RICK M.A. HOLLEN

Exploratory Studies into Strategies to Enhance Innovation-Driven International Competitiveness in a Port Context

Toward Ambidextrous Ports

Exploratory Studies into Strategies to Enhance Innovation-Driven International Competitiveness in a Port Context:

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Toward Ambidextrous Ports

Verkennende studies naar strategieën ter versterking van innovatie-gedreven internationaal concurrentievermogen in een havencontext: Naar ambidexter havens

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To my network

Preface

This dissertation is the result of over three years of dedication, curiosity and perseverance, a great interest in port-related developments and, moreover, the opportunities, insights and support that I have received from several people during this challenging period. I use this opportunity to express my gratitude to them. First of all, I am tremendously grateful to my supervisors from the Department of Strategic Management and Entrepreneurship, Rotterdam School of Management, Erasmus University. Frans A.J. van den Bosch has been a constant source of wisdom, inspiration, encouragement and formative guidance since writing my MScBA thesis and, after I spent some time outside academia, throughout my PhD-candidacy in particular. I feel to have benefited especially from the training I received from him in conducting high-quality research in the field of management, writing academic papers, critical and creative thinking, supervising, time management and being a "happy scientist" (Van Den Bosch, 2012: 33). Henk Volberda has been an empowering supervisor as well and helped me gain valuable insights into various facets of strategic management and business policy. The papers that have been and will be submitted to international high-quality journals have clearly benefitted from their involvement. Frans and Henk, the penultimate proposition added separately to this dissertation is without doubt applicable to both of you.

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I hope you will enjoy and be inspired by reading this dissertation.

Rick M.A. Hollen

Rotterdam, August 2015

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CHAPTER 1

Introduction

1.1. Introduction

From a strategic management perspective, (sea)port-complexes, henceforth ports, constitute an interesting research setting. Being important junctions in international integrated chain systems (Huybrechts et al., 2002; Robinson, 2002), ports worldwide handle about 80% of global merchandise trade in terms of volume (UNCTAD, 2014). They comprise co-located firms from a variety of different interrelated logistics clusters (e.g. container handling, port services, and transport) and, depending on the presence of industrial activity, industrial clusters (e.g. energy, chemicals, and oil-refining). The majority of these firms operate in an environment that is strongly competitive, regulatory demanding, and highly dynamic. Developments such as shifts in the main centers of economic growth and international goods flows, expanding vessel sizes and accompanying higher peak loads, growing digitization of information, transitions toward a more biobased and circular economy, and the shale gas revolution have far-reaching implications for many port-related firms. Notwithstanding the fact that strategic management is largely concerned with how firms generate and sustain a competitive advantage by coping effectively with these and other types of complex issues in their external environment (Johnson et al., 2005; Nag et al., 2007), ports remain under-researched within the field of strategy. In the extant port-related literature, in turn, studies on strategic management-related issues are underrepresented.

This introductory chapter to the dissertation starts by elaborating two opposed activities – i.e. exploitation and exploration activities – that need to be balanced in order for ports and the constituent organizations to strengthen their international competitive position. Exploitation activities are an outcome of pressures for stability, enabling ports/organizations to make the most of today's competences and situations so as to succeed in the short run, whereas exploration activities result from pressures for change, enabling the creation and seizing of new opportunities in order to remain successful in the long run (e.g. Benner & Tushman, 2003; He & Wong, 2004; March, 1991). Next, bridging these two 'qualities', which are interdependent (Levinthal & March, 1993), the concept of ambidexterity (e.g. Birkinshaw & Gupta, 2013; Cao et al., 2009; Duncan, 1976) is discussed and subsequently related to ports. Ambidexterity refers to "[…] the state of attaining exploitation and exploration with dexterity, or achieving high levels of both" (Simsek, 2009: 602). In what

follows, the scope of the dissertation is described in relation to the encompassing theme: *ambidextrous ports*. The central tenet is that in order for ports in economically advanced economies to strengthen their sustainable international competitiveness over time, they have to become ambidextrous. Finally, an outline is provided of the different studies included in this dissertation.

1.2. Exploitation and Exploration

In order to remain fit for the future, firms and port authorities alike need to innovate and renew in a way that enables these organizations – and, in turn, the port(s) in which they are located – to keep up with and give directions to new developments in their external environment (e.g. Acciaro et al., 2014; Notteboom & Rodrigue, 2005; Van Den Bosch, 2015; Van Den Bosch et al., 2011; Verhoeven, 2010). It may therefore indeed be argued that "management's ability to consolidate a port's capabilities and skills into competencies that empowers the port industry to adapt quickly to changing opportunities is the real source of competitive advantage" (Haezendonck & Notteboom, 2002: 68). Renewal and innovation in the broad sense are about what has been labelled in the literature as 'exploration'.

Exploration-directed activities imply adaptation to changing external circumstances or conditions by creating variety in experience, in the form of alternative practices and competencies, through episodic and relatively radical changes (Birkinshaw & Gibson, 2004). These changes may include developing new process technologies, products, services and knowledge, entering new customer or market domains, pursuing new organizational competencies, engaging in new ways of organizing and managing, and developing new (types of) organizational relationships (e.g. Holmqvist, 2004; Jansen et al., 2009; March, 1991). Exploration-directed activities are often in particular about seizing or creating new, often uncertain market opportunities and coping proactively with new environmental threats in ways that can be considered as new to the organization, network or even to the entire industry. The main focus is on improving organizational performance over the long term.

Notwithstanding the importance of adapting to changing environmental conditions as an act of exploration, however, organizations appear to focus mainly on increasing their short-term performance by being efficient in managing present demands and, in this connection, improving current organizational conduct in existing market domains (e.g. Flier et al., 2003; March, 1991). Such a focus is associated with *exploitation-directed activities*, such as increasing operational efficiency, rolling out the current business model, and gradually improving current product and service offerings – based on the leveraging of existing knowledge and capabilities. These activities entail alignment in operations through continuous incremental changes, and particularly revolve around such things as efficiency, cost reductions, risk avoidance, optimization, and/or routinization (Barr et al., 1992; Birkinshaw & Gibson, 2004; March, 1991; Tushman & O'Reilly, 1996); see also Table 1.1.

Table 1.1. *Exploitation activities versus exploration activities in organizational life*

	Exploitation activities	**Exploration activities**
Conceptualization	Exploitation activities imply "[…] such things as refinement, choice, production, efficiency, selection, implementation, execution" (March, 1991: 71)	Exploration activities imply "[…] things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation" (March, 1991: 71)
Type of activity	Alignment (efficiency-driven)	Adaptation (renewal-driven)
Competitive aim	Improving short-term performance by being efficient in managing present demands, based on the leveraging of existing knowledge and capabilities	Improving long-term performance by creating and seizing new demand opportunities, based on the development of new knowledge and capabilities

1.2.1. Focus on efficiency (exploitation) versus innovation (exploration) in port studies

In the extant literature on ports there appears to be a dominant focus on exploitation- over exploration-directed activities. For instance, as is shown in Table 1.2, a search in Google Scholar for the words "efficient" and "efficiency" in the title of scholarly papers published in the period 2000–2014 in the five journals with the highest number of port research papers (Pallis et al., 2010; see also the Table's footnote) yields more than seven times more hits than the words "innovation", "innovate" and "innovative". Executing the same search with regard to entire papers (rather than title only), the efficiency-related keywords yield almost two and a half times more hits. Whereas more than 60% of all 3887 papers in the journals contain the search word "efficiency" and/or "efficient", less than only 25% contain the words "innovation", "innovate" and/or "innovative".

The question can be raised whether this scholarly emphasis on efficiency – compared to innovation – in port-related journals is also found in *leading academic management and strategy journals*. A comparable search in Google Scholar suggests that this is not the case. For instance, a search for the words "efficiency" and "efficient" in the title of the 1640 papers published in *Strategic Management Journal* (SMJ) in the period 2000–2014 yields seven times *less* hits than the words "innovation", "innovate", and "innovative". And when the same search is executed with regard to the entire paper (rather than the title only), the efficiency keywords yield 902 hits (i.e. these keywords were found in 55.0% of all SMJ papers published between 2000 and 2014), whereas the innovation-related keywords yield 974 hits (59.4%). Searches in other leading journals, including the *Academy of Management Journal* (AMJ)*, Administrative Science Quarterly* (ASQ)*, Journal of Management Studies*

Table 1.2. *The dominant focus on efficiency over innovation in port-related journals: Illustrative evidence from keywords searches (2000–2014) in Google Scholar**

	Keyword "efficiency" or "efficient"		Keyword "innovation", "innovate" or "innovative"	
	(in title)	(in paper)	(in title)	(in paper)
1. *Maritime Policy & Management* (539 papers)	***24*** *(4.5%)*	**389** (72.2%)	***6*** *(1.1%)*	**164** (30.4%)
2. *Maritime Economics & Logistics* (327 papers)	***25*** *(7.6%)*	**258** (78.9%)	***1*** *(0.3%)*	**72** (22.0%)
3. *International Journal of Transport Economics* (341 papers)	***33*** *(9.7%)*	**183** (53.7%)	***1*** *(0.3%)*	**47** (13.8%)
4. *Journal of Transport Geography* (1380 papers)	***9*** *(0.7%)*	**677** (49.1%)	***6*** *(0.4%)*	**364** (26.4%)
5. *Transportation Research Part A* (1300 papers)	***43*** *(3.3%)*	**842** (64.8%)	***5*** *(0.4%)*	**310** (23.8%)
Total keyword hits for all five journals (3887 papers)	***134*** *(3.4%)*	**2349** (60.4%)	***19*** *(0.5%)*	**957** (24.6%)

(*) The journals mentioned in this table are the five academic journals with the highest number of port research papers (compared to 46 other journals) in the period 1997–2008 according to a review study by Pallis et al. (2010). All searches in Google Scholar pertain to the period 2000–2014, and were conducted in August 2015.

(JMS) and *Organization Science* (OrgSc), lead to rather comparable results as the search in SMJ. That is, a clear emphasis on innovation (compared to efficiency) in the title of papers and a quite balanced use of the efficiency- and innovation-related search words (i.e. with a slightly larger emphasis on innovation in four of the five journals). In total, 45.3% of the 7797 papers that appeared in AMJ, ASQ, JMS, OrgSc and SMJ in the period 2000–2014 (according to Google Scholar) contain the words "efficient" and/or "efficiency", whereas the words "innovation", "innovate", and/or "innovative" are found in 51.9% of the papers.

When the search for the same keywords is broadened to all papers in Google Scholar (i.e. over 780,000 papers in the period 2000–2014), the number of hits for "innovation", "innovate" and "innovative" exceeds the number of hits for "efficient" and "efficiency" with a factor of approximately 1.8. This outcome suggests that the emphasis on efficiency in port-related journals – compared to innovation – should not be merely attributed to the frequency of the search words in natural (scholarly) language.

1.2.2. The importance of engaging in both exploitation- and exploration-directed activities

Largely drawing on James March's (1991) seminal work on exploration and exploitation in organizational learning and the associated allocation of organizational resources, one of the most highly cited studies in the field of management and organization, several scholars have convincingly argued that an important source of long-term competitiveness in the context of changing environments is the ability to engage in both exploration- and exploitation-directed activities (e.g. Benner & Tushman, 2003; Gibson & Birkinshaw, 2004; Gupta et al., 2006; He & Wong, 2004; Jansen et al., 2009; Tushman & O'Reilly, 1996). As pointed out above, however, organizations tend to prefer exploitation over exploration (e.g. Flier et al., 2003; March, 1991). The former enable them to make the most of their present competences and situations, utilize existing complementary assets (Tripsas & Gavetti, 2000), and achieve high reproducibility, accountability, and reliability (Hannan & Freeman, 1984; Holmqvist, 2004).

The exploitative processes and incentives that they use to keep focused on their main customers work so well that, over time, many organizations become blindsided by industry changes and the related need for explorative processes (Birkinshaw & Gibson, 2004; Bower & Christensen, 1995). This so-called 'success trap' (Levinthal & March, 1993) or 'competitive myopia' (Sidhu et al., 2004) leads to suboptimal stable equilibria (March, 1991), and reduces both the scope and flexibility of knowledge integration (Grant, 1996; Van Den Bosch et al., 1999). This in turn limits the existing knowledge base or search scope from which sets of decisions and new alternative practices are generated (e.g. Katila & Ahuja, 2002; March, 1991; Rivkin & Siggelkow, 2003).

Although efficiency is important, this stance may become problematic in dynamic environments as organizations risk losing the link to new knowledge, products and services. As Tushman and O'Reilly (1996: 15) stated, "slow evolutionary change in a fast-changing world is, as it was for the dinosaurs, a path to the boneyard". Hence, in order to increase their long-term performance, organizations in complex-dynamic business environments, such as those of leading ports, need to balance exploitation with exploration (e.g. He & Wong, 2004; Junni et al., 2013; Raisch et al., 2009), thereby empowering themselves to anticipate changed opportunities (Prahalad & Hamel, 1990) that can subsequently be exploited. As will be elaborated below, each of the six studies included in the dissertation (i.e. Chapters 2–7) relates to a particular challenge of realizing exploration-directed activities in an exploitation-dominated port, resulting in a more 'ambidextrous port'.

1.3. Ambidexterity

1.3.1. Conceptualization

The organizational ability or state of reconciling/balancing exploitation- and exploration-related activities is referred to as *ambidexterity* (Birkinshaw & Gupta, 2013; Jansen et al., 2009; Junni et al., 2013; Simsek, 2009). This term is derived from the Latin words *ambi-*

(meaning 'both') and *dexter* (meaning 'right', i.e. as opposed to left, and 'favorable'), and therefore translates into 'right on both sides'. It is commonly used in society to express the human ability to use both their hands with equal competency. The label 'ambidextrous organization' was introduced in the business literature by Robert Duncan (1976), and has gained momentum since the work of March (1991) and Tushman and O'Reilly (1996, 1997). In the last two decades the ambidexterity concept has been used by scholars in different fields, including organization theory (e.g. Adler et al., 1999; Benner & Tushman, 2003), strategic management (e.g. Jansen et al., 2009; Lubatkin et al., 2006), and innovation and technology management (e.g. Andriopoulos & Lewis, 2010; He & Wong, 2004). Box 1.1 provides a selected number of definitions of ambidexterity in organization life.

Box 1.1. *Selected overview of scholarly definitions of organizational ambidexterity*[*]

- "[…] the ability to simultaneously pursue both incremental and discontinuous innovation and change [that result] from hosting multiple contradictory structures, processes, and cultures within the same firm" (Tushman & O'Reilly, 1996: 24)
- "[…] simultaneously performing both routine and nonroutine tasks […]" (Adler et al., 1999: 45)
- "As defined, ambidextrous firms are capable of exploiting existing competencies as well as exploring new opportunities with equal dexterity" (Lubatkin et al., 2006: 647)
- "[…] the ability of a firm to simultaneously explore and exploit" (O'Reilly & Tushman, 2008: 185)
- "[…] the state of attaining exploitation and exploration with dexterity, or achieving high levels of both" (Simsek, 2009: 602)

[*)] *See Birkinshaw & Gupta (2013), Raisch & Birkinshaw (2008) and Simsek (2009) for more extended overviews*

1.3.2. Alternative modes of balancing exploitation and exploration

Given the breadth of research into ambidexterity, it is maybe not surprising that there are different (but partly overlapping) fundamental views on how to pursue the intended balance of exploitation and exploration activities so as to cope with their conflicting demands. At least four alternative modes of balancing can be distinguished: (i) structural ambidexterity; (ii) contextual ambidexterity; (iii) temporal ambidexterity; and (iv) domain ambidexterity (see also Table 1.3).

Table 1.3. *Alternative modes of balancing organizational exploitation and exploration*

	Mechanism of balance	*Illustrative literature*
1. Structural ambidexterity	Separate organizational units dedicated to either exploitation or exploration, simultaneously coordinated at corporate level (i.e. organizational separation).	Benner & Tushman (2003); Jansen et al. (2009); Tushman & O'Reilly (1996)
2. Contextual ambidexterity	Concurrent exploration and exploitation takes place within organizational units, in which individuals are encouraged to reconcile the associated tensions.	Cegarra-Navarro & Dewhurst (2007); Gibson & Birkinshaw (2004); Miron et al. (2004)
3. Temporal ambidexterity	Sequential shifts between exploitation and exploration, related to punctuated equilibria (i.e. temporal separation).	Duncan (1976); Eisenhardt & Brown (1997); Tushman & Romanelli (1985)
4. Domain ambidexterity	Exploitation in one or more domains is combined with exploration in other domains within or across organizational boundaries (i.e. domain separation).	Lavie et al. (2010); Lin et al. (2007); Russo & Vurro (2010)

Source: Author, partly adapted from Lavie et al. (2010)

The most traditional view of organizational ambidexterity, which draws partly on Duncan's (1976) notion of 'dual structures' as a means for organizations to effectively manage the initiation and implementation stages of innovation, is that ambidexterity is to be achieved through structural separation of organizational entities such as business units (e.g. Benner & Tushman, 2003; Burgelman, 2002; Jansen et al., 2009; Tushman & O'Reilly, 1996). This mode of *structural ambidexterity* implies that exploration and exploitation activities are performed in physically separated entities – defined by top management – with different competencies, performance targets, incentive systems and other managerial processes. These separated entities are "held together by a common strategic intent, an overarching set of values, and targeted structural linking mechanisms that enable a productive integration of independent efforts" (Simsek, 2009: 599). As illustrated in, for instance, Chapter 6 of this dissertation, structural ambidexterity may also be realized beyond the organizational level.

