Smart Port Perspectives

Essays in honour of Hans Smits

It is with great pleasure we offer **Hans Smits** this overview of the latest insights in research written by the Erasmus Smart Port professors on the occasion of his farewell as President of the Port of Rotterdam Authority. In this book, the Smart Port professors are in the lead. Most of the contributions are presented by a Smart Port professor together with a PhD-student or postdoctoral researcher, financed by the Smart Port initiative. This book is an illustration of the interdisciplinary way how ports can be studied. The different contributions in the book are from the Economics, History, Social Sciences, Management, and Law Schools of Erasmus University, but often borders are blurred.

Smart Port Perspectives

Essays in honour of Hans Smits

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Preface

Erasmus Universiteit Rotterdam was founded by Rotterdam businessmen who saw the need of highly educated professionals who could contribute to the development of the port and the city of Rotterdam. Offering academic education and research providing in societal needs is what Erasmus Universiteit Rotterdam still stands for after 100 years.

Erasmus Smart Port Rotterdam is an excellent example of the cooperation between the Port of Rotterdam Authority, the port related companies and port related scientists. It was Hans Smits who initiated talks with rector magnificus professor Steven Lamberts to explore the possibilities for closer cooperation. Discussions that resulted in the establishment of Erasmus Smart Port Rotterdam.

A considerable amount of research was done at several faculties of the Erasmus Universiteit Rotterdam and students and executives were offered tailor-made courses on port related topics. But Hans Smits still identified a gap between the requirements and queries specific to the harbour of Rotterdam and the research done by researchers. In the newly founded research centre Smart Port all "harbour professionals" now work closely together in research programs focused on topics formulated in close cooperation with Deltalinqs, the municipality of Rotterdam and Port of Rotterdam Authority. Currently many new research programmes are operational and new education programs are being developed.

It is with great pleasure we offer Hans Smits this overview of the latest insights in research written by the Smart Port professors, on the occasion of his farewell as President of the Port of Rotterdam Authority.

Pauline van der Meer Mohr
President

Introduction: Smart Port perspectives

Bart Kuipers and Rob Zuidwijk

On September 17, 2013, the German 'Wissenschaftlicher Beirat beim Bundesminister für Verkehr, Bau und Stadtentwicklung' paid a visit to the Port of Rotterdam Authority. Hans Smits, CEO of the Port of Rotterdam, gave a word of welcome to this distinguished committee of German professors. Hans Smits immediately felt relaxed in front of these professors and told them that many years ago he himself started a PhD project. All the information still was available in his office at home, so when the opportunity arose, he simply could continue were he stopped his research. We think this anecdote is an illustration of the scientific interest of Hans Smits. Next to all his impressive professional activities, he also spent time in starting a dissertation!

Hans Smits was one of the 'founding fathers' of Erasmus Smart Port Rotterdam. Together with rector magnificus professor Steven Lamberts, Jan Willem Oosterwijk, president of the Executive Board of Directors of Erasmus University, Wim van Sluis, chairman of Deltalinqs, Jeannette Baljeu, alderman of the city of Rotterdam, and Albert Thissen, managing director Hapag-Lloyd, the initiative was taken to develop Smart Port. With Professor Jo van Nunen as scientific director and Tijn Folmer as executive director, Smart Port started officially on December 6, 2010.

By presenting this book to Hans Smits, the Erasmus Smart Port professors and staff would like to express their gratitude for initiating and enabling Smart Port, and for his continued search for the right governance structure to establish a Rotterdam-based port research and education centre at Erasmus University. In addition, we want to show a selection of the results of Smart Port research of the last three years.

The aim of Smart Port formulated by the founding fathers is to strengthen the regional economy through a better match between supply and demand of knowledge. Smart Port should lead to closer cooperation between the universities and the port community, and must contribute to the attraction of knowledge-intensive companies to the port and city. The founding fathers formulated three spearheads to realize these goals. First, provide access to excellent scientific knowledge with the Smart Port professors being in the lead. Second, realize a multidisciplinary approach in both research and education, and thirdly, initiate knowledge development, customized to the needs of the port community. The development of Smart Port fits in the ambition of the Rotterdam Port Authority, to develop the most

efficient, safe and sustainable port in the world. Scientific knowledge is essential in solving problems in the domain of – amongst other things – safety and security, sustainability, business, and the port community at large. Smart Port builds a bridge between science and industry, based on a network that finds answers to current and future issues while sourcing ideas from various disciplines. In realizing these ambitious goals, Smart Port strengthens the competitive position of the Port of Rotterdam.

The importance given by the port of Rotterdam to scientific knowledge is formulated in 'Port Compass', the Port Vision 2030 for the port of Rotterdam. This strategic document was presented in 2011 by Hans Smits and gives direction to and formulates priorities for the Port of Rotterdam. By means of increasing the use of innovations, the port must contribute to more sustainable and efficient (production) chains, higher safety levels, and an improved accessibility of the port complex. Being a frontrunner in innovations is realized by increasing the general knowledge level of the port. This is accomplished by means of port chairs at Erasmus University Rotterdam and Delft University of Technology, together with lecturers at Rotterdam University of Applied Sciences. In addition to the port chairs and lecturers, the development of specific research aimed at concrete questions from the business community should be addressed. In the Port Vision 2030, eight innovation priorities are formulated. These innovation priorities were one of the starting points for the formulation of a Smart Port Academic Agenda.

The research presented in this book is in most of the contributions related to the Smart Port Academic Agenda, which emerged from projects and discussions with the Rotterdam port community and it is related to the innovation priorities of the port of Rotterdam Port Vision 2030.

The Smart Port Academic Agenda has five themes:

- *Operational Excellence in Ports and Networks*: Operational excellence creates an important competitive advantage for ports and for networks, either international shipping or land transport.
- *Drivers for Green Port Related Operations:* There is a need to reduce emissions caused by port related logistics. The interplay between the drivers and scopes of individual supply chains, international transportation networks, and port clusters, is important.
- *Governance for a Sustainable Port:* There is a strong need to stimulate a transition towards sustainability in ports and port related activities – a substantial and fundamental change, which requires also a new role of the port authority, government, and other stakeholders.
- *Ports in Global Networks:* In the context of the new role of ports and terminals as crucial nodes in global supply chain networks, the role of the port authority needs to be redefined and its performance assessed.
- *Visibility for a Connected Port:* There is a need to make the port more secure, efficient, and sustainable. Information infrastructure as an enabler may include in its scope not only logistics, but also energy grid, and co-production in the industrial cluster.

These five themes were leading Smart Port research in the past three years; most of the contributions in this book fit very well into these themes. In 2014, the Academic Agenda will be re-positioned as the 'Knowledge Agenda for the port'. The port community will be more actively involved in the formulation of research spearheads. Smart Port will start consultations with the port community at short notice to achieve this involvement.

In the coming years, the close relation between Hans Smits and Erasmus University Rotterdam will continue, because Hans Smits is a member of the Supervisory Board of Erasmus University. We therefore are sure that the future energy developed by the researchers of Smart Port in dissemination of knowledge, in organizing events and in building close relations with the port community of the port of Rotterdam will be noticed by Hans Smits.

In this book, the Smart Port professors are in the lead. Most of the contributions are presented by a Smart Port professor together with a PhD-student or postdoctoral researcher, financed by the Smart Port initiative. This book also illustrates the interdisciplinary nature of the Smart Port professors. The different contributions in the book are from the economics, history, social sciences, management, and law schools of Erasmus University, but often borders are blurred. A good example is the chapter by Smeele and Niessen on the legal aspects of new innovations in container hinterland networks, such as extended gates. We maintained the different handwritings of the diverse scientific backgrounds; heavy use of footnotes in the contributions from the schools of law and history or use of quantitative symbols in a contribution from the Rotterdam School of Management.

The contributions in this book are structured as follows. First, the chapters by Larissa van der Lugt and Rick Hollen, together with Frans van den Bosch and Henk Volberda, focus on port governance and port authority strategies. The chapters by Haralambides & Acciaro and Klemann & Koppenol both have the larger European as well as the policy perspective. The next three contributions – Geerlings, Smeele & Niessen and Zuidwijk & Ypsilantis – are devoted to the connections of the port to the hinterland from a social, legal and both organizational and network perspective. Zuidwijk & Ypsilantis introduce the container and terminal perspective. This perspective is further developed by Dekker & Van Riessen and Roy & De Koster in their contributions on intercontinental container transport and container terminal lay out. The final perspective is on the port-city, provided by Kuipers.

The first contribution in this the book is from Larissa van der Lugt. She pays attention to the strategic scope of port authorities, especially to their strategies to act 'beyond the landlord'. She points at port authorities redefining their goals and strategic scope. Research

applying a strategic management perspective on port authorities is limited and mostly consists of specific case studies or comparative analysis of port authorities in a specific geographical area. Her chapter provides results of a worldwide survey among port authorities that addresses the strategic scope of port authorities i.e. the set of activities they undertake. While many port authorities are described as 'landlords', they provide services that are not generally associated with a pure landlord role. Larissa's research gained personal interest by Hans Smits, therefore we start this overview of Smart Port research with her contribution.

In their contribution, Hollen, Van Den Bosch and Volberda elaborate on their influential study "The Strategic Value of the Port of Rotterdam for the International Competitiveness of The Netherlands", published in 2011. For the period 2000-2012, they examine and illustrate how the Port of Rotterdam Authority – triggered by environmental and competitive dynamics – has increased strategic value creation by innovating its business model: from a Landlord towards a Port Developer business model. In doing so, they particularly pay attention to the four levers of business model innovation of the Port Authority: changes in organisation, management, technologies and co-creation with external parties. They also reflect on the role of leadership of the CEO in business model innovation, and in particular on the leadership of Hans Smits. In addition, the authors describe and analyse four illustrative cases of new businesses of the Port of Rotterdam Authority resulting from the renewed business model. These new businesses are (1) the participation in the Port of Sohar in Oman, (2) the initiation and commercialization of underground distribution system Multicore, (3) the introduction of the joint (i.e., with the Port of Amsterdam) port community system Portbase, and (4) the realization of inland container terminal Alpherium. The development of these new businesses particularly emphasizes the important role of the business model lever of co-creation with external parties. Hollen, Van Den Bosch and Volberda also address how these new businesses contribute to strategic value creation by enhancing the international competitive position of firms in the Port of Rotterdam and elsewhere in the Netherlands.

Haralambides and Acciaro provide an overview of the recent EU policy developments. The European Commission recently developed new proposals for a uniform and coherent policy for ports, aimed at achieving a level playing field contributing towards the improvement of port services provided to the sector both in terms of quality and efficiency. In their paper the authors elaborate on some of the controversies arising from the new EU policy approaches. They argue in favour of a balanced EU policy intervention inclusive of stakeholders' demands, aiming at advancing a sector in many respects still characterised by inefficiencies and potential for improvement. The overview and assessment of recent EU port policy initiatives provided by Haralambides and Acciaro is of great importance to the port of Rotterdam (and all ports in Europe). Their advice on critical issues like the freedom to provide port services, the determination of prices for the access to ports or increasing transparency and regulatory control should be taken seriously into account in determining a position in the European port arena. We consider the interpretation of new (EU) policy approaches and the impact of those policies on the position of ports from an academic perspective an important contribution from Smart Port researchers. The importance given to Europe in the Port Vision 2030 Agenda of the Port of Rotterdam speaks for itself.

Hein Klemann and Dirk Koppenol explain why Rotterdam became the first port of Europe and gained a dominant position in the Ruhr area. They also explain why in the post-war period, the port grew fast until 1973, but slowed down as competition became fiercer after 1989. For a basic understanding of the competitive position of the port of Rotterdam they turn to the Rhine. By 1870, most transport in the Rhine basin took place by rail. But inland navigation made a come-back and from the 1890s recaptured its dominance. This development requires explanation as such a recovery did not take place in other industrialized regions. It strengthened the competitiveness of Rotterdam against Antwerp, Hamburg, and Bremen. From the 1890s, Rotterdam developed into the most important seaport of the Ruhr area and as that area became the principal industrial centre of Europe, it became Europe's main port. Especially in the post-1945 period this caused an enormous port expansion in the direction of and even into the sea. Next to the important functioning of the Rhine, Klemann and Koppenol pay attention to some important issues in the history of the port of Rotterdam like the Betuweroute and the introduction of the mainport concept by the economists Poeth and Van Dongen of Erasmus University. We think the historical analysis presented, explaining the dynamics of the hinterland of the port, is of great importance to be able to understand what underlies the current position of the port of Rotterdam. Also, it provides insight into the business networks and network relations between actors in the Ruhr area and the port of Rotterdam – historical relations that still matter today.

Harry Geerlings describes the challenges the inland shipping sector is facing and the need for an integrated approach – a so called transition – to keep the sector viable and the port of Rotterdam sustainable and accessible. Geerlings presents a transition agenda for inland container shipping starting from three levels: strategic, tactical and operational. At the strategic level it is especially important to form a shared vision. In the problem analysis he presents it became clear that currently there is a lack of such a vision. He presents a transition approach providing tools to facilitate a transition in three paths: large scale industrial corridors, radical greening and dense distribution networks. The research he presents is an example of direct valorisation of Smart Port knowledge and of inter-disciplinary cooperation between three faculties of Erasmus University: Faculty of Social Sciences, Erasmus School of Law and Erasmus School of Economics. It is also an example of research typical for the Research Agenda theme 'Governance for a sustainable port'.

The contribution of Frank Smeele and Susan Niessen is made up of two parts, both very relevant for Hans Smits. In the first part, professor Frank Smeele presents a case related to a strike at Smit Harbour Towage Rotterdam and to what extent financial losses suffered by third parties both in the Rotterdam port area and its hinterland may affect the lawfulness of industrial action and strikes taking place in the Rotterdam port area. This case is very interesting because it illustrates the potential damage of such a strike, ranging from a shutdown of the oil refineries in the port of Rotterdam to a possible shut down of the steel works of Thyssen at Duisburg, Germany, because of insufficient supplies of coal and iron ore. The case is also very interesting because Hans Smits as CEO of the Port of Rotterdam is directly involved as a stakeholder. Next, Susan Niessen presents the legal implications of a shift of focus by terminal operators from cargo handling to the coordination and control of inland transport – very relevant and related to concepts like synchromodality and extended gates. The liability of subcontractors is a particularly relevant aspect for those terminals that assume new roles in Hinterland networks. This is relevant because the terminal operator often acts as a subcontractor or delegates activities to subcontractors. Moreover, in case the terminal operator is a subcontractor himself the absence of a contractual link with cargo interests, poses a liability risk.

The chapter of Rob Zuidwijk and Panagiotis Ypsilantis first reviews the role of the port authority in establishing an accessible port and some of the instruments which have already been put in place. Examples are the organizations introduced to improve accessibility on the road network (Traffic Management Company) and the rail network (Keyrail). The authors also consider the role of a private organization, the deep sea terminal operator, which is developing new services to more effectively use alternative modes of transportation, according to the extended gate concept. The chapter focuses on the Ph.D. research of the second author on this concept, in which joint design and pricing of container transport services on an extended gate network are considered. It turns out that pricing of services from sea port to final customer is determined by the competitive environment and does not influence service design. In contrast, the pricing of services from sea port to inland port (extended gate) needs to be considered jointly with service design. The authors further explain the development of synchromodal services and argue that the Rotterdam Port Authority will need to recalibrate its role in this new environment.

Dekker en Van Riessen have reviewed scientific research in container transport chains. They focus their contribution on the improvements being made in the last decades and investigate the advantages and disadvantages of using the port of Rotterdam in container transport chains compared to other ports. They review in particular the contribution from quantitative methods intended to evaluate design options and to improve planning and scheduling operations. Their review is structured according to three phases in the transport chain: first the ocean transport phase, including scientific methods for the design of shipping networks. Second, terminal handling operations and third, the hinterland transport – in which dry ports and extended gate research is presented. Apart from presenting methodological contributions, Dekker en Van Riessen discuss trends and make a comparison with other transport sectors. They conclude that research on container logistics is increasing in a substantial way. Several research centers have been created where research is flourishing, like in Singapore, Hong Kong, Trondheim, Antwerp and Rotterdam. According to both authors, more interaction of academia with industry is definitely needed. This requires efforts from both sides. One of the problems of quantitative research is that common elements exist in methods, rather than in applications. The implementation of all these research papers, require a translation of the general methods in specific applications. Close cooperation between academia and industry is required to solve this.

The chapter of Debjit Roy and René de Koster is also made possible by Smart Port funding. Debjit Roy worked as a post doc and visiting assistant professor in operations management at the department of Management of Technology and Innovation at RSM from August 2011 to February 2012 and April-May 2013, funded by Erasmus Smart Port. He presented his work to the Smart Port community in a lunch seminar and enjoyed being amongst colleague scientist in the group of professor De Koster. Together with René de Koster he developed an integrated analytical model for the unloading operations in the container terminal using Automated Guided Vehicles. By means of numerical experiments the authors make clear that the stochastic models of the container handling operations can be used for rapid analysis of multiple design configurations for container port terminals and improve container-handling efficiencies. The results presented are an excellent example of the research topic 'operational excellence in ports and networks'. Improving efficiency op container operations creates an important competitive advantage of the port of Rotterdam.

Bart Kuipers presents in the last chapter of this volume the shift of the mainport policy concept to the world port city concept. The mainport concept has been very important to spatial and infrastructure policymaking in the Netherlands, especially related to mainports Rotterdam and Schiphol. Kuipers pays attention to the personal involvement of Hans Smits with these two mainports. Since 2005, he is CEO of the Port of Rotterdam Authority and in 1992-1998 he was president and CEO of Amsterdam Airport Schiphol. In addition, as Director-General and Secretary-General of the Dutch Ministry of Transport, Public Works and Water Management (1988-1992), he was responsible for the introduction of the mainport concept in Dutch policy making. Kuipers points at the use of new concepts instead of the mainport concept in the widely acclaimed 'Port Compass', the Port Vision towards 2030 of the Port of Rotterdam Authority, for which Hans Smits was responsible. The chapter by Kuipers pays attention to the relation between (main)port Rotterdam and the city of Rotterdam, being an example of a world port city. He starts his chapter by illustrating the process by which Rotterdam became a 'port with a city'. Next he discusses

attempts to initiate a transition towards knowledge intensive activities in the 1990s by combining 'mainport' Rotterdam with 'brainport' Rotterdam. He presents the driving forces behind recent attention given to advanced producer services and the potential for Rotterdam in becoming an international shipping centre. Finally, he assesses the current position of Rotterdam as a potential location for advanced, high value port related services.

Beyond the landlord: typologies of port authority strategies

Larissa van der Lugt
Co-authors: Peter de Langen and Lorike Hagdorn

This chapter represents a part of my PhD research. It is added to this book as an acknowledgement to Hans Smits. I would like to thank him for supporting the relationship between the Port Community and the Erasmus University, for personally providing input to my PhD research and for expressing a personal interest in the progress of my PhD. This all certainly has strengthened my motivation.

Abstract

The chapter is on the strategic scope of the port authority, especially their strategies to act 'beyond the landlord'. Port authorities are redefining their goals and strategic scope. Research applying a strategic management perspective on port authorities is limited and mostly consists of specific case studies or comparative analysis of port authorities in a specific geographical area. This paper provides results of a worldwide survey among port authorities that addresses the strategic scope of port authorities i.e. the set of activities they undertake. While many port authorities are described as 'landlords', they provide services that are not generally associated with a pure landlord role. Factor analysis of the survey results of 94 responding port authorities shows recurring patterns of strategic activities beyond the landlord. These patterns can be viewed as dimensions for scope strategies of port authorities. Further statistical analysis confirms relationships between institutional position, the strategic goals port authorities pursue and their strategic scope.

1. Introduction

Port authorities are specific types of organizations. They are in most cases publicly owned organizations, but act in a highly competitive environment (Verhoeven 2010). Port authorities (PAs), in fact, operate as public-private 'interfaces'. They synchronize the interest and action of all public institutions (central government, municipality, etc.) with the behavior and the strategic intent of private operators and, increasingly, their own strategic intent. On the one hand PAs, as task organizations, have to defend the public interest, by generating revenues from the use of public assets (i.e. port land, breakwaters, superstructures, etc.), by favoring the creation of employment, by reducing negative externalities, by attracting foreign direct investments, etc. At the same time, PAs are growingly called to be proactive and to take initiatives through a more market-oriented and managerial logic. In a few cases, PAs really act as entrepreneurs and supply additional services within the port (real estate, operational services) or even in other ports (overseas port management, consultancy). In other words, a modern PA pursues both public and private goals and as such resembles the nature of a hybrid, shared value organization.

This chapter's goal is to understand the nature and the drivers of the changes in the strategic scope of port authorities. Port governance is widely studied (Goss, 1990a, Brooks, 2004, Cullinane and Song, 2002, Ng and Pallis, 2010). Many of these studies identify and classify activities in ports and consequently assess whether they are publicly or privately owned and/or managed. This leads to a description of the governance structure for the port in which the position and function of the port authority is center stage (Baird, 2000; Brooks, 2004; De Langen, 2004, Wang and Slack, 2004). However, the studies on port governance generally do not address in detail the scope of activities of port authorities and do not consider discussions on the scope of activities as real strategic choices, but rather as outcome of the institutional setting and forces. In answer to this we see academic contributions emerging on port authority strategies (see also Woo et al, 2011, the special issue volume 8, 2013 of Research in Transportation Business Management).

In this paper we start adding to this emerging research stream by empirically investigating the strategic scope of port authorities at a global scale and by exploring factors that influence this strategic scope, based on a structured survey send to all major port authorities worldwide. More specifically, we investigate whether recurring configurations of strategic scope exist and to what extent these relates to contextual factors of PAs. This provides a basis for further theory development and empirical analysis of strategies of port authorities.

2. Methodology and research construct

The empirical data of this research is achieved through a survey of port authorities. We developed a set of 445 port authorities, representing the largest multi-user ports worldwide to which we sent the survey.

2.1 Research construct

The research focuses on the strategic scope of port authorities. The strategic scope is one of the fundamental issues in strategy research (Foss and Mahnke, 2002) dealing with strategic problems of organizations. Each strategic problem can be divided into process, content and context (Pettigrew and Whipp, 1991). Strategy content is the outcome of the strategy process and is "a pattern of actions trough which an organization propose to achieve desired goals, modify current circumstances and/ or realize latent opportunities" (Rubin, 1988). As a consequence, strategy and organization researchers focus on the relationships among the aspects organizational environments, strategy processes, strategy content, and organizational performance. The organizational environment is for a large part formed by the institutional environment, which has brought institutional theory into the field of organizational research (Rodrigues and Child, 2008). Institutional theories of organizations state that organizations are influenced by normative pressures, sometimes arise from external sources such as the state, other times arising from within the organization itself (North, 1986, Zucker, 1987). They argue that the three main differences between organizations related to their strategic actions and performances are the internal goals and values, the legitimacy of external

control, and the relative control or power of the organization. Strongly institutionalized organizations may serve many important legitimating functions whereby institutionalization increases stability, creating routines that enhance organizational performance, however except when more efficient alternatives are available but ignored (Zucker, 1987). The resulting stability increases effectiveness when it is linked to goals of the organization by creating "routines" that diminish transaction and coordination costs. But stability decreases effectiveness if the strategic and operational environment change, asking for renewal and adaptation. Port authorities are traditionally institutionalized organizations and their institutional context, which differs among countries, strongly influences the way in which they develop strategically (Ng, Pallis, 2010, Child et al, 2012). At the same time PAs act in a dynamic environment: competition is increasing, customers and users globalize and integrate both horizontally as vertically and environmental pressures increase. The recent changes on port authority governance, which provided greater autonomy and delegated managerial power to PAs (Verhoeven 2010), have opened windows of opportunities for extending their role in shaping the port's competitive position (Notteboom et al, 2012). The question underlying our research construct is: how do PAs concretize these windows of opportunity, i.e. what strategic role and actions do they adopt, and to what extent is this impacted by their institutionalized character? Figure 1 illustrates the research construct.

2.2 Measurement constructs

The three research constructs (institutional structure, strategic goals and strategic scope) are measured with different items. These items were identified based on analysis of the relevant literature in combination with an in-depth analysis of annual reports and strategic documents of a small set of ports.

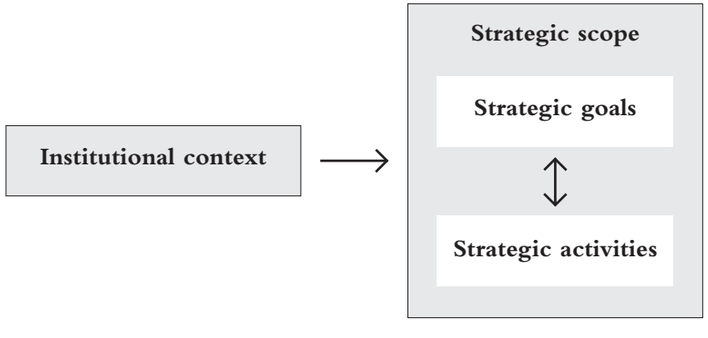

Figure 1: Research construct
The straight arrows assume explanatory value in the form of a causal relationship: variables in the institutional context influence the strategic scope of the organization, comprising both the strategic goals as the strategic activities. The two-sided arrow assume a seemingly related construct: the strategic scope of a firm, i.e. its set of strategic activities should be aligned with its strategic goals.

Strategic Goals

Port authorities generally have specific strategic goals that relate to their responsibilities and function. They combine public and private goals and can be characterized as hybrid or shared value organizations (Verhoeven, 2010, Koppell 2013, Van der Lugt et al, 2013). A second assumption is that given the differences in institutional structure and market environment, strategic goals may differ between port authorities (Ng and Pallis, 2011). To confirm both assumptions, a measurement construct consisting of a list of different possible strategic goals of PAs is developed, which is empirically tested by the survey. The list of strategic goals is developed based on literature review and a scan of websites and annual reports of a selected set of PAs. Eleven strategic goals were identified which are described in this section mentioning for each goal also a concrete PA that explicitly states the goal in its communication.

A first common strategic goal of port authorities is port competitiveness, with the implicit assumption that this will contribute to *local, regional and national economic growth* (Port Metro Vancouver). Two related goals are creating *employment* and facilitating *trade* (De Langen, 2008; Port of Houston Authority, St. Johns Port Authority). *Maximizing throughput volumes* (Port of Tauranga Ltd.) is a fourth goal mentioned by port authorities and often used as a primary performance indicator for ports. More recently PAs have developed a rather value oriented approach (Robinson, 2002), and express the two strategic goals of maximizing *value added of the port as a whole* (Antwerp Port Authority) and maximizing *added value of the individual businesses* (Barcelona Port Authority) located in the port. Other trends are the increased importance of the integration of ports in their forelands and hinterland (Notteboom and Rodrigue, 2005) which has brought *accessibility* (Port of Rotterdam NV, Antwerp Port Authority) on the list of strategic objectives of PAs, and the increased importance of the environmental impact of ports causing *sustainability* to develop as a major strategic goal (Port of Los Angeles). For autonomous and financially self supporting port authorities (for example in the UK and Australia, Port of Tauranga Ltd.) often generating *incomes* and *profits* are main strategic goals. A last goal mentioned by a few port authorities is that they strive to become *world leading port authorities* (Port of Rotterdam NV, Port of Los Angeles).

Institutional context

Institutions shape the institutional context of an organization. Institutions are defined as customs and rules that provide a set of incentives and disincentives for organizations (North, 1986). They work either internally through codes of behavior, or externally, by third party

policing and monitoring. Indicators of institutional environment reflect pressures generated external to the organization, such as those created by the state via law and regulation or by the professions, based on their widespread authority (Zucker, 1987). The institutional context of the port authority as we define it consists of a set of both external and internal aspects: it is detailed in the items ownership, institutional structure, level of institutional autonomy, level of strategic freedom and composition of Board of Commissioners (see also Verhoeven, 2011).

Scope of activities

Starting point for defining the strategic scope of the PA is the landlord model. In the landlord model, a port authority plans its port and exercises overall control over the activities carried on within it, but delegates these activities extensively to private sector companies (Goss 1990a). As a consequence, the pure landlord port authority is restricted in its opportunities to participate in activities beyond its jurisdiction (Heaver et al, 2010). The analysis of strategic scope of PAs 'beyond the landlord' considers potential strategic development directions out of the landlord model.

In general firms can expand along a limited set of generic dimensions. Schendel and Hofer (1979) distinguish two generic dimensions for scope development of a firm: product/market combinations and geographical territories. Collis and Montgomery (2005) add a third scope dimension: vertical boundaries in the value chains. For PAs these three dimensions also hold. PAs not only develop new products and services but also extend the geographic space within which these activities take place from the local level (the port area) to the regional level (inland networks) and even the global level (as evidenced by e.g., PAs taking financial participations in port projects in emerging economies). Vertical boundaries concern the institutional ways in which PAs expand: full investment, via alliances or joint ventures, or rather by contracting and using the institutional instruments they have available. Our search for concrete strategic activities that go beyond the landlord function is conceptually based in the three perspectives product, geographical and vertical boundaries.

2.3 Survey content and process

The survey-content was constructed based on the above described research construct and measurement constructs. The survey consists of a set of questions addressing together the institutional context, the strategic goals, the strategic role and activities and respondents-related attributes. The survey was sent in hardcopy and through e-mail, with a personal invitation letter, supported by ESPO and IAPH. Respondents could either fill out the survey online or in hardcopy. To enhance the rate of response, the survey was translated into French, Spanish and Chinese for the appropriate countries.

3. Analysis and Results

3.1 Data analysis

94 valid responses were obtained, out of the 445 port authorities the survey was sent to. The respondents were all executive managers, involved in the strategic decision making. The ports in the sample represent about 30% of world port cargo tonnage. Port authorities from developing (non-OECD) countries, in Africa, the Middle East and Asia responded to a limited extend. Most of the responding ports in Asia are in a developed country. Latin America is also underrepresented. This may be explained because port authorities in developing countries are generally more constrained to act 'beyond the landlord'. The underrepresentation of ports in Africa, Middle East and the developing parts of Asia does not negatively influence the reliability or relevance of the outcomes of the current analysis. Getting more insights on strategies of port authorities in developing countries remains a challenge for further research.

3.2 Analysis of institutional structure

The institutional structure was measured by asking the respondents on a set of aspects relating to the institutional structure of their organization. Main conclusion from this analysis was that corporatization mainly supports financial and strategic autonomy, but that due to their shared value character also corporatized PAs are still subject to a strong institutionalized environment, which is a relevant input for their strategy making.

3.3 Analysis of Strategic goals

From the analysis of the importance of strategic goals mentioned by PAs we draw a couple of conclusions. First, the two main strategic objectives across all port authorities are: 'to enable regional or national economic development' and 'to generate sufficient revenue to cover costs and investments'. This clearly illustrates the duality in goals that port authorities have: contributing to regional economic growth is a goal that lies at the macro level, with a high level of public interest, while generating income is a goal that rather lies at the organizational (micro) level. As such Port authorities resemble shared value organizations (Porter, 2011), further grounded by the relative high importance of the goals 'enhancing sustainability' and 'providing for accessibility'. Second, PAs are less focused on profitability for shareholders, an observation that is in line with the fact that many PAs are still publicly organized: only a limited share have real shareholders and are organized in a corporatized or privatized way. Third, the factor analysis shows that the goals can be grouped in three categories: goals at macro level (regional economic growth, trade), goals at cluster level (accessibility, added value of companies) and goals at firm/organization level (revenues, profit).

Relating the strategic goals to the institutional character provides the following insights:

- PAs with higher levels of private ownership give less importance to goals at macro and meso/cluster level.
- PAs with higher levels of strategic and institutional freedom give less importance to goals at macro and meso/cluster level and more importance to goals at firm level than PAs that are more restricted in their strategic and institutional freedom.
- Corporatized PAs focus more at firm level goals and focus clearly less at macro level and cluster level goals than PAs with a more public character.

3.3 Analysis of strategic scope

On their specific role, PA executives responded that first, the direct role that PAs have in the operations and services is expected to (further) diminish. Second, both the international role as the role in new activities, (both entrepreneurial roles) is expected to increase significantly. Third, the indirect role in the hinterland network is expected to increase stronger than the direct role in the hinterland network and shows a significant positive difference of means between 2015 and 2011: the direct role in the hinterland network is expected to increase, but only slightly. Fourth, also the facilitating function is expected to become more important in 2015, comparison of means shows a significant difference.

The outcome of the factor analysis shows that in their development of activities beyond the landlord, port authorities make different choices for which activities to develop. The result details the approach as developed by Verhoeven (2010), as the activities cluster around the different combinations of geographical and functional domains at which port authorities can act. The geographical domains comprise local, related to the activities within the port area, regional, referring to the activities in the hinterland and global, referring to internationalization activities. In the functional domain we also see an influence of the port's context: congestion reduction is a separate category. This can be explained by the fact that not all ports face congestion and thus it will be that set of port authorities that are faced with congestion in and around their port that develop activities related to this, not necessarily fitting in a typology of a port authority with a strong focus at cluster related and facilitating activities.

