstly, there is no contractual relationship between the barge operator and the deep-sea terminal operator. Secondly, due to the principles of the Mannheim Convention, there is no formal relationship between the barge operator or skipper and infrastructure manager.

The division of property and decision rights is hard to change in the short term. This research has shown that not only barge operators have an important stake in organising efficient container barge transport, but also deep-sea terminal operators need to increase their influence by different forms of vertical integration. The challenge is to develop an ex-ante methodology that addresses the new challenges in a coherent transition strategy. This implies that all stakeholders (forwarders, shippers, barge operators, etc.) have to reconsider their roles. It is necessary to work on awareness raising and to recognise the need for cooperation and interaction between the governments and private companies to improve the performance of container barging in the port of Rotterdam, and to fulfil the changing needs of society on logistics.

Disclosure statement

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