An alternative mode of balancing, originally proposed by Gibson and Birkinshaw (2004), is *contextual ambidexterity* (also referred to as 'behavioral ambidexterity'). This model, which is illustrated in Chapters 3 and 6, implies putting in place an organizational context that encourages and supports individuals in their efforts to balance the allocation of their time to the conflicting demands for exploitation and exploration in their day-to-day work context. The third mode of balancing exploitation and exploration as identified by

scholars, *temporal ambidexterity*, is rooted in the conceptual notion of sequential or punctuated equilibrium, which entails shifting between periods of exploitation and exploration (e.g. Duncan, 1976; Eisenhardt & Brown, 1997; Tushman & Romanelli, 1985). This temporal separation, illustrated in Chapter 5, necessitates the development of effective practices and procedures for organizing the transitions between these periods over time (Eisenhardt & Brown, 1997; Simsek, 2009). Finally, *domain ambidexterity,* pursued within or across organizational boundaries (e.g. Lin et al., 2007; Russo & Vurro, 2010), implies that organizations engage in exploitation-directed activities in one domain, like the attributes of partners or the network structure (cf. Lavie & Rosenkopf, 2006), while simultaneously engaging in exploration-directed activities in another (Lavie et al., 2010). This latter mode of ambidexterity is illustrated in, for instance, Chapter 7 of this dissertation.

1.3.3. Levels of analysis

As already became apparent from the abovementioned discussion of different modes of balancing exploitation and exploration, ambidexterity has been analyzed at several levels of analysis (see Table 1.4). In line with March (1991), the most commonly adopted level of analysis in the ambidexterity literature is the *organization level* (e.g. Kaplan & Henderson; 2005; Lubatkin et al., 2006; Tushman & O'Reilly, 1996). Other levels of analysis that have been adopted are the *business unit level* (e.g. Adler et al., 1999; Gibson & Birkinshaw, 2004; Jansen et al., 2005), *manager level* (e.g. Groysberg & Lee, 2009; Jasmand et al., 2012; Mom et al., 2009), and *dyadic interfirm (i.e. alliance) level* (e.g. Im & Rai, 2008; Lavie & Rosenkopf, 2006; Russo & Vurro, 2010). More recently scholars have also started to explore

Table 1.4. *Different levels of analysis of research into ambidexterity*

	Level of analysis	*Illustrative literature*
Higher level of analysis ↓	▪ Manager level	Groysberg & Lee (2009); Jasmand et al. (2012); Mom et al. (2007, 2009)
	▪ Business unit level	Adler et al. (1999); Gibson & Birkinshaw (2004); Hill & Birkinshaw (2014); Jansen et al. (2005)
	▪ Organization level	He & Wong (2004); Kaplan & Henderson (2005); Lubatkin et al. (2006); Tushman & O'Reilly (1996); *this dissertation ('ambidextrous port authority')*
	▪ Dyadic interfirm level	Im & Rai (2008); Lavie & Rosenkopf (2006); Lin, et al. (2007); Russo & Vurro (2010)
	▪ Multi-organizational level	Mazzola & Perrone (2014); *this dissertation ('ambidextrous port')*

Source: Author, based on literature study

ambidexterity at the *multi-organizational network level* (Mazzola & Perrone, 2014). The introduction of the latter two levels of analysis in the ambidexterity literature – which have been related to 'domain ambidexterity' (cf. Lavie et al., 2010) in particular – highlights the notion that a balance between exploration and exploitation can also be pursued and attained beyond the organizational level.

As elaborated next, the encompassing theme of this dissertation is the 'ambidextrous port', which embarks mainly on the multi-organizational/network level of analysis in the empirical context of ports (see Table 1.4). Related to this theme is the additional focus on the 'ambidextrous port authority', which entails ambidexterity at the organization level (see Table 1.4). As will be further elaborated in this dissertation, the latter implies a port authority that is able to act as both landlord and port developer (see Chapter 3), thereby engaging in both exploitation (i.e. landlord) and exploration (i.e. port developer) activities.

1.4. Scope of the Dissertation

1.4.1. Encompassing theme: Ambidextrous Ports

Building on the aforementioned literatures, the central tenet of this dissertation research is that *in order for ports to sustainably strengthen their international competitive position, they have to become more ambidextrous*. Ambidextrous ports are highly efficient *and* highly innovative, stable *and* flexible, adept at leveraging the returns from previous investments *and* seizing new opportunities, able to attain short-term performance gains *and* long-term success, capable of reconciling tensions between demands for collaboration *and* competition within and beyond the port, and home to firms from established *and* new industries, among others (see also Hollen et al., 2015; Van Den Bosch et al., 2011). These and comparable qualifications indicate a port's ability or state of balancing exploitation- and exploration-directed activities (see Box 1.2).

Balancing between these two types of activities is not straightforward since ports compete to a large extent on the basis of factor conditions, cost-effectiveness and operational efficiency (i.e. exploitation), mainly realized through a strict focus on minimizing the (generalized) costs of freight flows and production, and, related to that, optimizing integral chain systems (e.g. Bichou & Gray, 2004; Ng, 2009; Strandenes, 2014; Tongzon, 1995; Van Den Bosch et al., 2011; Van De Voorde & Winkelmans, 2002a). Efficiency-directed activities are considered especially important for those ports that are involved in traffic categories characterized by fierce competition (Huybrechts et al., 2002).

Box 1.2. *Ambidextrous ports: Increasing ports' international competitiveness*

- Ports (including port-related organizations) are principally focused on exploitation-directed activities.
- In a complex-dynamic environment, ports need to engage in exploration-directed activities in order to adapt (i.e. to keep up with and/or give directions) to new developments and changing environmental circumstances.
- *Ambidextrous ports* are able to reconcile/balance exploitation- and exploration-directed activities, thereby strengthening their international competitiveness.
- For instance, ambidextrous ports are highly efficient *and* highly innovative, stable *and* flexible, adept at leveraging the returns from previous investments *and* seizing new opportunities, able to attain short-term performance gains *and* long-term success, and capable of reconciling tensions between demands for competition *and* cooperation within and beyond the port.
- *This dissertation* focuses on how ports may become more ambidextrous, thereby enhancing their innovation-driven sustainable international competitiveness, by becoming more innovative.

1.4.2. Research question

Given the fact that ports are predominantly focused on the efficient employment of their existing assets, capabilities and market position, their quest to become more ambidextrous largely revolves around becoming more *innovative*. A focus on balancing efficiency with innovation is particularly salient for leading ports in economically advanced countries (Van Den Bosch et al., 2011), such as Belgium, France, Germany, Singapore, Switzerland, The Netherlands, the United Kingdom, and the United States. This is because such countries are innovation-driven economies (Schwab, 2014: 9), meaning that the firms – and ports – located in these countries can only remain internationally competitive over time through innovation and business sophistication. Hence, ambidexterity is a necessary condition for leading ports in economically advanced countries to strengthen their (innovation-driven) sustainable international competitiveness (see also Box 1.2).

The research question central to this dissertation is as follows: *How can ports become more ambidextrous, thereby enhancing their innovation-driven sustainable international competitiveness?* (Box 1.3). This question signifies that becoming a more ambidextrous port entails strengthening the innovation-driven sustainable international competitiveness of the port and, in turn, the organizations (e.g. firms, port authority, business associations) that are engaged in economic activities in this port. The main denotation of the adjacent 'sustainable' is 'difficult to duplicate or surpass by competitors', but it also refers to a responsible and accountable seizure of (natural) resources and the creation of economic and social value (e.g. Boons et al., 2013). Both denotations allow continuation of the competitive position in the

long run. Various scholars have empirically studied and pointed to the (direct or contingent) positive performance implications of ambidexterity – in terms of enhanced competitiveness – in dynamic environments (e.g. Gibson & Birkinshaw, 2004; He & Wong, 2004; Junni et al., 2013; Lin et al., 2007; Lubatkin et al., 2006; Uotila et al., 2009). Junni et al. (2009) found that ambidexterity is particularly important at higher levels of analysis – the alliance level being the highest examined level. For an extensive literature-based discussion regarding the outcomes of ambidexterity, see O'Reilly and Tushman (2013) and Simsek (2009).

Box 1.3. *Research question central to the dissertation*

How can port-complexes become more ambidextrous, thereby enhancing their innovation-driven sustainable international competitiveness?

1.4.3. Subthemes

The aforementioned research question and associated encompassing theme ('Ambidextrous Ports') can be addressed in several ways. As already mentioned, the main focus in this dissertation is on how ports may become more ambidextrous – and thereby enhance their sustainable international competitiveness – in terms of being more innovative. An important distinction can be made between technological and management innovation. The former includes technological product innovation, which has been defined as "new technology or combination of technologies introduced commercially to meet a user or a market need" (Utterback & Abernathy, 1975: 642), and technological process innovation, which has been defined as "new elements introduced into an organization's production system or service operation for producing its products or rendering its services to the clients" (Damanpour et al., 2009: 654). Recent development such as the massive-scale collection, linkage and analysis of data (Big Data, Internet of Things), the partial transition from fossil- to bio-based chemicals, sophisticated robotics, and 3D-printing are strongly technologically determined. Technological innovations, such as new production techniques and innovative container terminal technologies (e.g. Gharehgozli et al., 2015), are needed to adapt to these and other new developments. At the same time, however, these developments – with far-reaching implications for many of the world's ports – demand changes in management practices, processes, structures, and techniques (Birkinshaw et al., 2008). This so-called 'soft side' of innovation is referred to by scholars as *management innovation* (Birkinshaw et al., 2008; Damanpour & Aravind, 2012; Hamel, 2006; Meuer, 2014; Vaccaro et al., 2012; Volberda et al., 2013a, 2014). Management innovation, including its relationship with technological innovation, is one of the seven subthemes of this dissertation (see Box 1.4).

Box 1.4. *Subthemes of the dissertation and their relation to the theme 'ambidextrous ports'*

1. ***Management innovation****:* In order for efficiency-directed ports to become more ambidextrous, their innovative performance needs to increase. This performance is determined not only by technological innovation – i.e. new technological products and processes – but also to an important extent by so-called *management innovation* (Birkinshaw et al., 2008; Damanpour & Aravind, 2012; Volberda et al., 2014), i.e. new management practices, processes, and structures.

2. ***Strategic connectivity****:* Ports consist of co-located firms from different clusters that jointly form important junctions in integrated chain systems (e.g. Robinson, 2002). In order for ports to become ambidextrous, the interfirm linkages that make up these chain systems need to focus on both minimization of transport and production costs (efficiency-driven transactional focus) and knowledge-intensive value creation for enhanced interfirm competitiveness (innovation-driven relational focus). The latter is captured by the concept of *strategic connectivity* (Van Den Bosch et al., 2011).

3. ***Industrial ecosystems****:* In ambidextrous port-industrial complexes, industrial firms actively look for more resource efficient and innovative ways of interorganizational collaboration. An interesting example in this respect is the formation of *industrial ecosystems* (e.g. Baas & Huisingh, 2008; Ehrenfeld & Gertler, 1997), in which the multiple constituent firms use one another's chemical effluents and residual energy as input for their own production processes.

4. ***Meta-organizations****:* Business or industry associations, which are types of *meta-organizations* (e.g. Ahrne & Brunsson, 2008; Gulati et al., 2012; Reveley & Ville, 2010), may play a valuable strategic role in enhancing a port's level of ambidexterity by performing activities and developing services for their member organizations that result in innovative port-level outcomes in different domains.

5. ***Business model innovation of port authorities****:* Ambidextrous ports require an ambidextrous port authority, i.e. a port authority that is able to act as both a traditional landlord and an entrepreneurial port developer. This envisioned ambidextrous stance may require the renewal of its current business model, i.e. *business model innovation* (e.g. Amit & Zott, 2012; Chesbrough, 2010; Markides, 2013).

6. ***Strategic value creation****:* In order for port authorities to prolong an ambidextrous port's 'license to operate and grow' from political and societal stakeholders over time, they are continually required to ensure that the port contributes to strengthening of the sustainable international competitiveness of its region and country, implying so-called *strategic value creation* (Van Den Bosch et al., 2011).

7. ***Port authority strategies****:* Port authorities need to develop and implement new strategies to increase the level of innovation in efficiency-directed ports, thereby contributing to a more ambidextrous port.

A second important subtheme is *strategic connectivity* (as distinct from the more commonly discussed concept of 'structural connectivity') on the intra- and inter-port level (Van Den Bosch et al., 2011), conceptualized in this dissertation as the relationally-oriented and generally knowledge-intensive interrelationships that enable the organizations involved to enhance their interorganizational competitive advantage (cf. Dyer & Singh, 1998). Drawing on prior research (e.g. Moon et al., 1995; Porter, 1990; Van Den Bosch et al., 2011), it is argued that ports in innovation-driven countries need to develop strategic connectivity in order to reach higher levels of business sophistication and innovation. In relation to this subtheme, part of the dissertation focuses on how multi-partner collaboration within ports – in multi-organizational networks (e.g. Das & Teng, 2002; Provan et al., 2007) – contributes to a more ambidextrous port. In ambidextrous ports, these relationships, which constitute an integral part of ports and the associated value systems – are organized and managed in ways that are conducive to both greater efficiency and innovation.

One type of multi-organizational collaboration in port-industrial complexes that is interesting in this regard is the *industrial ecosystem*, which is the third subtheme. Industrial ecosystems are alliances of multiple physically interlinked but autonomous firms that use one another's residual output as inputs for their production process (e.g. Baas & Huisingh, 2008; Ehrenfeld & Gertler, 1997; Tsvetkova & Gustafsson, 2012). Another type of multi-organizational collaboration, which is found in many ports, is the business association (e.g. Reveley & Ville, 2010). Such an association is an example of a *meta-organization*, being the dissertation's fourth subtheme, which is a formally established organization whose members are other organizations (e.g. Ahrne & Brunsson, 2008; Gulati et al., 2012; Hollen et al., 2014; König et al., 2012). It is examined in this dissertation how an established meta-organization can renew the activities that it performs for its members in the face of changing environmental conditions, thereby contributing to a more ambidextrous port.

The fifth subtheme is *business model innovation* of port authorities. Business models give a broad-based picture of how, with whom and for whom an organization creates value for its stakeholders, and how it both delivers and appropriates returns from that value (Baden-Fuller & Mangematin, 2013; Casadesus-Masanell & Ricart, 2010; Teece, 2010). Prior literature points out that disruptive changes in their environment require organizations to renew (i.e. innovate) their business model so as to survive in the long term (e.g. Chesbrough, 2010; Doz & Kosonen, 2010; Nunes & Breene, 2011). It is arguably the case that in order for port authorities to be able to trigger and facilitate an increase in innovation in their port, they are required to become more ambidextrous themselves as well, which may necessitate the renewal of these port authorities' business model. In order for port authorities to prolong an ambidextrous port's 'license to operate and grow' from stakeholders over time, they need to ensure that the port contributes to strengthening of the sustainable international competitiveness of its region and country, which implies '*strategic value creation'* (Van Den Bosch et al., 2011). Strategic value creation is the dissertation's sixth subtheme. Finally,

zeroing in on port authorities' strategic role in enabling a more ambidextrous port, the last subtheme is *port authority strategies*.

As shown in Table 1.5, each of the subthemes is covered by at least two chapters of the dissertation. As the multiple X' in each of the seven chapter-columns already suggest, these subthemes are clearly interlinked. For instance, as further elaborated in Chapter 4, port authorities can play an important strategic role in fostering interorganizational collaboration in the form of industrial ecosystems, which is an example of strategic connectivity. Taking on such a role, however, may require business model innovation. Besides, the firms involved in the industrial ecosystems may need to engage in management innovation.

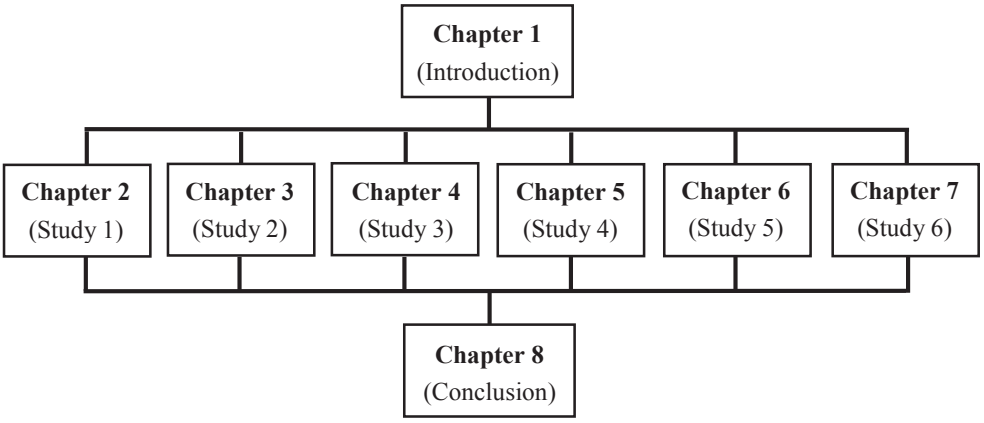
Table 1.5. *Subthemes of the dissertation: Coverage by the different chapters*

	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8
1. Management innovation		X	X	X	X	X	X
2. Strategic connectivity	X		X	X	X	X	X
3. Industrial ecosystems			X	X			X
4. Meta-organizations						X	X
5. Business model innovation of port authorities		X	X				X
6. Strategic value creation	X	X					X
7. Port authority strategies	X	X	X		X		X

1.5. Overview of the Studies in the Dissertation

The remainder of the dissertation consists of seven chapters (Chapters 2–8) that contribute to an increased understanding of how ports can become more ambidextrous, with a focus on enhancing ports' innovation-driven sustainable competitive advantage. Each of the chapters relates to at least three of the subthemes mentioned in Box 1.4 and Table 1.5 and, as can be derived from the dissertation's structure (depicted in Figure 1.1), can be read separately and independently of one another. The final chapter, Chapter 8, comprises a discussion of the dissertation's overall contributions, managerial implications and future research agenda.