3.4 Relation of strategic scope with institutional structure

A last research action in this study was to relate the strategic scope to the institutional characteristics. From the observed correlations we draw the conclusion first, that corporatized PAs show greatest involvement in activities beyond the landlord, with operations, investment in inland facilities and fighting congestion showing highest correlation. Second, the group of PAs with larger share of private ownership shows less involvement in stimulating and facilitating activities, especially with regard to accessibility, congestion avoidance and education and marketing. Third, PAs with more public ownership and boards with members from political background restrict their activities beyond the landlord rather to stimulating and enforcing activities instead of active involvement and investments. They pay highest attention to sustainability.

4. Conclusions

This research empirically analyses the (changing) strategic scope of port authorities worldwide and explores relationships between the institutional structure of PAs and their strategic scope. Based on the analysis of data obtained by a worldwide survey we can draw a set of conclusions. PAs substantially execute a variety of activities that go beyond a landlord role and this role will increase further in future both in functional, geographical and organizational perspective. PAs differ clearly in their institutional settings, along the dimensions public/private, level of institutional autonomy and level of strategic and financial freedom. The institutional settings impact both the strategic goals and strategic actions of port authorities. Based on the results of the data-analysis we argue that port authorities moving along the line towards more autonomy and more commercial orientation show more attention for goals at the firm level whereas port authorities acting in a more institutionalized setting give more weight to the goals at macro level and even also at the cluster level. The ranking of strategic goals according to their level of importance with the two highest scoring goals being one at macro level and one at firm level underlines the shared value character of PAs (Porter and Kramer, 2011). Although the statistically identified relationship between the institutional structure of the port authority and its strategic scope is not a strong one, indicating the existence of other factors impacting strategic scope, some tentative conclusions can be drawn on the patterns of the relations. Corporatized PAs show greatest involvement in activities beyond the landlord, with operations, investment in inland facilities and fighting congestion showing highest correlation. Contrary to the group of PAs with larger share of private ownership, the group of corporatized PAs shows larger involvement in stimulating and facilitating activities, especially with regard to accessibility, congestion avoidance and activities as education and marketing. PAs with private ownership and boards with commercial oriented members seem to be less involved in facilitating activities in the cluster and also show less a stimulating and enforcing role. PAs with public ownership do most stimulating and facilitating activities and pay relative highest attention to sustainability. Combining the results and conclusions from the different steps in the analysis brings us to the statement that bringing in more autonomy and a more business alike structure in PAs widens their strategic scope and brings in more objective, value oriented goals, but at the same time might imply a shift in focus from goals at the macro level to goals at the firm level and a shift from a rather facilitating role towards a more investing and entrepreneurial role. These developments can certainly add positively to the performance of

port authorities and the ports they are responsible for but at the same time ask for a well and continuous consideration of thoughts about the key function of the port authority and its main responsibilities, both within the port authority as within its key governing bodies.

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Note

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Business model innovation of the Port of Rotterdam Authority (2000-2012)

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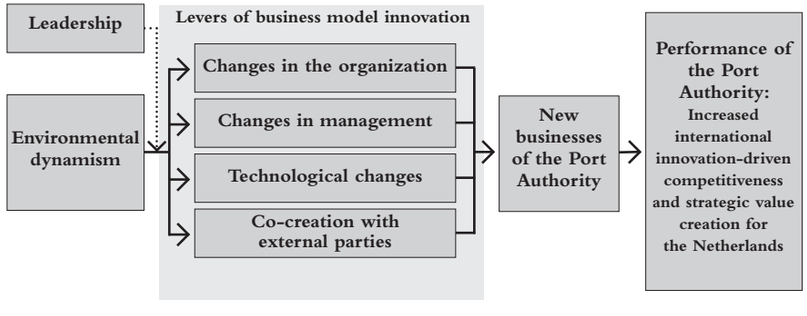
1. Introduction

The Port of Rotterdam Authority (hereafter 'Port Authority') – with a turnover of approximately 615 million euro and around 1,160 employees in 2012 – has been able to successfully realize innovation of its business model in recent years[1]. A business model gives a broad-based picture of how, with whom and for whom a business creates value and how it can appropriate created value. Business models consist of several components and are focused on strengthening the competitive position[2]. This article focuses on the role of the Port Authority's (top) management in the timely innovation of the business model in a response to environmental dynamism. The Port Authority's business model innovation not only contributed to strengthening its own competitive position as Port Developer, but also the international competitiveness of other firms in Rotterdam's port and industrial complex – by far the largest in Europe – and elsewhere in the Netherlands. This illustrates how business model innovation contributes to strategic value creation.[3]

In this article, we first address the changing environment in which the Port Authority operates and competes. Then we elaborate on the development of its new business model: from a 'Landlord' towards a 'Port Developer' business model. Next, we focus on the four levers of business model innovation: organisation, management, technologies and co-creation. After that we have a closer look at four developed new businesses that result from the innovative business model. We also address the way in which these new businesses contribute to a stronger international competitive position. In a separate text box we will discuss the specific role of leadership in the innovation process. Box 1 shows the conceptual framework for this article. We focus on the years 2000-2012 so as to include in our analysis a period before and after the Port Authority's corporatization in 2004. Finally, based on these insights, we discuss a number of key findings.



Box 1. Conceptual framework

[1] A substantially shortened/adapted version in Dutch of this article was included as a case study in Volberda et al. (2013a).
[2] See also Volberda et al. (2013a).
[3] Van Den Bosch et al. (2011).

2. Environmental dynamism and focus on strategic value creation for the Netherlands

The international environment in which the market-oriented Port Authority operates and competes is continuously changing. Important developments in the years 2000-2012 include the growing world trade, a shift in the centre of economic growth (mainly towards Asia) and, in turn, a shift in international goods flows. Furthermore, being located in a densely populated area, the Port Authority is confronted with increasing environmental regulation. Also questions about the value created for the city, region and the country began to rise. But also developments with regard to increased scale in transport, increasing containerisation, growing scarcity of commodities, and intensifying competition between ports on the base of the integration of both logistics chains and (petro)chemical clusters[4]; see also Box 2.

- Increasing pressure to provide evidence about the strategic value of the port for Rotterdam, the region and the Netherlands besides its economic value (Van Den Bosch et al., 2011).
- Intensification and shift of international goods flows.
- Larger negotiation power of shipping companies as a result of increased shipping scales and hub-and-spoke approach.
- Increasing international competition between integrated (petro)chemical clusters.
- Increasing congestion, scarcity of raw materials and more stringent rules and legislation in terms of safety and environment.
- Increasing competition on the base of chain control / integrated supply chain management.

Box 2. Environmental dynamism: illustrative developments in the period 2000-2012

As conceptualized in Box 1, responding to these external developments requires vision, leadership and innovation of the business model focused on *strategic value creation for the Netherlands* and thereby on keeping the 'license to grow' of the government and other external stakeholders. In addition, competition between Western European ports within the so-called 'Hamburg-Le Havre range' is substantial. Therefore, there is a need to excel in terms of both efficiency and innovation in, for instance, infrastructural facilities.

The decision to corporatize the Port Authority – which turned the Municipal Port of Rotterdam Authority ('Gemeentelijk Havenbedrijf Rotterdam') into an independent public limited company (N.V.) with as shareholders the Municipality of Rotterdam and – later[5] – the Dutch State – created new opportunities. For instance, the Port Authority could now

[4] More information on these and future developments can be found in the Port Authority's Port Vision 2030 (2012).
[5] To facilitate financing of the Maasvlakte 2 area – as part of Project Mainportontwikkeling Rotterdam (Mainport Rotterdam Development) – in January 2007 the Dutch State became co-shareholder with 30% of the shares.

operate on the capital market independently, operate in a more flexible manner and act more proactively with the private sector in the port. In this way, co-creation of, among others, new sources of added value with firms – leading to new businesses and income streams – could be realised faster and more effectively.

The realization of new large projects in the port, such as the construction of Maasvlakte 2, takes place in the context of an intricate field of rules and legislation. The complexity of the Port Authority's playing field is further increased by the large number of stakeholders that continuously have to be taken into account in planning and implementing projects in the port. Sustainability and safety are expected to meet strict requirements. Hans Smits, CEO of the Port Authority, points out: *"We have more and also different types of discussions. It has become more complex, also in our considerations. We are in the middle of this process and it also has an impact on our decision-making. That is new for us."* [6]

The further increase of the strategic value of the Port of Rotterdam for the Netherlands is a very important necessary condition for the Port Authority's 'license to grow'. The stakeholders are and remain prepared to provide this license as long as the contribution to the strategic value for the Netherlands will be made clear and is taken into account in choosing new activities and in business model innovation. Box 3 provides a first quantitative indication of the strategic value as investigated in the report: "The strategic value of the Port of Rotterdam for the international competitiveness of the Netherlands: A first exploration"[7].

Strategic value consists of:

- quantitative part, i.e. the economic importance (directly and indirectly value added): around 22 billion euro;
- qualitative part, i.e. the contribution to the international, innovation-driven competitiveness of the Netherlands: estimated at a minimum of 6 billion euro.

Box 3. Strategic value of the Port of Rotterdam for the Netherlands[8]

3. Business model innovation: from a Landlord towards a Port Developer business model

The Port Authority, established in 1932, was focused particularly on administration, infrastructural maintenance, economic exploitation of the port area and other traditional landlord functions. For instance, it is also responsible for continued safe and effective handling of shipping traffic. Increasingly, however, it focuses also on the role of developer of the Port of Rotterdam and of international strategic connectivity[9] Its main sources of income are rents and port dues. In the years 2000-2012, the Port Authority's business model increasingly changed from a *Landlord* to a *Port Developer* business model; see Box 4.

[6] Het Financieele Dagblad, 29-11-2009. Interview with Hans Smits: 'Je moet een open oog hebben voor de wereld'.
[7] Van Den Bosch et al. (2011).
[8] Van Den Bosch et al. (2011), Box 4.21 and 4.23; the figures pertain to the year 2010.
[9] Van Den Bosch et al. (2011).

- **Landlord business model**: focus on land exploitation (lease and maintenance) and shipping traffic handling in the Port of Rotterdam and the nearby coastal area.
  - Characteristics: mainly hierarchically organised, reactive, with a focus on the exploitation of current activities.
- **Port Developer business model**: complementary to carrying out Landlord activities also focus on entrepreneurship (often in cooperation with the private sector through *co-creation*) and on innovation-driven port development in a broad sense ('entrepreneurial developer').
  - Characteristics: mainly decentralised, proactive, with a focus on both exploitation and renewal (exploration) and *strategic value creation* for the port, the region and the Netherlands.
- Through a stronger focus on strategic innovation, the Port Developer business model contributes to proactively creating strategic value for the *international competitive position* of the established firms in the Port of Rotterdam and elsewhere in the Netherlands (Van Den Bosch et al., 2011).

Box 4. Business model innovation of the Port of Rotterdam Authority in the period 2000-2012: from a Landlord to a Port Developer business model

The renewed business model has an explicit focus on proactively creating strategic value, based on customer requirements, by developing strategic connectivity[10] in the form of knowledge intensive and innovation-driven supply chains, networks, clusters and customer relationships; see also Box 5.

- Strategic connectivity comprises of the connections and/or organizational relations between e.g. firms and ports that contribute to an increasing access to and utilization of determinants of competitiveness that are present elsewhere, resulting in innovation and renewal.
- Strategic connectivity consist of two dimensions:
  - *Structural (i.e., quantitative) dimension:* focus on the structural dimension of connections (e.g., number of connections, centrality in networks);
  - *Strategic (i.e,. qualitative) dimension*: focus on the quality (relational and knowledge dimension) of connections and organizational relations, aimed at innovation and renewal in firms and in their networks.
- Interorganizational cooperation between partners aimed at strategic connectivity presupposes complementarity regarding, among others, market and knowledge, and contributes to a more sustainable competitive position.

Box 5. Strategic connectivity: structural and strategic dimension[11]

[10] See Van Den Bosch et al. (2011) for a further description and illustrations of the concept 'strategic connectivity'.
[11] This Box is an adapted from Box 3.8 in Van Den Bosch et al. (2011).

Hereafter, we will address changes in the *four management levers* that pertain to respectively changes in (1) the organisation, (2) the management itself, (3) technologies and (4) the extent and manner in which co-creation of strategic value occurs with external parties. Changes in these levers have led to business model innovation. These changes have contributed to an increase in proactive decisiveness, flexibility and transparency, as a result of which the Port Authority has become better able to operate and compete in the changing and increasingly complex environment and to create sustainable strategic value. As indicated in the left part of Box 1, we will briefly describe how leadership can translate the need to respond to environmental dynamism into business model innovation; see Text frame 1 and Box 6.

Text frame 1.
Role and importance of leadership in business model innovation

In the period 2000-2012, the Port Authority had two CEO's. In the years 1992 to 2004 Willem Scholten functioned as CEO. Scholten is considered as a transformational leader, strategic thinker and visionary[12]. Under his leadership, the Port Authority started to operate in a more commercial and businesslike way. The high-profile guarantees in what has become known as the so-called RDM affair in 2004 led to Scholten's mandatory departure. Hans Smits was appointed as director ad interim and subsequently as the new CEO. His appointment heralded a period with more emphasis on transparency and a more focused participation portfolio. Also Smits can be typified as a transformational leader, with a businesslike and cutting-edge way of leadership[13]. His arrival resulted in a continuation of the Port Authority's businesslike approach and a more transparent way of operating both internally and externally. For instance, a considerable amount of information for the employees was placed on the Intranet. Several measures were taken to improve the Port Authority's financial position so as to, among others, meet dividend arrangements made and to ensure value for money for customers.

The under Smits' leadership prepared business plans (2006-2010 and 2011-2015) as well as the Port Vision 2030 stress the Port Authority's role as Port Developer. Smits supports simplification of procedures in order to operate more decisively in the interest of the Dutch economy. He also emphasizes the importance of innovation to be able to remain competitive in the context of continuously changing market circumstances: *"The fact that we are a world market leader puts more pressure on the organisation to always be at the forefront and innovate ourselves continuously, which will enable us to strengthen that position in the increasingly competitive environment"*[14].

[12] Description of Scholten based on Brolsma (2007) and interviews.
[13] Description of Smits based on Brolsma (2007) and interviews. See for a description of transformational leadership and how it influences changes in organization and management, i.e. management innovation, Vaccaro et al. (2012) and Van Den Bosch (2012).
[14] European Academy of Management (EURAM) Conference, Plenary session speech Hans Smits on "Social innovation: A crucial factor for the future of Mainport Rotterdam", Erasmus University, 7 June 2012, Rotterdam.

Smits considers leadership important for stimulating a continuous focus on innovation, in which changing human behaviour through social innovation is often key; to be enabled by the complementary levers management and organization of business model innovation. Through both levers, transformational leadership by the top management team is being embedded within the organization. To realise innovative projects, *stakeholder management* – including finding a proper balance between the different stakeholder interests – is one of Hans Smits' leadership skills[15]. Box 6 summarises some important attributes of effective leadership at the Port Authority.

- Translating environmental dynamism and social developments into challenges for changes in the four levers focused on business model innovation.
- Transformational leadership focused on creating sustainable strategic value for the international competitive position of the industrial port complex Rotterdam and for the Netherlands (Van Den Bosch et al., 2011).
- Continuous focus on stakeholder management.
- Focus on adjustment of human behaviour by means of renewal of the organisation and management levers, which emphasises the importance of social innovation.

Box 6. Attributes of transformational leadership at the Port of Rotterdam Authority

3.1 Lever 1 of business model innovation: changes in the organisation

Successive changes in the internal organisational structure of the Port Authority, both before and after its corporatization, have led to a flatter organisational structure with more horizontal relations. The organisation also started operating closer to the market and in closer contact with the customer – e.g., through marketing decentralisation – than was previously the case. This change enabled the organisation to respond with more flexibility to new developments and opportunities for the improvement of the international competitive position and sustainability. Operations also were more and more project-based, such as in operations concerning Maasvlakte 2 – through Project Organisation Maasvlakte 2 – and in creating working groups around so-called critical success factors. Such a project-based approach became important to be able to manage the more complex environment. The possibilities for employees to switch functions within the organization was deliberately increased. These factors resulted in a larger internal flexibility; see also Box 7.

Illustrative examples of newly established business units in the period 2000-2012, focused on new business or income streams, are the Innovation Board and Port of Rotterdam International (PORint). The Innovation Board was established in 2012 to bundle

[15] This stakeholder focus can e.g. be seen in the initiated structural dialogue sessions – under Hans Smits' leadership – in the form of meetings with several customers from all sections of the port as part of what has been called '(Dial)Oog op de haven' (with a pun on the word dialogue, referring to both having discussions as well as having the focus on the port) as well as the organization of roundtable meetings with the main logistics players in the Netherlands and other stakeholders on modal split initiatives.

innovation-related issues and give them a more prominent focus. All foreign activities[16] of the Port Authority were transferred to its new department PORint, with a stronger focus on a foreign participation portfolio than before[17].

- More horizontal internal relationships; more internal flexibility.
- More project-based way of organizing.
- Decentralisation of the marketing function.
- Establishment of new departments focused on new business creation.

Box 7. Business model innovation: illustrative examples of changes in the lever 'organisation'

3.2 Lever 2 of business model innovation: changes in management

With the increasingly flatter organisation, the number of management layers was reduced substantially. In addition, the management itself went through multiple changes. At the beginning of 2005, Hans Smits became the Port Authority's new CEO, and in the following period a large number of the original top 20 managers was replaced by managers that each had their own working area (such as Corporate Strategy and Treasury). This change in the Management Model enabled the creation of new strategies. The new organizational structure was shaped in such a way that a number of these managers report directly to each member of the new three-headed top management team, consisting of the CEO, CFO and COO.

The appointment of those 'direct reports' managers and, in doing so, the initiation of a new form of decision-making and providing direction, meant a significant departure from the past, and can therefore be seen as an example of a company-specific change in its Management Model, i.e. *management innovation*[18]. Also, the degree of professionalization increased in the coordination of projects and other operations. Examples are the introduction of standard financial and operational audits. In 2011, the Port Authority started the programme 'Groen 2.0' to promote collaboration and to professionalize project management within the whole organization, based on the PRINCE2 methodology[19].

Another management innovation at the Port Authority in the period 2000-2012 is a larger focus on new management practices focused on involving external stakeholders – such as representatives from port industries, NGOs, employers' and employees' organisations – in the decision-making process. Hans Smits: *"I can see only one way to prevent paralysis and remain flexible and alert, and that is to always seek the dialogue, which means that we really have to listen to one another"*[20]. This focus on actively managing external stakeholders in decision-making and on executing projects that enjoy broad levels of support (stakeholder management; see also Text frame 1) is also reflected in the implementation agenda of the

- New top management structure with 'direct reports' and decentralisation in decision-making.
- New way to promote collaboration and to professionalize project management.
- More focus on management of stakeholders and co-creation in developing new business.

Box 8. Business model innovation: illustrative examples of change in the lever 'management'

Port Vision 2030. In addition, management initiated a larger focus on the role of the Port Authority as a so-called entrepreneurial developer. Co-creation (especially with customer segments) is thereby seen as an effective way to realize innovative projects that contribute to the international competitiveness of the private sector in the port and elsewhere in the Netherlands; see also Box 8.

3.3 Lever 3 of business model innovation: technological changes

Considering the Port Authority's role as service provider and enforcer of rules and regulations, the influence of changes in technologies within the Port Authority on the innovation of its business model is limited. It is interesting though to mention the new ICT systems for a more efficient and safer handling of shipping traffic, which enabled the Port Authority to manage the growth of the port-industrial complex and related developments in shipping. Through the developed Harbour Master Management Information System (HaMIS; first stage completed in 2011), the Port Authority is better equipped to be coordinator of the nautical supply chain. And by means of the developed innovative communication system Portbase (initiated in 2009 through co-creation with the Port of

- New ICT systems for more efficient/safer handling of shipping traffic.
- Development of an innovative communication system that goes beyond the port itself, focused on customer requirements; smart use of data.

Box 9. Business model innovation: illustrative examples of change in the lever 'technologies'

[16] This includes both port participations (like in the Port of Sohar) and boardroom consultancy activities.

[17] Precursors of the department were called successively Bureau Assistentie Derde Wereld (BADW) ('Agency for Third World Assistance'), TEMPO and Mainport Holding Rotterdam (MHR) Consultancy. The name change over time implied a stronger focus on a foreign port participation portfolio.

[18] For additional literature on the concept 'management innovation' see Birkinshaw (2010) and Van Den Bosch (2012). Furthermore, see our contributions (Hollen et al., 2013a; Volberda et al., 2013b) in the Special Issue of European Management Review, volume 10(1), on Management Innovation.

[19] The PRINCE2 methodology produces standards for project management norms. By having used this methodology before for the Project Organisation Maasvlakte 2, the Port Authority has been able to realize the construction of Maasvlakte 2 according to all quality specifications, without exceeding the budget and within the set timeframe, which is quite exceptional.

[20] Het Financieele Dagblad, 29-11-2009; Interview with Hans Smits: 'Je moet een open oog hebben voor de wereld'.

Amsterdam), firms are enabled to optimize their logistical processes; see also Box 9. These examples illustrate the supporting role of the lever technology, i.e. new technologies, in the gradual transformation of the Port Authority towards a 'Port Developer'. In this transformation process, the use of ICT and 'smart use of data' will emerge as a strategic value creating lever.

3.4 Lever 4 of business model innovation: co-creation with external parties

Creating new business through co-creation implies a way of entrepreneurship of the Port Authority that is aimed at the development of new (combinations of) activities and knowledge with external parties. These efforts result in strategic renewal, knowledge development, innovation and an international strategic positioning of the Port of Rotterdam that is harder to copy; see also Box 10. Such a position is of great importance for the sustainable international competitiveness of both firms in the Port of Rotterdam and firms elsewhere in the Netherlands[21]. Examples of external parties are customers in the petrochemical, energy, transport and logistics industries, other Dutch as well as foreign port authorities and other stakeholders. Through partnering the Port Authority can focus on its own core business while for additional tasks and activities it can use the expertise of the party with which it creates strategic value. This way of cooperating with the private sector is required for, among others, interconnecting logistical supply chains so as to make them more efficient. As mentioned by Smits: *"In this way, the port can play its role as intermediary: get the parties around the table to bundle transport operations. Or as an investor: become the owner of large inland terminals for inland shipping or rail transport."*[22]

The new businesses are especially focused on increasing the port's and the Netherlands' international competitive position through the further development and strengthening of the port's *strategic connectivity*[23]. Strategic connectivity explicitly centres on the qualitative value (relational and knowledge dimension) of the connections, including the organizational design of the relations. The focus is on (hard to copy) innovation and strategic renewal of the firms involved in the network. These activities did not fit the traditional (exploitation focused) Landlord business model. Yet investing in strategic connectivity is a proper way to serve the business and public interest as, for instance, the case of the Port of Sohar – to be discussed below – will show. The changes in the lever co-creation resulted in improved international competitiveness of the region and the Netherlands[24] and as such contributes to the 'license to operate and grow'.

- Co-creation is focused on developing new forms of value creation by means of the development of new (combinations of) activities and knowledge with external parties, resulting in innovation and a harder-to-copy strategic positioning of the Port of Rotterdam.
- Co-creation of the Port Authority with external parties is mainly focused on further increasing the strategic connectivity.

Box 10. Business model innovation via the lever co-creation

4. Increased international competitiveness through new businesses

In the business plan 1997-2000 the Port Authority already expressed its ambition to become a mainport coordinator with emphasis on creating the right circumstances and providing facilities "that would go further than only leasing sites and water"[25] to further strengthen the Port of Rotterdam's competitiveness. In the period 2000-2012, this ambition was further developed, in which the Port Authority's role increasingly changed towards a Landlord-exceeding Port Developer. To illustrate this development, four representative cases[26] of new businesses will be discussed that could be realised by the Port Authority in this period through business model innovation. These cases are: (1) the participation in the Port of Sohar; (2) the initiation and commercialization of underground distribution system Multicore, (3) the introduction of the joint (i.e., with the Port of Amsterdam) port community system Portbase, and (4) the realization of inland container terminal Alpherium; see Box 11.

[21] In carrying out new activities as 'entrepreneurial developer', the starting point is usually to create strategic value through investments that on the one hand increase the sustainable competitiveness of the port and on the other hand cannot reasonably (in an efficient manner) be taken up exclusively by individual firms. The instrument of the 'strategic balance' – developed in Van Den Bosch et al. (2011) – will be useful for assessing alternative investment projects.

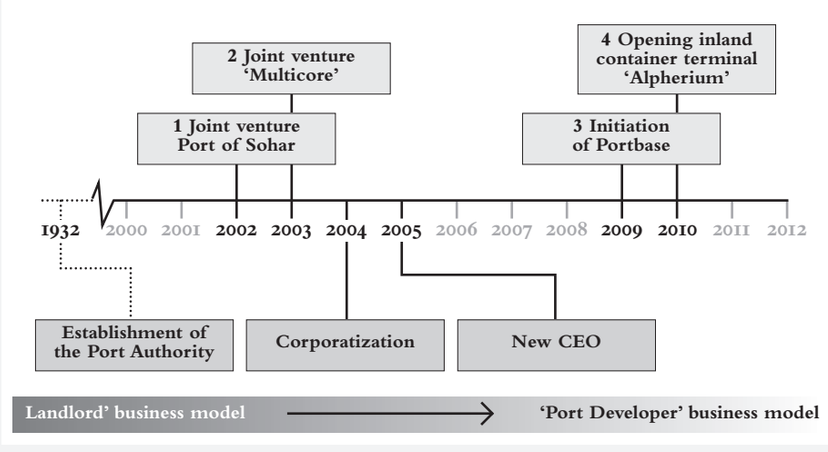
[22] NRC Handelsblad, 19-05-2011; 'Havenvisie 2030: Wat goed is voor Rotterdam, is goed voor Nederland'.

[23] A distinction can be made between three levels of strategic connectivity: (1) strategic connectivity within the port-industrial complex (focused on the strengthening of clusters); (2) national strategic connectivity (with other Dutch ports, like the Port of Amsterdam, or logistical hubs); and (3) international strategic connectivity (with foreign ports, like the Port of Antwerp, or logistical hubs abroad); see Van Den Bosch et al. (2011).

[24] For a more detailed elaboration, see Van Den Bosch et al. (2011).

[25] Source: Brolsma (2007: 324).

[26] Other illustrative examples of new businesses that suit the role of 'entrepreneurial developer' not discussed in more detail in this paper are: the development of real estate (Port City); setting up an innovation fund (Innovatiefonds); the Verkeersonderneming (a collaboration to keep the port accessible; the fostering of industrial ecosystems such as around the steam network in the Botlek area (see also Hollen et al., 2013b, 2013c); the development of the RDM complex; the construction of a Common Carrier Pipeline System (for the transport of ethylene via an open access pipeline from Antwerp to the Maasvlakte); setting up in collaboration with other ports a network of LNG petrol stations to reduce CO2 emissions; investing in Plant One, which is a test facility for sustainable process innovation; for recent research on Plant One, see Hollen et al. (2013a).



Box 11. Timeline: Port of Rotterdam Authority (2000-2012) – Four illustrative cases of new businesses

4.1 Participation in Port of Sohar: Increasing international strategic connectivity

In the eyes of globally operating supply chain coordinators, the Port of Rotterdam is a link in transport supply chains. In order to respond to trends, threats, opportunities and acquisition efforts related to cargo and/or company establishments, international strategic connectivity with growth markets is therefore important. Participating in the management of international ports is a new business for the Port Authority through which it can better respond to shifts in international traffic flows. It will also enables the Port Authority to market and further develop its portfolio of port management competences. In addition, developing and managing ports elsewhere enables the Port Authority to playing a bigger role as supply chain coordinator and, in turn, to maintain existing customers and attract new ones. Besides, increasing the available knowledge about growth markets and opportunities and customer requirements regarding those markets is important for Port Authorities of global ports.[27]

The importance of international strategic connectivity will be illustrated by the participation in the Port of Sohar. Since 2002, the Port Authority has a 50% share in the Sohar International Development Company and the Sohar Industrial Port Company (the 'landlord' of the Port of Sohar) in Oman. The joint venture agreement with the Omani government pertains to both the management and the development of this port-industrial complex. Considering the fact that this is the Port Authority's first international port participation, this new business – leading to an additional income stream for the Port Authority – is an interesting example of new 'products and services' resulting from innovation of the business model. As elaborated in the report on the strategic value of the Port of Rotterdam (Van Den Bosch et al., 2011), firms located in the Rotterdam area and elsewhere in the Netherlands clearly benefit from this joint venture. For instance, with Oman now seeking the expertise of Dutch firms such as Arcadis, BAM Group, C. Steinweg-Handelsveem, Royal HaskoningDHV, Tebodin and Van Oord.

4.2 Multicore: Increasing strategic connectivity within the port

Another interesting example of the Port Authority's business model innovation is the co-creation in the form of the joint venture 'Multicore' with Vopak Chemicals Logistics in 2003. Multicore operates on a commercial basis an underground distribution system of a bundle of pipelines for the (petro)chemical and gas industry over relatively short distances in the port area. This stimulates a more efficient and effective use of transport of chemical products through pipelines, which is beneficial for, among others, the formation and productivity of *industrial ecosystems*[28]. The petrochemical cluster within the port will become both more sustainable and competitive. Improving the internal pipeline network with a focus on the promotion of innovation and strategic renewal of firms – and, in turn, on increased strategic connectivity within the port – is important for the Port of Rotterdam to keep its position as the primary energy port in Europe for the supply and processing of energy carriers based on hydrocarbons.

Multicore can be seen as high-risk entrepreneurial investment to increase the vitality of the Port of Rotterdam. The investment was deemed necessary as the pipeline system would not (or not in a cost-effective manner) have been realized if the firms themselves would have had to take the initiative. In the new business model, the Port Authority is well suited to play an active market role in constructing and commercializing this pipeline infrastructure. By initiating Multicore, the Port Authority showed to develop from port administrator and exploiter towards coordinator and facilitator of the port. Established firms such as Abengoa, Air Products, ExxonMobil, Koch, Linde Gas, Shell Chemicals Europe and Shin-Etsu have all made use of Multicore.[29]

[27] This overseas port participation offers several large advantages for the international competitiveness of firms in the Netherlands (see also Van Den Bosch et al., 2011). For instance, it gives the Netherlands better options to develop towards becoming the energy-hub of Europe (through improved connections via Sohar with regional oil and gas networks in the Middle East), leads to new exposure of and demand for Dutch know-how, and stimulates leading firms from Oman and surrounding countries to establish businesses or their (regional) head office in the Netherlands. In addition, the participation enables to a better utilization of international goods flows, the strengthening of customer relations, and offers a stepping stone for Dutch firms for influence in and knowledge of this growth region. That makes such overseas port participations also important for the strengthening of the international innovation-driven competitiveness of the Netherlands.

[28] See for additional literature on industrial ecosystems: Hollen et al. (2013b, 2013c).

[29] See the website of Multicore (www.multicorerotterdam.com) for more information.

4.3 Alpherium: Increasing hinterland-oriented national strategic connectivity

The private sector increasingly grants the Port Authority the role of intermediate and stimulator in implementing initiatives, enabling a larger percentage of the imported and exported goods transported in the Netherlands via rail and inland shipping. These initiatives are required to be able to respond to the expected substantial growth in container transport and as such lower the congestion on the Dutch motorways[30]. To stimulate the desired shift from road transport to inland shipping – to make transport more sustainable – and to increase transport security and improve accessibility of the port of Rotterdam, the Port Authority has invested in setting up inland transhipment terminal 'Alpherium' in the city of Alphen aan den Rijn. Alpherium, which opened in 2010, is the largest inland port (ca. 6 ha.) for container transhipment in the Netherlands. Strengthening the Port of Rotterdam's position in hinterland networks in this way is important to improve the port's position towards its hinterland and, in turn, the (efficiency of the) transport capacity to the hinterland.

Alpherium was the result of co-creation with the private sector[31]. The Port Authority has purchased the land. The main initiators, however, are the Van Uden Group and Heineken. The Van Uden Group has invested in the construction and is the shipper and operator of the inland port. Heineken, which was looking for an alternative for the transport by truck of beer containers from its brewery in Zoeterwoude to the ports of Rotterdam and Antwerp, acted as 'launching customer'. The Port Authority may be Alpherium's 'landlord', but considering the fact that investments were made in this terminal *outside* of the Rotterdam port area and *together* with customers – or the customers' customers – of the Port Authority, makes it an example of a new business.

4.4 Portbase: Increasing ICT-related national strategic connectivity

The Port Authority has also increasingly developed towards a supply chain coordinator and facilitator by investing in a joint Port Community System with the Port of Amsterdam Authority. This system, called Portbase, was established in 2009. It is a joint ICT-platform that offers over forty intelligent services for efficient mutual exchange of information between firms – port customers – and between firms and governments, suited for all port sectors. As all information exchanges are conducted via one central point, the firms involved no longer need to develop and maintain a multiplicity of bilateral connections. Hence, by initiating Portbase, the Port Authority has created strategic value for shippers and carriers by developing and optimizing logistical chains and networks.

Portbase, which has gained broad support of the private port sector, arose from Port Infolink in Rotterdam and PortNET in Amsterdam. One of the main objectives is to make the logistical chains of both ports more attractive through a central point of contact. In addition, Portbase aims to play a key role in national as well as foreign port logistics networks[32] . Investing in Portbase provides a good example of a new role the Port Authority has taken on to strengthen innovation in its home base, i.e. the Port of Rotterdam. This innovation and renewal focused on strategic connectivity with, among others, the Port of Amsterdam is therefore a good example of ICT-related national strategic connectivity of the Port of Rotterdam.

4.5 Summary of the four cases

The changes in the four levers of business model innovation as described and analysed above have contributed to the realization and further development of the four cases. It is important to notice the complementarities between the levers. The lever co-creation for instance is not very effective without proper changes in the other levers. Box 12 gives an overview of the abovementioned new businesses of the Port Authority and how these contribute to the innovation-driven competitiveness of the Port Authority and the Port of Rotterdam as well as to strategic value creation for the Netherlands.

- **Case 1. Participation in the Port of Sohar in Oman:** Participating in developing/managing/exploiting a foreign port (co-creation with the Omani government).
  - *Contribution to the international competitiveness through*: increased international strategic connectivity by more influence in/knowledge of growth regions elsewhere; extending business capacities; attracting innovative, demanding new firms (so-called 'leader firms').
- **Case 2. Multicore:** Participating in realizing/commercializing underground distribution systems (co-creation with Vopak Chemicals Logistics; customers include Air Products, Shin-Etsu and Shell).
  - *Contribution to international competitiveness through*: increased strategic connectivity within the port and associated stronger, more integrated clusters, enabling industrial ecosystems and increased attractiveness for investments in the port-industrial complex.
- **Case 3. Inland shipping terminal Alpherium:** Participating in setting up and managing logistical hub in the hinterland (co-creation with Van Uden Group; Heineken as 'launching customer').
  - *Contribution to international competitiveness through*: increased national strategic connectivity by improved possibilities for larger intermodal cargo flows to the hinterland.
- **Case 4. Portbase:** Participating in extensive logistics communication system (co-creation with the Port of Amsterdam Authority).
  - *Contribution to the international competitive position through*: increased national strategic connectivity, more influence/higher reach as chain coordinator of logistics activities.

Box 12. Four illustrative new businesses of the Port of Rotterdam Authority (2000-2012) and how these contribute to the international competitiveness of the port and the Netherlands

[30] For the accessibility of the port of Rotterdam it is also important that the congestion on the A15 is reduced.

[31] See also Van Den Bosch et al. (2011), in particular Box 4.16 in this report.

[32] See the website of Portbase (www.portbase.com) for more information.

5. Business model innovation

As illustrated in the framework in Box 1, the above sections show that substantial changes in the environment in which a business operates requires innovation of the business model to be able to keep and further strengthen the international competitive position in the long run. A more dynamic-complex environment of the Port Authority requires a continuous focus on strategic renewal and innovation (both technological and social innovation), cutting back the number of management layers, more horizontal partnerships and a more decentralised market approach. Apart from the fact that environmental dynamism functions as a 'trigger' for internal change – innovation of the business model – it also necessitates to seek new forms of *strategic value creation* through new businesses to be able to stay viable in the future. See Box 13 summarizes some key findings.

- External environmental dynamics such as (de)regulation, changing international markets and growing competition are the 'triggers' for necessary innovation of existing business models.
- Transformational leadership has a positive influence on the (pro)active changes in the four levers of business model innovation and emphasizes stakeholder management, thereby accelerating business model innovation.
- A more dynamic-complex environment requires, among others, a reduction in the number of management layers, more project-based operations, operating closer to the market, a continuous focus on strategic renewal and innovation, and a more flexible organization to be able to respond faster to environmental changes.
- Co-creation with demanding international customers accelerates innovation of the business model and contributes to proper control of the risks.
- Change in the four levers of business model innovation requires time and a lot of managerial attention, also to make strategic use of the complementarities (i.e., mutual supportive influences) between the levers.
- The development of the 'Landlord' business model towards the 'Port Developer' business model contributes to both the Port Authority's performance and strategic value creation for the Port of Rotterdam, the region and the Netherlands.

Box 13. Business model innovation at the Port Authority (2000-2012): findings and implications

The process of implementing the Port Authority's business model innovation towards a Port Developer business model encountered several barriers. Besides a focus on exploitation of the current activities focused on increased efficiency, this type of business model also implies a focus on exploration: developing new activities and innovation for both current and new customers, markets and regions. Such a dual focus on exploitation and exploration – also called an *'ambidextrous'* focus – often leads to intra-organizational tensions – meaning tensions *within* the organisation itself – as the accompanying two 'managerial mindsets' of exploitation and exploration are mutually opposed. Hence, a balance must be found to be able to effectively innovate the business model. The period when Scholten was CEO did result in more strategic renewal compared to the previous period, but it was partly at the expense of transparency and audit procedures, so CEO Smits had to address these issues. Initially this meant that there became more focus – especially from an administration stance – on operating cautiously and improving things such as the transparency of existing organisational procedures (exploitation). Subsequently the organisation increasingly focused on change and as such on coordinating and facilitating new businesses.

The business model innovation towards 'Port Developer' also meant a stronger focus on creating strategic value by increasing strategic connectivity on a regional, national and international level, aimed at increasing the international innovation-driven competitiveness of the Port of Rotterdam and of firms elsewhere in the Netherlands. This increasing focus on strategic connectivity is relatively new for the Port Authority, and created some uncertainties about how to effectively address this focus. The Port Authority's participation in the Port of Sohar in Oman worked out very successfully, but unfortunately it has not been possible yet to repeat this success with other international ports.

The realised business model innovation of the Port Authority can also be seen in the more innovative way in which the Port Authority uses its own policy instruments to create more innovation and strategic renewal in newly developed port areas. For instance, it was decided to use a tender procedure for container terminals on the new Maasvlakte 2 area, resulting in more competition between – and innovative solutions from – terminal operators. The recent developments around the conflict between ECT and the Port Authority illustrate that a larger focus on stimulating competition within the port – important for innovation and as such for increasing the port's strategic value for the Netherlands – may lead to tensions and objections from external parties. It requires a lot of time and attention from the Port Authority's management to effectively manage these types of issues.

Our analysis and findings cover the period 2000-2012, and show that timely innovation of the existing business model – through insight into expected international environmental dynamism, with the help of transformational leadership and the four levers of business model innovation – has resulted in a strategic response to important environmental dynamics. In this regard the important question can be raised whether the Port Authority's *current business model is also equipped for the coming period*? Just think of the changing energy landscape and the fundamental transition that the substantial petrochemical industry in the

port will be confronted with. These major developments make it hard to answer that question upfront[33]. We will, however, contribute to this question in our scientific research.

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[33] See in this regard also the do's and don'ts of business model innovation in Volberda et al. (2013a).

The New European Port Policy: Old Issues, New Solutions?

Hercules E. Haralambides and Michele Acciaro

Abstract

European ports are an essential component of the logistics and supply chain networks of Europe and it is of primary importance that they operate efficiently. It is furthermore necessary that the port logistics infrastructure is continuously developed so as to avoid congestion, and ensure the seamless movement of cargo among ports and to and from the European hinterlands. As a result of the recent financial crisis; the increasing focus on safety and security; and the growing awareness of the environmental impacts of port operations, the sector is anew facing new and old challenges related to its long-term sustainability.

These challenges, and arguably the inability of the port sector and the EU Member States to meaningfully react to such challenges on their own, are at the basis of the renewed attempt by the European Commission to develop a uniform and coherent policy for ports. The need for increasing autonomy, efficiency and sustainability of the sector and the desire to avoid the emergence of anticompetitive behaviours in ports, have motivated the Commission to pursue a unified policy design, in an attempt to achieve that level playing field which would hopefully contribute towards the improvement of port services provided to the sector both in terms of quality and efficiency.

This paper provides an account of the recent EU policy developments, focusing on the most recent attempt by the Commission to address some of the issues facing the port sector. The paper highlights some of the controversies arising from the new EU policy approach, which, albeit milder in its contents than the previous attempts, recalls, especially in the areas of access to port services and state aid provisions, the content of the previous policy proposals. The paper argues in favour of a balanced policy intervention inclusive of stakeholders' demands, aiming at advancing a sector in many respects still characterised by inefficiencies and potential for improvement.

1. Introduction

One of the distinctive characteristics of most ports around the world is their mandate to contribute to trade facilitation and regional development. Efficient port operations are a necessary condition for economic competitiveness, and globalized markets would be unconceivable without an efficient port and shipping industry. Furthermore, ports are a sizeable component in public budgets and contribute substantially in terms of employment and value added to the well-being of regions or countries. Large public expenditures are thus tied up in port investments, while considerable positive and negative external effects are associated with port infrastructure development and operations.

The reasons enunciated in the previous paragraph are sufficient to justify the interest of society in ensuring efficient port operations and a meaningful expenditure of public resources ports command. It is thus not surprising that the intervention of public authorities in port affairs is significant. In the case of Europe, ports are one of the major components of the transport and logistics infrastructure that has allowed the European economy to develop, as one among the most prosperous in the world. The EU highly depends on ports for its trade with the rest of the world, and its ports also play a key role for its own internal market. The EU transport and port network is the single most important pillar for closer European integration and international competitiveness of Europe's external trade (European Commission 2013b).

Port activities contribute directly to employment, inward investment and GDP growth. 2,200 port operators currently employ around 110,000 port workers. In total, ports offer around 3 million jobs (direct and indirect) in the 22 maritime Member States, and they are a major source of tax revenue for local, regional and national governments.

The European Union comprises more than 1,200 ports, along a coastline of some 70,000 km. Of these, 319 principal ports are included in our Trans-European Transport Network (TEN-T) and are the subject of the new European Commission Regulation *on market access to port services and financial transparency of ports* (European Commission 2013a). The 96% of all freight and 93% of all passengers through EU ports transit through these 319 seaports.

In 2011, around 3.7 billion tonnes of cargo, or 74% of Europe's external trade, transited through European ports (more than 60,000 port calls of merchant ships). However, 20% of this traffic was served by only three ports: Rotterdam, Antwerp and Hamburg (European Commission 2013b).

The new TEN-T proposals of the EU could thus save the European Economy up to 10 billion Euros by 2030, and they could contribute to the development of new maritime connections with third countries through Short Sea Shipping. Currently, short sea shipping represents 60% of the tons handled in EU ports. In this respect, seaports are key nodal points of the EU intermodal transport chains, using this mode of transport as an alternative to saturated land transport routes, and as a way to connect peripheral and island regions. In terms of passenger transport, also in 2011, EU ports handled 385 million maritime passengers (European Commission 2013b).

As a result of their importance, ports have been included in EU regulation as early as the European transport policy itself and, over the years, a conspicuous body of reports and academic literature has followed the various policy attempts (Goulielmos and Lun 2012, Acciaro 2013). The prolific stream of academic literature that has emerged, providing guidance or criticism to the EU port policy, has contributed to the identification of some of the critical issues, many of which not yet entirely resolved (Roe 2009).

One of the most debated issues concerns the financing and charging practices of ports and the need to harmonise rules and increase transparency (Haralambides *et al.*, 2001; Bergantino, 2002; Acciaro, 2013). While there is in general agreement (Pallis 2006) that, in the long term, a more transparent regime would favour the port sector, in the short term implementing such regime would cause market distortions and probably favour well

established ports against smaller ones in less developed areas. Moreover, contrarily to what is established in the common transport policy, there is evidence of a reduction in infrastructure investments over time (Chlomoudis and Pallis 2002) and surely the current financial crisis has not favoured port developments. There is a risk, therefore, that divergence between Member State objectives could result in an uncoordinated development of ports around Europe, where large ports keep on prospering and smaller ports are relegated to a marginalised position. The ever-increasing size of ships, together with the notable concentration taking place in the shipping industry, favouring the largest of ports, are also having their effect on the accentuation of differences among European ports.

A further area that has characterised the Commission's approach towards port matters relates to the need to promote efficiency by stimulating competition, develop a level playing field and improve transparency in financing practices (Verhoeven 2009). While the Commission seems to favour public intervention aiming at fostering intermodality and the improvement of logistics activities, it objects on ports protecting their own service providers though the use of anticompetitive practices. In particular, one area of policy reform that has been omnipresent in the previous versions of the so-called "port packages" relates to port services. Already in the Green Paper of 1997, the Commission had made it clear that, with respect to the *general public interest* and safety issues, the port sector would benefit from the harmonization of management practices, towards a wider liberalization of the sector of port services. Although lightened by the exclusion of cargo handling, the new port policy leaves no doubt about the vision of the Commission on a more competitive market for port services. It is to this last point that this paper aims at providing some contributions.

2. The European port policy

2.1 Overview

Given the strategic importance of European ports, the European Commission has persistently attempted to develop a coherent regulative package aiming at promoting the efficiency and efficacy of the ports of the EU. Some of the recurrent ideas that have shaped the European Commission's vision on port policy are briefly discussed below.

I Characteristics of regions

The European port policy recognizes the diversity of European regions (North Sea; Mediterranean; Atlantic; Baltic) and the need to at least try to tailor policy intervention to their economic and social characteristics, under a common set of guidelines. It is well established that the geographical, economic and social contexts in which ports operate, as well as the different purpose and type of operations carried out at ports, have resulted in distinctive governance structures, at times even within the same member state. Having said this, however, such differences do not constitute, in the eyes of the Commission, a sufficient reason to renounce the need for greater autonomy; efficiency, and liberalization of port services across ports (European Commission 2013a).

II Regional Development and Economic and Social Cohesion

Ports should contribute to the development of European regions, when possible favouring least developed and peripheral regions such as islands and areas located on the EU border. For ports included in these regions the European Commission, in addition to structural and cohesion funding, provides policy instruments such as the Marco Polo scheme or the motorways of the sea (MoS) aiming at contributing, also financially, to the development of economically marginalised or peripheral regions (Goulielmos et al. 2012).

III Port Competition and Overcapacity

It is the objective of the European port policy, while respecting the overarching need for better infrastructure planning, to stimulate competition among ports and ensure that adequate capacity is available for a sustainable growth of European trade and effective port operations. It is furthermore the objective of the European policy to ensure that ports compete on an equitable basis -the often cited level *playing field*- through ample transparency, and commercial pricing aimed at full cost recovery. In this way, excessive overcapacity, at the cost of the taxpayer, should be contained at no more than what is operationally necessary (Haralambides, 2002).

IV Transport Externalities

The issue of transport externalities and their internalisation appeared in European policy in the 1991 White Paper (European Commission, 1991) and it was subsequently included in the Green Paper of 1997 (European Commission, 1997; Carpenter, 2012). The main issue there was the assumption that through *long-run marginal cost pricing* port authorities should aim at charging port users also the external costs they are responsible for (Psaraftis, 2005). Beyond the criticism that the pursuit of *marginal cost pricing* has generated, one of the main issues associated with this approach relates to the need of internalising transport externalities across modes (Acciaro, 2013).

V Trans-European Transport Networks

The EU has identified in the TEN-T networks one of the main pillars for European integration. The network aims at overcoming the obstacles to the movement of goods and people across the Member State national borders, improving the efficiency and effectiveness of the European transport systems, and in turn fostering European economic development. The efficiency and competitiveness of EU ports depends naturally also on efficient hinterland transport connections (OECD, 2009). Ports are recognised as crucial nodes of the

TEN-T network and as such are included in the EU TEN-T policy and are eligible to apply for the TEN-T financial support schemes of the EU (Goulielmos *et al.*, 2012).

VI Concessions

An important component of European transport policy is to ensure the involvement of the private sector, whenever possible, to improve efficiency and reduce public expenditures (Haralambides, HE and Gujar G, 2011). Also in the case of ports, private sector involvement in terminal operations and other port services is well established in the EU (Notteboom et al., 2012). This policy pillar is well argued already in the EU White Paper (e.g. European Commission, 2001), and more in detail in the Green Paper (European Commission 1997). Concession policy is at present, awaiting the adoption of the Concession Directive.

VII Market Access to Port Services

The topic of market access to port services has been one of the policy areas that has been present in previous European port policy packages. Under such policy efforts, there is the recognition that those services that are necessary for the functioning of ports require liberalization, monitoring and regulation in order to ensure that anticompetitive behaviours affecting the efficiency of the port sector would not be maintained (European Commission, 2013a).

VIII Financial Transparency

One of the issues that emerged through the various studies at European level, such as the *Financing and Charging practices of the ports of the European Union*, is the difficulty in obtaining and comparing financial information for ports. The different governance and administrative structures adopted by European ports imply that financial transactions between ports, local and national governments do not follow the same procedures or exhibit the same level of transparency. One of the objectives of the European Commission is ensuring transparency of financial transactions in order, among other objectives, to identify eventual subsidies and state aid to ports (see next point) (European Commission, 1998).

IX Subsidies and State Aid to Ports

The lack of transparency makes it complex to identify eventual subsidies and direct or indirect state aid to ports. While there is consensus that public funds, and European funding, as in the case of TEN-T networks, should be provided to support certain types of port infrastructure, it has been one of the main concerns of the Commission to ensure that subsidies and state aid do not interfere with a *level playing field* (European Commission, 2013a, 1998). The issue of public subsidies and state aid has been one of the most controversial, and it derives from the assumption that European ports have developed beyond their traditional role of providing only *services of general economic interest* (Haralambides *et al.*, 2001). Most European ports, and surely the larger ones, are seen as commercial enterprises which, instead of relying on taxation for developing their infrastructure, they should aim at recovering their costs from their users, who are, ultimately, the direct beneficiaries of the port infrastructure.

2.2 Liberalisation of the European Port sector

"…Europe is one of the most dense port regions in the world. At the same time, the port sector is very heterogeneous and characterised by a wide diversity in types and organisation…"

For years, arguments like the above (together with strong national and European lobbying) have not allowed the liberalization of the port sector which, in many member states, is plagued by bureaucracy; closed markets; unnecessarily tight economic regulation; and anachronistic central control of port operations.

Of course each port is different. To that effect, each country is different. But this has not prevented countries to eagerly line up to join the European Union. It seems that countries and ports are not different when they claim funding (e.g. TEN-T; CEF), but, all of a sudden, they become 'different' when they have to comply, open up markets, and be transparent.

Ports and countries which resist change and adaptation could be excluded from TEN-T financing. Ports which ask for 'soft measures', i.e. a Directive instead of a Regulation, do so in order to proliferate their particular status quo and lack of transparency.

3. The European Commission's new Regulation - COM(2013) 296

The Regulation describes an open business model for ports, intending to empower port authorities as autonomous organisations, more similar to entrepreneurs than public bodies. In particular the focus of the regulation is on allowing port authorities to act independently in terms of commercial strategies, i.e. pricing, and long-term investment. The regulation also contributes to developing a vision for European ports.

The Regulation is the Commission's 3rd (and hopefully last) attempt to liberalize the European port sector. To achieve this, and in view of the forthcoming Concessions Directive, the European Commission exempts cargo-handling and passenger services from the provisions of the *market access* chapter (but not from the other chapters, e.g. autonomy, pricing, user consultation and transparency). The liberalization of the port labour market is also not addressed.

In principle, the Regulation addresses two important aspects that will be discussed more in detail in sections 4 and 5 below: (1) Freedom to provide port services and (2) Pricing and financial autonomy of ports

Furthermore, the regulation proposes the new idea of a *supervisory authority* in each member state[1] , and aims at increasing transparency of port authority finances. This provision is discussed in section 6.

4. Freedom to provide port services

The market access chapter of the Regulation confirms that freedom to provide services principle of the Treaty applies also to ports (i.e. liberalization and competition).

The chapter starts with the general possibility of managing bodies (port authorities) to set minimum requirements for the provision of port services (articles 4 and 5). It then explains the formal reasons and conditions under which managing bodies of ports may limit the number of service providers (articles 6 and 7). Next to reasons of scarcity and reserved use of land, these reasons may relate to public service obligations. *Public service obligations* can furthermore make a competent authority decide to be an *internal operator* (article 9). The chapter finally deals with the safeguarding of employees' rights (article 10). It is important to keep in mind that the provisions of this chapter do not apply to cargo handling and passenger services (article 11).

It should be discussed what precisely is intended by the regulator as *port services*, and to what extent these services fall into the scope of the Regulation. Port services considered are:

a. Cargo-handling (*market access* chapter does not apply). The definition of cargo-handling (article 2.2) explicitly excludes warehousing, stripping and stuffing of containers, or any other value added services related to the handling cargo. This implies that these activities are not regarded as port services and they are therefore directly subject to the *freedom to provide services* stipulations of the Treaty.
b. Passenger services (*market access* chapter does not apply)
c. Dredging (here, questions have been raised by a number of member states, as to whether dredging shouldn't instead be considered as «public works». This is also the view of the European Parliament).
d. Pilotage
e. Towage
f. Mooring
g. Bunkering
h. Port reception facilities

The regulation also allows that the managing body of the port (i.e. the port authority and not the harbour master, in cases where they are separate) may require that providers of port services comply with certain minimum requirements to perform the corresponding port service. Where applicable, these requirements relate to:

a. The professional qualifications of the port service provider and its personnel (training);
b. The equipment needed to provide the relevant port service in normal and safe conditions, and the capacity to maintain this equipment at the appropriate level;
c. The compliance with requirements of maritime safety, or the safety and security of the port, or access to it, its installations, equipment and persons;
d. The compliance with local, national, EU and international environmental requirements;
e. Knowledge of local circumstances and conditions.

Attention is needed here, e.g. with the requirement of "local knowledge", so as these requirements and market limitations (see below) are not used by managing bodies as 'pretexts' aimed at hindering or delaying liberalisation, or engaging in self-provision. For instance, one could not easily see what can be so specific in local circumstances to prevent a line-handler, or an experienced pilot, from operating at a local port, the more so when the managing body ought to provide information and fast-track training to all those potential operators who would like to enter the port. In our view, therefore, both minimum requirements and market limitations should be determined at European level.

As regards the issue of statutorily limiting market access to port services, the following are some of the arguments the 'legitimacy' of which has occupied the attention of the Commission in the context of Regulation 296:

a. Availability of Land: compatibility with master plan provisions;
b. Public Service Obligations: i.e. availability of service over time; availability of service to all users; affordability of service. We, believe that PSOs should not be a valid argument for either self-provision or limitation to the number of providers; Instead, PSOs should be uniformly imposed on all operators interested in offering the service in question);
c. Market Size: This has to do with the natural monopoly argument. In other words, the 'market' of a service in a certain (small) port might be too small to withstand open competition which could possibly become destructive. We however believe that once minimum requirements are determined and imposed, entry to the market should be decided by the operators themselves, according to their own commercial criteria and calculations.
d. Internal Operator (self-provision): under certain conditions, this should be allowed when PSOs are present or when there is an alleged lack of commercial interest.

A word of caution is due here with regard to the master plan and the related designation port areas. The purpose of a Master Plan is to design or 're-design' the infrastructure of a port, in order to cater for the long-term economic and technological trends in shipping, transport and logistics. The plan should be designed taking into account the needs of the

[1] In its first reading (Fleckenstein Report) the European Parliament, as well as ESPO, appear to be contrary to this idea. We are particularly happy that all our prior reservations in the Commission's draft text (supervisory authorities; user committees; sharing cost information with users; etc.) have all been taken onboard by the European Parliament.

hosting society (city); urban planning; and environmental laws. But, most definitely, a port Master Plan should neither enter into-, nor limit, management autonomy, by designating specific port areas for specific uses. This is particularly important, given that master plans change very slowly, opposite to port business, which changes very fast. To give a simple example: in the Regulation, the *scarcity of land* argument is connected to the port's master plan. In other words, the land is 'scarce' because the port infrastructure has been designated in a certain way.

In the port of Brindisi, for instance, a port with considerable infrastructural excess capacity, we are unable to find 200 meters of berth to moor 5 tugs, because of master plan designations of 40 years ago!

Another important issue in the Regulation is linked to the *affordability* of port services to *certain* users (albeit undefined). Affordability notwithstanding, however, the Commission clarifies that public funds cannot be directed indiscriminately to ports that provide port services themselves (internal operator), either because of PSOs, or because *allegedly* there is no commercial interest to provide the service. In cases where self-provision is sufficiently argued on the part of the managing body, the latter should keep separate accounts, while the Regulation would ideally like to see at least one private operator offering services together with the port authority. Finally, in case PSOs are imposed on the private operator, the port authority should not use public funds to subsidize its own service, in order to make it *"affordable"* to "certain" users.

The Regulation leaves the matter of the determination of tariffs of port services quite open, stating that these should be determined by conditions of open markets, and they should be proportionate to the value of the service. We believe neither concept is actually defendable if left only at that: there is no such thing as open market for pilots; tugs; etc., and the value of the service depends, for instance, on what value we ascribe to the loss of human life. Finally, market considerations cannot apply when the number of providers is statutorily limited, or when private operators provide the service in competition with the public sector (port authority).

To remedy this, the European Commission proposes *annual review and consultation* with users. In our view, this is wrong, given the inherent conflict of interest (users will never be satisfied, no matter how low these prices are). Instead, we believe that tariffs should be regulated by an Independent Supervisory Authority, at a European (and not at national) level. The costs of a service provider, e.g. a towage company, can be easily estimated in every EU country and, to increase efficiency, price regulation should be exercised on the basis of *price caps* rather than *cost control*, which proliferates inefficiency.

5. Port pricing: determination of prices for the access to the port

The Regulation provides that these (port dues; anchorage; or wharfage taxes) should be *determined by the port authority in full autonomy*, taking into account commercial and market considerations, as well as considerations pertaining to the promotion of short sea shipping; regular calls; environmental ships; efficient use of berths; etc.

The Regulation also stipulates that in the determination of those dues, costs of the provision of the port service should also be taken into account. This is very important given that such costs may need to include the costs of developing past infrastructure. This issue is bound to raise considerable controversy, given that some investments are quite old (e.g. breakwaters) and they have been amortized.

This argument (i.e. the cost of past investments) is, however, debatable: In the past, port investments were publicly funded throughout Europe, i.e. they were considered as *public investment*, and public investment does not need to be amortized. Charging to recover past investments could render European ports (and thus trade) uncompetitive and attention is required. On the other hand, ports which have already developed extensive infrastructure (and thus a strong market position) with public money cannot, now, claim that "only from now on" investment costs need to be recovered. This penalizes smaller and peripheral ports, like those in southern Europe, which are in the process of development. A balanced approach thus needs to be developed. In other words, either dominant ports will have to charge in a way as to recover their past investments, or peripheral and developing ports should continue to be publicly funded until they reach their *minimum efficient size* (MES).

In many countries, port infrastructure is considered as *state property*. As such, the State is *entitled* to invest in its ports. In such cases, this investment is *public investment* and it 'ought not' be considered as subsidy or 'state aid'. The State, or the competent regional authority, decides itself what is good for its ports, centrally, and outside market forces. Ports, in such a model, ought not compete but cooperate, on the basis of some so-called *complementarities* that someone else has decided for them, often irrationally or, more often than not, politically. Thus, ports favoured in the past remain favoured, while others remain backward; and backwardness is then the latter ports' own fault – and that of their management –, rather than the result of decisions made in their absence.

The Regulation aims to change this *unfair* situation, by empowering ports, allowing them to determine prices (and investments) in full autonomy.

Finally, the question has been raised as to whether it would be useful to have common classifications of vessels, fuels and types of operations according to which infrastructure charges can vary, and whether it would be useful to have common charging principles for port infrastructure charges, even if one would not be obliged to apply such reductions or variations (article 14.5).

Over the last 20 years, our answer to this question has been consistently "no". A *harmonized* pricing policy is anticompetitive and contravenes the Regulation's fundamental provisions, i.e. those of autonomy and entrepreneurship.

Pricing autonomy should be left to the managing authorities, under regulatory control, and under the fundamental understandings of transparency and cost recovery. Moreover, the structure of prices should be clear, and information should be provided to port users (the Regulation requires that price changes should be announced three months in advance).

6. Increasing transparency and regulatory control

Managing bodies of ports should be in a position to provide information, including detailed costs and revenues, on the structure and level of port infrastructure charges, including methodology, if so requested by the *independent supervisory authority* or by the Commission (article 14.7)

However, to provide information on costs to users, one needs first to answer the question of how ports are financed (public investment / investor principle) and whether a port's pricing principle aims to recover costs. Ports, according to the Commission, are becoming 'enterprises' and there is no other firm that subjects its costs to the scrutiny of its consumers, particularly when confidentiality cannot be guaranteed. If ports are expected to compete, cost information cannot be shared with users. Most definitely, cost information should not be subject to user consultation given the inherent conflict of interest of users. In this regard, the Commission's proposal to institute new *Port Users' Advisory Committees* adds another, unnecessary, layer of administrative bureaucracy and it should be carefully reconsidered.

The only thing that an *independent supervisory authority* should do is to ensure, following complaints, that there is no abuse of market power or hidden subsidies. Again, to avoid distortions to regional port competition, the Authority should ideally be at a European level. In addition to its main task of monitoring and supervising the application of the Regulation and the settlement of disputes and complaints, the Authority should thus engage in price control and it should regulate: (a) minimum requirements; (b) limitations to market access.

Minimum requirements and limitations should be based on sound economic and technical considerations, applicable to all European ports. Any individual derogations, due to local specificities, should be subject to consultation and approval by the Authority so that regional port competition is not distorted. Finally, and at the danger of becoming repetitive, the Authority should be a European institution and not a motley of 28 (cooperating) national ones, something that could only lead to 'decision paralysis', given that each MS would tend to interpret and apply the Regulation according to its own laws, regulations, standards and practices.

7. Concluding remarks

The new EU regulation is lighter in many respects, compared to its predecessors. It applies to all 319 TEN-T ports although Member States can extend its application also to other ports. Similarly to the previous attempts, the Regulation promotes an entrepreneurial port model characterised by managerial autonomy, liberalisation and competition.

The first reading of the European Parliament (Fleckenstein Report), a much watered-down version of the Commission text, has already been endorsed by ESPO, almost in its totality. It therefore appears that the Regulation will be voted favourably by both Parliament and Council. This is encouraging news and about time, but the work towards a new European port policy is not over yet. On the contrary, the work now starts, in view of the forthcoming Concession Directive, which will also deal with cargo-handling services, and, finally, the ultimate step that still needs to be taken as regards dealing with the 'thorny' port labour issues. Then and only then, Europe will have a "comprehensive port package" conducive to its global trade aspirations.

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Port competition. Rotterdam within the Le-Havre – Hamburg range (1850-2013)

Hein A.M. Klemann and Dirk M. Koppenol

1. Introduction

In the nineteenth century, steam power and railways caused a transport revolution. Not only did investments in railways push industrialization as the demand for coal, iron, and steel rocketed with their development, but the railways also connected industrial centres with markets, raw material producing areas, and seaports.[1] Inland transport became possible on a previously unknown scale.[2] Indeed, in the period 1840–70, the train became the dominant mode of transport, with inland navigation losing its leading position.[3] A rapidly growing rail network was able to solve most transport problems of the developing industry, including that in the Ruhr area. This region built one of the densest rail networks in Europe, with numerous national and international connections. By 1870, most transport in the Rhine basin took place by rail. Nevertheless, in this part of Europe, inland navigation made a come-back and from the 1890s recaptured its dominance. This development requires explanation as such a recovery did not take place in other industrialized regions.[4]
It strengthened the competitiveness of Rotterdam against Antwerp, Hamburg and Bremen. From the 1890s, Rotterdam developed into the most important seaport of the Ruhr area and as that area became the principal industrial centre of Europe, it became Europe's main port. Especially in the post-1945 period this caused an enormous port expansion in the direction of and even into the sea. This article tries to explain why Rotterdam became the first port of Europe and its consequences for its expansion, but also why in the post-war period the port grew fast again until 1973, but competition became fiercer after 1989.
To understand that it is necessary to turn first to the Rhine.

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[4] Ville, *Transport*, 42; A. Kunz, 'The performance of inland navigation in Germany, 1835–1935.' In: A. Kunz and J. Armstrong (eds.), *Inland navigation and economic development in nineteenth-century Europe* (Mainz, 1995) 45-78, 76.

2. Part I: The 19th century

Already since ancient times the river was adapted to the needs of the people living on its banks. Only during the nineteenth century, however, the Rhine was transformed from a more or less natural river, full of sandbanks, rapids, overflows, bending, rocks, floating islands of quicksand, but also with salmon and sturgeon living and breeding in it, into a canalized waterway adapted to the needs of large-scale shipping. Protecting the banks from floods remained important, but creating a save, straight and deep channel that could be sailed under all weather conditions became the prime target.[5] Canalization made it possible in the early 1900s to use big iron barges combined in steam-tugged trains of four ships of altogether 400 metres, with a steamer of 1500 hp and a capacity of 6,000 tons. Since the 1840s, when the first steam-tugged trains emerged, the cargo of barge trains fifteen folded, while fuel consumption decreased.[6] The new scale in shipping only became possible as a result of the improved capacity of the river. Thus transport facilities could adapt to the demand of transport of enormous quantities of uniform cargo – coal, ore, cereals, and wood – generated by the German industry and the industrial cities along the river shores. In the transformation of the river the supranational Central Commission for the Navigation of the Rhine (CCNR) played a major role.