Figure 1.1. *Structure of the dissertation*



An overview of the six core studies in Chapter 2–7 of the dissertation is provided in Table 1.6. In the remaining sections of this chapter, an abstract is provided for each of these six studies. As can be distilled from these abstracts, five studies contain a (port-related) case study. The predominant use of case studies is largely explained by the exploratory nature of the inquiries and the underlying research questions (see the third column in Table 1.6), as well as by the importance of addressing these questions – most of which pertain to rather complex processes of change with regard to changes in managing/organizing – in a real-life context. For such exploratory research, which can draw upon previous literature only to a relatively limited extent, a case study approach is considered appropriate (Yin, 2013). Given this emphasis on exploratory case studies, it can be stated that the dissertation's predominant focus is on the 'exploration' – rather than 'exploitation' – of theory (i.e. theory building).

Abstract of Study 1 (see Chapter 2) – Enhancing the International Competitiveness of Ports and Strategic Value for their Country: A Multi-Level Strategic Connectivity Lens

Drawing on the notion that ports are nodes in global, integral chain systems, this study adds to previous research on international port competitiveness by adopting a strategic network perspective on how to sustainably enhance such competitiveness and, in addition, strategic value creation for the country. In doing so, it focuses on the interorganizational knowledge-intensive relationships within and between ports that enable the organizations involved to enhance their competitive performance. These ties are referred to as strategic connectivity (being different than structural connectivity). An extension of Porter's (1990) widely applied Diamond Framework is used as an illustrative conceptualization of strategic connectivity.

Table 1.6. *Overview of the six studies in this dissertation (see Chapters 2–7)*

	Title	***Research question***	***Research activities***	***Main contributions***
Study 1 *(Ch. 2)*	*Enhancing the International Competitiveness of Ports and the Strategic Value for their Country: A Multi-Level Strategic Connectivity Lens*	How to enhance a port's sustainable international competitiveness through strategic connectivity on various levels?	- Literature review - Secondary data collection - Method comparisons	- Conceptualization of strategic connectivity - Clarification of the challenge to focus on the competitiveness of port *and* country - Comparison of two existing methods for assessing ports' strategic value creation
Study 2 *(Ch. 3)*	*Business Model Innovation of Port Authorities: A Case Study of the Port of Rotterdam Authority (2000–2012)*	How can port authorities increase their strategic value creation by renewing their business model?	- Literature review - In-depth interviews - Secondary data Collection	- Conceptualization of business model innovation of (semi-)public port authorities - Empirical analysis of the different levers of business model innovation of port authorities and resulting new businesses
Study 3 *(Ch. 4)*	*Strategic Levers of Port Authorities for Industrial Ecosystem Development*	How can port authorities foster the development of industrial ecosystems in order to improve both the competitiveness and environmental performance of a port-industrial complex?	- Literature review - In-depth interviews - Secondary data collection	- Identification of how generic policy instruments of port authorities can be turned into strategic levers to foster industrial ecosystem development in ports - Empirical analysis of these strategic levers

Table 1.6 (continued). *Overview of the six studies in this dissertation (see Chapters 2–7)*

	Title	***Research question***	***Research activities***	***Main contributions***
Study 4 *(Ch. 5)*	*Managing Organizational Interdependence for Enhanced Resource Productivity: The Role of Management Innovation in Industrial Ecosystems in Ports*	How can the development of new management practices in managing organizational interdependence in the setting of industrial ecosystems lead to enhanced resource productivity?	- Literature review - In-depth interviews - Secondary data collection - Feedback sessions - Data analysis	- Identification of management innovation at the multi-organizational level of analysis - Empirical analysis of (multi-)organizational dynamics and outcomes of management innovation in industrial ecosystems
Study 5 *(Ch. 6)*	*The Role of Management Innovation in Enabling Technological Process Innovation in Ports: An Interorganizational Perspective*	How can management innovation enable firms to perform the development phase of technological process innovation in an external test facility?	- Literature review - In-depth interviews	- Identification of management innovation at the interorganizational level of analysis. - Clarification of how technological process innovation and management innovation may be combined over time in an intertwined way
Study 6 *(Ch. 7)*	*How Changes in Organizing Meta-Organizations Contribute to Attaining Collective Port-related Goals: A Case Study of Business Association Deltalinqs*	How may changes in organizing an established meta-organization contribute to the renewal of its goal-directed activities in order to adapt to changing conditions in the environments?	- Literature review - In-depth interviews - Secondary data collection - Feedback sessions - Data analysis	- Empirical analysis for enhanced theoretical insights into levers of meta-organization renewal, including changes in organizing as regards the meta-organization's structure, the division of labor and integration of efforts by its members, board and staff, and the involvement of external stakeholders

In line with prior research, a distinction is made between three interrelated levels of strategic connectivity, i.e. port level, national level and international level, resulting in a conceptual framework of multi-level strategic connectivity. Based on reports by the World Economic Forum, it is explained that strategic connectivity of ports located in economically advanced countries needs to be primarily innovation-driven. In addition, the study stresses the need for port authorities to contribute to the international competitiveness of both the port and its country, and compares two recent methods for assessing the strategic value of ports for their country. The inclusion of an additional focus on strategic value creation leads to an extended conceptual framework of strategic connectivity. The main contributions and implications of the study are discussed, followed by several suggestions for future research.

Abstract of Study 2 (see Chapter 3) – Business Model Innovation of Port Authorities: A Case Study of the Port of Rotterdam Authority (2000–2012)

Scholars have examined various ways in which business model innovation enables a firm to create and appropriate more value so as to improve its international competitive advantage. For port authorities and other organizations with public responsibilities, however, the main purpose of business model innovation is to create value for other organizations and society. This entails that the activities performed by port authorities need to contribute to a stronger competitiveness of firms in their region and country, while taking the living conditions of inhabitants into account. Presenting a case study of business model innovation of the Port of Rotterdam Authority in the period 2000–2012, this study aims to increase our understanding of business model innovation of port authorities focused on strategic value creation.

The study focuses on how changes in different levers of business model innovation, i.e. changes in organization, management and co-creation with external actors, but also CEO leadership and changes in the external environment, have resulted in the development of several new businesses of the Port of Rotterdam Authority. In doing so, these changes have contributed to a transition from a 'landlord' business model toward an 'extended landlord' (port developer) business model and to the accompanying creation of additional strategic value for both the port and the country.

Abstract of Study 3 (see Chapter 4) – Strategic Levers of Port Authorities for Industrial Ecosystem Development

Major leading ports such as Rotterdam, Antwerp, Houston, and Singapore's Jurong Port host large industrial complexes of (petro)chemical and other energy-intensive process industry firms. The development of industrial ecosystems, in which firms use one another's residual energy and chemical effluents as input for their own production, contributes to both greater international competitiveness and better environmental performance of these complexes. This study examines how port authorities can foster this development within their port-industrial complex. A case study is presented of the port of Rotterdam to empirically capture

how its port authority has done so in the last decade by strategically making use of two generic types of policy instruments: (i) investments in infrastructure (including both physical and knowledge infrastructure), and (ii) land allocation.

On the basis of the case study and prior literature, the study derives a set of strategic levers of port authorities to foster the development of industrial ecosystems. These strategic levers include: investing in the construction of common carrier pipeline bundles and in the realization of 'plug and play areas' with bundled utility services; investing in linkages with knowledge institutes; co-creating platforms for interorganizational information/knowledge sharing; stimulating co-siting; and introducing stringent environmental sustainability criteria for land lease contracts. Implications and challenges for port authorities are discussed.

Abstract of Study 4 (see Chapter 5) – Managing Organizational Interdependence for Enhanced Resource Productivity: The Role of Management Innovation in Industrial Ecosystems in Ports

Industrial firms increasingly face a dual challenge of further improving their competitiveness and environmental performance. Gains in resource productivity, important for effectively dealing with this dual challenge, are largely contingent on their collaborative efforts to engage in resource-based interactions. However, both in the literature and in practice it remains unclear how new multi-firm interactions and, in particular, the interdependencies involved are to be managed in a way that enables such gains over time. This study addresses this void by examining how legally autonomous firms that form an industrial ecosystems manage their interdependence. In doing so, the study focuses on the development of new management practices by these firms, i.e. management innovation.

A case study is presented of an industrial ecosystem that consists of three established chemical firms. It shows the importance of developing new management practices such as the measuring and reporting on joint performance, the introduction of structurally planned interorganizational meetings at several hierarchical layers, and the development of cross-functional interorganizational procedures. The case study also highlights the complex, time-consuming process involved, and points out contextual triggers. The study suggests that, although established firms tend to manage their interdependence by using their current formal management practices that seek to protect and enhance their own competitiveness (in terms of resource productivity), they would benefit from purposefully developing new (types of) management practices which are directed at enhancing joint resource productivity.

Abstract of Study 5 (see Chapter 6) – The Role of Management Innovation in Enabling Technological Process Innovation: An Interorganizational Perspective

For enhanced sustainable competitive advantage of established process manufacturing firms, technological process innovation to improve resource productivity as well as environmental performance has become of pivotal importance. Many established firms, however, face

intra-organizational tensions to reconcile pressures for exploration and exploitation across subsequent phases (i.e. discovery, development and deployment) of technological process innovation. These firms may therefore benefit from performing the development phase – which is the most sensitive to these tensions – in the interorganizational context of an external dedicated development facility. Doing so requires new-to-the-firm management activities, i.e. management innovation, but the role of management innovation in enabling technological process innovation in this type of interorganizational context remains largely unexplored. To address this gap in the literature, in developing propositions this study uses illustrative examples from the research context of an external test facility for sustainable process technology in the port of Rotterdam.

The study's contributions are twofold. First, it contributes to increased understanding of the interrelationship between management innovation and technological (process) innovation. Adopting a process perspective, it is clarified how these two types of innovation may be combined over time in an intertwined way. Second, the study extends and advances the existing body of management innovation-related studies by conceptualizing management innovation in an interorganizational context. Taking this context into account enables a broader recognition of the role of interorganizational interactions and the associated change agents in shaping and influencing the process of developing new management practices. The study is concluded with implications for theory, practice, and future research.

Abstract of Study 6 (see Chapter 7) – How Changes in Organizing Meta-Organizations Contribute to Attaining Collective Port-related Goals: A Case Study of Business Association Deltalinqs

Many organizations in ports are member of one or more industry or business associations, which are examples of so-called 'meta-organizations'. The meta-organization, which has been previously defined as a formally established organization whose members are other organizations, constitutes an important yet underexplored subject of organization studies. Prior scholarship revolves largely around why meta-organizations exist, how they differ from individual-based organizations (e.g. firms), and how their idiosyncratic characteristics and initial structural design choices shape their goal-directed activities (e.g. standard setting and facilitating member-interaction). Far less attention has been given to how established meta-organizations renew their current activities when faced with changing environmental conditions. Studies on organizational renewal, which stress the need for co-alignment with dynamic environments, are predominantly centered on firms, in which there is managerial authority. Their applicability to meta-organizations is therefore restricted.

Drawing on prior literature and a case study of Deltalinqs, the business association of more than 700 organizations in the port of Rotterdam, this study examines how changes in organizing an established meta-organization contribute to the renewal of its goal-directed activities. In particular, the study's findings show the enabling role of changes in a meta-

organization's internal structure and, concurrently, in the roles of its members, staff, board, and external stakeholders, and highlight the importance of fostering a norm of generalized reciprocity. Propositions and a conceptual framework are developed that provide directions in which the body of meta-organization studies may be usefully enriched.

1.6. Declaration of Contribution

In what follows I (hereinafter 'the author') declare my contributions to the eight chapters in this dissertation and acknowledge the contributions of other people involved.

Chapter 1: The work in this chapter has been done by the author.

Chapter 2: The majority of the work in this chapter has been done by the author in collaboration with his promotors (i.e. Prof.dr. Frans A.J. van den Bosch and Prof.dr. Henk W. Volberda). The author is the first author. The work builds on and borrows concepts from a previously published research report (Van Den Bosch et al., 2011) written by the author, his promotors and dr. Marc G. Baaij.

Chapter 3: The work in this chapter has been done by the author in collaboration with his promotors, who are the co-authors. The author is the first author. Part of the work has been published as a book chapter; see also the footnote on page 43.

Chapter 4: The work in this chapter has been done by the author in collaboration with his promotors, who are the co-authors. The author is the first author. The work has benefitted from the comments by anonymous reviewers and a guest editor of *Maritime Economics & Logistics*; see also the footnote on page 61.

Chapter 5: The work in this chapter has been done by the author in collaboration with his promotors and Rianne M. van Nieuwland, who are the co-authors of the work. The author is the first author. The work, which has been submitted for publication in an international academic journal, has benefitted from the comments by anonymous reviewers for several academic conferences; see also the footnote on page 77.

Chapter 6: The work in this chapter has been done by the author in collaboration with his promotors, who are the co-authors. The author is the first author. The work has benefitted from comments by anonymous reviewers of *European Management Review* and anonymous reviewers for several academic conferences; see also the footnote on page 103.

Chapter 7: The work in this chapter has been done by the author in collaboration with his promotors and Jochem T. Hummel (VU University Amsterdam), who are the co-authors of the work, which has been submitted for publication in an academic journal. The author is the first author. The work benefitted from comments by anonymous reviewers for different academic conferences; see also the footnote on page 127.

Chapter 8: The work in this final chapter has been done by the author.

CHAPTER 2

Enhancing the International Competitiveness of Ports and the Strategic Value for their Country: A Multi-Level Strategic Connectivity Perspective*

2.1. Introduction

Authorities of leading ports are continually looking for new ways to increase a port's market share and, related to this, contribute to its *international competitiveness*. A large number of academic studies have looked into the determinants of international competitiveness of ports (De Lombaerde & Verbeke, 1989; De Martino & Morvillo, 2008; Ha, 2003; Haezendonck, 2001; Huybrechts et al., 2002; Kreukels & Wever, 1998; Lirn et al., 2004; Ng, 2009; Notteboom et al., 1997; Pallis & Vaggelas, 2005; Song & Panayides, 2008; Teng et al., 2004; Tongzon, 2007; Tongzon & Heng, 2005; Yeo et al., 2008). Most of these studies adopt a principally economic, legal and/or logistic point of view to analyze the factors that explain differences in the relative attractiveness of ports for their clients (i.e. firms) in terms of service quality and costs. These factors may include – but are not limited to – the level of economic activity around a port, political stability and other macro-economic factors, rules and regulations, rents and harbor dues, a port's geographical location, loading and unloading efficiencies, the quality of port infra- and superstructure, cargo handling capacity, logistics and operational costs, the availability of skilled and flexible labor, and the size, condition and accessibility of the hinterland.

Drawing on the notion that ports are nodes in global, complex, and integral chain systems (Huybrechts et al., 2002; Robinson, 2002), this study adds to previous research on international port competitiveness by presenting a strategic network perspective on how such competitiveness may be enhanced. This perspective entails a particular focus on knowledge-intensive organizational interrelationships within and between ports – or inland logistic and industrial centers – that enable the organizations involved to enhance their competitive performance. We refer to the set of these interorganizational ties as *strategic connectivity*.

*) Parts of this work have been presented at the World Conference on Transport Research Society (WCTRS), SIG2 (Maritime Transport and Ports), in Antwerp (Belgium) in May 2015.

We acknowledge that ports' international competitiveness is partly beyond the coordinating and controlling influence of port authorities. As Haezendonck and Notteboom (2002: 68) pointed out: "A port's prosperity is also conditioned by links in the logistics chain on which ports have no direct influence". Taking this notion into account, the *research question* that guides our study is as follows: What is the role of strategic connectivity in enhancing the international competitiveness of ports?

In addressing this research question, we draw on previous theory and research (e.g. Hollen et al., 2015; Van Den Bosch et al., 2011) to distinguish between three different but interrelated levels of strategic connectivity: (1) within a port; (2) between this port and one or more other ports or "multimodal inland centres" (Haezendonck & Notteboom, 2002: 68) within the same country; and (3) between this port and ports located abroad. In an effort to establish an enhanced empirical basis for understanding the role of strategic connectivity in enhancing ports' international competitiveness, and how port authorities can boost strategic connectivity, we provide several illustrative examples from the port of Rotterdam, Europe's largest port-industrial complex.

The outline of this study is as follows. In the following section we elaborate on the concept of strategic connectivity and its importance for enhancing ports' competitiveness, followed by a conceptual framework of multi-level strategic connectivity. We then introduce the extended Diamond model, based on Porter (1990) and others (e.g. Moon et al., 1995; Rugman & Verbeke, 1993), as an illustrative conceptualization of strategic connectivity. In what follows we distinguish, based on reports by the World Economic Forum (e.g. Schwab, 2014) between three different types of competitive foci of strategic connectivity. Next, we stress the importance for port authorities to focus on not only contributing to the international competitiveness of a port but also that of the country where it is located, i.e. the importance of strategic value creation for the country. In this vein, we compare two methods – cf. Van Den Bosch et al. (2011) and Vonck & Notteboom (2015) – for the assessment of ports' strategic value creation. This inclusion of a focus on strategic value creation for a country leads us to suggest an extended conceptual framework of multi-level strategic connectivity. The study concludes by discussing its contributions and implications for port authorities.

2.2. Strategic Connectivity of Ports: A Conceptual Analysis

Prior research in the field of organization and management suggests that the competitiveness of established firms is profoundly influenced by the networks of relationships in which these firms are embedded (e.g. Dyer & Singh, 1998; Gulati, 2007; Lorenzoni & Lipparini, 1999; Zaheer & Bell, 2005). For instance, collaboration up, down, and outside their production/ supply chain may enable firms to improve the optimization of fleet patterns, freight flows and throughput, organize for complex innovation, introduce new products and services, and increase the value of by-products. In the extant port-related literature, interorganizational

ties have been examined as regards, among others, shipping alliances (e.g. Das, 2011; Song & Panayides, 2002), supply chain management (e.g. De Martino & Morvillo, 2008; Grewal & Haugstetter, 2007), and port co-opetition (e.g. Song, 2003; Wang et al., 2012). These ties are largely about *connectivity* between actors within ports, between ports, and among ports and multimodal inland centers (including logistic and industrial inland centers).