For centuries, disputes on the channel or the tow-paths (needed to tow barges by horse stream upwards) were quite normal. Already in the Act of Mainz (1831) it was decided that technicians of the CCNR would regularly check the river's navigability. That the tow-paths should be kept in condition was agreed in numerous treaties and again in the Treaty of Vienna of 1815. In fact, disputes on the channel or tow-paths never stopped, and until 1847 the agreed supervision on the channel did exist only on paper. In that year, the Prussian Commissioner in the CCNR initiated an inspection of the entire river from Basel to the sea, as he feared competition by railways. Just before, the railway Basel-Strasbourg wiped out all shipping on this thorny track.[7] Two years later, in 1849, the Commissioners of Prussia, Nassau, and the Grand-Duchy Hessen wrote that the channels of the Dutch Rhine branches were in a terrible shape. During the 1840s, there had been a number of conflicts between the Dutch and the by the German Rhine states, resulting from the fact that as a consequence of the delta character of the lower Rhine, the amount of water in each branch was much less than in the German Rhine, while the slow current caused that sand, peddles and clay from higher parts settled there, thus raising the bed. Only by raising the dikes as well, the water could be checked. Consequently, the water level often was higher than the surrounding land, not just resulting in seepage water, but also in terrible floods when ice

[5] A. van Heezik, Strijd om de rivieren. 200 jaar rivierenbeleid in Nederland of de opkomst en ondergang van het streven naar de normale rivier (Haarlem 2007) 89 ff; David Blackbourn, The conquest of nature: water, landscape, and the making of modern Germany (New York, 2006) 77-119.

[6] E.J. Clapp, The navigable Rhine: the development of its shipping, the basis of the prosperity of its commerce and its traffic in 1907 (Boston, Mass. 1911) 44.

[7] Ibidem.

prevented a quick flow of water.[8] Canalization projects in higher parts of the river only increased these problems.[9]

According to the Dutch internal ministry the technical problems were too complicated and it was impossible to improve the limited navigability of the Rhine branches. In Germany this was simply not believed.[10] Actually, the channels of the Waal and Lek were in a terrible shape. Near Tiel the depth of the Waal – considered to be the main shipping route – was little more than a metre, while the Rotterdam port could only be reached from the sea during high water. In diverse German states, the river also was unregulated and hardly navigable, but that was not Prussia's main concern. It needed a cheap, efficient transport route for its developing industry to the sea. Considering that transhipment was hardly necessary, rail transport was not very expensive, but it was feared that when rail competition had destroyed barge shipping, the resulting monopolies – one will seldom find two railways on the same track – would raise freight rates. Since the Rhine Convention of Mainz (1831) the principle of the 1814 Peace Treaty of Paris and the Vienna Treaty of 1815 was implemented. Barging became free regardless of flag or cargo. Consequently, inland transport freight rates were kept low by a competitive transport market. Therefore, a smooth river channel to the sea was of major German interest as small scale shipping with tiny trains of barges with a maximum capacity of 400 ton, not to mention traditional sailing barges, had no future and would not survive the competition by the railways. Berlin's message to The Hague therefore was that the Dutch had to improve their channels. In 1850, the year after the Prussian Rhine inspection, the liberal Dutch internal minister Rudolf Thorbecke changed the Dutch policy by initiating the building of dikes and groins to improve the depth by limiting the width of the river.[11] Later this proved not enough. It was necessary to dredge. Until 1850 the main Dutch hydraulic engineering problem had been how to transform the river in a drainpipe to remove superfluous water. Now getting a straight, deep channel became a prime target.[12]

From 1849, river inspections were regularly returning events resulting in reports on how to improve the navigability. In 1861, technicians from all Rhine states made a trip to check bottlenecks and set new, common targets. When the water was low, so they decided, from Strasbourg to Mannheim the depth of the channel should be at least 1.5 metres, 2 from Mannheim to Koblenz, 2.5 from Koblenz to Cologne and from there to the sea, including the connection from Rotterdam to the sea, 3 metres. When these targets were realized, it would become possible to sail with barges with a loaded draft of 2 metres from Rotterdam to Mannheim without any obstacles.[13] Meeting these targets proved a long process.

[8] Auke Van der Woud, Het lege land 1798-1848 (Amsterdam 19984) 95 ff.
[9] Harry Lintsen, 'Two Centuries of Central Water Management in the Netherlands.' Technology and Culture, 43 (2002) 549-568, 552.
[10] Van Heezik, Strijd om de rivieren, 73-74.
[11] Ibidem 87 ff.
[12] C. Bloys, 'Onze handelsplaatsen en Verkeerswegen.' De Economist, 1886, 1011-1032.
[13] W. Nasse, *Die Schiffahrt der deutsche Strome. Untersuchung über deren Abgabenwesen, Regulierungskosten und Verkehrsverhältnisse. 3 Der Rhein als Wasserstraße* (Leipzig 1905) 32.

Enormous projects were executed by the Rhine Stream Building Administrations – *Rheinstrombauverwaltung* – of diverse German states, or the Dutch Internal Ministry. Although the actual execution of the projects was done by the member-states, the CCNR became the supervisor and coordinator.

In 1851 Berlin founded the first Rheinstrombauverwaltung, and did not hesitate to put ruthless pressure on the Netherlands, Hessen and Nassau to normalize their tracks as well.[14] Especially for Nassau this was an unsurpassable problem as this tiny state that badly needed its Rhine to balance its budget, saw its source of money turn into a head of expenditure. Nassau was on the right bank of a most problematic part of the river, Prussia on the left bank, near the Binger Loch. There a granite mountain wall left only a very narrow passage. To remove this was a major technical problem, and negotiations on what exactly should be done took years. Only in 1856, in a special meeting of the CCNR, solutions were found for the technically difficult track between Mainz and Bingen.[15] The supervision on the execution of all building activities agreed between the Rhine states became the task of the CCNR that by now seemed an instrument of Prussia.[16]

It was Prussia that put pressure on Rhine regulation, but after the railway Antwerp-Cologne opened in 1844, The Hague understood that without improving Rhine navigability the country would loose all transit to Antwerp. Therefore, from the mid-nineteenth century only some small German Rhine states with limited interest in navigation and tiny budgets tried to evade their obligations. In 1866 the situation changed fundamentally, when after the Austro-Prussian war, Prime-Minister Otto von Bismarck further improved Prussia's position in the region and liberalized Rhine navigation once and for all by annexing some smaller Rhine states: Nassau, Hessen-Kassel, and Frankfurt. As Prussia became hegemonial, it could use the peace-negotiations in Prague to dictate a new Rhine regime. Bayern, Baden, and Hessen – who all fought at the Austrian side – had to accept the complete liberalisation of navigation and supervision by the CCNR over normalisation.[17] The Dutch and French who were not involved in the war, did not oppose liberalisation, but feared Prussia.[18] France, Prussia's main rival on the continent, wanted to be compensated for its neutrality and rumours in the international press said that Bismarck and Napoleon III discussed a division of the Low Countries.[19] In the Netherlands, as in all small

[13] W. Nasse, *Die Schiffahrt der deutsche Strome. Untersuchung über deren Abgabenwesen, Regulierungskosten und Verkehrsverhältnisse. 3 Der Rhein als Wasserstraße* (Leipzig 1905) 32.
[14] Ibidem 58; Van Heezik, *Strijd om de rivieren*, 22-35.
[15] Jhr. W.J.M. van Eysinga, *Geschichte der Zentralkommission für die Rheinschiffahrt* 1816 bis 1969 (Straßburg 19942) 83-84.
[16] Van Eysinga, Geschichte der Zentralkommission, 81 ff.
[17] H.A. Schmitt, 'Prussia's last fling: the annexation of Hanover, Hesse, Frankfurt, and Nassau, June 15–October 8, 1866', Central European History, 8 (1975) 316-347.
[18] Anne Doedens, Nederland en de Frans-Duitse oorlog. Enige aspecten van de buitenlandse politiek en de binnenlandse verhoudingen van ons land omstreeks het jaar 1870 (Zeist 1973) 18.
[19] 'London, Friday, November 16, 1811.' The Times, 16 November 1866; ´Particuliere Correspondentie. Brussel 11 Augustus.´ Nieuwe Rotterdamsche Courant, 13-08-1866, Dag; 'België.' Nieuwe Rotterdamsche Courant, 17-08-1866, Dag; G. Groen van Prinsterer, La Prusse et les Pays-Bas. A mes amis de Berlin (Amsterdam 1867) 6-7.

countries of Europe, Prussia's aggression was considered a threat. The annexations created the impression that the position of the smaller principalities of Europe was dependent on the whims of Berlin. 'Prussia uses the new nationalistic principle, for conquests according to old traditional power politics', Thorbecke wrote.[20] In the following decades there were rumours again and again in the international press about a German annexation of the Netherlands, always mentioning the economic and military importance of the Dutch ports.[21] As the Netherlands controlled the most important port of the militaristic Germany, itsd position seemed most uncertain. During the 1868 Mannheim negotiations on Rhine liberalisation, Berlin did little to comfort its small neighbour as Dutch panic was a Prussian interest.

In 1868, Berlin only had to persuade France and the Netherlands to accept Rhine liberalization as agreed in the Peace of Prague among the German Rhine states. The Hague had major objections. Although it accepted liberalisation and in 1851 gave up all tolls, transit levies or taxation, the articles allowing every Rhine State to control all hydraulic engineering activities when these had any relation with the Rhine, were against Dutch interests as it included the vital defence works of the Holland Waterline. Giving Prussia control over the cornerstone of the Dutch defence system was too much, just as the extension of the police control and juridical powers of the CCNR to other waterways. Many in the Netherlands feared that it was not the CCNR, but Prussia behind a CCNR mask that would execute these rights.[22] The Dutch delegation left the negotiations. Thereupon Berlin mobilized its public opinion, suggesting in more or less official newspapers that the Netherlands tried to reintroduce its policy of exploiting the German access to the sea, in a by the way manner discussing the need of an independent Dutch state in modern Europe.[23] Dutch newspapers discussing Prussia's political ambitions were in a pessimistic mood.[24] Prussia's power and its willingness to use force made the Netherlands accept Berlin's demands. It resulted in the Mannheim Convention of 1868.[25]

Notwithstanding these problems in 1886, a Dutch author could conclude that in the Dutch as well as in German Rhine policy from 1850 the prime target had been to get a straight and deep channel and that the resulting projects were almost completed. Therefore, he expected the Rhine to become even more the prime transport route for the most important industrial areas of Europe, Westphalia and the Prussian Rhine province. The nearness of the best navigable river was of principal importance for these regions. At that moment in upstream direction iron ore and cereals were dominant in transport and he thought transporting coal as return cargo a logical development that would increase the competitiveness of barging.[26] In the same period the government announced that the target to deepen the channel to 3 meters on the track Cologne-Rotterdam, was almost completed. According to its protocols, the technical committee of the CCNR agreed. Between 1852 and 1882 Prussia had spent 20 million guilders to improve the river; the Dutch 35 million.[27] After the Rhine was canalized steam-tugged barges the scale of barge transport could multiply. Especially big German industrial companies in the Ruhr area who needed large scale transport of ore and coal – Haniel, Stinnes, Thyssen or Krupp – used the opportunity to lower transport costs by building Rhine fleets of modern steam-tugged barges, often using the Dutch flag for fiscal reasons. Rhine shipping became cheap. As a consequence, just before World War I almost a quarter of all German trade (in tons) crossed the German-Dutch border in barges.[28]

In the 60 years before the First World War, transport costs fell dramatically. Indeed, freight rates for maritime shipping plummeted from 140 in 1860 (1870 = 100) to less than 50 in 1913, equating to an average decrease of 2.3 per cent per year for over half a century.[29] Less well known, is that freight rates for Rhine shipping fell even faster. Between 1860 and 1913 transport costs on international rivers, declined by 82 per cent or with 3.2 per cent annually for over 50 years. Neither in Germany nor in the Netherlands the general price developments could explain this. The German wholesale price index (1870 = 100; 108 in 1913) and the Dutch GDP-deflator (103 in 1913) increased by only a few per cent. When 1870 = 100, then in 1913 the cost of inland navigation was 19; if corrected for price developments 18.

[20] 'Aantekeningen ongedateerd.' In: Briefwisseling van J.R. Thorbecke, 1830-1872, 7, KS 98, 487.
[21] Le Comte d'Haussonville, *La France et la Prusse devant l'Europe* (Brussels 1870) 39-40; 'Germany, Berlin March 18.' *The Times*, March 19, 1878.
[22] 'Duitschland.' *Dagblad van Zuidholland en 's-Gravenhage*, 30-8-1868.
[23] Handelingen Tweede Kamer der Staten-Generaal 1868-1869, 5 Maart 1869, 973-975; 'Nederlanden. Breda, den 2den September.' *Bredasche courant*, 3-09-1868, Dag; 'Duitschland.' *Dagblad van Zuidholland en 's-Gravenhage*, 30-8-1868.
[24] ''s-Gravenhage, 24 Augustus.' *Dagblad van Zuidholland en 's-Gravenhage*, 25-08-1868, Dag; 'Nederland en de Rijnvaart.' *Dagblad van Zuidholland en 's-Gravenhage*, 9-10-1861, Dag; 'Nog iets over de Rijnvaartkwestie.' *Algemeen Handelsblad*, 5-09-1868, Dag; 'Binnenland. Rotterdam, 29 Augustus.' *Nieuwe Rotterdamsche Courant*, 30-08-1868, Dag.
[25] Handelingen Tweede Kamer, 1868-1869, 5 Maart 1869, 973-975.
[26] Bloys, 'Onze handelsplaatsen,'1018-1020.
[27] '84a. Nota behorende bij de brief van Waterstaat, Handel en Nijverheid van 19 maart 1887, No. 38, Afd. Waterstaat A. Rijksgeschiedkundige Publicatiën, *Buitenlandse Politiek van Nederland 1848-1945*, 41886-1890, GS126.
[28] Klemann, Schenk, 'Competition in the Rhine delta,' 841.
[29] Douglas North, 'Ocean freight rates and economic development 1750-1913.' *Journal of Economic History*, 18 (1958), 537–555.; C. K. Harley, 'Ocean freight rates and productivity, 1740-1913: the primacy of mechanical invention reaffirmed.' *Journal of Economic History*, 48 (1988) 851-876.

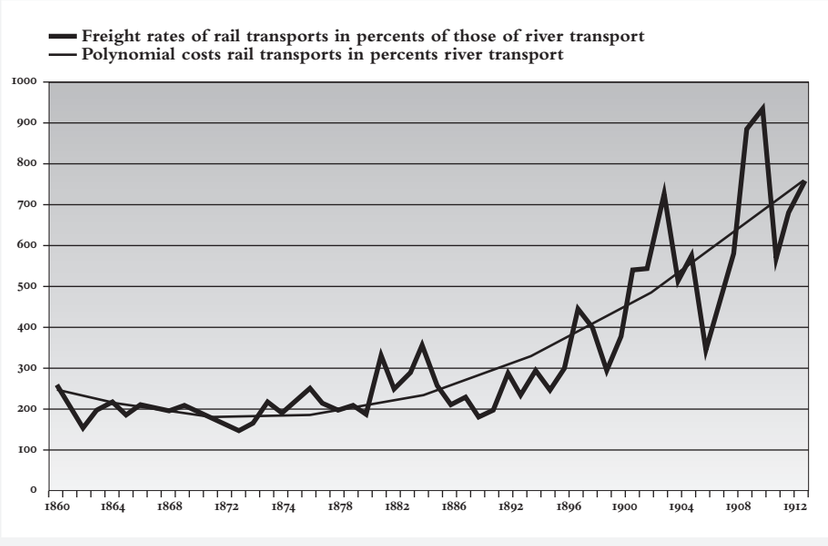

Figure 1. Freight rates of German rail transport in percentages of those of intermodal river transport (1860-1913).
Sources: Jan Pieter Smits, Edwin Horlings and Jan Luiten van Zanden, Dutch GNP and it components, 1800-1913 (Groningen 2000); Rainer Fremdling, Eisenbahnen und deutsches Wirtschaftswachstum 1840-1879 (Dortmund 1975); Own calculations.

Figure 1 shows the growing competitiveness of Rhine traffic. The freight rates of the railways in percentage terms compared to those of inland navigation increased from the 1870s onwards. In the 1890s and the early twentieth century, the competitive strength of Rhine shipping became overwhelming, with freight rates of German railways up to nine times as high as those of barge shipping. Between 1868 and 1889, freight rates for inland shipping fell by 42 per cent, but from 1890 to 1913 with 75 per cent. In t his period, the Rhine became a highway for bulk transport. The enormous advantage in the competitive strength of river transport also explains the development of the ports at the Rhine estuary. German rail freight rates were falling much faster than those of their Dutch counterparts, but from the 1890s German railways were nonetheless losing their prime position while inland shipping revived. It resulted in extremely cheap bulk transport.

In 1873, little more than 13 per cent of all German exports crossed the German–Dutch border in Rhine barges. This figure remained more or less stable until 1901, but from then on grew, with some fluctuations, to 22 per cent in 1913.[30] For imports the developments were more spectacular. Rhine traffic had a growing share of total German imports, rising from less than 5 per cent in 1874 to almost 25 per cent in 1913. For the 1874–1913 period (the years for which data are available), there was a close correlation between the share of Rhine transport in German imports and freight rates of rail transport in percentage terms of those of Rhine shipping, r = 0.855; n = 39. For exports this relationship was weaker, but significant nonetheless: r = 0.780. That it was weaker is explainable from the policy of the German coal cartel – Rheinisch-Westfälisches Kohlensyndikat – which until 1904 could not control exports by barges and therefore sent its coal by rail.[31] Transport by barge between German industrial centres and the sea was closely related to German activity in the Dutch port[32]. The correlation between the outgoing cargo from Rotterdam and German exports was only r = 0.282, n = 32. Many other developments influenced Rotterdam transport, especially the policy of the Coal Cartel. Nonetheless, incoming cargo and German imports sailing the Rhine were closely related: r = 0.802. The German need for the importation of bulk goods transported by Rhine barges determined developments in the port of Rotterdam. During the interwar period Rhine shipping would also transport German coal to its export markets. As a consequence, an almost complete balance in upstream and downstream barging developed, making Rhine shipping even cheaper. Rotterdam became so important that even the Nazi, although endeavouring autarky recognized its importance during the late 1930s.

From the 1890s until the early 1960s, bulk cargo like ore, coal, cereals, oil, or fertilizers, primarily went by barge. Consequently, Rotterdam became Europe's major seaport.[33] Still in 2001, of all Dutch cross border traffic, 60 per cent (in weight) was transported by inland navigation, most of it on the Rhine.[34] That the river still is by far the most important German waterway and Rotterdam still the major port of Germany and Europe, suggests a huge continuity.[35] Not only in the first decades of the Second Industrial Revolution, the Rhine was a major highway, but the river and parallel motorways, pipelines, and railroads still are. Economic ties which developed during the nineteenth century survived. From the 1860s, the Rhine and Ruhr region gained in competitive strength to become one of the richest, highest-industrialized, and densely populated parts of the world, and continued to be a centre of economic activity long after some of its natural advantages, especially its coal layers, lost relevance. Besides great advantages the region had disadvantages: it stretched over a number of countries that during the last one and a half century had major conflicts. It nevertheless survived two world wars, the most severe economic crisis ever, inter-war protectionism, Nazi autarky, the allied occupation of Germany, and post-war recovery.

[30] Kaiserliches Statistisches Amt, *Statistisches Jahrbuch für das deutsche Reich* (Berlin 1880-1917); F.M.M. de Goey, 'Database on cargo flows in the port of Rotterdam, 1880–2000 (2003) https://easy.dans.knaw.nl/ui/datasets/id/easy-dataset:39487; authors' own calculations.

[31] Eva-Maria Roelevink, Joep Schenk, 'Dutch-German coal business, 1918–1925.' Paper presented at the 15th Annual Conference of the European Business History Association, Athens (26 August 2011); R.W.J.M. Bos, *Brits-Nederlandse handel en scheepvaart, 1870–1914. Een analyse van machtsafbrokkeling op een markt* (sl 1978) 114-147.

[32] Kaiserliches Statistisches Amt, *Statistisches Jahrbuch* (1880-1917); De Goey, 'Database'; authors' own calculations.

[33] Peter P. Waller, Harry S. Swain, 'Changing Patterns of Oil Transportation and Refining in West Germany.' *Economic Geography*, 43 (1967) 143-156; Renate Laspeyres, *Rotterdam und das Ruhrgebiet* (Marburg 1969).

[34] Van Heezik, *Strijd om de rivieren*, 28.

[35] Horst Winter, 'Binnenschifffahrt 2005-Güterbeförderung nimmt weiter zu.' Statistisches Bundesamt, *Wirtschaft und Statistik* (2006) 747-758, 750.

Now it has to deal with the deindustrialization of the Ruhr. After the war, growth of Rhine transport and the port that profited from it was however even faster than it was ever before.

3. Part II: The post-war period (1945-2013)

After the Second World War, two periods of fast growth can be distinguished in the port of Rotterdam. In the period 1946-1973 transhipment grew from 8.1 to 309.8 million tons (figure 2) and Rotterdam outgrew its competitors Antwerp and Hamburg.[36] As a result of this expansions were needed and the port became five times larger. Due to the oil crises of 1973 and 1979 a period of stagnation followed that lasted until 1989. Only then another period of growth began. During this period of growth, 1989-2005, transhipment grew from 292.8 to 370.2 million tons, but in contrast to all earlier growth periods since the 1890s, Antwerp and Hamburg grew faster than their Dutch rival as these ports managed to attract large containers flows.

In 1945, the port of Rotterdam lay in ruins. Large parts of the Rotterdam quays and cranes were destroyed by the German army and ships and mines barricaded the port's mouth. In the following years the port was renovated and modernized. As a result of this, the port of Rotterdam grew faster than its direct competitors Antwerp and Hamburg. Whereas

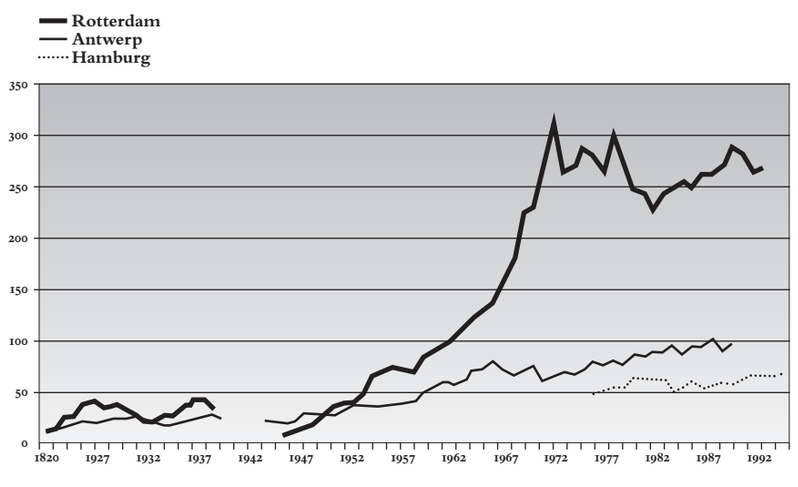

Figure 2. Transhipment in Hamburg, Antwerp and Rotterdam (1924-1994) Million tons
Source: Reginald Loyen, Haven in de branding (Leuven 2008) 245.

[36] J.U. Brolsma, *Havens, kranen, dokken en veren*. De Gemeentelijke Handelsinrichtingen en het Havenbedrijf der gemeente Rotterdam, 1882-2006 (Rotterdam 2006) 380.

Rotterdam could innovate fast as docks, quays and infrastructure were destroyed, Antwerp still used the obsolete pre-war material and infrastructure.[37] Moreover, Hamburg lost half of its hinterland as a result of the Cold War, slowing down its growth.[38]

During the late 1940s, while transport for Germany was still at an extremely low level, the first plans for port expansion were put forward already. The port prepared for future developments, but the Dutch government only accepted the first plane for major expansions outside the city, the Botlek-plan, in 1953. It was executed during the mid-1950s.[39] Soon after the construction of Botlek, the Europoort-plan was accepted, which decision-making process can be marked as extremely efficient. In November 1957 the first ideas were announced in the press and within two years construction began.[40] Large oil companies, as Esso, Shell and Callex requested for deep docks in order to cope with the growth of the oil trade in this period during which the European coal production stagnated while energy consumption boomed. Moreover, these companies demanded pipeline connections to the Ruhr area and further to the chemical industry near Mannheim. These were complete new connections to the hinterland, and were foremost constructed next to the Rhine. Also because of the fast construction of Europoort, Shell and Caltex could be persuaded to establish their main European refineries in Rotterdam. Esso and other oil companies chose for Wilhelmshaven. A fast response was vital in order to take advantage from the oil trade towards the Ruhr area. Besides the need for a direct responds to the demand for pipeline connections and space for petro-chemical activities, the German trade function of the port of Rotterdam was stimulated by the 1958, new European Economic Community (EEC) that would create an open internal market for the six European member-states. Rotterdam's status as an important gateway toward Germany increased, but this also resulted in extra competitions from ports of other European member-states, like Antwerp.

Apart from the demand for oil transport to Germany and the creation of an open European internal market, in these post-war years of recovery – *wederopbouw* – the general public support for the development of the port was a major asset. Although in 1957 complete villages such as Nieuwesluis and Blankenburg had to be removed to create Europoort, there were hardly any protests. A broad public consensus considered the central economic focus on the Rotterdam port a national interest.[41] In 1973 and 1979 the oil crises ended the rapid growth of the port of Rotterdam, while at the same time new environmental ideas and the fear that the available raw materials would be exhausted, created

[37] R. Loyen, *Haven in de branding: de economische ontwikkeling van de Antwerpse haven vanaf 1900* (Leuven 2008) 247.
[38] Ibidem, 247
[39] F. de Goey, Ruimte voor industrie. Rotterdam en de vestiging van industrie in de haven 1945-1975 (Delft 1990) 72.
[40] F. Posthuma, 'Het Havenbedrijf der Gemeente Rotterdam 1945-1965.' In: G.E. van Walsum (ed.), Rotterdam Europoort, 1945-1970 (Rotterdam 1945) 47.
[41] P.T. van de Laar, *Stad van formaat: geschiedenis van Rotterdam in de negentiende en twintigste eeuw*, 296; F. M. M. De Goey, *Geen woorden, maar daden: de relatie tussen het bedrijfsleven en de lokale overheid van Rotterdam, 1945-1960* (Rotterdam 1987) 149.

another, less positive public attitude. As Rotterdam had developed a large petro-chemical cluster, the impact of the oil crises was even more profound than in the competing ports. The transhipment in tonnage dropped and the recent expansion of Maasvlakte I – mainly built for the petro-chemical sector – stayed largely empty until the mid-1990s. Only then transhipment in the port of Rotterdam began to grow faster again.

In 1989, there was again a growing confidence in the future. Not only, was it expected that in the early 1990s, as a result of further European integration internal trade barriers would further disappear, but the 1989 collapse of the Soviet-system also resulted in the opening up of Eastern-Europe as a new hinterland for the port. In this period, the term mainport was introduced by G. Poeth and H. van Dongen, two economists of the Erasmus University Rotterdam who analysed trends in world transport.[42] They thought 'certain activities [would] concentrate in large, centrally located ports'.[43] One port per continent would become the central hub. Of course Rotterdam wanted to become such a mainport. To become competitive enough to earn that position, further improvement and expansion of the port and its infrastructure seemed necessary. In order to become a mainport, in 1991 the Port Management developed the Port Plan 2010. In this Plan not only the need for a dedicated freight railway track towards Germany – the Betuweroute – was put forward, but also the need for port expansion into the sea. The goal of the new railway was to add another modality to the already existing ones: the Rhine as the major inland shipping route of Europe, roads and pipelines. Expansion plans were in this period foremost a signal that the port was preparing to become the European mainport. Rotterdam should be able to defeat all ports in the Le-Havre-Hamburg range. Against these hopes that already became an expectation, competition in the Le-Havre-Hamburg range became stronger. For the first time since the 1890s, Rotterdam had to give way to its competitors. Whether in the future new port expansions will be needed is not for historians to decide, but some of the most important advantages that gave Rotterdam a strong competitive position during the last 150 years, seemed to have lost their strength.[44] In the last decades, the heart of its traditional hinterland, the Ruhr area, developed into a post-industrial region with high unemployment levels, a decreasing population, and a stagnating economy, while the transport of the more dynamic parts of German industry near Mannheim and in Bavaria, goes in the first place over Antwerp and the German ports.[45] The other major task of the Dutch port, the transport of oil and oil products to Germany is threatened by the fast German transition to wind and solar energy and the policy of the Bundesregierung to stimulate this develop-

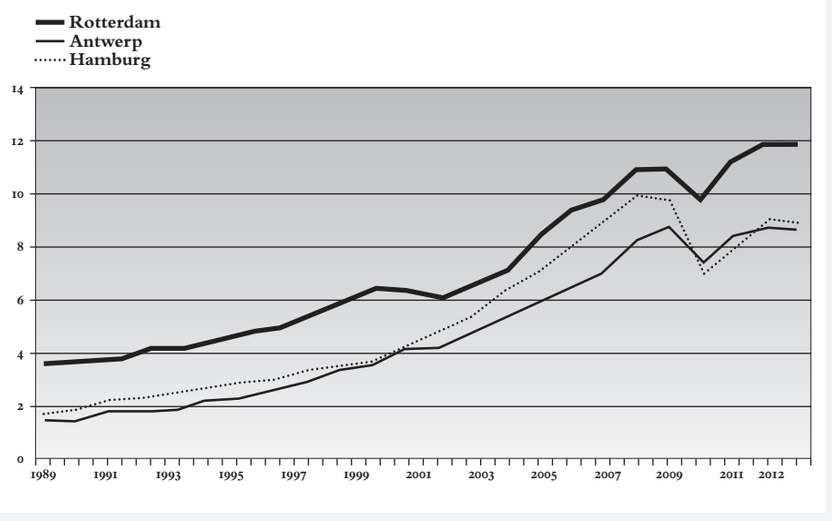

Figure 3. Transhipment of containers in TEU in Hamburg, Antwerp and Rotterdam (1989-2012). Source: Port of Rotterdam[46]

ment.[47] The hope for the future is the container, but in this transport the advantages of Rotterdam are limited. As a railway port it has strong competitors, while barge shipping takes only a very limited part of this cargo and trucks are just used for short distances.[48] The period that the competitiveness of Rotterdam was self-evident that started in the 1890s when Rhine shipping became so much cheaper than rail transport that Rotterdam almost automatically became the main port of this part of Europe, seems over.

In 1989 a new period of growth started in which container transport requested for an increase of scale. At first Maasvlakte I was used to construct new terminals. However, during the early 2000s an urgent need for port expansion was felt. An enormous growth of container transport between Asia and Germany was expected and shipping and container companies began to request new plots within the port. Moreover, between 1999 and 2001, Hamburg and Antwerp were closing in (figure 3) and both ports developed space for new container terminals. In 2005, Antwerp finished the Deurganckdok, fully dedicated to the

42 G.G.J.M. Poeth, H.J. van Dongen, *Rotterdam of de noodzaak van een infrastruktuur voor informatie* (Rotterdam 1985) 9-11.

43 Ibidem 12; L. van Duinen, *Planning Imagery. The emergence and development of new planning concepts in Dutch national spatial policy* (Amsterdam 2004) 71.

44 See: Hein A.M. Klemann, Waarom bestaat Nederland eigenlijk nog? (Rotterdam 2006) 63-64.

45 Industrie- und Handelskammer Ruhr für Essen, Mühlheim an der Ruhr, Oberhausen zu Essen, Das Ruhrgebiet, Eine Region im strukturellen Wandel (August 2013); Metropoleruhr, http://www.ruhrgebietregionalkunde.de/aufstieg_und_rueckzug_der_montanindustrie/bevoelkerung_und_arbeit/arbeitslosigkeit.php

46 http://www.portofrotterdam.com/nl/Overdehaven/havenstatistieken/Documents/Containeroverslag%20Hamburg%20-%20Le%20Havre%20range%20tijdreeks.pdf (23-10-2013).

47 Die Bundesregierung, Energiekonzept, http://www.bundesregierung.de/Content/DE/StatischeSeiten/Breg/Energiekonzept/0-B%C3%BChne/ma%C3%9Fnahmen-im-ueberblick.html.

48 Klara Paardenkooper, 'Rotterdam Containerhaven.' Box, magazine for intermodal exchange and development, 2012, 46-49.

transhipment of containers and in 2003 the first container terminals on Altenwerder in Hamburg was finished. The reason for the fierce competition is that the container-sector is foot-loose. In other words, the flows of containers can more easily be diverted towards other ports within the Le Havre-Hamburg range and shipping companies can chose in which ports they wanted their ships will be unloaded.

4. Conclusion

Here the question is tackled why transhipment in Rotterdam and the port itself grew so fast during the 1850-2010 period. The answer seems easy. From the 1890s Rotterdam became the main port of the main industrial centre of Europe as after the canalization of the Rhine inland shipping became much cheaper than the only alternative mode of transport the period, railways. This remained a major advantage for Rotterdam and the port therefore concentrated on bulk transport. From the 1950s onwards Rotterdam outgrew its competitors for different reasons. Rotterdam was able to react fast to the demand for pipelines to the Ruhr area and harbour plots for the oil-companies. Furthermore, the trade relations with Germany improved due to the more open European market. Finally, fast port expansions was possible as port development had an almost unopposed public support. Between 1989-2005, in the second period, the growth of the trade with Asia, the opening-up of East-Europe and the creation of a truly open market again resulted in fast growth, now of container transhipment. The early expectation of these developments resulted in the creation of a dedicated railway track – *the Betuweroute* –, and stimulated the fast growth of this sector in the port of Rotterdam. However, competition became fiercer despite the idea that Rotterdam would become the mainport of Europe, as the container-sector was more food-loose than the oil sector and in this transport barge transport was of limited importance. Competition also becomes more difficult as the traditional hinterland, the Ruhr area, is in a serious crisis, while the more dynamic parts of the German economy are not automatically concentrated on the Dutch port, while the energy flows through Rotterdam are threatened by the German energy policy.

Acknowledgements

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The challenge for inland shipping: a prospect for a bright future or prodigy of 50 years old?

The urgent need for a transition to serve new requirements

Harry Geerlings

The period Hans Smits chaired the Rotterdam Port Authority can definitely be characterised as a period of major developments: the Second Maasvlakte became into operation, the port and the business community had to resist against a deep financial crises, sustainability became a licence to operate and Erasmus Smart Port was established. What people might not see is that all these trends come together in the actual performance and expectations of the inland shipping sector. This contribution describes the challenges the inland shipping is facing and the need for an integrated approach (a so called transition), to keep the sector viable and the port sustainable and accessible. This chapter is based on a most recent Smart Port Research-project.

1. Introduction

Transport has many positive characteristics both for the individual user as for society as a whole. This explains why the transport sector as a whole, for more then a century now, has experienced an unprecedented growth. At the same time, transport has undesired side effects. The almost unlimited demand for transport leads to congestion and at the same time, there are other serious concerns related to emissions (at the regional, national and the global level). These concerns are encompassed in the concept of sustainability and sustainable mobility.

Governments and other stakeholders are generally aware that policy measures are needed to find a balance between accessibility and sustainability objectives. This is an enormous challenge, and the question arises: How can this be materialised? The sometimes seemingly opposing goals of accessibility and sustainability are also coming together in the Port of Rotterdam. The port invested in the development of new port capacity, called the 'Second Maasvlakte' – an extension of the port including large scale container infrastructure. A major problem related to this port extension is the accessibility of the Second Maasvlakte and the effects on the quality of life in the surrounded urban areas.

A powerful tool to diminish the negative external effects is the modal shift policy aimed at shifting cargo from truck to barge (and rail). The requires two tasks for the inland shipping sector: there is a need for a performance of inland shipping according to the highest standards that are comparative to the other modalities and it requires another way of thinking and acting. We call this a transition. This article deals with this transition and the question why this transition is not realised yet.

2. The emerging concept of sustainability and transition management

There is no universally accepted definition of sustainability, sustainable development, or sustainable transport. The Brundtland report (1987) interprets sustainable development as a process of change in which the exploitation of resources, the direction of investments, the orientation of technical development and institutional change are all in harmony, and enhance both current and future potential to meet human needs and aspirations. Sustainable development can distinguishes several, sometimes seemingly opposing, goals, which hence make it a very difficult task to find synergy between these different goals. In other words, the concept of sustainable development implies that it is a subjective, dynamic concept with different degrees of freedom (Geerlings, 2012).

It is also important to stress that the concept of sustainable mobility is not a static situation. The concept of sustainability has to be achieved over time, and is part of a process (temporal aspects) which is also manifest on a spatial scale (spatial aspects). It is already being applied in the transport sector, but in the development of the transport sector and all its external effects, this optimum situation rarely occurs (Banister, 2008).

In the field of transport, there is a general awareness among governments and other stakeholders that new approaches and policy measures are needed to find a balance between accessibility and sustainability. New principles of policy making for the transport sector need to be introduced based on a set of priorities which are in balance with the importance to facilitate transport, but which also specifies enhance criteria from the point of view of sustainable development. Evolving within the framework of policy making, one of these new approaches is named 'transition management'.

Transition studies refers to a field of research that focuses on 'transitions', generally defined as non-linear processes of social change in which a societal system is structurally transformed (Avelino, 2011). A 'sustainability transition' generally pertains to a "radical transformation towards a sustainable society as a response to a number of persistent problems confronting contemporary modern societies" (Grin et al., 2010). One of the central premises in transition studies is that persistent problems are symptoms of unsustainable societies and that dealing with these persistent problems in order to enable more sustainable systems requires transitions and system innovations. Transition research has its intellectual roots in innovation studies as found in social studies of technology (Geels, 2005). The new approach of transition management seems to evolve in a natural way from the existing process-oriented perspectives and the dynamics of integrated system innovation. Transition management is defined by Rotmans (2003) as "a management strategy for public decision makers and private actors that deals with the question how and to what extent complex societal transformation processes can be directed in a certain desirable direction".

The theoretical concept of transitions refers to a transformation process in which society changes in a fundamental way over a generation or more. Transitions can best be understood as gradual transformation processes as a result of simultaneous developments in different societal domains and the combined action of macro-, meso- and micro-level developments (Rotmans, 2003). Transition management can also be described as a governance model for

sustainable development, as a specific policy discourse and as a field of academic research. Transition management differs from classical management or innovation management in that it is not so much concerned with achieving predefined results, but rather with orienting development towards sustainability goals, while acknowledging that the exact outcomes of this development are unknown. Transition management is a governance approach which makes the future more clearly manifest in current decisions, by adopting longer time frames, exploring alternative trajectories, and opening avenues for system innovation (as well as system improvement). The basic premise of transition management in both theory and practice, is that sustainable development requires transitions: non-linear processes of social change in which a societal system is structurally transformed In order to describe processes of change in these complex societal systems, different levels in time and (functional) aggregation are distinguished, resulting in the 'multi-phase', 'multi-level' frameworks applied in transition analysis (Rotmans, 2005; Rotmans and Loorbach, 2009). The multi-level framework is one of the most central concepts in transition studies: it distinguishes between different levels of functional aggregation; the multi-level framework serves to analyze a transition process as an interaction through time, between 'landscape' (macro), 'regimes' (meso), and 'niches' (micro). This complex system- perspective and the multi-level and multi-phase frameworks in transition studies form the theoretical basis of transition management.

An important hypothesis in transition theory is that fundamental change only breaks through if developments at the macro-, meso- and micro-level reinforce each other, and if developments within different domains come together at a particular scale level. A transition then is the result of a mixture of long-term, slow developments and short-term, fast

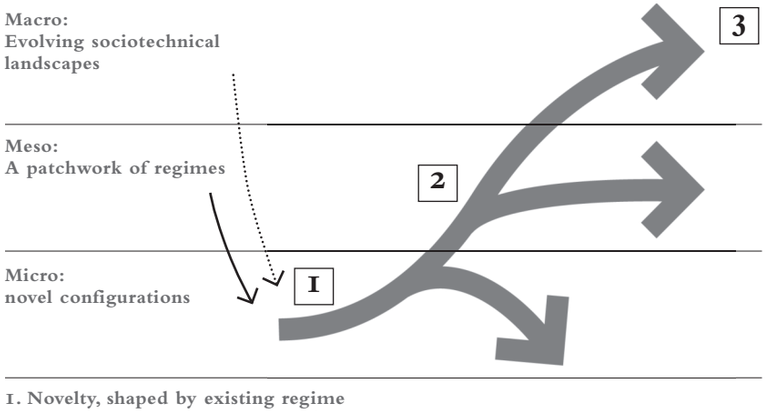

Figure 1. The multilevel model of innovation and transformation Source: Geerlings et al. (2012)

developments. This is illustrated in figure 1, where the classical linear approach and the evolutionary way of thinking are combined and integrated in the concept of transition management.

Transition management aims to foster learning about system innovations and to bring together many actors (technologists, designers, governments, business and citizens) to work on sustainability transitions, taking on board criticism of sociologists that ecological modernisation is often too much supply and technology oriented and that it neglects issues of lifestyle and values. It is a model for working towards systemic change and innovation (Geerlings et al, 2009).

3. The meaning of transition management for sustainable transport

The concept of transition management is being applied in various sectors, such as the energy sector, agriculture and water management. The transport sector is considered as another suitable sector in this regard. It is generally accepted that the physical infrastructure is considered as a relatively stable environment where change is difficult to achieve (e.g. cities, road infrastructures). But the situation in relation to transport is becoming more and more challenging. The continuous growth of transport in all parts of the world has created problems such as the emission of CO2, noise, congestion and a strong dependency on energy supply. It seems quite clear that sustainable solutions need to be found for these transport problems and that technology in relation to transition management might be a promising approach: a significant environmental amelioration can be gained from the implementation of new technologies. These prospects are in line with the revaluation of the role of technology in society that is presently taking place. We observe a certain fascination with technology which is seen as key to a number of different problems (e.g. introducing filters, alternative fuels). From this perspective, technological innovations are considered to be the motor for economic welfare. This opinion is expressed particularly in the transport sector. Indeed, it is indisputable that technological development has made possible the more efficient use of energy, materials and capital that, in turn, has led to higher productivity and, as a direct effect, more transport in the world.

Rotmans (2003) states that a significant improvement of the factors contributing to transport problems are simply not attainable with present technological insights and policy structures. Measures to tackle these problems often lack widespread support or fail to bring true solutions. In his opinion, the transport system seems to be locked-in, and is not developing in a sustainable direction. He thinks that this is caused by lack of a sustainability objectives, and innovation on the system level. In this context, Rotmans calls for change in thinking, leading to new perspectives, with far-reaching measures and integrated solutions based on the new theory of transition management. Some authors (Rotmans, 2003; Grin et

al, 2010) present the concept of transition management as an innovative approach to overcome barriers from the past. They advocate solutions for the system as a whole, instead for parts of the system. Therefore, top-down governance needs to be partly abandoned in favour of user demands and market-developments. In this way, a transition path is not chosen, but rather created in the attempt to traverse. In this way possible breakthrough solutions have to be generated instead of designed, with technology playing a role.

The above-mentioned approach of transition management sounds ambitious, but the practical implications still remain rather unspecific. Past transport policies are described as ineffective, but a thorough analysis has not been made, and appealing alternatives are lacking. Specific expertise in the technological aspects of the transport sector is needed in order to understand its underlying processes and mechanisms. However, the impression has been created that transition management is a methodology that consists of a toolbox applicable in every sector, in every situation, and at any moment. In its case studies, the approach is rather descriptive, not analytical and hardly ex-ante oriented (applicable). In advocating a 'radical' approach and ideas, the different scholars do not acknowledge the achievements achieved in the past.

4. The position of inland shipping in the Rotterdam port area

The Rotterdam port area is an area of major economic importance for the Netherlands; about 5 per cent of the national employment, and about 10 per cent of the GDP is generated in this region. Rotterdam is Europe's largest logistic and industrial hub (Port of Rotterdam, 2008). 'Maasvlakte' is the name of the port and industrial zone built on reclaimed land in the region of the Port of Rotterdam. It was created because more space was needed in the Europoort – the complex of ports and industrial areas that was created in 1957 between the city of Rotterdam and the North Sea. The Port is thus growing, and from an economic perspective it is seen as important that ongoing growth of the port is facilitated. However, the handling capacity of the port is bounded by the transport capacity of the available infrastructure. In the port there are five major transport modalities: road, rail, coastal and inland shipping and pipeline. Most containers are transported by road, but increasing congestion lengthens travel time considerably (however, competitors are of course confronted with the phenomenon). This not only increases the transport costs of transporters and shippers, but also has a negative impact on the international competition position of the port. To be able to transport the growing volumes of goods in a reliable, fast and sustainable way it is necessary that inland waterway transport will be making up a larger share in the transport system.

As well as longer travel time and congestion, there are also impacts on the regional environment. Air pollution and noise put pressure on the quality of life in the region. In the neighbourhood of the A15 motorway that runs from the Maasvlakte eastwards, there are several urban areas that suffer from pollution and noise. In the short term, between 2010 and 2015 a large-scale road expansion from two to three lanes is planned for busiest parts of the highway (Geerlings et al., 2009). However, this extra capacity will only be a temporary solution. The ongoing expansion of the road capacity with additional lanes is not considered a sustainable solution in the long run: in the light of the expected growth in transport it enhances capacity only temporarily. Apart from that, traffic is expected to increase further, as the government has decided to invest in an expansion of the port area.

This enlargement of 2000 ha, called Maasvlakte 2, is being achieved by reclaiming new land from the sea. This additional area will provide increased growth possibilities for the port, and hence, increased transport volumes. Furthermore, the extra infrastructure will probably attract latent transport (Geerlings et al. 2009), which means that more sustainable solutions are needed. One could think of many different solutions, such as the modal shift policy (e.g. more rail transport and inland shipping), increasing the efficiency of existing infrastructure, the introduction of new technology, logistical innovations, organizational innovations, and better cooperation. The combined issues at play in the port area lead to a high degree of complexity in the decision-making processes and complicate the determination of future directions.

The inland shipping sector has to play a key role in the transport of the anticipated volume of containers in 2030 from and to the hinterland of the port of Rotterdam. It is to be expected that the container transhipment in the port will grow significantly. The expectations regarding inland container shipping for 2030 are high. In 2010 container transport by road from the Maasvlakte to the hinterland and vice versa was responsible for a share of 48 percent and inland waterway transport for 39 per cent of total transport. In 2035 the share of road transport should have been reduced to 35 per cent and the share of intermodal transport should have grown to 65 per cent – whereby the starting point is that the share of the inland waterway transport has grown to 45 per cent. This change in the modal split was contractually agreed upon with the terminal operators active on the Second Maasvlakte: European Combined Terminals, APM Terminals and Rotterdam World Gateway. This means that the volume of the expected number of containers that will be processed via inland waterway transport will increase even further, also because of these 'modal split requirements' (Port of Rotterdam, 2008).

Is the inland shipping sector capable to absorb the expected increase in containers that will be processed on the Maasvlakte according to the demands as required by the principal – sustainable, reliable, flexible, safe, transparent? To be able to answer this question, a description of the inland waterway transport and a problem analysis of the sector is needed (IDVV, 2012). The performance of inland container shipping is not an isolated issue but is related to the context of the inland shipping sector as a whole. To be able to renew the

sector, the context will have to be involved as well. The sector is well represented in the Netherlands. Almost 60% of the total European fleet is registered in the Netherlands.

Generally speaking, the strengths of inland shipping are fourfold. Firstly, in the past years inland waterway transport has managed to build up a strong market share in the container waterway transport and it is showing a strong performance in this market. Secondly, there is a well-equipped and modern fleet. Thirdly, the sector is generating considerable value for the Dutch economy. Finally: per transported weight unit, the level of greenhouse substances is low.

But there are also sincere weaknesses. Theses weaknesses have to do with: the inland container shipping's organization (market segments, principals), the broader cultural environment: customs, traditions, norms and values in a society such as work ethos, the governance policies, the innovative capacity, the use of the infrastructure – both waterways as well as terminals (inland & deep sea), rules and regulation, like the Convention of Mannheim and finally the performance. We will have a closer look at these elements.

4.1 Characteristics of the organisation of inland container shipping sector

When we take a look at the characteristics of the organization of the container inland shipping sector, we can also see both strengths as well as weaknesses. Strong points are:

- The relatively high organizational level of the inland waterway transport, inland container terminal operators and of particular skippers.
- The variety in applied business models.
- The focus between parties on solutions to improve problems – like finding a balance between deep sea container terminals and inland container shipping by using new communication technology.
- A lot of dynamics in – and increase of – vertical integration between port and inland container shipping.
- In general the privately operating skipper has a lower education and will be aged – in this respect the inland container shipping is a positive exception.

However, next to these strengths in the organization there are also weaknesses. The most important ones are:

- Lack of contractual relations between deepsea container terminal and hinterland modes of transport – leading to a long stay of container ships in the port.
- Insufficient (shared) attention for the 'orgware' to improve the balance between deepsea container terminals and inland container shipping and a limited involvement of shippers in solving these problems.

4.2 Characteristics of the culture of inland container shipping industry: sector is focused on the future

Cultural differences are changing only very slowly – during many decades. The inland container shipping's culture is usually identified with that of the individual skippers, who have a strong focus on 'shipping', instead of being service-focused towards customers with a 'logistics product'. To this we can add the complex and for outsiders unclear combined action of supply and demand with different agents – resulting in large differences in tariffs. Both elements reinforce the idea of a weak culture in the sector that is not likely to change in the short term. Still, the sector also has several strong elements, which make the cultural aspect one of the inland waterway transport's strengths. We are referring to:

- A high level of adaptability of privately operating skippers to changing conditions.
- The inland container shipping's focus on the future.
- A culture with an ethos of hard work and entrepreneurship.

4.3 Characteristics of the government policy: pro-inland waterway transport

We can characterize the Dutch government's policy as pro-inland waterway transport. In the past years, the Dutch government's policy was next to fulfilling the role of provider of preconditions – focused on the availability and quality of the infrastructure (core network of main waterways) – focused on (financial) stimulation and facilitating things like innovations and sustainability. In the last years, the state government's role is increasingly focused on being the provider of preconditions: the role of provider of allowances, stimulator and facilitator is phased out. The European policy (as for example stated in the White Papers) also reserves a large role for the inland waterway transport. This makes the policy an important strength for the sector. We can however also point at a few weaknesses, like a relatively cut up stimulus policy and the lagging of monitoring in execution of the policy and the lacking of clear vision by the port authorities on the role they can play.

4.4 Characteristics of innovation of the inland container shipping industry: lead is under pressure

There is a strong awareness that innovation is the driving force towards sustainability and a competitive management style in the inland waterway transport. Worthwhile innovations and exemplary projects are definitely created in the sector. It is a strong point that successful innovations are realized on an individual basis. But the sector's innovative force is also showing several remarkable weaknesses that are tipping the scales of the total image of the inland waterway transport towards the negative.

Other modes of transport (road transport!) are innovating in a relatively faster way which makes that the lead in the area of sustainability performance is under pressure.

- The sector is characterized by a lack of standardization and by a long replacement cycle (long lifespan inland shipping vessel as compared to truck). This hinders the innovation.
- The costs of investments related to innovations are relatively high for the sector and it takes a long time to earn back the costs.
- The sector as 'market for innovation' is small in size.
- The government policy is very fragmented and has a very following nature, so the sector is insufficiently responding to new concepts or organizational innovations. This policy has not strengthened the sector as a whole.

4.5 Characteristics of the inland waterway transport infrastructure: an important strength of the sector

The inland waterway transport's waterway and terminal infrastructure is an important strength of the sector – especially when compared to other modes of transport. There is sufficient capacity on the waterways and a differentiated supply of inland waterway transport container terminals – a supply that is currently further developed, both in number as well as in the area of logistical-organisational innovation, for example through the development of extended gates. There is also a strongly developed network of bulk terminals for construction, chemical and agricultural industries in operation. Still, there also are several worries and weaknesses regarding the inland waterway transport infrastructure.

- The first one is concentrated on the capacity problems of a number of locks, whereby especially the Westerschelde-Rhine connection is expected to come across capacity problems in the longer term.
- The second weakness is related to the still structurally too limited capacity for the inland waterway transport at the deep-sea container terminals in the Port of Rotterdam. Previously, the sector's focus on solutions for these problems was mentioned as a strength, but a structural solution still hasn't been found.
- The third and final worrying aspect is related to the pressure on wet company grounds and inland ports by competing activities, like housing and recreation.

At this moment the inland container shipping's performance is lagging too much to be able to play the required dominant role in the hinterland transport related to the Maasvlakte. The inland container shipping's market share in the supply and transport of containers to the Maasvlakte is currently remaining stable (around 40%), but the inland container shipping's share in the total modal split in both the inland as in international transport is decreasing. And even more alarming is that the favourable environmental performance per unity transported weight were one of the sector's traditional strengths. However, relatively speaking, these performances are decreasing compared to the road transport. Furthermore we see that in certain market segments of the inland waterway transport – including container transport – there is overcapacity which has an impact on tariffs, and the profitability of skipper-owners is currently under a lot of pressure. This leads to the conclusion that the sector is insufficiently capable to manage the level of the sector as a whole to be able to improve these performances. There are many loose initiatives taking place, but at present none of the actors involved in the sector is capable, or willing, to lift the inland shipping sector as a whole – if necessary in coordination – to a higher plan. And however the sector's performance is continually changing, technology, infrastructure, regulation and cultural environment are changing slowly to – in the case of the cultural environment – very slowly. This means that a change in the system can't be realized in the short term.

And what is remarkable is that the elements as mentioned above are interrelated: it is not easy to pick up one aspect without this having consequences for other aspects or stakeholders. We could even say that it is in the interest of some stakeholders to have the current situation last as long as possible. If we take a look at all aspects, this situation raises the question if the sector can develop towards an inland container shipping industry that is performing in a clean, safe, efficient and trustworthy way and that can serve the predicted 45 per cent of the hinterland flows from and to the Maasvlaktes.

4.6 Analysis

In spite of the big strategic and economic importance of a well-functioning inland container shipping industry, the large number of stakeholders and the worrying situation in regards to the (relatively lagging) performance in the sector at this moment, there is no common and supported vision about the direction in which the inland waterway transport should develop.

5. The transition of inland shipping

As stated in section 2, we define as an innovation or transition changes in the inland waterway transport that surpass the level of procedure or product innovations. The sector won't be able to play the required role if we only proceed towards the use of very clean engines, for example the currently applied LNG-technology. The whole system has to innovate and go through a transition.

The best example of such a transition in the traffic and transport system is the transition to the container as cargo unit. The impact of this system innovation has clearly changed the global economic system. As such we can say that there is a need for a radical innovation of the inland shipping sector with an impact on the broader freight transport system.

But why is such a system innovation necessary? Is the sector currently not already working very efficiently – it already being a sustainable and successful way of freight transport? Or: why no gradual innovation and reaping the benefits of the innovation of the freight transport as a whole and of taking over innovations from other sectors? These are the

three options that the inland container shipping can choose from:

- Optimizing the current way of functioning of the inland container shipping without radical sector changes being anticipated (doing nothing).
- Moving along with a general mobility transition, whereby the environmental performance remains at an acceptable level, capacity is sufficiently present and being adapted into certain logistics chains is realized (passively moving along with other parties/sectors).
- A full transition or system innovation in which the role of the inland waterway transport is extended, in which new markets are developed and in which the sector itself is the main instigator of the right direction for innovation (jump in the system).

We think that it is necessary to have a system innovation, due to the character of the complexity as stated in this study, the scope of the challenges the sector is facing and the sector's characteristics:

- The volume of the expected flows of goods between now and 2030 – especially the expected flow of containers from/to the Port of Rotterdam – means that a fundamentally different way of processing is required not to increase the current problems in deep-sea container terminals and congestion at locks in the waterway network from and to the main ports.
- The inland container shipping plays a key role in the strategic importance of the further development of mainport Rotterdam because the new suppliers on the Maasvlakte have contractually obliged themselves to a minimum share intermodal t transport – and in this especially use of the inland waterway transport – in the modal split. The future of the Second Maasvlakte is closely linked to the functioning of the inland container shipping.
- In spite of an active policy and a persistent effort, the sector is currently incapable of increasing its market share and environmental performance.
- There is a lack of a strategic vision with a broad support, in which the elements that are important for the required functioning of the sector will be considered in full – a vision that is also instigating action.
- In the covering container logistics there are innovative principles like synchro-modality, whereby the container cargo is at the centre of attention, instead of managing the box. This requires the sector to make a transition from the transport of containers 'in bulk' to logistical provision of services.

Without system innovation the sector won't be able to play the anticipated dominant role in freight transport in the future. Stabilisation of the sector equals stagnation, will not increase the share of the inland container shipping in the modal split and will lead to a marginalization of the sector – especially when other modes of transport dó go through a development stage.

The transition must go via three paths: ① large scale industrial corridors, ② radical greening and ③ a dense distribution network transition.

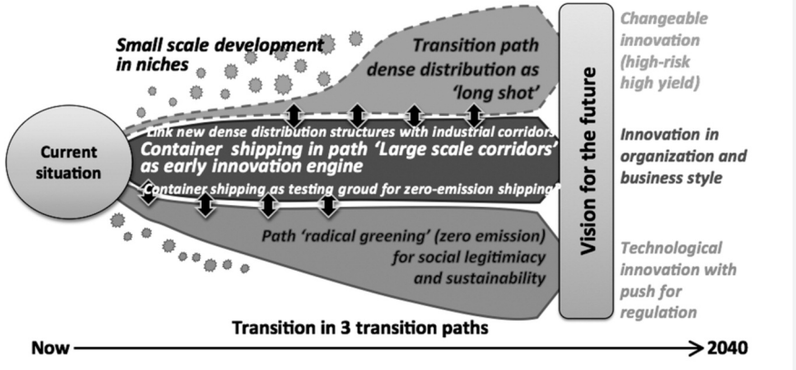

Figure 2. Three innovations paths of inland shipping Source: Van Raak e.a., 2012

1. Transition path 'Large scale industrial corridors in the logistics chain'

The transition path large scale, industrial corridors in the logistics chain is focused on:

- increasing the added value,
- a 'better' modal-split,
- a healthier, more rational management style by organising the existing larger flow of goods in a different way.

This requires limited innovations in 'techware' but large innovations in 'orgware', including the underlying culture. In this track it is about a new organization (and corresponding systems) of the sector that are facilitating 'climbing in the value chain' and that offer the customer (shipper) services at service and function level.

This transition path is the least radical, but it is comprehensive and the system innovation in the inland container shipping can be the motor of this track. Out of all shareholders it looks like in this track especially the inland container shipping industry – and the large players therein – itself is the main player (and the government to make sure the infrastructure will grow). Even though this path is well advanced in its development compared to the two other paths, significant barriers will have to be removed to reach an

2. Transition path 'Radical greening'

The transition path radical greening tries to have all of the inland waterway transport make a catch-up effort focused on keeping the 'environmental competitive advantage'. In this path, a relatively large role is reserved for technical suppliers – like the boat engine sector –, the government as stimulating / standards setting party and technical research parties. These parties will have to convince the sector with innovation and vision, but also with regulation and stimulation, of the urgent need to start 'chasing up' road transport, in which respect it is not a matter of catching up with road transport within 5 to 10 years, but of overtaking road transport in about 10 to 20 years.

The transition path radical greening starts with end-of-pipe projects, like blending with clean fuel, and ends with radical clean transport. Much technology has already been developed, the challenge is especially adaptation and a broad application in the market segment inland container shipping – which has only a limited number of vessels and thus motors. This track is further characterized by a limited transition path that must lead to a system innovation and a larger role for the public parties as the right paths towards a solution are still far away from a competitive alternative.

3. Transition path 'Dense distribution network'

The transition path dense distribution network is focused on forcing a trend break by reintroducing the inland container shipping as dense distribution network solution – focused on the regional markets, the inland waterway transport on small waterways and/or for the benefit of partial loads (pallets/LCL). This refers here to the connections that are nót part of the large corridors (Rotterdam-Germany and Rotterdam-Antwerp), the core network of inland waterways or fixed routes, like Alphen aan de Rijn-Rotterdam. It refers to the more 'high risk-high yield', experimental developments. These developments have in common that it is all about dense network solutions that are often linked to specific custom made work for a region, type of product, specific inner port or organization. The shippers as consulted by us for this study (see: Kuipers et al, 2012) indicate that especially innovations in the characteristics of the ship are very important – in this regard innovation is not synonymous with 'scaling up'.

With respect to the dense distribution network developments as mentioned above, it is less likely that large players from the existing sector will integrate this from the start into the core of their activities. It will rather be the small players or relatively independently operating sections of large players that will play a leading role in this type of developments. Here a large role is also reserved for public parties, as the paths towards a solution in this track are still too far away to make a competitive alternative for, especially, road transport. Adjusting to innovations in the inland waterway transport is of vital importance.

6. Synthesis and conclusions; the need for an integrated approach

The inland shipping sector is in a critical situation. We observe a so called 'inland waterway transport paradox': on the one hand many independent stakeholders are undertaking a range of activities to optimally develop the inland container shipping's potential, whereby their own agenda is the central focus. At the same time we see that through a lack of a shared vision, no 'sense of urgency' and the unwillingness to cooperate, the sector's 'fundamentals' are weakening. Inspired by a song of Boudewijn de Groot: there are high expectations, but the sector gets the image of a 'Wonderkind van Vijftig' (a prodigy of 50 years old). The high expectations exist for more than 50 years now but they never come through. Regarding these fundamentals, we should be thinking about the development of the market share, the environmental performance, the economic output ,the finance structures and the role port authorities are willing to play.

There is at present much discussion what is needed to give an impetus to inland shipping. The current policy is lacking or formulated by means of the traditional "government" approach, including certain optimism in the effects of technology. Not all stakeholders are aware that new roles and new approaches are needed to benefit from opportunities for inland shipping. The need for a sustainable and well functioning inland shipping sector is relevant on different levels such as local, regional national and even European level, but manifests most directly in the performance of the port(s). The challenge is to develop an ex-ante methodology that addresses the new challenges in coherent strategy. This implies that all stakeholders (forwarders, shippers, etc.) have to reconsider their role. It is necessary to work on awareness raising and to recognize the need for cooperation and interaction between the governments and private firms to fulfil the changing needs of society on logistics. The port authorities have the position and tools to take a leading and pro-active position in this recalcitrant issue.

This requires a transition and integrated approach. The transition agenda for the inland container shipping must presume three levels: strategic, tactical and operational. At the strategic level it is especially important to form a shared vision. In the aforementioned problem analysis it became clear that currently there is a lack of such a vision. The transition approach provides tools to facilitate a similar vision procedure, like a 'transition-arena'. The assessment makes clear that there are means and innovations available to make progress on a tactical level. It is however also clear that these means are especially available for the transition path 'Large scale industrial corridors' and less for the other paths. On the operational level several initiatives can already be noticed, varying from extended gates and corporations/franchises in the large scale transition path towards an LNG-vessel in the greening path and experiments with small scale distribution shipping in the dense distribution network path. But only when this transition is a common attempt based on a

shared vision and a sense of urgency now, there are chances for success. Otherwise the sector will become a prodigy of 100 years old.

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The port of Rotterdam and its Hinterland connections, some legal aspects

Frank Smeele and Susan Niessen

1. Introduction

In January 2005, Hans Smits took over at the helm of the Port of Rotterdam Authority in roaring times. The year before, the Rotterdam municipal service for the port had been transformed into Havenbedrijf Rotterdam N.V., a corporate entity with two shareholders, the city of Rotterdam and the Dutch State. In 2007, the "Betuweroute", a new dedicated railroad for freight trains connecting the port of Rotterdam with its Hinterland in western Germany was completed and brought into operation. In 2005 the Maasvlakte 2-project was still on the drawing board and it was under his watch as CEO that in 2007 the momentous decision was taken to commence as from 2008 with the first stage of this major harbour extension project, a public investment of no less than € 3 Billion. By the time that this first stage is completed in 2015, probably on time and within budget, Hans Smits will already have been succeeded as CEO by Allard Castelein.

In this joint contribution certain legal aspects of the relation between the port of Rotterdam and its Hinterland connections, will be discussed. In parts 2 and 3 it will be explored if and to what extent financial losses suffered by third parties both in the Rotterdam port area and its Hinterland may affect the lawfulness of industrial action and strikes taking place in the Rotterdam port area. In parts 4, 5 and 6 the legal implications will be examined of a new business model of certain sea terminals which offer extended gate services within their Hinterland networks.

2. Industrial action in the port of Rotterdam

My first meeting with Hans Smits dates back to Friday 9 March 2007. At the time, I was a attorney-at-law and partner with the Rotterdam law firm of Van Traa Advocaten as well as part-time professor of maritime law at Erasmus School of Law. The day before, I had worked late into the night to complete an advice for a foreign shipping line about option(s) to challenge the lawfulness of the strike at Smit Harbour Towage Rotterdam (hereafter: SHTR). Due to this strike, which had started over two weeks earlier, two of its ships were trapped in the Rotterdam port, thus causing substantial financial losses to my client. Further, one of its large bulk carriers was due to arrive at Rotterdam in the near future, which was likely to lead to a further escalation of losses. Unfortunately, for reasons explained below there was little that could be done to help my client out of its predicament.

Under the Revised European Social Charter (RESC)[1], the mere fact that a strike or industrial action causes substantial financial losses to a third-party, is insufficient to make the strike unlawful. The RESC explicitly recognizes "the right of workers and employers to collective action in cases of conflicts of interest, including the right to strike, subject to obligations that might arise out of collective agreements previously entered into". [2] Although national law may[3] impose restrictions upon the way in which the right to strike is exercised, such restrictions must be "prescribed by law and … necessary in a democratic society for the protection of the rights and freedoms of others or for the protection of public interest, national security, public health, or morals."

Under Dutch law it is settled jurisprudence of the Hoge Raad, the Dutch Supreme Court, that in general a restriction on the right of workers to strike must be assumed if – considering all prevailing circumstances, including but not limited to the economic interests of third parties – the trade unions could not reasonably have decided to the industrial action/strike at hand. Whether or not a restriction must be made on the fundamental right of workers to strike therefore depends on a test of unreasonableness on the part of trade unions in view of all the surrounding circumstances.

In a decision dating from the 1990s[4], the Hoge Raad had to rule about the lawfulness of a strike in the port of Rotterdam aimed against certain policy proposals of the Dutch government. The federation of employers in the Rotterdam port sued the trade unions in order to have the politically motivated strike prohibited. The Hoge Raad reasoned as follows (in my free translation):

"Restrictions on the right in art. 6-4 RESC can only be based on the general notion of "unlawful act" (tort) in Article 6:162 Dutch Civil Code (DCC) if these restrictions can be derived with sufficient sharpness from the general duty of care that according to this provision must be exercised in society towards others with regard to their person and property. Furthermore, it is required that such restrictions are necessary in a democratic society for the protection of the said rights of others, such as the employers in this case.