Most port-related studies in which connectivity takes center stage pertain to international maritime networks of liner shipping, intermodal transport networks, and physical supply chains in general (e.g. Banomyong, 2013; De Langen & Sharypova, 2013; Ducruet et al., 2010, 2011; Jiang et al., 2015; Low et al., 2009; Paflioti et al., 2014). Many of these studies adopt a network structural perspective by focusing primarily on ports' network position in terms of quantifiable measures such as the number of connections to and from other ports of call on international freight routes, betweenness centrality with regard to these routes, the number of hinterland connections, and the frequency and capacity of goods flows pertaining to the shipping routes and hinterland connections. These and comparable measures relate to what has been referred to as the *structural connectivity* of ports (e.g. Van Den Bosch et al., 2011) – see also Table 2.1.

Table 2.1. *Structural connectivity versus strategic connectivity in the context of ports*

	Structural connectivity	**Strategic connectivity**
Definition	A port's structural network position in global, integral chains of transport.	The organizational knowledge-intensive interrelationships within and between ports/ hubs that enable organizations involved to enhance their competitive performance.
Focus	Transactional focus on minimizing the (generalized) costs of transport, and optimizing operations.	Relational focus on creating added value through knowledge-intensive interorganizational exchanges.
Examples	Number of connections to/from other ports of call on international freight routes; betweenness centrality regarding such routes; number of hinterland connections; frequency of goods flows pertaining to shipping routes and hinterland connections.	The access to and utilization of unique, high-quality knowledge, supplier or customer networks in ports, resulting in e.g. strategic renewal, specialization, smart and secure trade lanes, synchromodal planning systems, and logistics communication platforms.
Outcome	Mainly short-term organizational competitive advantage.	Aimed at long-term *inter*organizational competitive advantage.

Source: Author

Managing and organizing structural connectivity is predominantly realized through a so-called *transactional approach* (cf. Macneil, 1974; Ring & Van De Ven, 1992). Such an approach implies an emphasis on the contractual aspects of transactions and the generalized costs of freight flows in order to protect or enhance a firm's or port's short-term competitive advantage (see Table 2.1). The firms involved tend to be reluctant to make unilateral and voluntary commitments not specified in contracts (Madhok & Tallman, 1998). The activities of these firms – being principally motivated by self-interest – that are consistent with this transactional approach are embedded in "atomistic" network ties (Uzzi, 1997: 36). These ties lack social embeddedness and the typical accompanying exchanges of information and knowledge. For port authorities to improve a port's international competitiveness on the long run, merely enhancing its structural connectivity is often insufficient. For that to accomplish, connectivity particularly needs to become more unique – i.e. difficult to acquire or replicate by competitors – through, for instance, sharing of information and knowledge on relevant operational and managerial processes by the organizations involved.

Based on previous research (e.g. Van Den Bosch et al., 2011), we define *strategic connectivity* in the context of ports as the set of knowledge-intensive interorganizational relationships within and between ports – and between ports and inland logistic/industrial centers – that enable the organizations involved to enhance their long-term international competitiveness. In order for this competitiveness to be sustainable, all organizations involved should benefit from strategic connectivity by appropriating part of the value it generates. Hence, strategic connectivity is aimed at enhancing *inter*organizational (rather than firm-centric) competitive advantage (cf. Dyer & Singh, 1998) in particular.

Accordingly, strategic connectivity is associated with a *relational approach* (e.g. Macneil, 1974; Ring & Van De Ven, 1992, 1994; Zajac & Olsen, 1993) in organizational interrelationships (see Table 2.1), which is socially embedded (Doménech & Davies, 2011). A change from mainly structural connectivity toward more strategic connectivity hence implies a transition from an approach to managing organizational interactions which is predominantly transactionally oriented to one which is more relationally oriented (Hollen et al., 2015; Ring & Van De Ven, 1994). The literature suggests that such a transition arises largely from recurrent interactions and the attendant building of trust among each of the organizations involved (Elfenbein & Zenger, 2014; Lorenzoni & Lipparini, 1999; Ring & Van De Ven, 1994; Zajac & Olsen, 1993). In contrast to structural connectivity, strategic connectivity is commonly assessed qualitatively, although it is possible to make quantitative estimates (Van Den Bosch et al., 2011). Strategic connectivity often builds on structural connectivity. However, ports can be strategically interconnected also without physical goods flows taking place. As elaborated below, for ports in economically advanced countries to become more internationally competitive, their strategic connectivity should be focused on strengthening innovation, strategic renewal, and business sophistication factors in particular.

2.2.1. Example of conceptualizing strategic connectivity: The (extended) Diamond Framework

One way to illustrate the concept of strategic connectivity is by incorporating Porter's (1990) Diamond Framework (see Figure 2.1). This framework, introduced in his influential book *The Competitive Advantage of Nations*, has frequently been used to analyze the international competitiveness of firms (irrespective of their nationality) in a particular industry or cluster of industries in a country. As further elaborated in Box 2.1, the Diamond Framework has four interrelated components that jointly enable firms to increase their productivity and, accordingly, be internationally competitive. These components, which hence are to be seen as different domestic determinants of international competitiveness (Porter, 1990; Van Den Bosch & De Man, 1997), are: (1) factor conditions; (2) demand conditions; (3) related and supporting industries; and (4) the context for firm strategy, industry structure and rivalry.

Figure 2.1. *Diamond Framework: Determinants of international competitiveness*

Source: Adapted from Figure 3.5 in Porter (1990)

This diamond-shaped framework has been previously utilized in several port-related studies (Haezendonck, 2001; Haezendonck & Notteboom, 2002; Ng, 2009; Van Den Bosch et al., 2011). The factor conditions in a port context, for instance, refer to the developed or inherited means employed for providing port-related services, such as a port's geographic location (Hayuth & Fleming, 1994), infra- and superstructure, skilled labor, and maritime and hinterland access.

The notion of strategic connectivity pertains to the organizational interrelationships that contribute to strengthening of the determinants of a port's international competitiveness. There are dynamic interactions taking place among these determinants (Porter, 1990). For

Box 2.1. *The determinants of international competitiveness of the Diamond Framework*

- The determinant *factor conditions* refers to the developed and inherited means employed for providing port-related services, such as a port's geographic location, maritime and hinterland access, infrastructure (e.g. berths, roads and railways), superstructure (e.g. cranes), ICT platforms, skilled labour, and capital resources. The more factor conditions are advanced and specialized, the higher their contribution to a port's international competitiveness.
- The determinant *demand conditions* refers to the extent that there are advanced firms in and beyond the port – such as shipping companies, terminal operators, and producers – that are generally internationally oriented (in the business-to-consumer or business-to-business segment) and demanding in the sense that they pressure other firms to innovate (e.g. in terms of creating new, more advanced products and/or services) and to increase productivity so as to meet their needs.
- The determinant *related and supporting industries* refers to the presence of internationally competitive domestic supporting industries – such as legal services, shipping agents, ship repair, banking and insurance, towing services and transport – and related industries. When the firms in these industries are embedded in leading networks and operate internationally, they catalyse high-quality or low cost services and thereby contribute to a port's international competiveness.
- The determinant *context for firm strategy, structure and rivalry* emphasizes (1) how organizations are established, organized, managed, and deal with stakeholders (e.g. clients) and (2) the intensity of rivalry in their home base, which pressures these organizations to renew and remain flexible.
- *Governmental* and *quasi-governmental organizations* on local, regional, national, and supranational level can have an important influence on the four abovementioned determinants and their interactions. For instance, their rules and regulations, policies, tax-related stimulation programs, and investments can stimulate or inhibit firms to reach higher levels of innovation, renewal and international competitiveness.

Sources: Porter (1990), Haezendonck & Notteboom (2002), Ng (2009), Van Den Bosch & De Man (1994, 1997); Van Den Bosch et al. (2011)

instance, interactions between supporting industries and demand conditions will be stronger when the interrelationships between suppliers and demanding clients are characterized by relational exchanges of resources rather than by mere market transactions. Both formal and informal relations between organizations play important roles in the interactions among determinants. *Governmental bodies*, including national or state governments, municipalities, tax and customs authorities, and port authorities, are viewed as playing a potentially important role in influencing the determinants and their interactions through, for instance, legislation, financing, and concessioning policies (Van Den Bosch & De Man, 1994).

Dunning (1999) pointed out that the international competitiveness of firms and industries in one country may be partly explained by certain linkages with other countries. In a similar vein, Rugman and colleagues (Moon, Rugman, & Verbeke, 1995; Rugman & D'Cruz, 1991; Rugman & Verbeke, 1993) suggested to expand Porter's single and 'home-based' Diamond Framework by incorporating the fact that strategic connections between countries enable entities in these countries to draw on (i.e. tap into) the strengths of each other's determinants of international competitiveness. According to this 'multiple diamond perspective', "[…] managers should build upon both domestic and foreign diamonds to become globally competitive in terms of survival, profitability and growth" (Moon et al., 1995: 98). This extension of the traditional Diamond model – based on the inclusion of linkages with so-called 'foreign diamonds' – is particularly applicable to relatively small, open economies (Moon et al., 1995). The extended model has been applied also to the port-context (Haezendonck, 2001; Haezendonck & Notteboom, 2002; Van Den Bosch et al., 2011). By developing strategic connections with other ports (or inland centers), a port increases its ability to access and utilize the set of determinants of international competitiveness present in these other ports (or inland centers), thereby leveraging or strengthening the determinants presents in its own port. Haezendonck and Notteboom (2002: 85) concluded that this approach of the extended diamond model is "[…] appropriate for the analysis of a port cluster's competitiveness".

2.2.2. Three levels of strategic connectivity: Toward an encompassing framework

We can distinguish between strategic connectivity in an international context at (at least) *three geographical levels of analysis* (Van Den Bosch et al., 2011). First of all, there is strategic connectivity within a port, i.e. *port-level strategic connectivity*, implying both the vertical interorganizational relationships (i.e. between firms operating in distinct stages of the value chain) and horizontal interrelationships (i.e. between firms belonging to the same industry that operate in the same value chain stage) within a particular port that strengthen the port-wide determinants of international competitiveness (Porter, 1990) or the interactions between these determinants. Examples of port-level strategic connectivity can be found in, for example, closed-loop supply chains (Van Nunen & Zuidwijk, 2004), including industrial ecosystems (Baas & Huisingh, 2008; Hollen et al., 2015), and, as elaborated in Box 2.2, business association platforms. As asserted by Haezendonck and Notteboom (2002: 68), however, "[…] gaining competitive advantage is increasingly a matter of going beyond the port boundaries both in a physical and psychological sense", as ports have become "increasingly interrelated with other ports and multimodal inland centres". In this relation, it has been underlined that competition is unfolding not just between ports individually but also between integral (product and logistic) chain systems, in which these ports constitute important nodes and links (Notteboom & Rodrigue, 2005; Robinson, 2002; Van De Voorde & Winkelmans, 2002b). This emphasizes the importance of strategic connectivity beyond a

Box 2.2. *Strategic connectivity: Three levels of analysis and illustrative examples*

- Strategic connectivity at the ***port level****:* strategic connectivity between organizations (both domestically owned and foreign owned) within the port.
  - *Illustrative example:* In 2003 the port of Rotterdam business association Deltalinqs launched Deltalinqs 'University', a coordination platform for safety-related issues. Within this platform a Safety Management System was developed that promotes harmonization of safety measures and instructions by enabling members to learn by benchmarking. This new activity revolves around various safety-management procedures that describe generic safety-standards and guidelines with respect to operations. Committed members meet twice a year to evaluate the procedures' content and decide on adding objectives. (See also Chapter 7 in this dissertation).
- Strategic connectivity at the ***national level****:* strategic connectivity of a port with other ports or multimodal inland centres (e.g. inland terminals and industrial complexes) within the same country.
  - *Illustrative example:* In 2009, the ports of Rotterdam and Amsterdam established Portbase, a joint logistics communication platform. Portbase offers a broad range of intelligent services developed for the efficient mutual exchange of port-transcending information between the ports' customers and between these firms and governments. All the exchanges are conducted via one central point. Hence, the organizations that use Portbase no longer need to maintain a multiplicity of bilateral connections and are enabled to optimize their processes and cooperation with different supply chain partners. (See also Van Den Bosch et al., 2011).
- Strategic connectivity at the ***international level****:* strategic connectivity of a port with foreign-located ports (or other hubs) abroad.
  - *Illustrative example:* Traditionally, the Dutch Tax & Customs Authority controlled all port-related transactions. In 2007, it started with providing Authorised Economic Operator (AEO) certificates to firms considered to be in self-control and therefore trustworthy at firm-level. Firms with this certificate are controlled less strictly, which saves them significant time. Also, the Tax and Customs Authority have initiated the implementation of so-called 'Smart and Secure Trade Lanes' between, for instance, the ports of Rotterdam and Shanghai, meaning that entire end-to-end supply chains (rather than single firms) are being certified (Van Den Bosch & Hollen, 2015).

port's perimeter. In that vein, in addition to port-level strategic connectivity one can also distinguish strategic connectivity at the national and international level, as elaborated next.

National strategic connectivity implies strategic connectivity of a port with other ports – or with other hubs such as inland terminals – within the same country. The example of Portbase is provided in Box 2.2. Strategic connectivity at the international level, i.e.

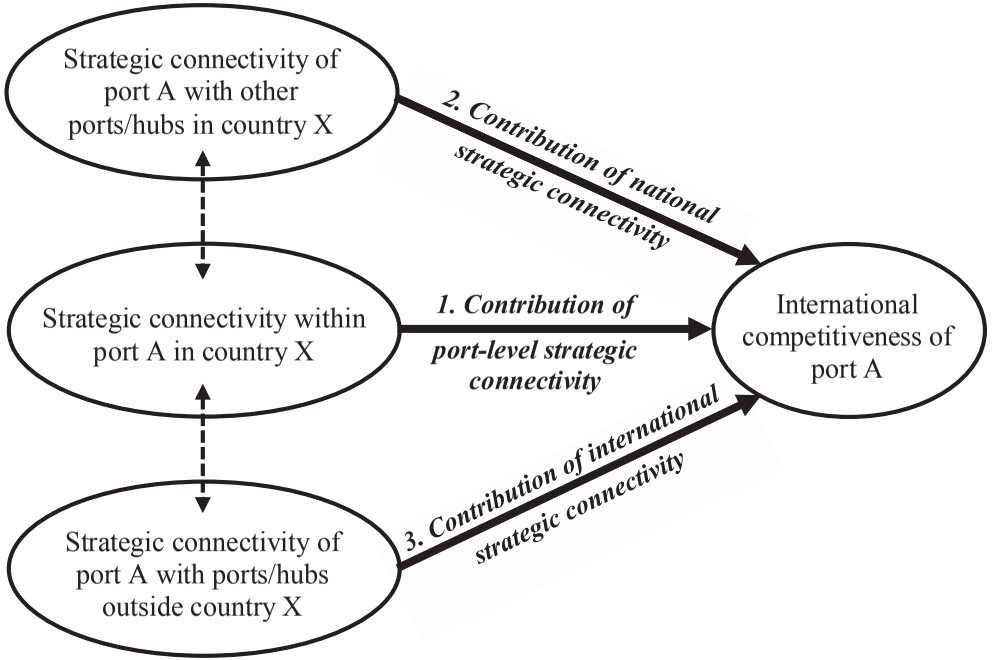
international strategic connectivity, in turn, implies strategic connectivity of a port with foreign-located ports or other hubs abroad. These foreign-located ports may be located within the same port range, such as the Hamburg–Le Havre range, the Mediterranean range or the Baltic range in Europe, but also outside this range. An interesting example of international strategic connectivity of a port with logistic and industrial hubs in its captive hinterland, within the same port range, is the application of synchromodal transport in supply chains by terminal operators, allowing a smarter and more sustainable use of different modes of transport and related infrastructure. An example of international strategic connectivity beyond a port range is the strategic connectivity of the port of Rotterdam with the port of Sohar (Van Den Bosch et al., 2011) in the form of two joint ventures (i.e. Sohar Industrial Port Company and Sohar International Development Company) of the Sultanate of Oman and the Port of Rotterdam Authority. Another example of increased international strategic connectivity, the development of so-called 'Safe and Secure Trade Lanes' between the ports of Rotterdam and Shanghai (Van Den Bosch & Hollen, 2015), is provided in Box 2.2.

In general, the notions of national and international strategic connectivity resonate with the logic of the 'multiple diamond perspective' (Moon, Rugman, & Verbeke, 1995; Rugman & D'Cruz, 1991; Rugman & Verbeke, 1993) as elaborated above. That is, strategic connectivity at the national and international level strengthens a port's set of determinants of international competitiveness by enabling improved access to and utilization of the various determinants that are present in ports and inland centers elsewhere in the country and abroad, respectively. In sum, taking a strategic network perspective (e.g. Zaheer & Bell, 2005), it can be argued that there are – at least – three interrelated ways to enhance a port's international competitiveness: (1) by enhancing the strategic connectivity within the port; (2) by enhancing its strategic connectivity with other ports/hubs in the same country; and (3) by enhancing its strategic connectivity with other ports/hubs abroad. This distinction leads to the *conceptual framework of multi-level strategic connectivity* depicted in Figure 2.2.

Two remarks need to be made at this point. First, both national and international strategic connectivity can be focused on *downstream* and *upstream* integral chain systems of logistics and production. Downstream strategic connectivity, which relates to forward collaboration, pertains to the relationships of (organizations in) a port with (organizations in) both logistic hubs in its hinterland and overseas ports that are supplied from the port (e.g. after transshipment). Upstream strategic connectivity, in contrast, which relates to backward collaboration, pertains to the port's relationships with feeder ports in its foreland from which goods flow to the port before, in turn, being transported to its hinterland. Besides vertical (upstream or downstream) organizational interrelationships, both national and international strategic connectivity can relate to *horizontal* interrelationships (e.g. a collaborative inter-port platform for cyber security).

Second, it deserves mention that a port's strategic connectivity is determined partly by the networks of the actors located in this port. The more geographically extended these networks are, stretching out over multiple ports, the larger the port's strategic connectivity.