The questions whether such a restriction is indeed necessary here and can be derived with sufficient sharpness from the above requirements, must be answered by reference to the circumstances which are characteristic for a case such as this. In a case like this, the following applies. **With regard to the right of collective action with a purpose, which** – although aimed at government policy – **concerns essential employment conditions, and which therefore affects the interests of the workers considerably, the mere fact that the employers suffer substantial damage cannot justify a restriction of this right of collective action, if only because otherwise an in any sense effective exercise of this right would hardly be possible anymore.**

However, it may be that the damage to be expected can reach such a magnitude that nevertheless a restriction becomes necessary. Here that shall not be the case, as long as it concerns only damage of individual businesses suffered over a short period of time and without causing significant and lasting consequences for the businesses involved. Such losses must be deemed a normal business risk. **It would become a different matter however, if the damage resulting from this industrial action were to exceed these boundaries, either because one or more businesses are affected disproportionately**

[1] Part II, Article 6 of the Revised European Social Charter (RESC) grants workers the right to bargain collectively (whe¬ther represented by trade unions or not) with employers.
[2] Article 6-4 RESC.
[3] Part V, Article G-1 RESC.
[4] Hoge Raad (HR) 11 November 1994, Nederlandse Jurisprudentie (NJ) 1995, No. 152.

harder, or because the damage to be expected on the part of the employers is of a more general nature, e.g. because by its nature and size it affects the entire port or the Dutch economy as a whole. Nevertheless, in all instances in which on such a ground a restriction is deemed necessary, **there must be an immediate and concrete danger of a specific, considerable damage, of which the nature and the size, if disputed, must be made plausible by the employers.** In judging the seriousness of the consequences of the industrial action, the damage already suffered by previous actions of a different nature may be considered as well." (with added stress)

Applying the above reasoning to my client's position, I concluded that although it clearly suffered considerable financial losses due to the strike, its interest by itself was probably insufficient to persuade the Rotterdam court to restrict the right to strike of the workers and at SHTR. More was needed before exercising the right to strike could become unreasonable, e.g. the strike continuing for an extended period of time or a third party being disproportionally affected[5] or considerable damage of a more general nature being caused to businesses in the Rotterdam port and in its Hinterland[6] or to the entire Dutch economy. Also relevant is the way in which the workers and trade unions conduct the strike or industrial action. In this case the strike had not been called for an indefinite period of time, but rather it was decided from day to day whether to go on with it. Further the strike was interrupted briefly during the weekend of 3 and 4 March 2007 in order to allow the worst congestion in the Rotterdam port to be dealt with. Both factors added support to the reasonableness of the strike action.

However the trade unions also declared the towage services provided by SHTR for certain customers under framework contracts of long duration to be 'besmet werk' (contaminated work) and made it clear that it would not be tolerated if the regular customers of SHTR (who at the time had over 65% of the market share in port towage services in the Rotterdam port) were to go to its competitors (e.g. Kotug) in the Rotterdam port to service their harbour towage needs. It was intimated that such 'scabbing' practices might lead to intentional interference with the business operations of SHTR's competitors, customers and even third parties. The threats seem to have been effective since no 'scabbing incidents' were reported.

Arguably however, if these threats had been implemented, such conduct might be a factor pointing towards the strike becoming unreasonable, since there seems to be a contradiction between the strikers and unions on the one hand exerting pressure on Smit through the industrial action/strike, yet on the other hand 'protecting' their jobs (and indirectly SHTR) by making threats aimed at restraining its regular customers from going elsewhere to service their towage needs in the Rotterdam port. Furthermore, considering the dominant market position that SHTR had at the time in the Rotterdam port area, such conduct by the strikers and trade unions could arguably even constitute a restraint of free competition.

In summary, the advice to my foreign client was that there was little that we could do at the time about the on-going strike at SHTR. The best we could do was to keep monitoring events and developments regarding the strike and to wait and see.

3. The Friday Night Summary Relief Hearing

The next day, Friday 7 March 2007, I was mainly occupied with other matters. However at 16.00 hours the phone rang and I was informed that three oil majors – each with oil refineries in the Rotterdam port area and close to a shutdown due to lack of supply of crude oil – were seeking amongst others an injunction restraining the trade unions from continuing with the strike at SHTR. The summary relief hearing before the Court of Rotterdam was scheduled for the same (Friday) evening at 21.00 hours. Havenbedrijf Rotterdam N.V. wished to join in with the claimants on behalf of the wider port business community and asked if I was available to act as advocate on its behalf. After obtaining the approval of my foreign client, I could accept the instruction and less than an hour later I was in a meeting with Hans Smits and Frans van Zoelen (head of legal affairs) at the World Port Center. During this meeting it was decided to support the oil majors in their claim for an injunction terminating the strike, but in addition to present a subsidiary or alternative claim for an injunction imposing a cooling-off period of thirty days upon SHTR and the trade unions as parties to the labour dispute.

At the hearing, the Injunction judge inquired whether temporary interruption(s) of the strike could help to avoid disproportional losses being suffered by third parties and of what duration the interruption should be to be effective. Asked on the spot, Hans Smits present at the summary relief hearing, asked for seven days. Around midnight, the Injunction judge of the Rotterdam court gave its interim decision and ordered that within six hours from the notification of the decision, the trade unions were to resume harbour towage services for at least 75% for the duration of four days (96 hours) and to the extent that the strike/industrial action is resumed, for each five days of strike to resume the work for at least four days at a level of 75%. In fact, the strike was never resumed because shortly after SHTR and the trade unions reached agreement in the wages dispute. Neither did the trade unions appeal against the interim decision of the Rotterdam Court.

It is interesting to take notice of some of the considerations and reasoning applied by the Rotterdam court (in my office translation) in determining whether the losses suffered by third parties in the Rotterdam port and its Hinterland were becoming disproportional.[7]

[5] E.g. if a huge bulk carrier costing hundreds of thousands of dollars per day, was delayed by the strike.

[6] I.e. the geographical area inland surrounding the port that is actually serviced with goods from the port

[7] The case is reported in full in: Rechtbank Rotterdam (Voorzieningenrechter) 9 March 2007, Schip & Schade 2007, 97 Shell Nederland Raffinaderij B.V. a.o. vs. FNV Bondgenoten a.o..

(Factual basis) A strike by union members in connection with a wages dispute between their employer Smit, which holds about 60 to 65% of the harbour towage capacity in the port of Rotterdam. Because of this strike – and due to the fact that the trade union have declared the interrupted work 'contaminated', because of which other towage companies are unwilling to provide these services – container vessels, oil tankers and bulk carriers cannot enter or leave the Rotterdam port, because of which the supply of crude oil needed for the production processes of the refineries stagnates and also other businesses suffer damage. Supported by Havenbedrijf, the refineries seek the termination of the strike, which, apart from intervals for consultations and/or work, lasts already for more than 14 days.

The unions stick to the rules of the game, which must be observed when exercising the right to strike. The actions are used as an ultimum remedium. The work interruptions are always announced in advance. In between the strikes work has been executed, so that there some continuity in the port. In principle therefore, the strike is to be considered lawful. Restrictions on the right to strike are pursuant to Article G of the Revised European Social Charter (RESC) only permitted if these are necessary in a democratic society for the protection of the rights and freedoms of others or for the protection of public interest, national security, public health, or morals." Such restrictions need a legal basis, for which it is sufficient that these can be derived from the duty of care which based on Article 6:162 Dutch Civil Code must be observed towards others in society.

Firstly, the mere circumstance that third parties suffer some loss as a result of a strike, is insufficient for a restriction of the right to strike. However, against the background of the fact of general knowledge that the port of Rotterdam plays a pivotal economical role for Western Europe, in the present case it has become sufficiently plausible that there is such disproportional damage for amongst others the refineries, so that restriction is deemed an urgent necessity. In particular it has become plausible that in case of continuation of the strike, the refineries must interrupt their production processes, which will be associated with environmental damage, in the form of air pollution, stench- and noise nuisance. Further, there is no other realistic possibility to avoid the problems which the strike causes for the refineries and third parties. De tankers and other vessels waiting at anchorage cannot go elsewhere for discharge and alternative transport methods are not realistic. As a result, the consequences of the strike for the refineries and other parties not involved in the labour dispute are no longer in proportion with the purpose of the strike, so that a continuation of the strike for an indefinite time would go beyond the boundaries of the duty of care owed to society.

By imposing a general prohibition to strike, the unions would be deprived of their most effective and legally permitted tool in case of deadlocked negotiations. Therefore a balance must be struck. Thereby it is taken into consideration (i) that a strike of (each time) limited duration can be accommodated provided that it is clear that this duration is limited and when the work shall be resumed, so that planning and supply can be adjusted accordingly, and (ii) that the Havenbedrijf can allocate the available services according to necessity. For these reasons, it is sufficient to command a limited resumption of work (resuming the towage services for at least 755 during four days, and to the extent that the strike/industrial action is resumed, for each five days of strike to resume the work for at least four days at a level of 75%.

In the above case, the disproportional damage about to be caused by a shutdown of the oil refineries in the Rotterdam port, proved sufficient to achieve the temporary interruption of the strike at Smit Harbour Towage Services Rotterdam. Although the court mentioned also the alleged danger that if the strike were to continue, the steel works of Thyssen at Duisburg, Germany might have to shut down failing sufficient supplies of coal and iron ore, this allegation was not used to base the decision upon. For that an active intervention of Thyssen and more factual support would have been necessary to make it sufficiently plausible to the court.

4. The importance of Hinterland networks

A key success factor for main ports such as Rotterdam lies in the quality of their multimodal Hinterland networks. The Rotterdam port is well connected to inland destinations by various modes of transport; road, rail, inland waterways and pipelines. However, a more efficient and sustainable use could be made of these multimodal connections with the Rotterdam Hinterland. For this reason, improving the use of inland networks is one of the main objectives of the Port of Rotterdam as expressed in its 'Port Vision 2030'.[8] Terminal operators can play a vital role in this development. In addition to their traditional role in the loading, discharging and storage of cargo (hereafter: cargo handling) in the sea port area, sea terminals may also assume responsibility for coordinating and controlling the inland flow of goods from the sea terminal to hinterland terminals, and thus contribute significantly to the efficiency of Hinterland networks[9] and to achieving a more sustainable modal split in the carriage of goods to the Hinterland.

This shift of focus from cargo handling to carriage of goods will change the legal position of terminal operators profoundly. This is because the law differentiates between several types of contracts and the legal regimes applicable to these contracts diverge. Additional to the general law of contract that applies to all contracts, certain types of contracts are specifically regulated by law. E.g. specific rules exist for the contracts of services,

[8] Port Vision 2030, approved by the Rotterdam city council on 15 December 2011. http://www.portofrotterdam.com/en/Brochures/Port-Vision-2030.pdf , p. 3. (last tested on 18 October 2013).

[9] A. Veenstra, R. Zuidwijk & E. van Asperen, 'The extended gate concept for container terminals: Expanding the notion of dry ports', Maritime Economics & Logistics 2012, vol. 14, p. 14-32. See the ECT-report on 'the future of freight transport': http://www.ect.nl/sites/www.ect.nl/files/ect_ boekvisieect_04k_nl_lr.pdf (last tested on 8 October 2013).

deposit, carriage of goods and freight forwarding. There are major differences between the applicable rules to these types of contracts. Therefore, a terminal operator who provides a variety of services which fall under different types of contracts is confronted with a variety of possibly applicable legal regimes. This is underlined by the fact that some of these legal regimes (e.g. contracts of carriage) are of a mandatory nature whereas others (e.g. services and storage contracts) are not. Another major difference concerns the liability of subcontractors.

In the remainder of this contribution, the emphasis will be on these legal implications since it is particularly relevant for terminal operators that are developing their role and are becoming active in the Hinterland.

5. The terminal operator in control of the inland flow of goods

Taking control over the inland flow of goods will bring about some changes for the terminal operator and for the maritime and business community at large. Currently, the main customers of terminal operators are shipping lines, who sub-contract and delegate the performance of certain transport-related services to the terminals. This is changing however as, increasingly, terminal operators offer their services directly to shippers. Shippers, or their forwarding agents, can book inland transport directly with a terminal operator. By attracting to their terminals the cargo of shippers, the terminal operator's bargaining position towards the shipping lines improves. For sea terminals it is of strategic importance that their port (i.e. their terminal) is included in the list of ports of call (terminals) that are visited on a regular basis by the vessels operating the shipping line. To achieve this objective it helps if the terminal gathers a substantial volume of cargo from shippers in its Hinterland. Moreover, the terminal operator also becomes more attractive for shipping lines as they offer the service to carry goods to inland terminals in addition to mere cargo handling in the sea port terminal. Providing this extra service also makes the terminal operator more competitive compared to other terminals, which is an important advantage in view of the increased competition between terminals which is anticipated once the Maasvlakte 2-project is completed.

Furthermore, the terminal operator is in an excellent position to perform, or to instruct sub-carriers to perform, inland carriage and inter-terminal-transports (ITT). Arguably, its position might even be more favourable than the position of those currently in the lead, i.e. the freight forwarders and multimodal transport operators. This is particularly true for terminals, like ECT,[10] capable of making arrangements with their customers and customs to treat certain inland terminals as (inland) extensions of the sea port terminal. The gate of the sea port terminal is extended to include the inland terminals and the carriage of goods between the sea port terminal and the Hinterland is treated as a movement of cargo within the sea port terminal. In this way the terminal operator can transport the goods to and from the Hinterland in its own motion instead of awaiting the clearance and the pick-up of the goods. This results in less congestion at the terminal and in the port area.

Another advantage of this business model is the ability of terminal operators to improve the use of more sustainable modes of transport such as inland waterways and rails. At a sea terminal it is possible to collect and bundle the large quantities of cargo needed to load freight trains and inland barges to their full capacity and to reduce the use of road trucks to a minimum. Not only is this approach more sustainable, it can also lead to a reduction of costs thanks to the economies of scale. Further, it enables terminal operators to achieve the required modal split.[11] However, not always is the terminal operator free to choose the mode of inland transport. Some contracts of carriage are mode specific and do not allow the use of alternative modes of transport. This makes the terminal operator less flexible. It is important therefore that customers leave the options open so that the terminal operator can choose the most appropriate mode of transport at the time of performance of the contract. At that time the terminal operator is best placed to choose between the available means of inland transport based on their capacity and speed and on the needs of the particular cargo. Only when the contract does not specify the mode of transport, can the terminal operator use its excellent position to select the most efficient and/or most sustainable mode of inland transport.[12]

6. Legal implications: Liability of subcontractors

The terminal operator who takes control of the inland flow of goods is part of a network of contractual relations in which all parties co-operate in order to accomplish the transportation of goods (usually) pursuant to a contract of sale between a seller and buyer. Within this network the terminal operator can assume various roles and enter into contractual relations with different kinds of parties. In case the seller or buyer (possibly through a forwarding agent) is the contracting party, the terminal operator can be considered as the main contractor. In that case it is possible that he assumes responsibility for a task as main contractor, yet entrusts its performance to a subcontractor. However, very often the terminal operator will be engaged by another party in the network, e.g. the main carrier, in which case the terminal operator performs obligations as a subcontractor. In those cases the terminal operator faces the legal issues that may arise regarding subcontractors.

The main difficulty lies in the absence of a direct contractual relationship between the subcontractor and the cargo owner, or another party interested in the cargo. Most jurisdictions allow non-contractual claims from cargo interests against a subcontractor when goods are damaged or lost.[13] This subcontractor is liable since he owes a duty of care towards

[10] Europe Container Terminals, part of Hutchinson Port Holding (HPH), is a major deep sea terminal operator in the port of Rotterdam.

[11] Concessions granted in relation to the Maasvlakte 2-project, impose upon sea terminal certain targets concerning the 'modal split', i.e. the distribution of cargo over the various modes of transport.

[12] See the advisory report 'Partituur naar de top' of Topteam Logistiek. http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2011/06/17/partituur-naar-de-top.html, p. 14. (last tested on 18 October 2013)

[13] This is not possible in countries such as France and Belgium where, in principle a claim can only be brought against the main contractor and not against the subcontractors that perform the contract.

others and their property (tort of negligence). When confronted with non-contractual claims, the subcontractor finds himself in a difficult situation. The exclusions and limitations of liability usually included in their contracts may not be invoked against third parties because of the *privity of contract* rule, i.e. a contract is only binding upon the parties to it. Does this mean that the subcontractor is fully liable or can the subcontractor defend himself against these non-contractual claims? Since this depends on the type of contract performed, a distinction will be made between the terminal operator performing a contract for the provision of (stevedoring) services,[14] a contract of deposit and a contract of carriage.

6.1 The terminal operator as a stevedore

When performing stevedoring services the terminal operator is often a subcontractor of the main ocean carrier.[15] This ocean carrier takes upon himself the obligation to carry goods and entrusts the performance of certain obligations under the contract to a stevedore. In case goods are damaged or lost during loading or unloading of the vessel, the cargo interested party can either bring a claim for compensation against his contracting party, the main carrier, or against the stevedore. The ocean carrier can be confronted with a contractual claim, since a main contractor remains liable for the performance of the contract by his subcontractors (*vicarious liability*). Then, the carrier can in his turn bring a recourse claim against the stevedore. When following these contractual links the carrier and stevedore can rely on their contractual terms excluding or limiting liability. What is more, the carrier is also protected by national or international transport law.

However, in case cargo interests bring a non-contractual claim against the stevedore there is need for other means of protection. This is because independent (sub)contractors are not covered by international mandatory liability regimes,[16] in most cases national law does not offer protection[17] and it is generally not possible to rely on the terms of a subcontract to which the cargo interests are not a party.[18] This problem can be overcome by an agreement in the main contract between the ocean carrier and the shipper. In order to avoid full liability of his subcontractor, the main carrier can make a stipulation in his contract for the benefit of the stevedore. This can either be construed as agency[19] or as a contract for the benefit of a third party.[20]

An example of such a stipulation is the 'Himalaya clause', which stipulates that the carrier's agents, servants and independent contractors are entitled to the same protection as the carrier.[21] This enables the stevedore to benefit from defences, exclusions and limits of liability available to the main contractor.[22] Moreover, Himalaya clauses are often combined with 'circular indemnity clauses', which try to make sure that the protected parties are not confronted with direct claims at all.[23] This method of the stipulation for the benefit of a third party creates the required contractual link between the cargo interests and the stevedore. The result is that the stevedore, as a subcontractor, finds himself in a similar position as the carrier/main contractor because it is possible to rely on the terms of the main contract.

6.2 The terminal operator as a (sub)depositary

The terminal operator often stores goods at its terminal before or after the transport of goods or during an intermediate stage. This can be done for a main contractor (carrier or depositary) or it may be that the terminal operator has a direct contractual relationship with the cargo owner. In both cases the terminal operator can entrust the performance of this contract of deposit to (sub-) subcontractors, with the result that the terminal operator remains responsible.[24] Similar to service contracts, contracts of deposit are not subject to national or international mandatory liability rules.[25] Instead, national law merely provides default rules.[26] As a depositary, the terminal operator is free to override these default rules and to shape the contract as he wishes. This implies that exclusions and limits of liability for cargo loss or damage are to a large extent permitted.

However, with regard to non-contractual claims, the position of a depository differs considerably from that of a service provider under Dutch law. This results from the fact that

14 In most jurisdictions the contract for stevedoring services is not specifically regulated by law, but it falls in a broader category of service contracts (In Dutch: 'overeenkomst van opdracht', in German: 'Dienstvertrag' or 'Werkvertrag')

15 Unless a variation of a 'FIO clause' is inserted into the contract particulars of the main contract of carriage. In that case the terminal operator is more likely to be the main contractor.

16 When the Rotterdam Rules enter into force this situation will change. The stevedore will then be governed by a uniform liability regime since the Rotterdam Rules extend their application to independent contractors that fall within the definition of the maritime performing party.

17 For an overview of the legal position of independent contractors see: F. Smeele, 'The maritime performing party in the Rotterdam Rules 2009,' European Journal of Commercial Contract Law 2010-1/2, p. 72-86. For the legal position under English law see: S. Baughen, Terminal operators and liability for cargo claims under English law. In S. Soyer, A. Tettenborn eds. Carriage of goods by sea, land and air. Unimodal and multimodal transport in the 21st century, Abingdon: Informa Law 2013, p. 267-285.

18 Only under strict circumstances this is possible in the Netherlands. Examples of Dutch case law that allows reliance on contractual terms against third parties: HR 20 June 1986, Nederlandse Jurisprudentie 1987, 34 (Khaly Freezer); HR 9 June 1989, Nederlandse Jurisprudentie 1990, 40 (Vojvodina/ECT). This is similar to the situation under German and English law. See: R. Zwitser, 'Van Duitse naar Engelse aanpak bij derdenwerking', Nederlans Juristenblad 2001, p. 212-218; N. Palmer, Palmer on Bailment, (3th Ed.) London: Sweet & Maxwell 2009, p. 137, 1103.

19 This is required under English law: Elder Dempster & Co Ltd v Paterson, Zohonis & Co Ltd [1924] A.C. 522; Scruttons Ltd v Midland Silicones Ltd [1962] A.C. 446. See also: J. Chitty & H.G. Beale, Chitty on Contracts, The Law of Contracts, (30th Ed.) London: Sweet & Maxwell 2008, p. 939-942.

20 In Dutch law: 'Derdenbeding' (art. 6:253 DCC), in German law: 'Vertrag zugunsten Dritter' (§ 328 BGB).

21 The clause takes its name from the decision of the English Court of Appeal in the case of Adler v Dickson (The Himalaya) [1955] 1 QB 158.

22 T. Nikaki, 'Himalaya clauses and the Rotterdam Rules', Journal of International Maritime Law 2011, p. 20-22; W. Tetley, 'The Himalaya clause revisited', Journal of International Maritime Law 2003, p. 58-59.

23 Q.B. (Comm. Ct.) (The Elbe Maru) [1978] 1 Lloyd's Rep. 206.

24 However, under German law the main depositary needs authority from the depositor (the person who deposits the goods) to entrust the performance of the contract of deposit to subcontractors § 472 II HGB.

25 However, it has to be borne in mind that under German law a storage keeper is liable as a carrier and not as a depositary in case of transport-related storage.

26 In the Netherlands: art. 7:600-7:609 DCC. In Germany: § 467-475 HGB. In England this falls under the law of bailment. See N. Palmer, Palmer on Bailment, (3th Ed.) London: Sweet & Maxwell 2009.

Dutch law creates a legal basis for invoking contractual terms even if there is no contract between the person claiming compensation and the depositary.[27] A (sub)depositary can defend himself against claims from third parties by relying on the terms and conditions of a contract of deposit. This means that the terminal operator who performs a contract of deposit for a main carrier or depositary is protected against non-contractual claims from cargo interests. Also his subcontractors, for whose acts and omissions the terminal operator is vicariously liable, are protected.

6.3 The terminal operator as a (sub)carrier

Terminal operators taking control over the inland flow of goods, generally assume responsibility for the carriage of goods by inland waterways, rail or road. These terminal operators conclude contracts of carriage with main (ocean) carriers or directly with shippers (or their forwarding agents) in which they undertake to perform inland transport between inland terminals and terminals in the sea port area. The transport can be performed by the terminal operator himself, or it can be delegated to a subcarrier. It has to be borne in mind that even in the latter case the terminal operator remains responsible for the performance of the contract.

Generally, the law of carriage of goods is subject to mandatory rules. International conventions and national transport law are the source of these mandatory rules from which parties cannot deviate in their contracts. It follows from these rules that carriers act under strict liability and are therefore liable for damage to, loss of or delay of the goods. However, they are not always liable to compensate the full value of the cargo. Their liability is instead limited to a certain amount which is calculated with reference to the weight of the goods or the number of packages and expressed in Special Drawing Rights. This right to limit liability will only be lost in certain cases of misconduct. A peculiar aspect of the law of carriage of goods is that it differentiates between modes of transport. These rules differ as to the basis as well as limits of liability. However, these rules on different modes of transport all have in common that they are applicable irrespective of whether a claim is brought in contract, in tort or otherwise.[28] This means that the terminal operator who performs a contract of carriage as a subcarrier or as a main carrier has the benefit of defences and limits of liabilities when claims are either brought by contractual parties or by third parties.[29]

In conclusion, it can be said that the terminal operator's shift of focus from cargo handling to the coordination and control of inland transport has serious legal implications. The liability of subcontractors is a particularly relevant aspect for those terminals that assume new roles in Hinterland networks. This is relevant because the terminal operator often acts as a subcontractor or delegates activities to subcontractors. In principle, the terminal operator remains responsible for the performance of the contract even when obligations are delegated and actually performed by subcontractors (for example inland barges or storage keepers in the Hinterland). Moreover, in case the terminal operator is a subcontractor himself the absence of a contractual link with cargo interests, poses a liability risk. To avoid this risk the terminal operator needs a stipulation in the main contract for his benefit, as a subcontractor. Additionally, the terminal operator can profit from international conventions and national laws that offer protection in case of a contract of deposit and a contract of carriage.

Acknowledgements

Although both co-authors accept full responsibility for this article, Frank Smeele contributed most to parts 1, 2 and 3, whereas Susan Niessen contributed most to parts 4, 5 and 6.

[27] In Dutch law: art. 7:608 DCC. This is similar to the situation under the English law of bailment.

[28] For Dutch law see: Art. 8:31 DCC and art. 8:361-366 DCC. For German law: § 434 HGB. For the international conventions on different modes of transport see: art. 4 RR; art. IV bis HVR; art. 7 Hamburg Rules; art. 28 CMR; art. 29 Montreal Convention; art. 22 CMNI (however, not just the provisions in the convention apply, but also the terms of the contract of carriage); art. 41 Cotif-Cim.

[29] In some cases it is not only possible to rely on the national law or international conventions but it is also possible to rely on the terms and conditions of a contract. For carriage by inland waterways: Art. 4.4 CMNI and for carriage by rail: and Art. 3(b) and 27 Cotif-Cim. In Dutch law this follows from art. 8:361-366 DCC.

Accessibility of the Port and the Role of Terminal Operators

Rob Zuidwijk and Panagiotis Ypsilantis

1. Port Vision 2030

The Rotterdam Port Authority has considerable interest in the accessibility of the port at both the sea side and the land side. Its strategy document Port Vision 2030 reports the ambition: "In 2030, access to the port and industrial complex is easy and reliable by all four modes of hinterland transport (inland waterway, rail, road and pipeline)."[1] According to the forecasts used in the Port Vision document[2], even in a pessimistic future scenario of low growth, throughput volumes are expected to grow spectacularly, especially of container and break-bulk. As a result, meeting the ambition of an accessible port in the future requires actions.

Two observations can be made from the strategy document. First of all, the accessibility at the sea side is not considered a mayor issue. Most actions are geared toward ensuring accessibility at the land side. The basic approach is that accessibility is to be accomplished by several modes of transportation, and their corresponding infrastructures, in a coherent way.

There is circumstantial evidence that the capacity of existing transport means and infrastructure are not used to their full potential. For instance, the utilization of barges (i.e. inland waterway vessels) leaves room for improvement, and too many barges visit the port area to load and offload only a limited amount of containers[3]. Moreover, road infrastructure is overused and suffers from congestion, while waterways infrastructure capacity is seldom used to the full.

The strategy document adheres to the vision that he existing infrastructures road, rail, and waterways could be used more efficiently when used in a coordinated way. Inspired by governance principles used to manage road infrastructure, reference is made to traffic management which encompasses all infrastructure networks in an integrated way. In particular, this would require the synchronization between transport services among all modes of transport, i.e. it would require the organization of "synchromodal" transport. This concept has predominantly been coined to enable efficient switching between modes[4]; we will discuss the concept "synchromodality" in a later section.

In this chapter, we will discuss the combined use of transport modes and their infrastructures to improve accessibility of the sea port. First, in section 2 we discuss how the port authority has started to deploy a number of instruments to achieve this. In section 3, we discuss how one of the private companies, the main terminal operator in the sea port, has developed a new business model to make better use of the various transport modes. In section 4, we elaborate on the concept of "synchromodality" and associated knowledge questions. We shall argue that although this notion is being put into practice already, a lot of very interesting research remains to be done to reap the full potential of the concept, and that the port authority has a role in this as well.

[1] Port Vision 2030, Port of Rotterdam Authority, 2011. See www.portofrotterdam.com/portcompass
[2] "Forecasts of throughput" to be found at www.portofrotterdam.com/portcompass
[3] Martijn van der Horst and Peter de Langen (2008). Coordination in Hinterland Transport Chains: A Major Challenge for the Seaport Community. Maritime Economics & Logistics 10: 108–129.
[4] The future of freight transport. ECT's vision on sustainable and reliable European transport. Europe Combined Terminals Ltd., October 2011.

2. Role of the port authority: Governance

The Rotterdam Port Authority has established a number of measures to enable land side accessibility. Accessibility at the sea side seems less of an issue, as multiple deep sea terminals are under construction or planned on the new port extension "Maasvlakte 2", next to the existing port extension "Maasvlakte 1", that will provide sufficient capacity to meet future demand. Accessibility at the land side cannot be guaranteed without further actions.

The road infrastructure between the on-shore deep sea terminals and the hinterland consists basically of a single highway (A15). While visiting the ECT terminal one early morning, the first author of this paper was being kept "hostage" there for a full working day because a single truck spilled (non-hazardous) chemicals which were difficult to remove from the road pavement. Both sides of the highway were blocked for hours. Thousands of containers could not reach the terminal or their destination in the hinterland according to plan. The Rotterdam Port Authority is cofounder of the Traffic Management Company[5] to manage the use of the road infrastructure, in particular to address the reduced capacity during road constructions on the A15. The Traffic Management Company deploys both traffic management and mobility management measures, where the latter aims at avoiding the use of the highway during traffic hours.

The company Keyrail[6] is also partly owned by the Rotterdam Port Authority and manages the use of the "Betuweroute", a dedicated rail infrastructure between the Port of Rotterdam and the German hinterland. Keyrail aims to allocate the capacity of the rail infrastructure to users, manage traffic, and perform maintenance, in such a way that the capacity is used in an optimal way.

For inland waterway transportation, the Rotterdam Port Authority has not (yet) co-founded a company that manages barge traffic.

Exchange of information between organizations involved in transportation supports the more efficient use of existing modes of transport and their infrastructures. Port community system Portbase[7], another organization co-founded by the Port Authority Rotterdam, is providing an IT platform with a growing number of IT services aimed at this purpose.

The Rotterdam Port Authority is also taking other types of measures. In particular, it has set modal split targets conditional to the license to operate for sea terminal operators on the port extension "Maasvlakte 2". Hinterland transportation needs to be performed by inland waterways for at least 45% and by rail for at least 20% in 2035. In 2010, these mode shares were 30% and 13% for barge and rail, respectively. A recent progress report[8] by the Rotterdam Port Authority shows how the actual modal shares follow a trajectory pretty much on schedule toward these targets.

[5] See http://www.verkeersonderneming.nl
[6] See http://www.keyrail.nl
[7] See http://www.portbase.com
[8] Powerpoint presentation "Port of Rotterdam: Developing Logistics" by Wouter van Dijk, July 2013.

Container transport is usually performed under either one of two governance modes. In the first governance mode, known as carrier haulage, the deep sea carrier orchestrates not only deep sea transport, but also hinterland transport. In the second governance mode, merchant haulage, the shipper organizes hinterland transport. Under neither of the two governance modes, the sea terminal decides on the transport mode to be used in the hinterland. The question is whether imposing modal split targets on the sea terminal as an instrument can be effective at all. Before addressing this question, we will consider the role of the sea terminal operator in creating an accessible port.

3. Role of the sea terminal operator: Network

Recent growth in container throughput volumes created a number of challenges for the main sea terminal operator ECT (Europe Combined Terminals) in the Port of Rotterdam. Delays occurred at the sea side where deep sea vessels waited to berth, within the terminal where container stack got congested, and at the land side where trucks had to wait to load or unload containers.

These problems on the one hand could be considered a result of insufficient capacity. Solutions directions would then include extending the existing terminals and developing new terminals. ECT indeed developed the new and fully automated terminal "Euromax" on Maasvlakte 1, with the plan to extend it further on Maasvlakte 2.

However, ECT also decided to drastically change its business model. First of all, it decided to extend its role in the transport chain from the role of stevedore, i.e. the role of loading and unloading sea vessels in the port, with the role of carrying the containers to and from container terminals inland. These inland terminals are referred to as dry ports[9] , which are directly connected to seaport with high capacity transport modes, where customers can deliver and pick up their containers as if directly at a seaport. Customs release is postponed to the inland terminals as well.

However, ECT pushed the concept further and referred to the inland terminals as extended gates, to which large volumes of containers from seaport terminals are pushed immediately after arrival under control of the deep sea terminal operator itself[10].

In this manner, ECT was able to clear up container stacks at the terminal, reduce congestion at the land side, and use sustainable high capacity transport modes barge and train. ECT developed the European Gateway Services, which offers frequent barge and train services to a number of extended gates, and which also offers administrative services such as paperless administrative handling, and customs formalities taken care of upon arrival at the extended gate.

[9] Violeta Roso and Kent Lumsden (2010). A review of dry ports. Maritime Economics & Logistics 12(2):196-213.

[10] Albert Veenstra, Rob Zuidwijk, and Eelco van Asperen (2012). The extended gate concept for container terminals: Expanding the notion of dry ports. Maritime Economics & Logistics 14(1): 14-32.

The sea terminal operator ECT became a network operator and a new governance mode of container transport came into existence, i.e. terminal haulage[11].

In this chapter, we will not discuss in detail the design of the service package of European Gateway Services. Instead, we will focus on the design of the extended gate network in the next section.

4. Modeling of extended gate networks: Joint design and pricing

The sea terminal operator designs its extended gate network while facing the competition, not only by other sea terminal operators, but also by providers of hinterland transport services. To offer a competitive product, the sea terminal operator needs to consolidate container volumes and provide frequent services using high capacity transport modes to reap the benefits of economies of scale. While designing the Extended Gate Network, the sea terminal operator needs to make the following decisions: (1) Which inland terminals will act as extended gates? (2) What will be the capacity of the corridors between the sea port and the extended gates, which is determined by the size of transport modes and their frequency of service? (3) What will be the prices for the services?

We supported these decisions by modeling the joint design and pricing of container transport services on a network with economies of scale and transit time constraints[12]. In the model, the deep sea terminal operator maximizes his profits by designing the services on the network and by setting the prices for the services. The deep sea terminal operator may reap economies of scale driven by opening and operating high capacity corridors, i.e. by deploying high capacity transport means (large vessels or long train sets) between the sea port and the dry ports.

The shippers minimize costs of transport and handling. They do so by routing their containers via links controlled by the extended gate operator and its competitors. The shippers select minimum cost paths in the network under transit time constraints. These time constraints may preclude the use of barge and train, i.e. if goods need to be at the final destination in a very short time then direct trucking may be the only option.

The decisions made by the deep sea terminal operator and the shippers are linked. First of all, the deep sea terminal operator anticipates the minimum cost routing by its customers, the shippers. Second, the customers select their minimum cost paths from the services offered by the deep sea terminal operator or its competition.

The services designed on the extended gate network can be categorized as port-to-port services, i.e. logistics services from deep sea port to inland port, and port-to-door services, i.e. logistics services from deep sea port to final customer destinations.

[11] The future of freight transport: ECT's vision on sustainable and reliable European transport. ECT, October 2011.

[12] Panagiotis Ypsilantis and Rob Zuidwijk (2013). Joint Design and Pricing of Intermodal Port - Hinterland Network Services: Considering Economies of Scale and Service Time Constraints (No. ERS-2013-011-LIS). Erasmus Research Institute of Management (ERIM). Retrieved from http://hdl.handle.net/1765/40670

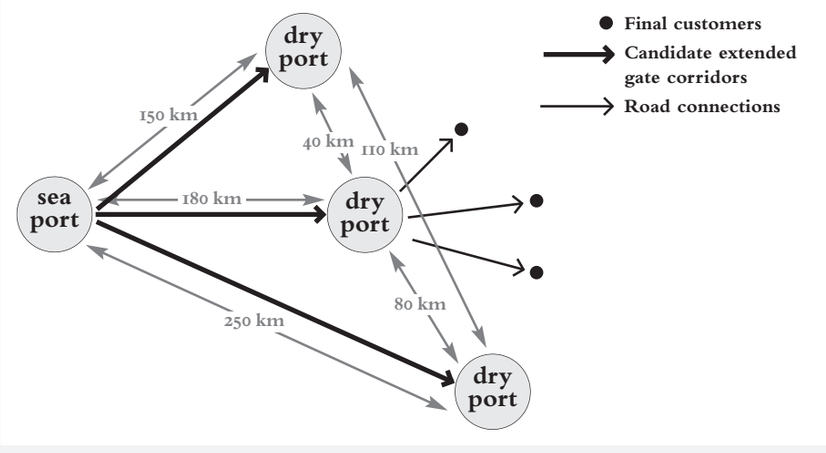

Figure 1: Model of the Extended Gate Network.

The following observations can be made. Port-to-door services are priced independently of routes through the network. The pricing of those services simply follows the competition. As a result, profit maximization comes down to cost minimization. The design of port-to-door services minimizes costs and is independent of the pricing of these services. Such network design is pretty much in line with classical network design[13].

Port-to-port services design and pricing decisions are mutually dependent. Maximizing profits is done by revenue enhancement through the pricing of intermodal transport services per (geographical) market segment. It is not necessarily optimal to create economies of scale by consolidating all freight flows through a limited number of corridors. In case competition allows for higher prices to a certain dry port, it may be worthwhile to open a corridor to this dry port. This may be more profitable than consolidating freight flows through a main corridor where one is able to fully reap the economies of scale.

Also, intermodal transport services may penetrate market segments of container flows under time pressure. This can be done by the deployment of small vessels that sail frequently, so that the average throughput time is low. The use of bigger vessels provides the advantage of economies of scale, but may preclude market penetration, as minimum requirements for the utilization of bigger vessels drive down the frequency of service so that longer waiting times between departures will occur.

As a result, the design of intermodal transport services does not necessarily result in the consolidation of container flows, and frequent services by smaller vessels may perform the transport of containers under time pressure instead of truck. We have learned that design of container transport services and pricing sometimes go hand in hand, and that profit maximization is not necessarily the same as cost minimization.

[13] See for instance: Teodor Gabriel Crainic and Kap Hwan Kim (2007). Intermodal Transportation, In: Cynthia Barnhart and Gilbert Laporte, Editor(s), Handbooks in Operations Research and Management Science, Elsevier, Volume 14: 467-537.

The pricing of container transport services is considered here as a static strategic decision, joint with the design of transport services on a network. In the next section, we will consider the deployment of transport services in a dynamic way.

5. Synchromodality and Revenue Management

Synchromodal transport can be compared to intermodal transport and co-modal transport as depicted by figure 2. Intermodal transport is defined as the use of multiple modes of transportation in sequence. For example, a container is shipped first by train from A to B, and then the container is trucked from B to C. In co-modal transport, the container may be transport from A to C by either one of the available modes. In Figure 2, the container is shipped by barge when possible, and alternatively trucked when e.g. the deadline at the final customer does not allow for shipment by barge.

Synchromodal transport allows for the deployment of any of the available transport modes for the transport between nodes A, B, and C. A synchromodal transportation system will e.g. use a truck when it is idling at the right place, and it will e.g. put a container on a barge when the departure time and expected transit time of the barge allow for timely arrival of the container at the final destination. In Figure 2, first barge is used to transport the container from A to B, and then it is decided to use the train to ship the container from B to C. The opportunistic allocation of containers to transport modes requires the possibility to book transport on a specific mode at the last moment. "Amodal booking" is a booking of transportation without specifying the mode of transport in advance.

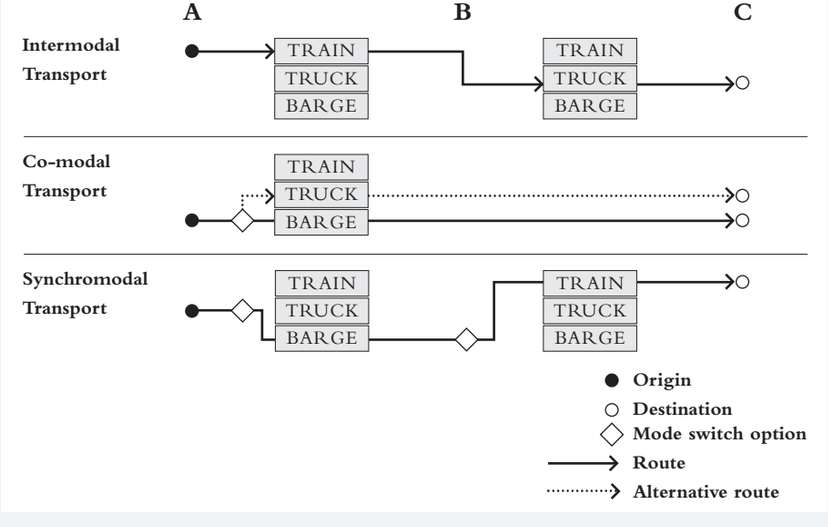

Figure 2: Container transport concepts[14].

[14] Graphic adapted from: The future of freight transport: ECT's vision on sustainable and reliable European transport. Europe Combined Terminals, October 2011.

The booking of transport in advance has some advantages. The booking in advance provides a signal to the transportation system that transportation capacity needs to be reserved and that logistics and administrative procedures need to be planned and executed. However, in the case when the booking is amodal, no specific transportation capacity can be reserved.

One important driver of using transport capacity in a more flexible way is uncertainty. The moment an import container is available for further transportation is subject to arrival of the deep sea vessel in the port, handling of the container at the terminal, customs clearance, and depends also on commercial release by the deep sea carrier and terminal operator upon payment of the respective invoices. The concept of co-modality already provides a flexible planning concept, as containers may be shipped by barge or train when time allows, and can be trucked otherwise. In the co-modal setting, the mode of transport is determined in advance, however.

If we postpone the decision on what mode of transport will ship the container upon release of the container, the system becomes even more flexible. However, it requires the planning of logistics and administrative procedures to be flexible as well. We will not discuss these complexities in detail in this chapter, but we focus on the pricing of such flexible services instead.

In the case when a transport mode is reserved in advance, a price can be determined. Just as in the airline industry, such reservation can be priced based on revenue management principles. Following these principles, one will determine the price of a unit of capacity while considering the opportunity to offer the capacity to another customer in the future who is willing to pay more. As time progresses, such opportunities will change, so this implies that the price will change as well.

For amodal booking, the situation is more complex. The pricing of an amodal service does not refer to a specific mode of transportation. It is probably best to consider amodal booking as the option to use a unit of transport capacity upon release of the container in question. One would determine the price of such an option while considering the opportunity to offer this option to a future customer who is willing to pay more. An interesting research question is how such options need to be priced. The answer is useful for those who want to offer and price synchromodal services in a smart way.

The execution of synchromodal services also faces some challenges at the supply side. The question of how to allocate demand to capacity requires a proper understanding of the available capacity. Sample questions upon release of a specific container are: (1) What transportation means is available shortly and is able to transport this container? (2) What are the costs and benefits if we use an alternative transport mode and infrastructure?

In principle, we need to be able to compare the available capacity on road, rail, and waterways in a comprehensive manner. What are the opportunity costs of putting the container on a truck instead of on a barge? Nowadays, a container will be put on a barge when possible. However, at some point, a careful assessment of available capacity among the various modes of transport and their infrastructures needs to be made. This is another interesting research question.

6. Discussion: The role of the Port Authority revisited?

We reviewed the role of the port authority in establishing an accessible port and some of the instruments which have already been put in place. We also considered the role of a private organization, the deep sea terminal operator, who is developing new services to more effectively use alternative modes of transportation. The development of synchromodal services as explained in this chapter offers further opportunities.

Directions of further research and innovation are the following. First of all, we envisage a competitive environment in which operators of extended gate networks compete similarly to how neighboring ports compete for their captive hinterland[15]. An extension of our work on joint design and pricing of network services would consider multiple operators on their own extended gate networks competing with each other. Another research direction would be the application of revenue management to synchromodal transportation as discussed in section 5.

We believe that in such contexts, the role of the Port Authority in facilitating accessibility requires the development of new instruments. We are looking forward to work together with our friends in the port community on these very interesting challenges.

[15] Theo Notteboom and Jean-Paul Rodrigue (2005). Port regionalization: Towards a new phase in port development. Maritime Policy and Management 32 (3): 297-313.

Rotterdam as linking pin in intercontinental container transport: trends and research in Smart Port

Rommert Dekker and Bart van Riessen

In writing this chapter we would like to express our gratitude to the Port of Rotterdam Authority, and its CEO Hans Smits in particular, for making Smart Port possible. This chapter shows some of the scientific developments obtained in and outside Smart Port. We wish Hans lots of success and good health in the coming future!

1. Introduction

Many container shipping lines operate schedules that have a stop in the Port of Rotterdam, which is Europe's largest container port. Accordingly Rotterdam is an important node in the container transport chain between many overseas origins and destinations in continental Europe. Yet, will it always be like this? Many other ports vie for the same transport connections. One important element in Rotterdam's Smart Port research is to come up with improvements and investigate the advantages and disadvantages of using the Port of Rotterdam in these chains compared to other ports. As this is a very ambitious research topic we like to review which contributions have been made by scientific research in this area and we will in particular review the contribution from quantitative methods intended to evaluate design options and to improve planning and scheduling operations. We will structure our review according to three phases in the transport chain: the ocean transport, the terminal handling and the hinterland transport. Apart from presenting methodological contributions we discuss trends and make a comparison with other transport sectors.

2. Ocean container transport

2.1 Scientific methods for the design of shipping networks

Scientific research for shipping lines has been lagging behind research for airlines and trucking companies. Developing shipping line optimization models is not easy as the problems are large, complex and there is much uncertainty in demands as well as prices. Topics include the determination of ship routes, the selection of the transfer hubs, the sailing frequency, the cargo allocation in case of multiple routing options, the choice of the type of ship, the selection of feeder transshipment ports as well as the ship speed and the place to bunker. The scientific approach has been to start with simplified models, analyzing and extending them step by step. Over the years larger and more complex problems could be attacked as both computer and algorithmic power increased substantially. Reviews by Ronen (1983, 1993) and Christiansen et al. (2003, 2013) show a steady progress and increased interest (39, 43, 78 and 131 papers are reviewed respectively). Recently also research within Smart Port was done on developing an integrated shipping line model. Mulder and Dekker (2013) developed a model to take both cargo allocation, ship deployment, route selection and speed into account and showed that an integrated model is possible. Coupled with hinterland demand forecasts, such as from Veldman and Buckmann (2003) , this research may yield insight into the development of Rotterdam's container flows, especially if transport to Eastern Europe is to increase. Mulder et al. (2012) also investigated the effect of buffer times in shipping schedules to improve schedule reliability and to help shipping lines negotiate berthing time at terminals.

2.2 Results and insights

The structure of most intercontinental shipping lines is the long pendulum string, e.g. from Asia to Europe and back through the Suez Canal or from Asia to the U.S. The pure hub-and-spoke system, as used by many airlines, is exceptional in container transport.

One of the reasons is that transshipment costs per container are high, which makes it more profitable to sail to another port rather than visiting only a hub port and transshipping containers from there. Of course transshipment is used for very small ports, but the presence of a lot of medium to large ports in the Hamburg-Le Havre ranges has led to many ports being called on a main string. Similarly, cargo airlines also make more stops on a route than passenger carriers: also in that case the transshipment is costly.

The Port of Rotterdam once was looking for a shuttle connection between Rotterdam and either Shanghai or Singapore, but that has not been realized so far. The increase in ship sizes has had an ambiguous impact. On one hand ship costs per hour have increased, which increases the costs of visiting a port; less ports on a main route would be the result. Yet on the other hand the volume per ship is too large for a single port so multiple ports need to be visited. Another issue in this respect is that despite the growth in number of containers shipped, terminals have not grown accordingly, rather the number of terminals in a port has increased. This means that terminals have not achieved the economies of scale for feeding a single ship, hence ships still tend to visit many terminals on a route.

Finally the schedule reliability remains an important issue. Commercial consultants regularly publish reports on schedule reliability, showing large deviations (about a day) from originally published schedules. This does create unwanted variability in supply chains, although one can wonder whether other variations, like rolling over cargo in case of too much demand and internal manufacturing delays, are not equally important. In any case leadtime variability is a high contributor to unwanted supply chain costs, so if shipping reliability would increase, shippers would substantially benefit from it and hinterland and feeder transport would be easier to plan.

3. Terminal operations

3.1 Developments

Container terminals are the major decoupling points between ocean going ships and feeders or hinterland transport. Ocean going vessels unload their containers at a terminal and take new containers with them. Those containers are stored in the main stack as direct transshipment is both technically difficult and difficult to plan. The capacity of the stack is one of the major terminal aspects, next to berth and crane capacity on the seaside as well as handling capacity for truck or rail at the landside. Although a main advantage of containers is that they can simply be stacked on top of each other rather than using expensive material racks, a disadvantage is that reshuffling is required to retrieve a bottom container. The reshuffling moves are unproductive moves. The capacity assessment is a very important aspect in designing automated container terminals as changes later on are very expensive to make. Accordingly, sophisticated simulation models have been set-up to assist in this respect. The Dutch TBA company (see www.tba.nl) has made quite some achievements in this respect.

One of the main developments in terminals has been the growing size of ships and similar growth of call sizes. This has put pressure on container terminals to increase their loading and unloading productivity. As more cranes on a ship does not help much (they hinder each other), industry have sought ways to reduce the loading cycle and lift more than one container in one cycle (dual lifting). Although this improves the quay handling productivity the terminal needs more equipment to transport the containers on the terminal and to the hinterland (see Saanen (2013)).

3.2 Scientific research on container terminals

Studying container terminals in a scientific way basically started in the 1980s with van Hee et al. (1988) as one of the first researchers in the Netherlands. In the nineties several research programs were started in the Netherlands, such as INCOMAAS and FAMAS. The latter aimed at the 8000 TEU ship (while in 2013 some ships can carry more than 18000 TEU). Internationally the area took off when automated terminals also found their way in Germany and Koreans as well as Singaporeans started to study container terminals. In Korea it was Prof. Kap Hwan Kim who played a leading role in the development, while in Germany it was Prof. H.O. Günter as well as Prof. Voss and in the Netherlands Profs. de Koster, Dekker, Vis and Evers. In 2003 the first review appeared on the area and many have appeared since (Vis and de Koster (2003), Steenken et al. (2004), Stahlbock and Vos (2008), Carlo et al. (2013a,b). Research has been done on several aspects of the terminal. This comprises berth planning, quay crane scheduling, the quay-to-stack transport, the stacking and scheduling of the stacking cranes and finally scheduling the work towards the hinterland. Some Smart Port contributions were devoted to developing online rules for stacking (see van Asperen et al (2013), Borgman et al (2010, 2013), others to improving the scheduling of the stacking operation (Gharehzogli et al. (2013)) and the best way of doing inter-terminal transport (Duinkerken et al (2006)).

Several of these ideas have found their way in terminal operating systems, e.g. from Navis and in the SPARCS suite from TBA. The most complex ideas are related to the movement of AGVs that had a lot of problems interfering with each other, resulting in late arrivals at cranes.

Despite many improvements in container terminal handling, the transshipment costs are still high compared to moving the container over many sea miles. The result is that there have been no changes to hub-and-spoke systems, which would require a higher number of transshipment moves.

3.3 Terminal – hinterland interface

Apart from the seaside, terminals also face bottlenecks at the landside, especially if peaks occur in arrivals of trucks, trains or barges. Several analyses have been done at quantifying these peaks and evaluating the effects of appointment systems or intermediate exchange terminals. Such a terminal seems to be a good alternative to increase truck load factors of trucks that visit multiple terminals and to shift some of the peak volume to the night, yet they do not reduce road transport (Dekker et al (2013).

4. Hinterland transport

4.1 Dry ports and extended gate

Although hinterland transport started from the moment the container was invented, research into it has only started recently. It was long considered to be part of the regular land transport and as such not a separate research topic. In the last decade new concepts were established. The dry port concept, formalized by Roso (2009) was defined as an inland terminal with frequent intermodal connections to it. The extended gate concept is a further elaboration of a dry port and states that the dry port works as an extension of a terminal and that all processes can be conducted from it (Veenstra et al. (2012)). The hinterland transport optimization has also been stimulated by looking at sustainability aspects within logistics. An example of such work is given in Mallidis et al. (2013).

4.2 Dry port and extended gate research

Apart from defining the concept, research for dry ports has focused on establishing the pros and cons of the dry port, both in terms of costs and in terms of environmental aspects. In the extended gate concept one even shifts the planning and scheduling of the transport to the container terminal. For both concepts one has to make design choices, such as where to locate the dry ports and which transport connections to offer. Accordingly research has been

done on the synchromodal planning of that transport. Examples within Smart Port are the Ultimate project (see Panagiotis and Zuidwijk (2013)) as well as the planning investigations by van Riessen et al. (2013a, b). More research is carried out in this respect, as real-time planning is necessary and also several kind of legal issues need to be addressed.

5. Discussion

From the foregoing it will be clear that research on container logistics is increasing in a substantial way. Several research centers have been created where research is flourishing, like in Singapore, Hongkong, Trondheim, Antwerpen and Rotterdam. There are several benefits a port can obtain from it :

a. research can be carried out with companies giving direct results. Within several Dinalog projects, like ULTIMATE, companies are directly involved in the research and can make use of it. Next, student projects at companies help in transferring research results to these companies (e.g. Maersk Line was assisted with buffer time optimization (Mulder et al. (2012)).
b. research results can be used by companies providing software for shipping lines and container terminals. Some Dutch examples are the companies Ortec Consultants (www.Ortec.com), Quintiq (www.Quintiq.com) and TBA (www.tba.nl). At the moment these companies are growing substantially.
c. (good) research leads to better education and a high international reputation of the research institute, which leads to an inflow of human talent. This talent diffuses into new knowledge-based companies around the research institute. One Rotterdam example is the Veneficus company (www.veneficus.nl).

Despite all these advantages, more interaction of academia with industry is definitely needed. This requires efforts from both sides. One of the problems of this type of quantitative research is that common elements exist in methods, rather than in applications. The implementation of all these research papers, require a translation of the general methods in specific applications. These applications are often more heuristic and computer driven rather than originating from a grand theory as in physics. Such heuristics are useful from a practical point of view, but provide fewer possibilities for scientific publications. Besides, for successful application of computer driven methods, the availability of complete, correct, and up-to-date information is essential. Often, the required information needs to come from various actors of the container supply chain, such as shipping lines, shippers, terminal operators and transport providers (Van der Horst and De Langen, 2008). Close cooperation between academia and industry is required to solve these issues.

From studying the reviews it may be clear that the U.S. is lagging behind in this type of research, while rather much research has and is being done in Europe. Yet the European market is quite scattered, scientific mobility is relatively low and so far it has not used the opportunities to establish really outstanding research centers like MIT in the U.S. Asia is definitely coming up and concentrated research programs have put China, Korea, Singapore and Hong Kong in forefront positions, very much more than other BRIC countries. New English-language journals are established over there (e.g the International Journal on Transport and Shipping Logistics) and researchers play an important role in journal editorial boards. As European research funding seems to be stagnating (especially in the Netherlands), it is to be expected that many new knowledge based companies will be established in Asia and that Europe's present knowledge advantage will decrease.

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Optimal design of container terminal layout

Debjit Roy and René de Koster

In writing this chapter we would like to express our gratitude to the Port of Rotterdam Authority, and its CEO Hans Smits in particular, for making Smart Port possible. This chapter is one of the first tangible Smart Port research results. We are confident more will follow. We wish Hans lots of success and good health in the coming future!

Abstract

Due to rapid growth in foreign trade using sea vessels, there is a growing focus in improving the infrastructure and operational efficiencies at the container terminals. Particularly, the operational responsiveness of loading and unloading of containers, affects the vessel idle times and profitability of the shipping liners. In this research, we determine optimal stack layout design, which minimizes the container unload times using Automated Guided Vehicles (AGVs). To analyse alternate stack layout designs, we develop integrated queuing network models that capture the stochastic interactions among the container terminal processes (quayside, vehicle transport, and stackside), and provides realistic estimates of expected container unload throughput times.

1. Background and Motivation

Due to growth in international trade and better accessibility to the major seaports via deep-sea vessels, containerization has become the preferred mode for maritime shipping and inland transportation. Between 1990 and 2008, container traffic has grown from 28.7 million TEU to 152.0 million TEU, an increase of about 430% (ESCAP, 2005). Currently, several new deep-sea as well as inland container terminals are being designed across continents. Several of the larger ones will be automated.

The design of the container terminal includes strategic design choices such as the terminal layout at the stackside, choice of equipment for handling containers at the seaside and landside, and type of vehicles for container transport between seaside and the landside. However, the process to arrive at an optimal design is extremely complex due to several reasons. They are: 1) physical constraints such as variations in ground conditions and topology of the terminal area, 2) large number of design parameters and corresponding solution search space, and 3) stochastic interactions among the three processes (quayside, vehicle transport, stackside). In this research, we analyse container terminal operations at the seaside using AGVs. Figure 1a shows an aerial view of a container terminal that includes vessels berthing at the quayside and the stackside whereas figure 1b describes AGVs transporting containers in the yard area.

Due to significant investments involved in the development of a container terminal, an optimal design of the terminal is crucial. Traditionally, the main research focus has been on

Figure 1. a: Aerial view of a container terminal (courtesy: marineinsght.com) and b: AGV's transporting containers in the yard area (courtesy: porttechnology.org)

building simulation and optimization models to address strategic and tactical issues such as the container stowage problem at ships and in the stack, as well as on operational issues such as vehicle dispatching rules and quay crane scheduling (De Koster et al, 2004, Liang & Mi, 2007). Practitioners also develop detailed simulation models to design new terminals or improve the efficiency of existing terminal operations. While simulation provides detailed performance measures, it limits the extent of the design search procedure due to associated model development time and costs. In this research, we develop analytical models, which enable the terminal operator to analyse alternate configurations rapidly and with sufficient accuracy.

Analytical models have also been built to analyse specific system design aspects, for instance, Canonaco et al. (2008) developed a queuing network model to analyse the container discharge and loading at any given berthing point. Hoshino et al. (2005) proposed an optimal design methodology for an Automated Guided Vehicles (AGV) transportation system by using a closed queuing network model. However, in literature, integrated analytical models for analysing the performance of loading and unloading operations by considering some of the stochastic inputs are scarce (Steenken, 2004, Vis & De Koster, 2003). For instance, Vis et al. (2001) assume deterministic AGV travel times while estimating the number of AGVs in a semi-automated container terminal.

New automated terminals typically adopt Automated Guided Vehicles (AGVs) for vehicle transport. AGVs do not have self-lifting capabilities and they need to be synchronized with the quay cranes at the quayside and with the stack cranes at the stackside to pick up or drop off the containers. In this research, we analyse alternate terminal layout configurations by varying the stackside configuration (number of stacks, bays, and height), and vehicle transport configuration (number of AGVs and travel path dimensions and topology) using analytical models. Each configuration may also impact the vehicle guide path and hence the travel times. For instance, by increasing the number of stack blocks, the length of the vehicle guide path also increases (refer figure 2). Therefore, the stacking time per stack may decrease whereas the vehicle transport time may increase. Therefore, the configuration of an optimal stack layout is not clear.

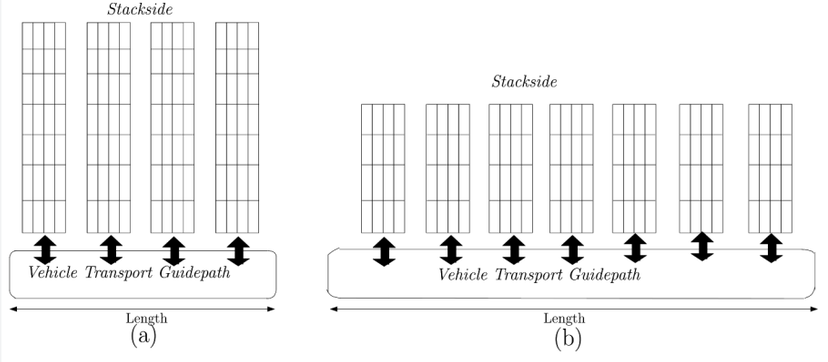

Figure 2. Alternate terminal layout configurations (a) small number of stacks and large number of bays (b) large number of stacks and small number of bays.

Our work closely aligns with the analytical model developed by Hoshino et al (2005). However our research differs from their work in several aspects:

- We develop a semi-open queuing network model of the terminal system, which considers the synchronization of the AGVs and the containers waiting at the vessel to be unloaded. In reality, on some occasions, an AGV would be waiting for a container to be unloaded while during other times, a container would be waiting in the vessel for unloading operations. In a closed queuing network (such as in Hoshino et al (2005)), synchronization effects are not considered.
- We consider realistic vehicle travel paths with multiple shortcuts that decrease the average travel times and improve vehicle capacity. Previous models do not consider the effects of multiple short cuts.
- We develop protocols for handling containers at the quayside and the stackside that allows us to model the vehicle synchronization effects at the quay and the stack area.
- We adopt our model to analyse alternate terminal layouts by varying the number of stacks, bays, and vehicle path dimensions, and arrive at a layout that minimizes throughput times and costs.

In this research, we develop an integrated analytical model for the unloading of containers at the seaside by considering the queuing dynamics at the quayside operations, vehicle transport operations, and stackside operations. Each quay crane is modelled as a single server station with general service times. The travel times associated with vehicles are modelled using Infinite server stations with general service times. Similarly, each stack crane is modelled as a single server station with general service times. Containers that wait to be unloaded may wait for an available vehicle, at the quayside. However, due to capacity limitations of the quay crane, a vehicle may also wait for a container arrival. This interaction between vehicles and containers is precisely modelled using a synchronization station and the queuing dynamics in the vehicle transport is modelled using a semi-open queuing network (SOQN) with V vehicles. The performance measures from the analytical model are validated using detailed simulations. Using the analytical tool, which can be evaluated rapidly, we analyse alternate terminal layout configurations and arrive at an optimal configuration. We believe that the stochastic model of the container handling operations can be used for rapid design conceptualization for container port terminals and improve container handling efficiencies.

The rest of this paper is organized as follows. The terminal layout adopted for this study is described in section 2. The queuing network model for terminal operations with AGVs along with the solution approach is provided in section 3. The results obtained from numerical experimentation and model insights are included in section 4. The conclusions of this study are drawn in section 5.

2. Description of Terminal Layout

Figure 3 depicts the top view of a part of a container terminal, which includes the quayside, transport and the stackside area (stack blocks with cranes, transport area with vehicles, QCs). The design of this layout is motivated from practice (see De Koster et al, 2004). We focus on the space allowing berthing of one jumbo vessel with a drop size of several thousands of containers. A large container terminal may contain several of such identical berthing positions. The number of stacks is denoted by N_s and each stack crane is referred as SC_i where $i \in \{1, \ldots, N_s\}$. Similarly, the number of QCs is denoted by N_q and

each crane is referred as QC_j where $j \in \{1, \ldots, N_q\}$. There is one shortcut path after each QC (referred as SP_j where $j \in \{1,...,Nq\}$) that connects the quayside and the stackside areas. Both stacks and QCs have a set of buffer lanes, which are used by the vehicles to park during loading or unloading containers. The number of buffer locations at each QC and SC are denoted by N_{qb} and N_{sb} respectively. The other notations present in figure 3 indicate path dimensions, which are used later to estimate the vehicle travel times.

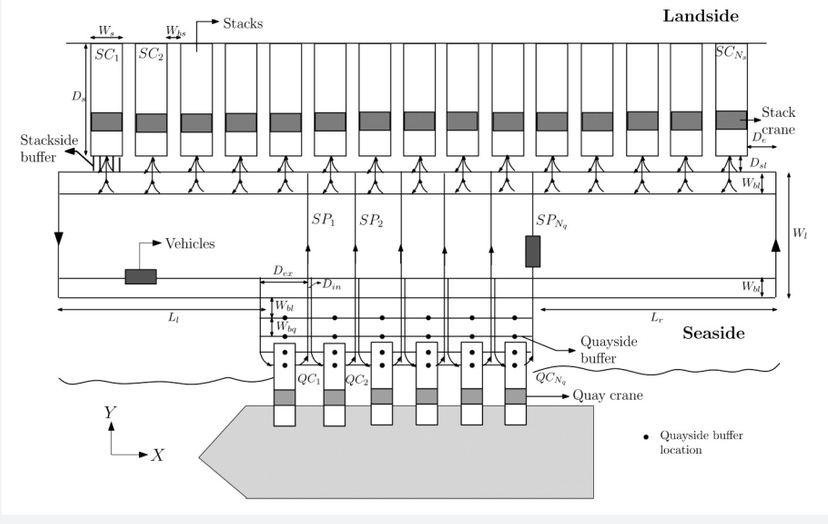

Figure 3: Layout of the container terminal used in this research

The container unload operation using an AGV is explained now. Due to hard coupling between the AGVs and the QCs, the containers that are waiting to be unloaded need to first wait for an AGV availability (waiting time denoted by W_v). When an AGV is available and the container needs unloading, it travels to the quayside (travel time denoted by T_{v1}). Then the AGV may wait for the QC to be available after which the QC repositions the container from the vessel to the AGV (the waiting time and repositioning time denoted by W_q and T_q respectively). Then the AGV, loaded with a container, travels to the stackside, may wait for the SC availability. Once a SC is available, the crane travels to the stack buffer lane and picks the container from the AGV. The container is then stored in the stack area. The AGV travel time to the stackside, waiting time for the SC, and the crane travel times are denoted by T_{v2}, W_s, and T_s respectively. Using these travel and wait time components, the throughput time for the unload operations with the AGVs is expressed using Equation 1.

$$CT_u = W_v + T_{v1} + W_q + T_q + T_{v2} + W_s + T_s \quad (1)$$

To determine the optimal layout of the terminal, the number of storage locations, number of vehicles (V), and the number of quay cranes (N_q) are fixed; we vary the number of stacks (N_s), number of rows per stack (N_r), bays per stack (N_b), and tiers per stack (N_t). By varying the four parameters, N_s, N_r, N_b, and N_t, the length of the vehicle guide path is also altered (figure 2), which affects the unload throughput time, CT_u. The optimization formulation to determine the optimal combination of the four design variables is presented in Equation 2. The objective function is to minimize $E[CT_u]$, subject to the network throughput ($X(V)$) stability constraint with V vehicles, fixed locations constraint (C), vehicle utilization constraint ($U(V)$), and upper and lower bound constraints for the decision variables. To determine the optimal terminal layout configuration for unloading operations with AGVs, we analyse alternate configurations for different combinations of design parameter settings using the integrated queuing network model (described in the following section).

$$\begin{aligned}
&\text{minimize} && E[CT_u]\,(N_q, N_t, N_s, N_r, N_b, V) \\
&N_t, N_s, N_r, N_b && \\
&\text{subject to} && X(V) \geq \lambda_u \\
& && N_t N_s N_r N_b = C \\
& && U(V) \geq U_{min} \\
& && N_{t_{min}} \leq N_t \leq N_{t_{max}} \\
& && N_{r_{min}} \leq N_r \leq N_{r_{max}} \\
& && N_{b_{min}} \leq N_b \leq N_{b_{max}} \\
& && N_{s_{min}} \leq N_s \leq N_{s_{max}} \\
& && N_t, N_s, N_r, N_b \in \mathbb{Z}^+
\end{aligned} \quad (2)$$

3. Queuing Network Model for Terminal Operations with AGVs

In this section, we develop the model of the unloading operations at a container terminal using AGVs. In an AGV-based system, both the QC and the SC drops-off (picks-up) the container on (from) the top of the vehicle. Therefore there is a hard coupling between the vehicle and the QC/SC. We first discuss the protocols that we develop to model the AGV-based terminal operations.