Figure 2.2. *Conceptual framework of multi-level strategic connectivity: Three ways to increase ports' international competitiveness*



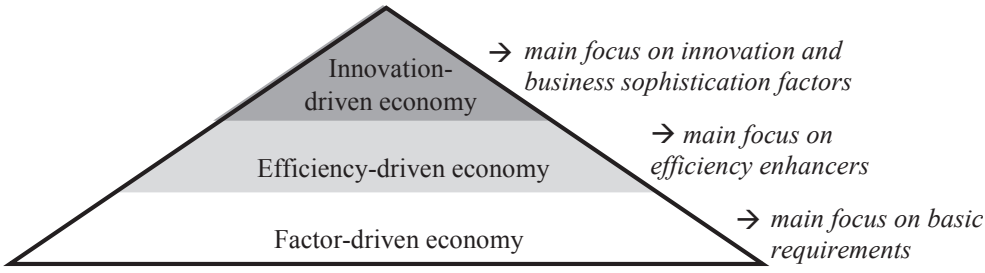
Source: adapted from Van Den Bosch et al. (2011)

Hence, one way to increase a port's strategic connectivity is to attract multinational firms. The internal and external networks of such internationally operating firms are generally used to enhance both their own international competitiveness and that of the cluster in which these firms are involved (Moon, Rugman, & Verbeke, 1995; Rugman & Verbeke, 1993).

2.2.3. Three types of competitive foci of strategic connectivity

The presented conceptual framework focuses on the role of multi-level strategic connectivity in enhancing a port's sustainable international competitiveness. It should be noted that such competitiveness, which is often indicated by a port's market share with respect to its captive hinterland in terms of volumes of containers and bulk goods handled, is a relative concept that needs to be measured according to an *external benchmark*. One such an external benchmark is the World Economic Forum (WEF) Global Competitiveness Index (GCI). The WEF discerns three stages of economic development of countries, with an increasing focus on innovation and business sophistication factors. As depicted in the pyramid below (see Figure 2.3), these stages correspond to (1) factor-driven economies (the lowest level of the pyramid), (2) efficiency-driven economies, and (3) innovation-driven economies (the highest level), respectively (Schwab, 2014). According to this distinction, the international competitiveness of a country is predominantly factor-, efficiency-, or innovation-driven. The higher a country's position in the WEF pyramid, the higher its GCI-score. Hence, countries with an innovation-driven economy are more competitive than countries that are characterized by an efficiency-driven or factor-driven economy. There are differences in international competitiveness of countries in a similar development phase. For instance, the efficiency-driven economy of the People's Republic of China (GCI ranking #28), excluding its Special Administrative Region Hong Kong (GCI ranking #7), was considered more competitive in 2014 than the efficiency-driven economy of Indonesia (GCI ranking #34).

Figure 2.3. *Pyramid of economic development phases and corresponding competitive foci*



Source: Adapted from World Economic Forum/Schwab (2014) and Van Den Bosch et al. (2011: 4)

The fact that the highest degree of international competitiveness is innovation-driven means that, in order for leading ports in economically advanced countries to become more competitive internationally, their strategic connectivity should be focused on strengthening and gaining access to innovation and business sophistication factors in particular. That is, for ports in such countries, the focus of strategic connectivity needs to be on enhancing their innovation-driven international competitiveness. The focus of ports in factor- and efficiency-driven economies as regards strategic connectivity is mainly on enhancing factor-driven and efficiency-driven competitiveness, respectively. In this vein, drawing on the normative logic of the WEF Global Competitiveness Report (e.g. Schwab, 2014), a distinction can be made between at least *three types of competitive foci of strategic connectivity* (see Table 2.2), each of which is most applicable to a certain stage of economic development. This implies that strategic connectivity is largely contextually determined.

Table 2.2. *Three types of contextually determined competitive foci of port-related strategic connectivity*

Context: country's stage of economic development	*Type of competitive focus*
Factor-driven economy (e.g. Bangladesh, Burundi, Chad, Mali, India, Nicaragua, Pakistan, Senegal, Vietnam, Zambia)	Improving a port's *factor-driven* international competitiveness
Efficiency-driven economy (e.g. Bulgaria, China, Colombia, Egypt, Jordan, Peru, Morocco, Serbia, South Africa, Thailand)	Improving a port's *efficiency-driven* international competitiveness
Innovation-driven economy (e.g. Belgium, France, Germany, Italy, Japan, the Netherlands, Singapore, Switzerland, UK, US)	Improving a port's *innovation-driven* international competitiveness

Source: World Economic Forum Global Competitiveness Report 2014–2015, see Schwab (2014)

2.3. A Dual Challenge for Port Authorities: Improving the International Competitiveness of both Port and Country

So far we have been focusing on the challenge for port authorities to contribute to a port's international competitiveness. A second important, partly related challenge is to contribute to the international competitiveness of the region and country in which the port is situated (Van Den Bosch et al., 2011) and, in relation to that, social welfare (Haezendonck, 2001; Huybrechts et al., 2002). It is the *economic* importance of ports – which may be of national interest – that has been dominating discussions about their significance for their country. This economic notion of value indicates what has been accomplished in a certain period of

time, such as the amount of value added created and the employment generated because of the port's presence. This is related to the value added concept mentioned by Haezendonck (2001: 26), which "[…] always aims to assess the contribution of port activities to a nation's Gross Domestic Product […]". In this connection, Goss (1990: 211) pointed out by that "[…] any improvement in the economic efficiency of a seaport will enhance economic welfare by increasing the producers' surplus for the originators of the goods being exported and consumers' surplus for the final consumers of the goods being imported."

From a *strategic* perspective, it is particularly important to look at how firms in a country benefit from a port in terms of its contribution to their international competitiveness, which is captured in the notion of a port's *strategic value* for its country (cf. Van Den Bosch et al., 2011). Focusing on contributing to the international competitiveness of both the port and its country is especially important for those port authorities that are public organizations or – when corporatized – whose shares are partly or entirely held by local, regional and/or national governments, such as the Port of Rotterdam Authority and the Port of Amsterdam Authority in The Netherlands. These port authorities are expected by society to improve the possibilities of firms located within and outside the port area to benefit from the port from an internationally competitive stance. Port authorities ought to assess this strategic value of the port in addition to the typically reported economic value, and to communicate this value to important external stakeholders such as governments (Van Den Bosch et al. 2011). The demonstrated total value of a port is associated positively with the amount of governmental and societal support for existing and new activities and projects in the port (Haezendonck, 2001). It can be expected that the more the strategic value is clarified and communicated to external stakeholders, the larger their willingness – based on these insights – to proactively contribute to further increase this value over time by, for instance, providing resources and adapting regulations. Doing so will contribute also to a port's own competitiveness.

2.3.1. Comparing two methods for assessing ports' strategic value for their country

In the last decade, two publications appeared in which a method was presented for assessing the strategic value of ports for their country. The first publication, titled *The strategic value of the Port of Rotterdam for the international competitiveness of the Netherlands: A first exploration,* by Van Den Bosch, Hollen, Volberda and Baaij (2011), focuses on the strategic value of the port of Rotterdam for The Netherlands. The second publication, titled *Strategic evaluation of the Belgian port sector and accompanying services*, by Vonck and Notteboom (2015), focuses on the strategic value of four seaports in Flanders – the ports of Antwerp, Ghent, Zeebrugge and Ostend – for Belgium. Table 2.3 provides a comparative overview of the key elements of these two assessments.

Whereas these assessment methods are similar with respect to the research problem (i.e. both methods aim to go beyond the economic value of ports), there are significant differences in their conceptual perspective, theoretical lens, and definition (see Table 2.3).

Table 2.3. *Comparison of two recent methods for the assessments of ports' strategic value for their country*

	Van Den Bosch et al. (2011)	**Vonck & Notteboom (2015)**
1. Conceptual perspective on strategic value	Besides generating economic value, ports contribute to the international innovation-driven competitiveness of firms in their country by creating *strategic connectivity* at three levels: (i) within port; (ii) inter-port level within country; (iii) internationally	What happens (with the economic value) if ports and a major part of port-related firms outside these ports vanish?
2. Main theoretical lens underlying the conceptual perspective	Strategy-based	Economics-based
3. Definition of strategic value (as used in the empirical analysis)	Consists of both a quantitative part (i.e. economic value) and a qualitative part (i.e. the contribution to the international innovation-driven competitiveness of firms in the port's country	1. Loss of economic value of ports 2. Increase import/export costs 3. Loss of economic value of a major part of port-related firms outside ports 4. Loss of value added due to loss of connectivity of firms outside ports
4. Application to port(s)	Port of Rotterdam, The Netherlands	Four Belgian ports (Antwerp, Ghent, Zeebrugge, and Ostend)
5. Year to which the empirical analysis pertains	2010	2012

Table 2.3 (continued). *Comparison of two recent methods for the assessments of ports' strategic value for their country*

	Van Den Bosch et al. (2011)	**Vonck & Notteboom (2015)**
6. Empirical assessment: strategic value (and how much the strategic value is higher compared to the economic value)	$22.2^{a} + 6^{b} = €28.2$ *billion* (Approximately 30%)	$27.8^{c} + 2.0^{d} + 10.5^{e} + 4.7^{f} = €\ 45.0$ *billion* (Approximately 60%)
7. Key levers to increase strategic value	Enhancing in particular strategic connectivity at port level, national level and international level.	Mainly port-area related issues

Sources: Van Den Bosch et al. (2011); Vonck & Notteboom (2015); PowerPoint presentation by Notteboom for ING Belgium, 30 April 2015, Brussels.

Notes:

a) Quantitative part, i.e. the economic value of the port of Rotterdam in terms of direct and indirect added value.

b) Qualitative part, i.e. the contribution of the port of Rotterdam to the international competitiveness of firms in the Netherlands. Estimate based on the assumption that the contribution to firms' international competitiveness is at least about 1% of the GDP of the Netherlands; the assumption of at least 1% more value added in both the import and export of firms (excluding re-export) for firms produces similar results.

c) Loss of economic value of the ports of Antwerp, Ghent, Zeebrugge, and Ostend.

d) Increase import/export costs in Belgium.

e) Loss of economic value of a major part of port-related firms outside the ports of Antwerp, Ghent, Zeebrugge, and Ostend.

f) Loss of value added due to loss of connectivity of firms outside the ports of Antwerp, Ghent, Zeebrugge, and Ostend. The estimate of this part of the strategic value has been based on the similar assumption as referred to in note (b): 1% of GDP.

For instance, regarding the conceptual perspective on strategic value, Van Den Bosch et al. (2011) point out that besides generating economic value ports contribute to the international competitiveness of firms in their country (see the 'Triple Value Framework' in their report, which is comparable to Figure 2.2) by creating *strategic connectivity* within ports as well as between ports on both a national and international level. Instead, Vonck and Notteboom (2015) particularly focus on what happens with the economic value if ports and a major part of the port-related firms outside these ports vanish. The main theoretical lens underlying their conceptual perspective is economics-based, whether the main theoretical lens used by Van Den Bosch et al. (2011) is predominantly strategy-based.

Van Den Bosch et al. (2011) define strategic value as consisting of both a quantitative part (economic value) and a qualitative part (contribution to the international competitive position of firms in the country. Vonck and Notteboom (2015) arrive at the strategic value by summing up (1) the loss of economic value of ports; (2) the increase in import and export costs; (3) the loss of economic value of a major part of port-related firms outside ports; and (4) the loss of value added due to the loss of connectivity of firms outside ports. The estimate of the latter part of the ports' strategic value according to Vonck and Notteboom (2015), i.e. the loss of value added due to the loss of connectivity of firms outside ports, has been based on the assumption made by Van Den Bosch et al. (2011) that the contribution to firms' international competitiveness is at least about 1% of the country's GDP. Finally, whereas Van Den Bosch et al. (2011) indicate that port authorities can increase a port's strategic value by enhancing its strategic connectivity at three levels, i.e. port level, national level *and* international level, Vonck and Notteboom (2015) primarily stress the necessity of improving *port-area* related issues. These various differences between the methods by Van Den Bosch et al. (2011) and Vonck and Notteboom (2015) are reflected in the assessment outcomes – e.g. how much the strategic value is higher compared to the known economic value.

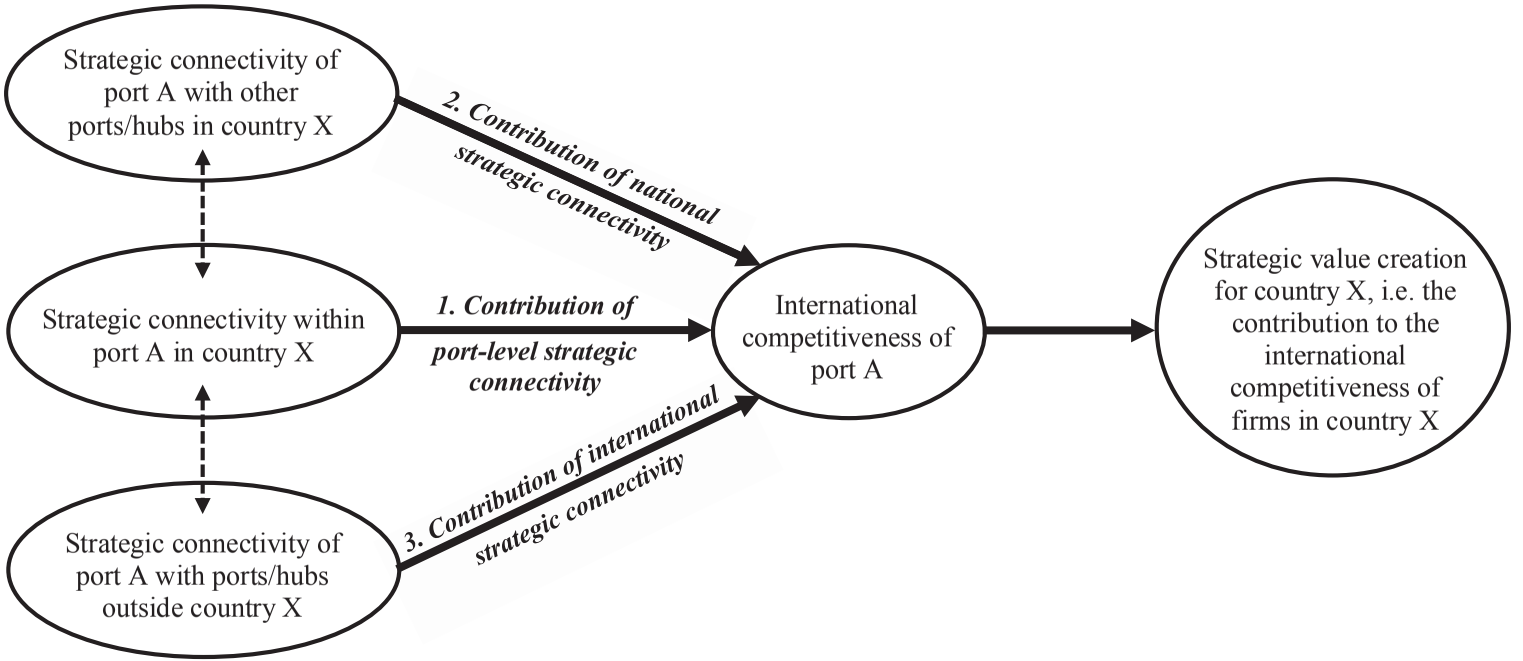
2.3.2. Extended conceptual framework of multi-level strategic connectivity

Drawing on Van Den Bosch et al. (2011) and Vonck and Notteboom (2015) by taking into account the challenge – besides increasing a port's competitiveness – of contributing to an increased international competitiveness of firms in its country, the conceptual framework of multi-level strategic connectivity introduced above is extended as depicted in Figure 2.4.

2.4. Contributions and Implications for Port Authorities

This study examined from a strategic network perspective how to enhance a port's – and its country's – international competitiveness through strategic connectivity. In doing so, the study contributes to the existing literature in several ways. First, drawing on a prior study by Van Den Bosch, Hollen, Volberda and Baaij (2011), the study suggests a conceptualization of 'strategic connectivity' (being different from structural connectivity) in the context of

Figure 2.4. *Extended conceptual framework of multi-level strategic connectivity: Contributing to the international competitiveness of both port and country*



Source: adapted from Van Den Bosch et al. (2011)

ports as the set of port-related knowledge-intensive organizational interlinkages that enable the organizations involved to enhance their long-term international competitiveness. It was highlighted that such competitiveness can be mainly innovation-, efficiency- or factor-driven, depending on the stage of economic development of a port's country. Based on Van Den Bosch and colleagues' study, and corroborated by several empirical observations, it was explained how a port's sustainable international competitiveness can be enhanced through increasing strategic connectivity at port level, national level and international level, resulting in a conceptual framework of multi-level strategic connectivity. Second, drawing on Van Den Bosch et al. (2011), this conceptual framework was extended by including not only a focus on strengthening a port's competitive position, but also a focus on contributing to the international competitiveness of the country (i.e. strategic value creation for the country) in which the port is situated and, in relation to that, social welfare. This implies a "dual strategic challenge" (Van Den Bosch & Hollen, 2015: 114). Third, in relation to this contribution, a comparison was made between two recent methods for assessing port's strategic value creation for their country, thereby clarifying the academic discussion regarding this topic.

De Martino and Morvillo (2008) stated that port authorities play an important role in identifying critical port-related assets that encourage the development of interorganizational relationships of port actors that generate more value added. In a similar vein, we suggest that port authorities can contribute to strengthening the sustainable international competitiveness of both port and country by contributing to foster a port's multi-level strategic connectivity. Port authorities are encouraged to, based on the concepts provided in this study, critically reflect on a port's current state of strategic connectivity, and on how they can use their policy instruments, such as investments in physical and knowledge infrastructure, regulations, and land allocation policy, in a way that optimally fosters and facilitates the further development of strategic connectivity at the port level, national level and international level over time.