- *Synchronization protocol at the quayside:* For the unloading operation, the QCs begin their operation only when an empty AGV has arrived at the buffer lane to transport the container.

Similarly, for the loading operation, the QCs begin their operation only when an AGV loaded with a container has arrived at the quay buffer lane from the stackside.

• *Synchronization protocol at the stackside: For* the unloading operation, the SCs begin their operation only when an AGV loaded with a container has arrived at the stack buffer lane to store the container. Similarly, for the loading operation, the SCs begin their operation only when an empty AGV has arrived at the stack buffer lane to transport the container to the quayside.

We now list the modelling assumptions for the three processes.

Quayside process: We assume that there is one trolley/QC. Further, there is infinite buffer space for parking vehicles at the QC location. The dwell point of QCs is the point of service completion. Containers arrive in single units with exponential inter-arrival times. Further, containers are randomly assigned to a QC.

Vehicle transport process: Each AGV can transport only one container at a time. The dwell point of the vehicles is the point of service completion. The vehicle dispatching policy is FCFS and the blocking among vehicles at path intersections is not considered. Further, vehicle acceleration and deceleration effects are ignored.

Stackside process: We assume that the stack layout is perpendicular to the quay and there is one crane per stack. The dwell point of cranes is the point of service completion. Similar to the quayside, we also assume infinite buffer space for parking vehicles at the SC location. Containers are randomly assigned to a SC.

3.1 Model Description

The inputs to the queuing network model are the first and second moment of the container inter arrival times, λ_a^{-1}, c_a^2, and the service time information at the resources. Each QC is modelled as a single server FCFS station with general service times. Likewise each SC is modelled as a single server FCFS station with general service times. The components of the AGV travel times are modelled as IS stations (VT_1 and VT_2). The AGVs circulate in the network processing container movements.

We now describe the routing of the AGVs and containers in the queuing network model with respect to the unloading operations. Figure 4 describes the queuing network model of the container unloading process with AGVs. The containers that need to be unloaded, wait for an available vehicle at buffer B_1 of the synchronization station J. Idle vehicles wait at buffer B_2. The physical location of the vehicles waiting in buffer B_2 would correspond to the stackside buffer lanes. Once a vehicle and a container is available to be unloaded, then the vehicle queues at the IS station (VT_1). The expected service time at VT_1, μ_{t1}^{-1}, denotes the expected travel time from its dwell point (point of previous service completion) to the QC buffer lane. After completion of service, the vehicle queues at the QC station (QC_i, $i = 1,\ldots,N_q$) to pick up the container. The expected service time at QC_i, μ_{qi}^{-1}, denotes the expected movement time of the QC to reach the container in the vessel, container pickup time, movement time to reach the AGV, and container dropoff time. Then, the vehicle queues at the IS station: VT_2. The expected service time at VT_2, μ_{t2}^{-1}, denotes the expected travel time from the QC buffer lane to the SC buffer lane. After completion of service at VT_2, the vehicle queues at the SC station (SC_i, $i = 1, \ldots, N_s$) to dropoff the container. The expected service time at SC_j, μ_{si}^{-1}, denotes the expected travel time of the SC from its dwell point to the stack buffer lane and the container pickup time. Once the container is picked up from the AGV, the AGV is now idle and available to transport the containers that are waiting to be unloaded at the quayside.

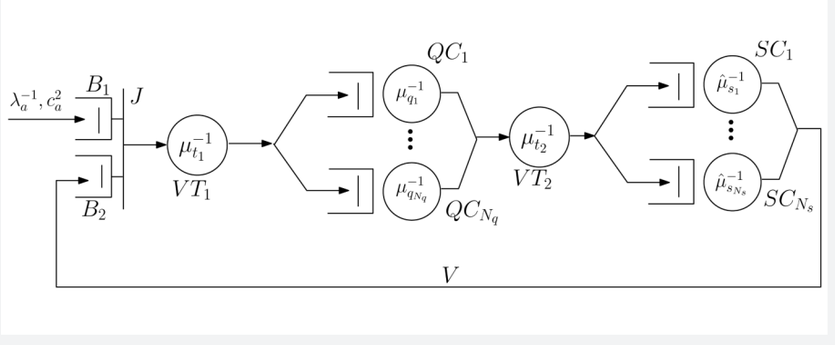

Figure 4. Queuing network model of the container unloading process with AGV's

Note that due to random assignment of containers to a QC and random storage of a container at a stack block, the routing probabilities from station VT_1 *to* QC_i $(i=1,\ldots,N_q)$ and from VT_2 *to* SC_i $(i=1,\ldots,N_s)$ are $\frac{1}{N_q}$ and $\frac{1}{N_s}$ respectively. The queuing network in figure 4 is a semi-open network model because the model possesses the characteristics of both open as well as closed queuing networks. The model is open with respect to the transactions and closed with respect to the vehicles in the network. Due to non-product form nature of the integrated network, an approximate procedure is developed to evaluate the network.
First, a sub-network of the original network is replaced by a load-dependent server.
The service rates correspond to the throughput of a closed queuing network (sub-network).
The reduced model is evaluated using a continuous time Markov chain (CTMC). This approximate procedure provides substantial computational advantage in evaluating the integrated queuing network and estimating performance measures. By accounting for the stochastic interactions among quay cranes, vehicles, and stacking cranes, realistic estimates of system performance measures such as throughput capacity, resource utilization, the container

waiting times for resources, and the expected cycle times are obtained. The expressions for the service times at various nodes and detailed description of the solution methodology are included in our working paper (Roy & De Koster, 2012).

4. Numerical Experiments and Insights

We considered a container terminal scenario with a quay crane capacity of 30 cycles/hr, 40 AGVs, each stack has 6 rows, 40 bays, and 5 tiers. The total number of container storage locations is fixed at 48000, which corresponds to the capacity of the stacking lanes to serve a deep-sea vessel at the ECT terminal at Rotterdam. The travel velocity of the AGV and the SC are assumed to be 6 m/s and 3m/s respectively. The area of the AGV path is 540m × 90m. There are 5 buffer lanes per stack block.

We validate the analytical model for the container terminal with AGVs using detailed simulations. The average percentage absolute errors in the expected queue lengths and the expected throughput times are less than 7% (refer Roy & De Koster, 2012, for details on the container terminal simulation model setup). To determine the optimal terminal layout configuration we varied the design parameters in the following manner: number of stack blocks is varied between 20 and 120 with an increment size of 20, number of rows/stack is varied between 4 and 10 with an increment of 2, number of tiers/stack is either 3 or 5.

N_s	N_r	N_b	N_t	$\mathbb{U}_v$	$\mathbb{E}[T_u]$ (sec)
30	6	89	3	26.8%	1338.7
110	8	11	5	95.9%	1399.9
110	8	19	3	95.9%	1413.1
20	10	80	3	24.6%	1772.4
20	6	80	5	20.0%	2000.4

Table 1. Poor terminal layout design choices

N_s	N_r	N_b	N_t	$\mathbb{U}_v$	$\mathbb{E}[T_u]$ (sec)
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Table 2. Good terminal layout design choices

The expected throughput times are determined for all possible layout combinations. Table 1 includes five poor layout choices whereas table 2 includes five good layout choices. The results suggest that a small number of stack blocks in combination with a small number of bays/block are a better design choice than either a large number of stack blocks in combination with a small number of bays/block or a small number of stack blocks in combination with a large number of bays/block.

5. Conclusions

In this research, we develop an integrated analytical model for the unloading operations in the container terminal using Automated Guided Vehicles. Numerical experiments suggest that stack configuration with a small number of stacks and a small number of bays (30 stacks, 30 bays) yields better throughput performance than a small number of stacks and a large number of bays (20 stacks, 80 bays). We believe that the stochastic models of the container handling operations can be used for rapid analysis of multiple design configurations for container port terminals and improve container-handling efficiencies.

Acknowledgements

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From mainport to world port city

Bart Kuipers

1. Introduction: 'Mister mainport'

Since 2005, Hans Smits is CEO of the Port of Rotterdam Authority. He also was president and CEO of Amsterdam Airport Schiphol in the years 1992-1998. Therefore he managed both Dutch mainports during his career – a unique fact. In addition, as Director-General and Secretary-General of the Dutch Ministry of Transport, Public Works and Water Management (1988-1992), he was responsible for the introduction of the mainport concept in Dutch policy making, for instance in the 'Second Structure Scheme Traffic and Transport' of 1988. The mainport concept proved to be a dominant policy paradigm in Dutch spatial and infrastructure planning practise for more than two decades (Van Gils et al, 2009). It is therefore surprising that the mainport concept cannot be found in the widely acclaimed 'Port Compass', the Port Vision towards 2030 of the Port of Rotterdam Authority, for which Hans Smits was responsible. Instead of the mainport, new concepts are introduced, like the port of Rotterdam as a 'Global hub' or as 'Europe's Industrial Centre'.

As early as 1997, Hans Smits challenged the mainports: "Tomorrow's mainport is (...) not just a central hub of traffic and transport flows. It is also not just a location, but a company providing services and supplying products based on highly developed know-how and expertise. Tomorrow's mainport does not think nationally, but internationally." (Smits, 1997:103). Although he was speaking of mainport Schiphol, his statement is also true for mainport Rotterdam. In the 1997 article quoted, he concluded by suggesting cooperation of Amsterdam Airport Schiphol with other airport-based companies from London and Brussels and, surprisingly, involvement of Rotterdam seaport.

Looking beyond the transport function of the mainport and include services, know-how and the international mindset is the perspective that was adopted in the development of the mainport concept (Van Gils et al, 2009). But in addition, the relation of the mainport with the urban environment, or the port-city, is a point of attention. This implicates a much broader perspective, in which the mainport needs to be replaced with a new concept: the world port city (Kuipers & Manshanden, 2010).

This chapter is focussed on the relation between (main)port Rotterdam and the city of Rotterdam. In his valedictory lecture, Van den Berg (2013:22) refers to Bram Peper, former mayor of the city of Rotterdam, stating in the 1980s: "Rotterdam has the challenge to develop the city from a port-city towards a 'city with a port.'". Peper especially refers to the location of port activities towards the western fringes of the city and port area. Three decades after this statement, the perspective has changed and the challenge for Rotterdam is to integrate the 'city with a port' – or the mainport – into a true port-city: Rotterdam World Port City. This new challenge is the central theme in this chapter.

Firstly, the process by which Rotterdam became a 'port with a city' will be illustrated. Secondly, attempts to initiate a transition towards knowledge intensive activities in the 1990s by combining 'mainport' Rotterdam with 'brainport' Rotterdam are discussed. Thirdly, advanced producer services and the potential for Rotterdam in becoming an international shipping centre will be presented. Fourthly, the current position of Rotterdam as a location for advanced, high value port related services is indicated. Finally, some concluding remarks will be made related to the new emphasis placed on Rotterdam as a world port city.

2. Rotterdam: a seaport with a city

Since the last two centuries, the port and city of Rotterdam have a restless and unstable relationship mainly because of the continuous change and increasing scale of the port. Meyer (1996:376) sees a paradox in the growing independence of the port relative to the city of Rotterdam on the one hand and on the other hand ongoing attempts to connect port and city: "...the port proved to be a slippery eel that constantly changed in its position and size." The speed of technological and economic developments makes it virtually impossible to predict the functioning of the port within the next decade, according to Meyer (1996).

The most important technological development of the last decades in the port was the introduction of the standardized container. The container resulted in a steep rise of labor productivity in the port. In 1962, 96 million tons of cargo were handled by 14,869 port workers (Ter Hoeven, 1963), in 2011 9,003 workers handled 435 million tons (Havenbedrijf Rotterdam, 2013). The container was responsible for the deconcentration of port-related activities – for example container-related European distribution centers and inland container terminals – out of the port region towards hinterland locations (Kuipers (1995), Notteboom & Vonk (2011)). The container also contributed to the shift of the port-city into a borderless port-network (Van Klink, 1995). This resulted in a spatial shift of existing activities and in investment in new port activities eastwards from the larger Rotterdam region towards logistics regions around cities like Venlo, Tilburg and Duisburg.

Long before the rise of the container, starting from the 1950s, a shift westwards out of the city occurred in Rotterdam towards the Botlek area because of the increasing scale of industrial and port handling operations. This spatial shift – disconnecting port and historical city – is visible in all major industrial seaports and was generalized by Bird (1971) in his 'Anyport model'. In Rotterdam the development of the Second Maasvlakte is the most recent step in this development.

Next to shifts of physical economic activities to the east and west of the port city, the port city itself was not a priority in port strategy making, as is illustrated by the recent port strategy formulated by the Port of Rotterdam (2011): 'Port Compass. Port Vision 2030'. In an assessment of the Port Vision, performed by Erasmus Smart Port (2011) at the request of the port authority, the need for giving priority to the concept of 'Rotterdam World Port City', next to 'Europe's Industrial Cluster' and the 'Global Hub', as being an integral part of the port economy, was stressed.

A further important reason behind the characterization of Rotterdam being a 'seaport with a city' is related to the economic relations between port and city. Both work by Oosterhaven et al (2001) and Manshanden (2002) indicate weak linkages between the port and city. Manshanden (2002, see figure 1) illustrates the strong economic relations of the port of Rotterdam with foreign countries, in which Germany of course is the most important relation. Manshanden therefore concludes that the port of Rotterdam must be characterized as a Dutch national port instead of a Rotterdam port.

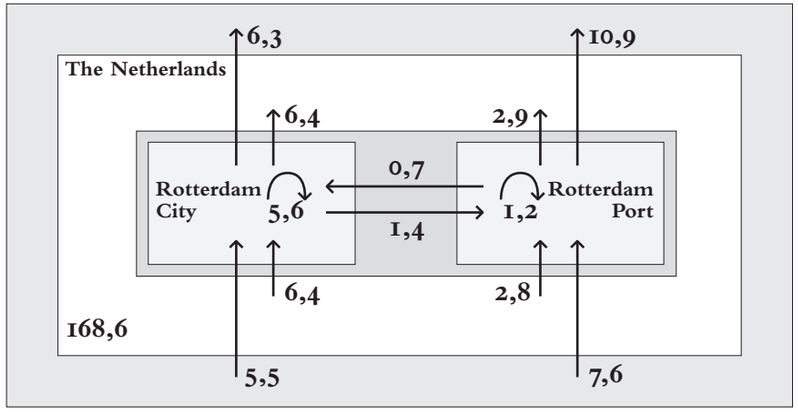

Figure 1. Backward & forward linkages between the port of Rotterdam, the city of Rotterdam, the Netherlands and foreign countries (billion euro's, 2002)
Source: Manshanden (2002)

These spatial, strategic and economic factors resulted in a weakening of the linkages between the city and the port of Rotterdam, a process further strengthened because of the bad image of port labour for new groups in the Rotterdam working population. This resulted in a psychological barrier in which the port was no longer an attractive job opportunity for large parts of the Rotterdam labour market (Zandvliet et al, 2011).

Periodically, new attempts were being made – based on new urban concepts – to connect the port and the city, but perseverance was missing to really accomplish the connection between port and city (Meyer, 1996). In the next two paragraphs two of those attempts are presented; an attempt started in the 1990s to develop Rotterdam as a brainport, next to the mainport function, based on the expected positive environmental performance of brainport activities – an attempt that clearly failed. And in addition a recent attempt to develop Rotterdam as a 'leading maritime service centre', as suggested by the OECD (Merk & Notteboom, 2013), this attempt is still under way.

3. No mainport without a brainport

"Niet lullen maar poetsen!" (Don't talk bullshit, but work hard!)" or "The shirts are hanging with rolled up sleeves in the closet" are typical port of Rotterdam expressions, indicating the strong emphasis on hard work in the port. The identity of dockers still is a central part of the Rotterdam port heritage.

However, this traditional Rotterdam image of port related drudging and toiling, together with shortcomings in acquisition capabilities, was one of the weak issues of the location climate of the port and city of Rotterdam in the 1990s as a location for head-offices by international ship-owners and maritime firms (Swaak et al, 1994). Traditional strengths of the port of Rotterdam in the mindsets of ship-owners and maritime service providers are, according to Swaak et al (1994), the port labour mentality, the maritime culture and heritage, port specific knowledge and experience, the port infrastructure, foreign language skills, the telecommunications infrastructure and the location of the port relative to the hinterland. Most of these elements strengthen the image of the port as a location for the executing of port operations, instead of being a location for decision making activities in (regional) head-offices or a location for advanced port and maritime related services.

The research of Swaak et al (1994) was part of a larger policy initiative, culminating in the 'Policy document on environment and economics' (VROM et al 1997). The central issue in this policy document was the uncoupling or disconnection of economic growth and environmental impact of economic activities. A system-innovation or transition was needed to realize sustainable development by means of internalizing negative externalities in accordance with 'market related instruments'. With respect to mainport Rotterdam this resulted in the slogan 'No mainport without a brainport' (Wijers, 1997). Mainport Rotterdam with its large container flows and impressive chemical and oil complex should realize the uncoupling of economic growth and environmental impact by the growth of brainport activities. Brainport activities were related to the work of (supply) chain-directors or -orchestrators located in the port and city of Rotterdam, professionals focusing on increasing the efficiency of transport operations. In addition, the brainport activities were related to the attraction of maritime headquarters to the city of Rotterdam, to become less dependent on the drudging associated with large transit-flows of containers to the hinterland of mainport Rotterdam.

The 'Policy document on environment and economics' had little impact and was heavily criticized by both environmental groups and business associations. During the '90s en '00s the development of the port of Rotterdam was related to strengthening the mainport character of the port by the realization of the Betuweroute, the dedicated railway-track from the port towards the German hinterland, and the Second Maasvlakte, the western extension of the port into the North Sea. Rotterdam continued facilitating the mainport and the brainport logo was cleverly used by the Brainport Region Eindhoven – the industrial high-

tech hart of the Netherlands focusing on technology and design with Philips Electronics and ASML as leader firms.

4. Rotterdam as a World Port City

Three initiatives were responsible for new emphasis on high-value port related services in mainport Rotterdam since the end of the '00s. These initiatives relate to (a) new policy making aimed at supply chain management in the Dinalog intiative and the 'Top-sectors policy', (b) research by Jacobs (2009), among others, indicating the potential of advanced maritime services for strengthening Rotterdam as a port-city and (c) the OECD Port-cities project (Merk, 2013).

4.1 Dinalog and the 'Dutch logistics house'

Dinalog is the national Dutch logistics 'Top-institute', located in the city of Breda and based on the report of the Van Laarhoven Committee (2009). This committee presented a vision for the Dutch logistics industry by making the analogy of a 'logistics house'. The foundations of this house were formed by transport and cargo handling operations, producing 10.8 billion euro added value for the Dutch economy, according to the Van Laarhoven Committee. The ground floor was occupied by the warehousing industry, realizing 4.2 billion euro added value, the first floor was occupied by value added logistics and value added service activities, responsible for 11.5 billion euro added value. Supply chain management activities like the organization, direction and coordination of logistics operations were housed on the top floor, realizing 3.4 billion euro added value. The staircase was a group of logistics support activities: legal, financial, ICT, insurance, employment agencies et cetera, realizing 10.3 billion euro added value for the Dutch economy. The total added value of the 'logistics house' for the Dutch economy exceeded 40 billion euro, or 8 percent of Dutch GDP (2004).

Dinalog focused especially on realizing growth of supply chain management activities for the Dutch economy, projected to produce an added value of 10 billion euro by 2020. Supply chain management activities – and most of the support activities as well – show high margins, are knowledge-intensive, do not need high investment in infrastructure and other assets and do not realize the negative externalities associated with more traditional activities of the logistics industry – like the brainport function discussed before.

The assumed positive effects on the Dutch economy of supply chain management and logistics support activities resulted in priority on the policy agenda of the national government and of the Dutch national 'Top-sectors' policy. However, the economic performance of supply chain management activities in reality proved to be much lower than calculated in the Van Laarhoven report, according to CBS (2013).

4.2 Jacobs' research on advanced producer services

The municipality and the Port of Rotterdam funded research on advanced producer services in the global maritime industry. Jacobs (2009) convincingly showed the potential of advanced producer services for revitalizing both port related and urban employment growth. Legal services, financial services, accountancy, insurance/risk management, tax advice and certification are examples of advanced producer services. The work of Jacobs (2009) was especially important because of three elements.

First he introduced a typology of port-cities based on the availability of advanced producer services in a port on the one hand and cargo and production plants on the other (figure 2). In addition, he stressed the importance of (commodity) trade activities in port-cities, next to advanced producer services (Jacobs & Van Dongen, 2012).

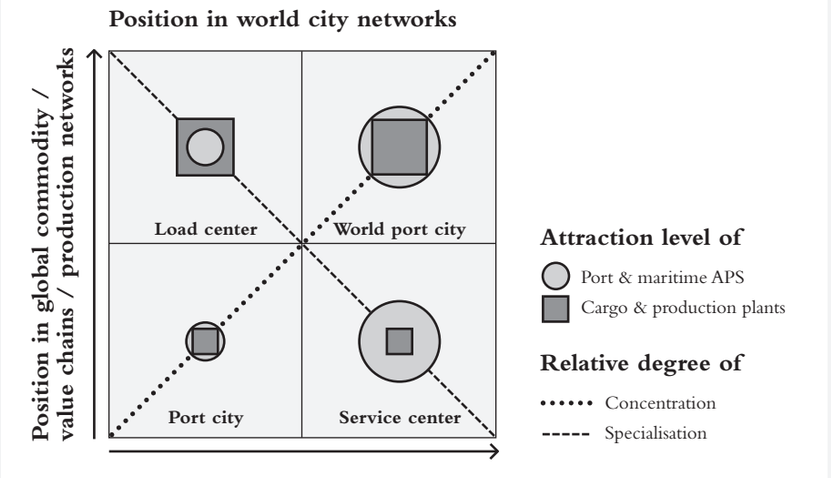

Figure 2. Typology of port-cities
Source: Jacobs (2009)

The second element in the work of Jacobs (2009) was the ranking of maritime service centres according to the total connectivity towards other centres or the number of advanced producers services/employment (Jacobs et al, 2010). In these rankings, the port of Rotterdam scored the number eight and five position respectively, indicating a relatively strong performance before port-cities like Hamburg and Antwerp, but clearly behind global maritime service centres like London, Singapore or New York. Being a world port city clearly underpinned the slogan of the municipality of Rotterdam: 'Rotterdam World Port World City'.

Thirdly, Jacobs (2009) produced some powerful network images, raising awareness for new port-city related networks and hierarchies (figure 3). The works of Jacobs – and related researchers like Ducruet and Lee (2006) – on the supply of high value service providers to the maritime industry in port-cities provoked further research, for instance related to the demand characteristics of these services.

Figure 3. Global network of advanced producer services to the maritime industry based on intra-firm connectivity.
Source: Jacobs (2009)

4.3 Demand for high-value port related business services in Rotterdam

The demand for high-value port-related business services in the Rotterdam port and industrial complex consists of three major segments (Kuipers et al, 2011).

a. 'basic services for the port economy'; business services needed for the everyday operation of port firms, usually locally sourced – such as legal, financial or technical services;
b. 'strategic services' for (regional) headquarters-functions, mostly sourced from locations such as London or the South Axis of the city of Amsterdam or near the headquarters of 'internationals' in the U.S. or Germany with branch-plants located in the port of Rotterdam – examples of these services are corporate financial services or strategic management consultancy;
c. 'shared service centres'; centres where in-house services are performed by firms, often as spin off of important operational activities such as purchasing, environmental services or supply chain management.

The Rotterdam port and industrial complex buys for one billion euro of these high value port-related business services (table 1), most of them 'basic services for the port economy', representing a value added of more than half a billion euro (2010). The number of corporate headquarters in Rotterdam is modest and therefore the demand for strategic services is limited – Jabobs et al (2010) count ten headquarters of advanced producer services, Merk and Notteboom (2013) identified two Forbes 2000 headquarter locations in the logistics industry based in Rotterdam and three in the petrochemical industry. Two thirds of the port related business services is locally sourced. Financial services, legal, accounting and computer services are the most demanded services by firms in the port of Rotterdam, in addition insurance and telecoms are important (table 1).

The petroleum industry is the most important purchasing sector in the port of Rotterdam, purchasing 313 million euro (2010) of high-value business services. Next to the petroleum-industry, the goods-transport industry and transport service providers – including port terminals – are responsible for a large amounts of purchases: between 150 and 170 million euro (2010). Both the industrial and transport function of the port buy an equal amount of services (Kuipers et al, 2011).

	Total amount of purchases	Added value
Post and telecom	97	46
Banks	264	125
Insurance	97	42
Financial services	12	9
Computer services	170	98
Research & development	12	9
Legal, accounting and economic services	340	170
Engineers and architects	18	9
Advertising	31	10
Total	**1,042**	**518**

Table 1. Purchases of high-value port-related business services by firms in the port of Rotterdam and added value realized by business services, million euro, 2010
Source: Kuipers et al (2011))

The demand for high-value port related business services is not only important because the quality of employment associated with these services, but also because these services are an integral part of the port and industrial cluster: the local presence of these services enhances the quality of the cluster as a whole. In addition, the local presence of high-value

port-related business services is vital to strengthen the attractiveness of the city of Rotterdam for the attraction of desired (regional) headquarters to the city. Conversely, these (regional) headquarters also have a demand for high-value services. These service providers are therefore relevant to both the port and the city.

	Number of firms	Employ-ment	Added value (mln euro)
Rotterdam-Rijnmond economy	25,535	299,146	44,448
Port complex Rotterdam-Rijnmond	1,391	89,840	13,011
High-value business services Rotterdam-Rijnmond	4,311	46,553	4,496
Economic impact of purchases high-value business services by port-industrial complex		5-8,000	518
Share high-value general business services Rotterdam-Rijnmond regional economy	17%	16%	10%
Share of port-related high-value business services in Rotterdam as part of general business services		10-13%	12%

Table 2. High-value port-related business services as part of the larger port complex and Rotterdam-Rijnmond region (2008).
Source: Kuipers et al (2011)

Nearly 300 thousand people are working in the Rotterdam-Rijnmond economy; some 90 thousand of this total is related to direct port-related employment (table 2). In addition, the employment in general high-value business services in the Rotterdam-Rijnmond region is 46.6 thousand employees: a share of 16 percent in the total Rotterdam-Rijnmond economy (table 2). High value port-related business services as part of the total employment and added value realised by the Rotterdam-Rijnmond varies between 10 and 13 percent (table 2): 5-8,000 employees and 518 million euro added value.

The research by Kuipers et al (2010) indicated that demand for high-value port related business services also includes services for the petrochemical sector in the port, next to maritime related advanced producer services, the research paid attention to 'shared service centres' as an important segment of high value port-related employment.

The main policy measures suggested by Kuipers et al (2010) to increase the number of high-value port-related service providers for the city of Rotterdam are:

a. Implement a comprehensive and integrative policy package, aimed at strengthening the Rotterdam business environment as a place to work, live and have fun, including high end cultural, educational, creative and innovation promoting facilities and also including an excellent accessibility to the port-areas as a place to work – "...places of pleasure as well as productivity." (Glaezer, 2011:10);
b. Part of this comprehensive approach is cooperation between Rotterdam and other cities in Randstad Holland, in the context of a network approach – not a narrow local approach restricted to the city borders, but a network approach, including the Flemish-Dutch Delta;
c. Point of attention is to cherish to the existing number of head-offices located in the larger Rotterdam area;
d. Implement a task-force including professionals of the departments of both the Port and City of Rotterdam.

4.4 OECD Port-cities Programme: Rotterdam-Amsterdam case study

Next to the start of Dinalog and the awareness of high value port-related services for the revitalization of Rotterdam, the launch of the OECD Port-Cities Programme was the third initiative raising awareness for the potential for high-value port related services (Merk, 2013).

In the OECD case study on the ports of Rotterdam and Amsterdam, Merk and Notteboom (2013) express the challenge to link port and urban functions. The city of Rotterdam has a mixed economic profile with GDP per capita, growth rates and employment rates below the national average. The urban attractiveness is limited, in comparison with other world port-cities, according to Merk and Notteboom. This has made it difficult to attract high-value added firms, headquarters and talent.

The port of Rotterdam is at the core of a maritime cluster with some very competitive sub-sectors, such as dredging and salvage services. Rotterdam is home to several maritime industries and services, certain port-related headquarter functions and a university that is one of the prime academic centres for port studies, according to the OECD case study. However, it is not a complete maritime cluster like Singapore or London and of relatively minor importance with regards to ship owners, ship operation, ship brokers, maritime insurance and ship classification.

Merk and Notteboom see a clear potential for Rotterdam and Amsterdam, in combination with Antwerp, to grow into one of the leading international maritime centres. To realize this potential, a much more holistic strategy on developing and sustaining the maritime cluster would be needed compared to the current Top-sectors policy and a much wider set of instruments could be more aggressively used to further develop a maritime cluster, such as development assistance, export promotion, trade missions and anti-piracy policies.

Rotterdam needs a long term and sustained strategy to improve urban quality, to convince global maritime industry leaders that it could be an attractive place to locate

corporate and headquarter functions according to Merk and Notteboom. The key for sustaining port performance and the development into a leading maritime service centre is regional cooperation at different levels:

a. cooperation at the level of the city-region is needed to sustain port growth in both Amsterdam and Rotterdam.
b. cooperation between the port clusters of Rotterdam, Amsterdam and other ports could be extended to reap possible synergies between them.
c. cross-border cooperation could build on the strong inter-relation between the port and logistics clusters of Rotterdam and Antwerp in terms of business and traffic relations, which would justify co-operation to sustain a joint petro-chemical cluster in the future.
d. In addition, there is a potential to build on the vicinity and differences of three important port-cities (Rotterdam, Amsterdam, Antwerp) as a source of metropolitan, poly-centric quality of life that could attract maritime services and business firms to the region.

5. Conclusion: from mainport Rotterdam to Rotterdam World Port City.

Especially the OECD case study on Rotterdam and Amsterdam (Merk & Notteboom, 2013) had impact in both the port and city of Rotterdam. The opportunities indicated by OECD to increase economic spin-off of the port by strengthening the connection between port and city were embraced by the Port of Rotterdam Authority and the municipality of Rotterdam (City of Rotterdam, 2013). Hans Smits agreed with the conclusions of the OECD-report: "The conclusions and recommendations of the OECD are in line with the Port Vision 2030. In particular, the environmental quality has been improved in recent decades, environmental limits are not exceeded at the port and the Port Vision is full of actions to improve the quality of the environment and accessibility. In addition, the Port Vision has a series of actions to increase the attractiveness of Rotterdam as a business location for office functions." (City of Rotterdam, 2013). But since the OECD-report, new priorities have been added to the Port Vision 2030. In the 'Implementation agenda 2013' (Port of Rotterdam, 2013) a new action called 'Strengthening economic synergies between port and city' has been added in the theme 'Port and region'. This action has been given maximum attention and is executed by the Port of Rotterdam Authority, City of Rotterdam and Deltalinqs, the port employers association, together – indicating the importance given to this issue. The municipality of Rotterdam and the Port Authority are working closely together to get more international companies to Rotterdam, including port-related business services, headquarters and shared service centers – recent examples of significant port-related office-employment for the city are: Shell Downstream, Petrobras and Lukoil Benelux. Finally, a number of initiatives were taken, making the port more visible in the city-center.

To conclude, the transition from the mainport and 'port with a city' has been taken up by the policy makers in the port and the city. The realization of such a transition will not be easy. After many decades of investing in the mainport, processes of path-dependency and lock-in seriously have diminished the degrees of freedom for the port of Rotterdam to change course (Atzema et al, 2009). It is like a 'supertanker', when changing course, only after several miles the tanker really starts changing direction. We have to wait until 2030, to be able to conclude: 'a course made good'.

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