According to the World Bank (2007), the dominant port governance model in large and medium-sized ports is the 'landlord model'. This model implies that a port authority is primarily responsible for economic exploitation, maintenance, and long-term development of the port area. In order for landlord port authorities to contribute to a port's multi-level strategic connectivity, they may have to strategize beyond the landlord function. This may imply, for instance, as has been done by the Port of Rotterdam Authority, participating in the commercial exploitation of common carrier pipeline bundles (in order to enhance port-level strategic connectivity) and participating in inland ports and ports abroad (in order to enhance national and international strategic connectivity, respectively). These are examples of activities that are beyond the scope of traditional landlord port authorities. Developing port authority activities that extend the traditional landlord model implies a renewal of port authorities' business model (e.g. Haugstetter & Cahoon, 2010; Van Der Lugt et al., 2013; Verhoeven, 2010), which is the main subject of the next study presented in this dissertation.

CHAPTER 3

Business Model Innovation of Port Authorities: A Case Study of the Port of Rotterdam Authority (2000–2012)*

3.1. Introduction

In the last two decades, business model innovation has gained increased recognition as a key strategic issue for those organizations that operate and compete in a dynamic environmental context (Baden-Fuller & Mangematin, 2013; Casadesus-Masanell & Ricart, 2010; Shafer et al., 2005; Teece, 2010; Zott et al., 2011). Business model innovation is particularly about changes in how, with whom, and for whom an organization creates value for its stakeholders and how the organization delivers and appropriates returns from this value. The predominant rationale for business model innovation in the literature is that such changes will at times be required in order for a profit-oriented organization to maintain and strengthen its competitive position (e.g. Amit & Zott, 2012). However, there are also organizations whose main purpose is to create value not just for themselves but also for society – these include, in particular, organizations with a semi-public profile. Port authorities are an interesting example. New businesses developed by municipal port authorities and corporatized ones are expected by their stakeholders to contribute to the strengthening of the competitiveness of a port and its region/country, thereby enhancing the competitiveness of firms within and beyond their port area, while also taking the living conditions of the area's inhabitants into account (Van Den Bosch et al., 2011). Hence, port authorities have to combine commercial and societal values and goals (Van Der Lugt et al., 2013). This may also apply to a certain extent to private port

*) Part of this work has been published as: Hollen, R.M.A., Van Den Bosch, F.A.J., & Volberda, H.W., 2013, Business model innovation of the Port of Rotterdam Authority (2000–2012), in B. Kuipers & R. Zuidwijk (eds.), *Smart Port Perspectives: Essays in honour of Hans Smits*: 29-47, Rotterdam: Erasmus Smart Port Rotterdam, ISBN 978–90–819767–1–8. In the same year, a substantially shortened and adapted version of this work was included as a case study (pp. 157–163) in H.W. Volberda, F.A.J. Van Den Bosch & C.V. Heij (eds.) (2013), *Re-inventing Business: Hoe bedrijven hun businessmodel innoveren* [How firms innovate their business model], Assen: Van Gorcum/ Stichting Management Studies, ISBN 978–90–232–5146–0. Furthermore, a preliminary version of this work has been presented at the European Group for Organizational Studies (EGOS) Colloquium in Rotterdam (The Netherlands) in July 2014.

authorities in the sense that they, in addition to pursuing their primary objective of generating profit, may need to take the creation of societal surplus value into account.

Business model innovation of port authorities has remained largely underexplored in the literature, however. In this study we aim to address this research void by examining the following research question: How may port authorities innovate their business model aimed at enhancing a port's and country's innovation-driven sustainable international competitive position? To empirically investigate this exploratory question, we conduct a case study of business model innovation of the Port of Rotterdam Authority covering the period 2000–2012 – in which it developed several new types of businesses – that contributes to enhanced understanding of business model innovation of port authorities.

The outline of this study is as follows. First, we set out the theoretical background and present a conceptual framework of business innovation, which has been derived from previous literature, according to which the remainder of the study is structured. Subsequently a case study of the Port of Rotterdam Authority is presented, in which we first address the changing environment in which it operates and competes before going on to elaborate on the renewal of its business model from a 'Landlord' toward a 'Port Developer' business model. In so doing, we focus on four different and interrelated levers of business model innovation. Then we take a closer look at four new businesses of the Port of Rotterdam Authority that resulted from this business model innovation, and how these businesses have contributed to the international competitiveness of the port-related business community in both Rotterdam and the Netherlands. Finally, based on these insights, we discuss a number of key findings and point out implications for port authorities.

3.2. Theoretical Background and Conceptual Framework

The business model concept has gained increasing interest of scholars and practitioners since the mid-nineties. Although the former have not yet come to a consensus as to what exactly a business model is, it is generally accepted that business models seek to explain how value is both created and captured (Zott et al., 2011), thereby promoting a clear outside-in focus (McGrath, 2010). Business models consist of several components that collectively determine how an organization does business (Morris et al., 2005). More specifically, business models give a broad-based picture of how, with whom and for whom a business creates value, as well as how it delivers this value and captures returns from this value (Baden-Fuller & Mangematin, 2013; Casadesus-Masanell & Ricart, 2010; Shafer et al., 2005; Teece, 2010). Box 3.1 provides an overview of some definitions of a business model that have been used by scholars. The main common elements in these and other definitions, as identified by Volberda, Van Den Bosch and Heij (2013), are subsequently summed up in Box 3.2.

Box 3.1. *Selective overview of scholarly definitions of a business model*

- A business model is "an architecture for the product, service and information flows, including a description of the various business actors and their roles; a description of the potential benefits for the various business actors; and a description of the sources of revenues" (Timmers, 1998: 4).
- A business model depicts "the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities" (Amit & Zott, 2001: 511).
- A business model is "the heuristic logic that connects technical potential with the realization of economic value" (Chesbrough & Rosenbloom, 2002: 529).
- A business model is a "concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets" (Morris et al., 2005: 727).
- "A business model articulates the logic, the data and other evidence that support a value proposition for the customer, and a viable structure of revenues and costs for the enterprise delivering that value" (Teece, 2010: 179).
- A business model is "a system of interdependent activities that transcends the focal firm and spans its boundaries" (Zott & Amit, 2010: 216).

Box 3.2. *The main common elements in business model definitions*

- A business model depicts the architecture of various organizational components, including the relations between these components, and the relations with external stakeholders.
- A business model captures how and for whom value is created in specific target markets, and how this value is subsequently appropriated by the organization.
- A business model articulates the competitive strategy that is used to achieve greater competitive advantages or create new ones.

Source: Volberda, Van Den Bosch, & Heij (2013)

It has been convincingly argued that disruptive changes in their external environment may require organizations to renew – i.e. innovate – their business model so as to survive in the long term (e.g. Chesbrough, 2010; Doz & Kosonen, 2010; Nunes & Breene, 2011). Without business model innovation, organizations in highly dynamic environments risk

becoming less relevant for their respective stakeholders and losing their business to existing or new competitors. Environmental dynamism hence is considered a key external antecedent of business model innovation.

An important internal antecedent that has been examined in relation to business model innovation is the role of the CEO (e.g. Govindarajan & Trimble, 2011) and, in particular, the role of transformational leadership (e.g. Vaccaro et al., 2012; Volberda et al., 2013b). Transformational leaders respond to "[…] the need to transform individuals, teams, and firms by going beyond the status quo and, in so doing, affect their firms' ability to innovate and adapt" (Ling et al., 2008: 557). Thanks to their vision, involvement and ability to transform organizations, these leaders are in a suitable position to translate the need to respond to environmental dynamism into renewal of the business model. Transformational leaders may create a context that stimulates individuals to come up with creative solutions to existing and emerging problems, and thereby contribute to the creation of new possibilities for value creation and appropriation (Volberda et al., 2013b).

Guided by previous business model literature (e.g. Amit & Zott, 2012; Chesbrough, 2010; Markides, 2013), Volberda et al. (2013b) distinguished three so-called 'levers' of business model innovation: (i) organizational forms (i.e. 'organization'); (ii) management; (iii) technology; and (iv) co-creation with external stakeholders. That is, changes in these four levers and their interactions may collectively contribute to business model innovation. A concise description of these levers is given in Box 3.3.

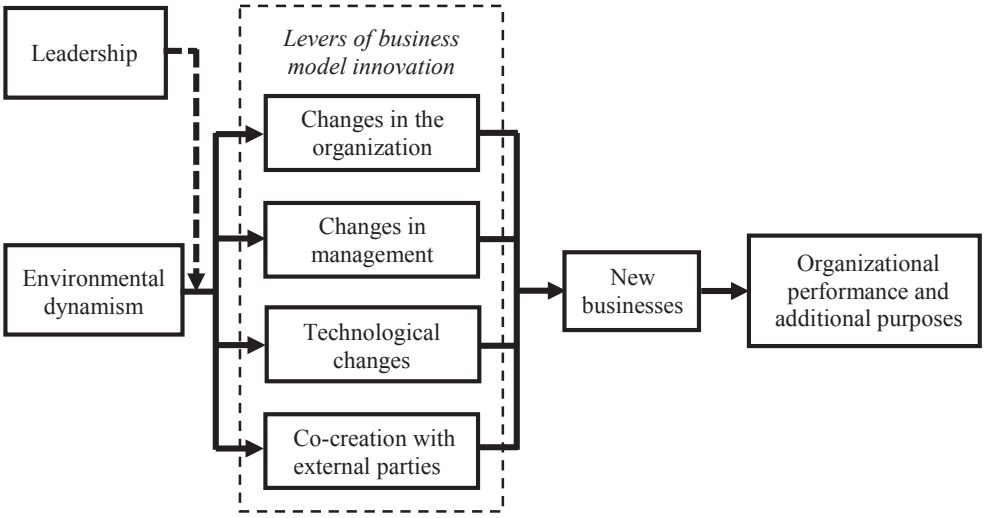
Box 3.3. *Four levers of business model innovation*[*]

- The lever ***organizational forms*** refers to the structure of and relationships within an organization and the associated division of labour and integration of efforts (e.g. Puranam et al., 2014).
- The lever ***management*** refers to the management practices and processes within an organization that have been developed and employed for coordinating activities, setting objectives, motivating employees, and decision-making (e.g. Birkinshaw, 2010).
- The lever ***technology*** refers to the organizational ability to both internally develop technological innovation (e.g. Meeus & Edquist, 2006) and absorb new technological knowledge from outside (e.g. Cohen & Levinthal, 1990).
- The lever ***co-creation*** refers to different forms of collaboration with external stakeholders – e.g. suppliers and clients – aimed at collective value creation (e.g. Prahalad & Ramaswamy, 2004).

[(*)] *Levers of business model innovation as distinguished by Volberda, Van Den Bosch and Heij (2013)*

Renewal of an organization's business model is reflected in the development of new value-creating businesses. Changes in the aforementioned levers and their interactions may enable and result in such new (types of) businesses and, in turn, enhanced organizational performance. Based on the literature mentioned above we suggest a conceptual framework of business model innovation as depicted in Figure 3.1. For most port authorities, enhanced organizational performance is not the main purpose of business model innovation: they need to focus primarily on contributing to the strengthening of the international competitiveness of (firms in) their port and their region and country (Van Den Bosch et al., 2011). By doing so, port authorities indirectly increase their own incomes: a more internationally competitive port, region and country will attract and generate more freight volumes and investments in the port. In the following sections, we will empirically examine how a port authority may engage in business model innovation aimed at enhancing a port's and country's innovation-driven international competitiveness.

Figure 3.1. *Conceptual framework of business model innovation*



3.3. Case Study Port of Rotterdam Authority (2000–2012)

The Port of Rotterdam Authority, hereafter 'Port Authority', is the manager, operator and developer of Europe's largest port. This port authority, with a turnover of approximately 615 million euro and approximately 1,160 employees in 2012, was selected as a case study because it had demonstrated to have been able to realize innovation of its business model in a reaction to the fact that the international environment in which it operates was – and still

is – continuously changing. The renewal of its business model did not only contribute to strengthening its own performance but also the international competitiveness of firms in the port of Rotterdam and elsewhere in The Netherlands. This exploratory case study of the Port Authority focuses on the years 2000–2012 to include in the analysis several years before and after its corporatization in 2004. In this period, its turnover increased with over 50% and its net income with more than 300%. Data was collected from a series of eight semi-structured interviews with the director and staff members of its Department of Corporate Strategy, as well as secondary sources such as internal documents and annual reports (2000–2012).

3.3.1. Environmental dynamism

Important developments in the period covered in this case study that were relevant for the Port Authority included the growing world trade, integration of markets, and shifts in the center of economic growth – mainly toward the Asian continent – and, in turn, international goods flows (e.g. Notteboom & Winkelmans, 2001). Also, with the port being located in a relatively densely populated area, it was confronted with stringent environmental regulation. Questions began to rise about the value being created for the city, region, and country. Other relevant developments, which have been timely identified by the Port Authority, include the increased scale in transport, increasing containerization, growing scarcity of commodities, and intensifying competition between ports on the base of the integration of logistics chains and industrial clusters (e.g. Vanelslander & Sys, 2014) (see also Box 3.4).

Box 3.4. *Environmental dynamism: Illustrative relevant developments (2000–2012)*

- Increasing pressure to provide evidence about the *strategic value* of the port for the city of Rotterdam, the region, and the country besides its economic value (Van Den Bosch et al., 2011).
- Intensification and shift of international goods flows.
- Larger negotiation power of shipping companies due to increased vessel dimensions 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.
- Stronger competition based on chain control / integrated supply chain management.

Responding to these various external developments required vision, leadership, and innovation of the Port Authority's business model focused on strategic value creation and, thereby, prolongation of the 'license to operate and grow' of the government and other

external stakeholders. In addition, competition between Western European ports in the Hamburg-Le Havre range was – and still is – substantial. Hence, there was a need to excel in both efficiency and innovation in, for instance, infrastructural facilities.

The realization of new large projects initiated by the Port Authority, such as the construction of the Maasvlakte 2 area (part of the Project Mainport Rotterdam Development) took place in the context of an intricate field of rules and legislation. The complexity of the Port Authority's playing field was further increased by the large number of stakeholders that continuously had to be taken into account in planning and implementing projects in the port. Sustainability and safety were increasingly expected to meet strict requirements. In this vein, Hans Smits, CEO of the Port Authority at that time, pointed out:

> *"We have had 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."* (Smits in *Het Financieele Dagblad*, November 29th, 2009).

3.3.2. From a Landlord toward a Port Developer business model

Since its establishment in 1932, the Port Authority has focused mainly on the administration, infrastructural maintenance and economic exploitation of the port area and other traditional landlord functions. For instance, it is responsible for continued safe and effective handling of shipping traffic. Its main sources of income are rents and port dues. In the period 2000–2012, the Port Authority's business model, which traditionally had been a Landlord business model, changed toward a Port Developer (i.e. extended landlord) model (see Box 3.5).

Box 3.5. *Business model innovation of the Port of Rotterdam Authority (2000–2012): From a Landlord business model to a Port Developer business model*

- ***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 a focus on entrepreneurship (often in cooperation with the private sector through *co-creation*) and, in that connection, 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 country.

The renewed business model has a more explicit focus on proactively creating strategic value, based on customer requirements, by developing strategic connectivity – as elaborated upon in the previous chapter – in the form of, for instance, knowledge-intensive supply chains, networks, clusters and customer relationships. Next, we elaborate on this innovation of the Port Authority's business model by examining the (interrelated) changes in the general levers of such innovation (as identified in the conceptual framework depicted in Figure 3.1), which pertain to respectively changes in (1) the organization, (2) the management itself, (3) technologies, and (4) the extent and manner in which co-creation of strategic value occurs with external actors. Changes in these 'levers' of business model innovation contributed to an increase in proactive decisiveness, flexibility and transparency of the Port Authority, which faced a continuously changing and complex environment. As a result, it became more able to create sustainable strategic value for firms in and beyond the Rotterdam port area.

3.3.3. Four levers of business model innovation: Changes in organization, management, technology and co-creation

With regard to *changes in the organization* (i.e. the first lever of business model innovation in Figure 3.1), the decision to corporatize the Port Authority in 2004, turning the Rotterdam Municipal Port Management (RMPM) (see, for instance, Doe & Schoenmakers, 1998) into an independent public-law limited company (N.V.) with the Municipality of Rotterdam as an initial 100% shareholder, created new opportunities. The increased detachment from the city administration enabled the Port Authority to operate independently on the capital market, operate in a more flexible manner, and act more proactively with the private sector in the port, for instance. Co-creation of new sources of added value with firms – leading to new businesses and income streams – could hence be realized faster and more effectively. As of January 2007, the Dutch State became shareholder with 30% of the shares to facilitate the financing of the Maasvlakte 2 port area.

Successive changes in the Port Authority's internal structure before and after its corporatization led to a flatter structure with more horizontal relations (see also Box 3.6). The organization also started operating closer to the market and in closer contact with the customer – e.g. through marketing decentralization. This change enabled the Port Authority to respond with more flexibility to new developments and opportunities for the improvement of the port's international competitiveness. Also, operations become increasingly project-based, like in operations concerning the Maasvlakte 2 area – through Project Organization Maasvlakte 2 – and in creating working groups around 'critical success factors'. Such a project-based approach became important for the Port Authority to cope with 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.

Box 3.6. *Levers of business model innovation of the Port of Rotterdam Authority: Illustrative examples (2000–2012)*

- *Illustrative changes in the lever 'organisation':*
  - 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.
- *Illustrative changes in the lever 'management':*
  - 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 businesses.
- *Illustrative changes in the lever 'technologies':*
  - New ICT systems for more efficient and safer handling of shipping traffic.
  - Development of an innovative communication system that goes beyond the purview of the port itself, focused on customer requirements; smart use of data.
- *Illustrative changes in the lever 'co-creation with external parties':*
  - Development of new (combinations of) activities and knowledge with external parties (as further elaborated in Box 3.7).

Illustrative examples of newly established business units within the Port Authority 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 innovation-related issues and to give these issues a more prominent focus. All foreign activities of the Port Authority – including both port participations (e.g. in the Port of Sohar) and boardroom consultancy activities – were transferred to its new department PoRint. Precursors of the department were successively named Bureau Assistentie Derde Wereld ['Agency for Third World Assistance'] (BADW), Technical and Managerial Port Assistance Office (TEMPO) – in which the Port Authority developed its international consultancy practices (Dooms et al., 2013) – and Mainport Holding Rotterdam (MHR) Consultancy. The name change over time reflects an increasingly stronger focus on a foreign port participation portfolio.

Second, regarding *changes in management* (i.e. the second lever of business model innovation in Figure 3.1), the number of management layers was reduced substantially. In addition, the management itself went through multiple changes. For instance, 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 fostered 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 way of decision-making and providing direction, meant a significant departure from the past.

Also, the degree of professionalization increased in the coordination of projects and other operations. The introduction of standard financial and operational audits are cases in point. In 2011, the Port Authority started the program 'Groen 2.0' [Green 2.0] to promote collaboration and to professionalize project management within the whole organization, based on the PRINCE2 methodology. PRINCE2 produces standards for project management norms, which played a valuable role in realizing the new Maasvlakte 2 area according to all quality specifications, without exceeding the budget and within the set timeframe.

In the period 2000–2012 the Port Authority focused increasingly on involving several external stakeholders – such as representatives from port industries, NGOs, employers' and employees' organizations – in the managerial decision-making process. Smits said:

> *"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."* (Smits in *Het Financieele Dagblad*, November 29th, 2009).

This focus on both actively managing external stakeholders in decision-making and executing projects that enjoy broad levels of support (i.e. stakeholder management) is also reflected in the Port Authority's implementation agenda Port Vision 2030 that was published in 2012. In addition, management initiated a larger focus on the role of the Port Authority as 'entrepreneurial developer'. Co-creation (especially with customer segments) was thereby seen as a suitable way to realize innovative projects that contribute to enhanced international competitiveness of the private sector in the port and elsewhere in The Netherlands.

Third, with regard to *technological changes* (i.e. the third lever of business model innovation in Figure 3.1), considering the Port Authority's role as service provider and enforcer of rules and regulations, the influence of changes in technologies within the organization on the renewal 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-complex and related developments in shipping. Through the developed Harbor Master Management Information System (HaMIS; first stage completed in 2011), it became better equipped to be coordinator of the nautical supply chain. By means of the developed innovative communication system Portbase, firms were enabled to optimize their logistical processes. These examples illustrate the supporting role of the lever technology (new technologies) in the gradual transformation of the Port Authority toward a port developer. In this transformation process, the use of ICT and 'smart use of data' emerges as a strategic value creating lever.

Fourth, with regard to *co-creation with external parties* (i.e. lever 4 of business model innovation), as will be elaborated further in this study, the Port Authority cooperated with the private sector as a way to, for instance, interconnect organizations within and beyond logistical supply chains so as to make these chains 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."* (Smits in *NRC Handelsblad*, May 19th, 2011).

3.3.4. The role of leadership

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 (Brolsma, 2007; Interviews). Under his leadership, the Port Authority started to operate in a more commercial and business-like way. The high-profile guarantees in what has become known as the so-called 'RDM affair' (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 business-like and cutting-edge way of leadership (Brolsma, 2007; interviews). Smits' arrival resulted in a continuation of the Port Authority's business-like approach but also in 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 in order to meet dividend arrangements and to ensure value for money for customers, for instance.

The under Smits' leadership prepared business plans (2006–2010 and 2011–2015) and Port Vision 2030 document stressed the Port Authority's role as Port Developer. Smits supported simplification of procedures in order to operate more decisively in the interest of the Dutch economy. He also emphasized 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 organization to always be at the forefront and innovate ourselves continuously, which will enable us to strengthen that position in the increasingly competitive environment."* (Smits, Presentation at EURAM Conference, 2012)

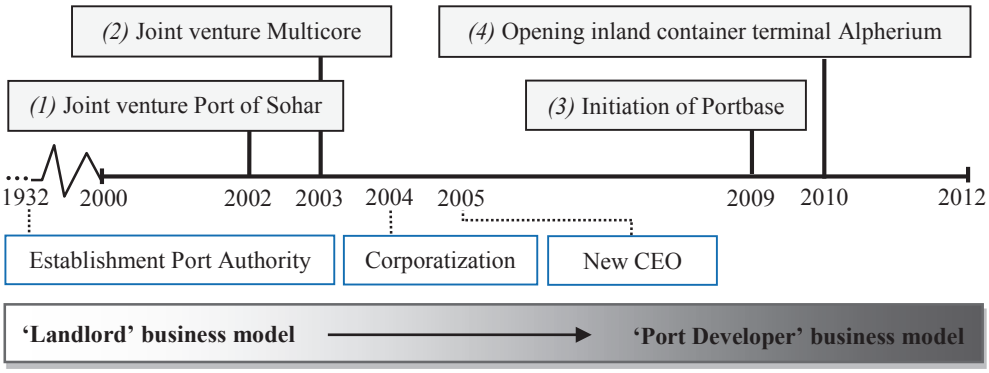
Smits considered leadership to be important for stimulating a continuous focus on innovation, in which changing human behavior – enabled by changes in the complementary business model innovation levers management and organization – through social innovation received special attention. One of Smits' leadership skills that fostered the realization of innovative projects was stakeholder management directed at finding a balance between the

different stakeholder interests. Evidence of this stakeholder focus is found in the structural dialogue sessions – initiated under Smits' leadership – in the form of meetings with several customers from all sections of the port, and the organization of roundtable meetings with the main logistics players in The Netherlands and other stakeholders concerned with modal split.

3.3.5. Increased international port competitiveness through new businesses

In its business plan 1997–2000 the Port Authority expressed its growing 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" (Brolsma, 2007: 324) to further strengthen the international competitiveness of the port of Rotterdam. In the period 2000–2010 this ambition was further developed, in which the Port Authority's role changed toward a Landlord-exceeding 'port developer'. To illustrate this business model innovation, four representative cases of new businesses will be discussed that were developed in this period: (i) the participation in the Port of Sohar; (ii) the initiation and commercialization of underground distribution system Multicore; (iii) the introduction of the joint (i.e. with Port of Amsterdam) port community system Portbase; and (iv) the realization of inland container terminal Alpherium (see Figure 3.2).

Figure 3.2. *Four Illustrative cases of new businesses of the Port of Rotterdam Authority*



Other examples of new businesses of the Port Authority that suit its new role of 'entrepreneurial developer', which will not be discussed in more detail, are: the development of real estate (Port City); setting up an innovation fund; the establishment of an organization (Verkeersonderneming) for implementing a program initiated by the state government to keep the port accessible; the construction of a pipeline system for the transport of ethylene via an open access pipeline from Antwerp to the Maasvlakte area (see Chapter 4); setting up

in collaboration with other ports a network of LNG petrol stations to reduce CO_2 emissions; investing in an external test facility for sustainable process innovation (see Chapter 6); and the development of the RDM Campus for research, design and manufacturing in the port.

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 global transport supply chains. Hence, international strategic connectivity with growth markets is important for responding to trends, threats, opportunities and acquisition efforts related to cargo and company establishments. 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. This joint venture agreement with the Omani government pertains to both the management and the development of the port-complex of Sohar, leading to an additional income stream. It was the Port Authority's first overseas port participation, enabling the Port Authority to better respond to shifts in international traffic flows, to increase its knowledge about customer requirements in this growth region, and to market and further develop its portfolio of port management competences. In addition, it helped the Port Authority to play a bigger role as a supply chain coordinator and, in this vein, to maintain existing customers and attract new ones.

The Port Authority's participation in the Port of Sohar has offered several strategic advantages for firms in Rotterdam and elsewhere in The Netherlands (Van Den Bosch et al., 2011). For instance, it led to new exposure of and demand for Dutch know-how, it provided Rotterdam with new opportunities to become the energy-hub of Europe (through improved connections via Sohar with oil/gas networks in the Middle East), it enabled strengthening of existing customer relations, and offered a stepping stone for Dutch firms for influence in and increased knowledge about a new growth region.

Multicore: Increasing intra-port strategic connectivity

Another interesting example of a new business of the Port Authority is the establishment 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 petrochemical and gas industry over relatively short distances in the port of Rotterdam 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. The improvement of the port's pipeline network was considered 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. Established firms that have made use of Multicore include Abengoa, Air Products, ExxonMobil, Linde Gas, Shell Chemicals and Shin-Etsu. The Port Authority's entrepreneurial investment in Multicore to increase the port's vitality was particularly deemed necessary as the pipeline network would not – or not

in a cost-effective manner – have been realized if firms themselves would have had to make a comparable investment. The fact that the Port Authority decided to play an active market role in initiating and commercializing a pipeline infrastructure is illustrative for its increased focus on being a coordinator and facilitator besides being a port administrator and exploiter.

Alpherium: Increasing hinterland-oriented national strategic connectivity

The substantial growth in container transport resulted in increased congestion on the Dutch motorways. To stimulate the desired partial shift from road transport to inland shipping – thereby reducing congestion and making transport more sustainable – and increase transport security and improve accessibility of the port of Rotterdam, the Port Authority invested in setting up the inland transshipment terminal 'Alpherium' in the Dutch city Alphen aan den Rijn. Alpherium, which opened in 2010, became the largest inland port (ca. 6 ha.) for container transshipment in the Netherlands. Strengthening the port of Rotterdam's position in hinterland networks in this way was particularly important to improve the port's position toward 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 (see also Van Den Bosch et al., 2011). The Port Authority has purchased the land. The main initiators, however, are Van Uden Group and Heineken. Van Uden Group 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 the city of 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 the Rotterdam port area, and together with customers (and the customers' customers) of the Port Authority, makes it an example of a new type of business of the Port Authority.

Portbase: Increasing ICT-related national strategic connectivity

The Port Authority has also increasingly developed toward a supply chain coordinator and facilitator by investing in a joint Port Community System with the Port of Amsterdam Authority in 2009. This system, called Portbase, is a joint ICT-platform that offers over 40 intelligent services for efficient information exchanges between firms (port customers) and between firms and governments, suited for all port sectors. These exchanges are conducted via one central point, as a result of which the firms involved no longer need to develop and maintain a multiplicity of bilateral connections. Therefore, by initiating Portbase, the Port Authority created strategic value for shippers, carriers and other firms by contributing to the optimization of national and international logistical chains. Portbase, which has gained broad support of the private port sector, arose from Port Infolink in Rotterdam and PortNET in Amsterdam. Investing in Portbase provides an interesting example of a new role that the Port Authority took on to strengthen innovation in its home base, i.e. the port of Rotterdam.

3.3.6. Summary of the four cases

Box 3.7 provides an overview of the abovementioned new businesses of the Port Authority – largely enabled by complementary changes in various levers of business model innovation, i.e. co-creation, organization and management – and how these new businesses contributed to the strategic connectivity (see Chapter 2) of the port of Rotterdam and, in turn, to both the international competitiveness of firms in the port and strategic value creation for its country.

Box 3.7. *Summary of the four illustrative new businesses of the Port Authority (2000–2012)*

- **Subcase 1. Participation in the Port of Sohar (Oman)**: Participating in developing, exploiting and managing a foreign port (co-creation with the Omani government).
  - Contribution to the international competitiveness of port/country through enhanced international strategic connectivity, i.e. more influence in and knowledge of growth region Middle East; attracting innovative, demanding new firms; generating new exposure of/demand for Dutch know-how; development towards energy-hub.
- **Subcase 2. Multicore**: Participating in the initiation and commercialization of a new underground distribution system for the (petro)chemical industry (co-creation with Vopak; customers include Abengoa, Air Products, Linde Gas, Shell and Shin-Etsu).
  - Contribution to the port's international competitiveness through enhanced intra-port strategic connectivity and, in this connection, stronger and more integrated clusters, enabling the further development of industrial ecosystems and increased attractiveness for investments in the port.
- **Subcase 3. Inland shipping terminal Alpherium**: Participating in setting up a logistical hub in the hinterland (co-creation with Van Uden Group and Heineken).
  - Contribution to the international competitiveness of port/country through enhanced national strategic connectivity by intelligent intermodal cargo flow opportunities.
- **Subcase 4. Portbase:** Participating in an extensive logistics communication system (co-creation with the Port of Amsterdam Authority).
  - Contribution to the international competitiveness of port/country through enhanced national strategic connectivity: more influence as coordinator of logistics chains.

3.4. Discussion and Conclusion

This study examined how port authorities may innovate their business model aimed at strengthening the international competitiveness of firms in their port, region and country. The financial performance of a landlord port authority is largely a derivative of these firms'

competitiveness. Substantial changes in the external environment in which port authorities operate require organizational reforms (Lai et al., 2014) and timely renewal of their business model in order to be able to contribute to strengthen a port's and a country's international competitiveness in the long run. Box 3.8 provides several implications for port authorities regarding business model innovation that can be derived from the case study findings.

Box 3.8. *Implications for port authorities*

- Environmental dynamics such as (de)regulation, changing international markets, and industrial transitions may trigger the necessary renewal of a port authority's existing business model. These dynamics need to be translated timely by senior management into challenges for changes in its organization, management, and co-creation.
- Changes in organization, management, and co-creation require time and significant managerial attention, also to make strategic use of their complementary effects.
- Transformational leadership can have a positive influence on (the acceleration of) a port authority's business model innovation.
- Important organizational/managerial enablers of business model innovation toward a more entrepreneurial ('port developer') business model include operating closer to the market, reducing the number of management layers, and realizing a more project-based and flexible organization capable of responding faster to external changes.
- For port authorities that aim to become more entrepreneurial, co-creation with clients may be of pivotal importance, enabling a port authority to focus on its core business while for additional activities it can rely on the expertise of other parties. Changes in this lever of (externally oriented) business model innovation offer new opportunities for value creation Decentralization of decision-making, well-organized internal communication and incentives for knowledge-sharing help to get more value creation from the interaction with clients in the port (see also Volberda et al., 2013b).
- A more extended Landlord model (with a 'port developer' portfolio) contributes to a port's and port authority's performance *and* strategic value creation for the country.

The process of realizing the Port of Rotterdam Authority's business model innovation toward a more entrepreneurial (i.e. 'Port Developer') business model, which is a transition also suggested by other scholars (e.g. Haugstetter & Cahoon, 2010; Verhoeven, 2010), encountered several barriers. This type of business model implies, besides a focus on the exploitation of current activities, a focus on exploration, i.e. on developing new activities for both current and new customers, markets and regions. Such a dual (ambidextrous) focus on exploitation and exploration may lead to intra-organizational tensions. Hence, a balance

must be found to be able to effectively innovate the business model (Markides, 2013). The period in which Scholten was CEO of the Port Authority did result in more strategic renewal compared to the previous period, but partly at the expense of transparency and audit procedures, as a result of which CEO Smits had to address these issues. Initially this meant more focus – especially from an administration point of view – on operating cautiously and improving the transparency of existing procedures, for instance. Next, the organization could increasingly focus again on coordinating and facilitating new businesses.

The realization of the Port Authority's business model innovation is partly reflected by new ways in which it uses its policy instruments to foster more innovation and strategic renewal in, for instance, newly developed port areas. For example, it was decided to use a tender procedure for container terminals on the new Maasvlakte 2 port 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 long-term competitiveness and strategic value creation – may lead to tensions and objections from external parties. It requires a lot of time and attention from a port authority's management to effectively manage these types of issues.

Our analysis and empirical findings regarding the Port of Rotterdam Authority show that timely innovation of the existing business model – mainly through insight into expected international environmental dynamism, transformational leadership, and various changes in the levers of business model innovation – contributes to a more effective strategic response to important environmental dynamics. In this regard the important question can be raised whether the current business model of port authorities of leading ports is also equipped for the coming period, in which they will increasingly face developments such as increased automatization and robotics, a changing energy landscape, and a fundamental transition in the chemical industry toward a more biobased and circular economy. Although these major developments make it hard to answer that question upfront (Volberda et al., 2013b), further research into business model innovation of port authorities will provide some support and clarification. This study provides several starting points for such further research.

CHAPTER 4

Strategic Levers of Port Authorities for Industrial Ecosystem Development*

4.1. Introduction

Major ports such as Rotterdam, Antwerp, Houston and Singapore's Jurong Port host large industrial complexes consisting of multiple refineries, chemical firms, energy service providers and other types of process industry firms. Recent developments such as the shale gas revolution in the United States (Joskow, 2013), the building of considerable new petrochemical capacity in the Gulf countries and investments in coal-to-chemicals in China (Zhou et al., 2012) have led to a changing competitive landscape, in which gains in resource productivity or energy efficiency are becoming increasingly important for firms in ports to maintain and improve their competitive position (e.g. Acciaro et al., 2014). Also, environmentally sensitive industries such as chemicals, petrochemicals and energy face an upsurge in regulatory and socio-political pressures to reduce, reuse and recycle raw materials and residual streams (Delmas & Toffel, 2004; Soylu & Dumville, 2011). Improvements in environmental performance by means of, for instance, enhanced resource productivity or energy efficiency are becoming of growing importance not only for firms in ports to maintain their license to operate and grow, but also for port authorities (Van Den Bosch et al., 2011). The 'greening' of ports (Lam & Notteboom, 2014) is particularly necessary when these ports are located in proximity to large residential areas, such as the ports of Rotterdam and Antwerp, and to ensure that the ports remain attractive for future employees and investors.

For firms and port authorities alike, the development of industrial ecosystems seems to be a promising strategic response to the challenge of improving both international competitiveness and environmental performance (e.g. Esty & Porter, 1998; Heeres et al., 2004). These ecosystems are networks of legally autonomous firms – usually physically

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interconnected by pipelines – that use one another's residual energy and chemical effluents as input for their own production process (Ayres, 2002; Doménech & Davies, 2011; Ehrenfeld & Gertler, 1997). By converting by-products into product streams for other firms, added value is created. Also, these streams provide an economical substitute for virgin materials (Mangan & Olivetti, 2010), resulting in a reduction in the total use of feedstock and energy (Shrivastava, 1995). Furthermore, industrial ecosystems enable firms to reduce their waste disposal and emissions (Schwarz & Steininger, 1997).

Notwithstanding these various possibilities for improving both their competitiveness and environmental performance, established firms in ports are often reluctant to get involved in or to further develop industrial ecosystems (e.g. Baas & Huisingh, 2008). Substantial investments generally need to be made in physical infrastructure, like in pipeline networks and complementary relation-specific assets, so as to enable the flow of residual energy or other by-products from one production plant to another. Also, the formation of industrial ecosystems implies increased interfirm interdependence (Ehrenfeld & Gertler, 1997), which established firms tend to avoid. Besides, firms with limited experience in properly managing interdependent relationships may encounter difficulties to reap the potential benefits. These and other factors hamper or slow down the development of industrial ecosystems in port-industrial complexes. One of the main goals of port authorities is to facilitate firms located in the port in a way that these firms "can contribute most to a competitive and sustainable development of the port" (Van Der Lugt et al., 2013: 111). However, most port authorities have largely ignored their key role in deliberately fostering industrial ecosystem development as a way of contributing to the achievement of these goals. Moreover, this role has been underexplored in the port-related literature.

In this study, we aim to fill this gap by examining the following research question: In order to improve both competitiveness and environmental performance of port-industrial complexes, how can port authorities foster the development of industrial ecosystems in these complexes? We contribute to the literature in at least two ways. First, we empirically and conceptually identify how two generic policy instruments of port authorities – i.e. (i) investments in physical and knowledge infrastructure, and (ii) land allocation – can be turned into strategic levers to foster this development. Second, by so doing, we emphasize the underexplored key role of port authorities in contributing to both greater competitiveness and better environmental performance of port-industrial complexes.

The study is structured as follows. First, we set out the theoretical background of our research. We then present the research setting and methodology, followed by our case study of the port of Rotterdam, describing how its port authority fosters the development of industrial ecosystems by strategically making use of the generic policy instruments mentioned above. Finally, we derive and discuss a set of strategic levers for port authorities to foster industrial ecosystem development.

4.2. Theoretical Background

Since the 1987 release of the United Nations Brundtland Report on the importance of sustainable development (WCED, 1987), the associated required change from linear to more closed-loop systems of production and consumption has gained increased scholarly attention. This spawned the emergence of academic research on industrial ecology. Industrial ecology is "a broad, holistic framework for guiding the transformation of the industrial system to a sustainable basis" (Lowe & Evans, 1995: 48). The main unit of analysis within this framework is the *industrial ecosystem*, which consists of firms that are engaged in symbiotic relationships with one another in the sense that residual energy (such as steam and waste heat from electricity), chemical effluents (such as hydrochloride and ethylene) or other residual resources (such as industrial CO2 and water) from one industrial process serve as energy or raw materials for another (Ayres, 2002; Ehrenfeld & Gertler, 1997; Shrivastava, 1995). Other terminologies used in this context include eco-industrial park (Heeres et al., 2004) and industrial symbiosis network (Doménech & Davies, 2011).

Industrial ecosystems are typically characterized by continuous resource transactions between firms, due to which the proper functioning of their production processes is fundamentally entwined (Ehrenfeld & Gertler, 1997). Breakdowns or output fluctuations – as a result of, for instance, technical problems or preventive maintenance – can seriously affect all the constituent firms (Tsvetkova & Gustafsson, 2012), especially when possibilities to buffer against instability are limited. The firms' production volumes may need to be mutually adjusted (Ayres, 2002). The classic example of an industrial ecosystem is the Kalundborg complex in Denmark nearby Port of Kalundborg. This complex accommodates physically interconnected local production sites of large multinational firms such as Novo Nordisk and Statoil but also smaller firms (Ehrenfeld & Gertler, 1997). Baas and colleagues (Baas & Boons, 2004; Baas & Huisingh, 2008) and Heeres et al. (2004) have examined the development of industrial ecosystems in the 1990s and early 2000s in the port of Rotterdam. These port-related studies, which did not particularly address the role of port authorities in fostering this development, focused in particular on the historical background of industrial ecosystems and the role of the constituent firms, as well as external organizations such as the representative organization of all the industrial and logistical firms in the port.

Notwithstanding the opportunities for both greater international competitiveness and better environmental performance inherent in getting involved in industrial ecosystems, as mentioned earlier, firms tend to be reluctant to do so (Baas & Huisingh, 2008). For instance, because involvement often implies considerable investments in relation-specific assets and increases interdependence. Furthermore, established firms that are satisfied with the status quo "may be uncomfortable with a process that requires shifting organizational cultures and crossing boundaries" (Mangan & Olivetti, 2010: 97). In this connection, various scholars have elaborated on the role of local or regional authorities – such as governmental agencies and other public bodies – in fostering the development of industrial ecosystems (e.g. Costa

& Ferrão, 2010; Deutz & Gibbs, 2004; Mangan & Olivetti, 2010; Mirata, 2004; Von Malmborg, 2004). For example, Costa and Ferrão (2010) address authorities' environmental and waste management policy instruments such as emission caps, landfill bans, incineration taxes, incentives for reduction targets, and cleantech programs. Mirata (2004) mentions their important role of helping to identify complementarities among the needs and capacities of geographically proximate firms so as to provide a basis for collaborative partnerships.

Important strategic goals of many port authorities are the improvement of both the competitiveness of the firms located in their port area and the overall sustainability – which includes environmental performance – of the port-related activities of these firms (Merk, 2013; Van Den Bosch et al., 2011; Van Der Lugt et al., 2013; Verhoeven, 2010). Yet, up till now, port research lacks an explicit focus on the role of port authorities in fostering industrial ecosystem development in the port area in order to achieve these strategic goals. In addressing this research gap and, in turn, addressing the research question raised in this study, we focus on port authorities operating with the (extended) landlord port model. In large and medium-sized ports, the landlord port model seems to be the dominant port governance model (World Bank, 2007). In this model, the port authority is mainly responsible for the economic exploitation, long-term development and infrastructural maintenance of the port area (Brooks, 2004). Most landlord port authorities have at least two types of policy instruments at their disposal for realizing their strategic goals: (i) investments in infrastructure, and (ii) land allocation (e.g. Baird, 2000).

Infrastructure investments pertain to investments in both the maintenance of existing port-related infrastructure and the development of new infrastructure. The preceding planning process may involve the inclusion of stakeholders (Dooms et al., 2013). There is an important distinction between physical and knowledge infrastructure (Van Den Bosch et al., 2011), although these two types of infrastructure development can be complementary to each other. Examples of *investments in physical infrastructure* are the construction of new pipeline bundles, dredging and other types of waterside maintenance that improve port access, and the construction or maintenance of roads and berths. Examples of *investments in knowledge infrastructure*, which are largely focused on increasing port-related innovation, are investments in information systems, open R&D facilities, innovation platforms and linkages with research institutes. Whereas most investments in physical infrastructure are associated with traditional landlord activities, investments in knowledge infrastructure are associated with a more extended landlord model. This more extended landlord model, which implies a more facilitating or entrepreneurial type of port authority (Verhoeven, 2010), usually requires a more proactive stance of the port authority and new managerial practices in its organization (Hollen et al., 2013a; Parola et al., 2013).

Land allocation pertains to the allocation of available land within the port-industrial area. This land, which may have been redeveloped or newly developed, "can either be leased on an initial lump sum payment or based on an annual rental payment" (Ho & Ho, 2006: 153). A port authority's land allocation policy includes pricing and criteria/requirements for

using land as stated in the associated land lease or rental contracts, such as financial criteria, technical criteria, strategic criteria and environmental criteria. Examples of these criteria are, respectively, the provision of volume and income guarantees for a proportion of throughput, the use of proper buffers for chemical compounds produced on-site, the contribution to the port's strategic value for the international competitiveness of its region/country (Van Den Bosch et al., 2011) and modal split requirements (De Langen et al., 2012). In the literature, the assignment of terminal concessions has received particular attention (e.g. Farrell, 2012; Parola et al., 2012). For port authorities, these concessions revolve mainly around procedures to select appropriate terminal operators for existing or newly constructed port areas and the conditions under which these operators are given the right to operate the terminal facilities (Notteboom et al., 2012). Land allocation also pertains to co-siting policies within the port-industrial area.

Other policy instruments for landlord port authorities besides land allocation (including concessioning) and investments in infrastructure may include, for instance, regulatory instruments associated with environmental standards (Lam & Notteboom, 2014), the approval of capital investments (Brooks & Cullinane, 2006), and pollution taxation (Homsombat et al., 2013). These instruments pertain to a regulatory functional role of the port authority (Baird, 2000; Brooks, 2004; Verhoeven, 2010). In this study, however, we focus on the two policy instruments specified above.

4.3. Research Setting and Methodology

In order to examine how port authorities can use strategic investment policy levers and strategic land allocation policy levers to foster industrial ecosystem development – and, in turn, improve the competitiveness and environmental performance of their port-industrial complex – we present a case study of the port of Rotterdam, focusing in particular on the role played by the Port of Rotterdam Authority. Given the exploratory nature of our enquiry, a case study approach is considered appropriate (Yin, 2013). This approach allows, amongst others, in-depth exploration and understanding of the 'how'-question with regard to encouraging industrial ecosystem development through the development and use of port authority levers in a real-life setting.

The port of Rotterdam has been chosen for several reasons. This port hosts one of the world's largest industrial complexes, which provides a rich research context for investigating industrial ecosystems (Baas & Boons, 2004; Baas & Huisingh, 2008). It is home to a large variety of firms from energy, chemical and petrochemical industries; examples are Air Liquide, Air Products, AkzoNobel, E.ON, ExxonMobil, Huntsman, Linde Gas, Neste Oil, Shell and Shin-Etsu. With more than 120 sites, the industrial cluster covers more than 60 per cent of the total surface area of the port. The port of Rotterdam is Europe's number one refinery hub and is also developing into Europe's main energy port. Multiple

firms are physically interconnected through pipelines on a large-scale point-to-point basis. Underneath the complex, there is an extensive (over 1500 km) pipeline network for oil and chemical products to transport liquid bulk quickly, safely and in an environmentally friendly way. The Port of Rotterdam Authority has increasingly extended its traditional landlord function by also focusing on becoming an entrepreneurial port developer (Hollen et al., 2013a). In that role, it is enlarging its focus on contributing to the development of industrial ecosystems in the port area and, more broadly, on actively supporting interfirm connectivity and collaboration, in order to further develop an integrated, modern and sustainable petrochemical and energy cluster that remains competitive in the future (PoRA, 2012).

Data was collected from multiple sources, and includes both primary and secondary data. The primary data consists of semi-structured interviews with managers and senior advisors from the Port of Rotterdam Authority that have been carried out between September 2012 and July 2014. The interviewees are from various departments within the Port of Rotterdam Authority, including Corporate Strategy, Industry & Bulk Cargo and Land Allocation, which enabled us to develop a broader view on the use of policy instruments to contribute to the development of industrial ecosystems and to address concerns about single-informant bias. All interviewees were knowledgeable about the topic. The interviews averaged about an hour each. We employed several procedures (Eisenhardt & Graebner, 2007) to reduce retrospective errors and impression management during the process of collecting the data. For example, we focused on retrospective accounts of concrete past events and behaviors, instead of on intentions and beliefs. Also, we triangulated the interview with secondary data from internal documents and annual reports of the Port of Rotterdam Authority and a variety of websites and publicly available archival sources, including press releases, which have been collected in a case study database.

4.4. The Port of Rotterdam Case

In the last decade (2003–2014), the Port of Rotterdam Authority has used its generic policy instruments – i.e. (i) investments in physical and knowledge infrastructure and, to a lesser extent, (ii) land allocation – to contribute to the development of industrial ecosystems in several ways, which are elaborated upon below. Table 4.1 provides a concise overview.

First and foremost, the Port of Rotterdam Authority has invested in *physical infrastructure* in the form of common carrier and open access pipeline infrastructure in and beyond the port area, in collaboration with external parties. In 2003, the Port of Rotterdam Authority and Vopak Chemicals Logistics initiated MultiCore, a leading-edge public–private partnership in the form of a 75:25 joint venture (75% Port of Rotterdam Authority, 25% Vopak) that commercially operates a newly constructed underground distribution system consisting of a pipeline bundle for the chemical and gas industry. The pipelines are designed for the transport and distribution of various chemicals and gases between firms in

Table 4.1. *Case study port of Rotterdam: Port of Rotterdam Authority's strategic use of two generic policy instruments to foster the development of industrial ecosystems (2003–2014)*

Type of policy instrument	*Case study findings*
Infrastructure investments	
- *Physical infrastructure*	▪ Investments in common carrier pipeline networks: Multicore pipeline bundle; RC2 ethylene pipeline; steam grid ▪ Investments in 'plug & play area' (availability of bundled services such as power supply, waste water processing and tank storage) for biobased cluster
- *Knowledge infrastructure*	▪ Investments in linkages with knowledge/research institutes: SmartPort; RDM ▪ Investments in knowledge/innovation platforms: bringing firms together around new initiatives (e.g. open innovation platform for energy-efficiency; 'heatway' between the port of Rotterdam and the Rotterdam city center)
Land allocation	▪ Stimulation (e.g. in land lease renegotiations) of co-siting of industrial firms ▪ Inclusion of stringent environmental sustainability criteria for land allocation with regard to firms' environmental footprint

the Rotterdam port-industrial complex, which is beneficial to the formation and productivity of industrial ecosystems in this area. The bundle of pipelines stretches over a 20 km distance and is ready for use. Firms can lease MultiCore's pipeline capacity and connect it to their own installation in order to transport chemicals. The investment in MultiCore by the Port of Rotterdam Authority was deemed necessary as this pipeline infrastructure would not have been constructed – or at least not in a cost efficient way – by the established firms in the port-industrial complex. Firms that have already made use of the MultiCore pipeline bundle include Abengoa, Air Products, ExxonMobil, Linde Gas, Shell Chemicals and Shin-Etsu.

The Port of Rotterdam Authority has also invested in pipeline infrastructure that connects the port of Rotterdam with industrial zones outside the port. In the same year MultiCore was launched, the Port of Rotterdam Authority initiated RC2, a 50:50 joint venture with ARG. The latter is owned by the chemical firms BASF, Bayer, BP, Degussa, SABIC and Sasol. RC2 commercially operates a common carrier pipeline system for the transport of the chemical compound ethylene between the ports of Rotterdam and Antwerp,

stretching over a 117 km distance. Within the available capacity, any firm can contract the transport of ethylene at a standard production specification and a public tariff system.

The Port of Rotterdam Authority also became involved in the construction of a high-quality steam grid in the Botlek area of the port according to the common carrier concept. Along with Rotterdam-based grid manager Stedin and contractor Visser & Smit Hanab, being responsible for building the grid on behalf of Stedin, the Port of Rotterdam Authority is initiator and co-sponsor of the steam grid's development. The steam grid, which has been put into use as of mid–2013, was built with the objective to distribute steam from one plant, where it is a residual energy, to surrounding plants that use this steam for production. Although the development started officially at the end of 2009, it took more than 15 years to realize the plan of establishing a steam grid in the port. The grid currently stretches over a 2 km distance to connect AVR, a waste services and energy provider (supplying the steam), to Emerald Kamala Chemical, a producer of specialized chemicals, where the steam is consumed. Plans have been made, however, to extend the grid with 3.5 km to one or more additional firms, including AkzoNobel, in the Botlek area of the port. This grid extension is likely to be partly financed through a deal with the Rotterdam Climate Initiative, which is co-founded by the Port of Rotterdam Authority.

Another way in which the Port of Rotterdam Authority aims to contribute to the development of industrial ecosystems in the port of Rotterdam is its so-called 'plug & play' initiative together with energy supplier E.ON, water solution supplier Evides, regional grid operator Stedin and tank terminal operator Vopak. This initiative, for which these five parties signed a long-term cooperation agreement in mid–2013, revolves around the creation of an 80 hectare 'plug & play area' to accommodate firms active in bio-chemicals, bio-energy and bio-fuels. Within this area – to be situated in the newly constructed Maasvlakte 2 port area – bundled services such as power and water supply (including process and drinking water), waste water processing and tank storage will be readily available to these biobased firms. All five organizations, including the Port of Rotterdam Authority, invest in the required basic infrastructure (such as pipelines). The presence of the bundled services imply that firms that establish themselves in this area will not have to make these investments themselves. Moreover, as stated by an interviewee from the Port Authority:

> *"This plug and play initiative enables the development of industrial ecosystems by encouraging energy flows from one industrial process to another."* (Manager Industry & Bulk Cargo, Port of Rotterdam Authority, interview, March 2014)

By allocating this 'plug & play area' to bio-based firms, in order to eventually create a bio-based cluster, the Port of Rotterdam Authority uses, besides its infrastructure investment policy instrument, its *land allocation* policy instrument to foster industrial ecosystem development. That is, it allocates land to innovative firms that can be part of a large industrial ecosystem – largely by means of co-siting – in which residual energy and other material is exchanged. Furthermore, as is largely the case also for MultiCore, RC2,

and the steam grid, the Port Authority allocates specified land area for new pipeline networks that enable industrial ecosystems to develop.

Furthermore, the Port of Rotterdam Authority has invested in *knowledge infrastructure* (see Table 4.1) that fosters the development of industrial ecosystems directly or indirectly. That is, for example, by encouraging firms in the port of Rotterdam to join existing industrial ecosystems or to talk with one another about creating new industrial ecosystems. The Port of Rotterdam Authority attempts to do so by bringing potential industrial ecosystem partners together by helping to offer platforms for informal contacts and meetings. For instance, by investing in the realization – in collaboration with other parties – of conferences where representatives of these firms meet and inform each other about, among others, potential ecosystem linkages and new ways of managing existing linkages. But also by bringing different parties together around new initiatives. One of these initiatives is the creation of a new 'heatway' that connects the port of Rotterdam to the Rotterdam city center, transporting excess residual heat from industrial firms in the port to households. This is comparable to the realization by the municipality of Kalundborg in 1981 of a district heating distribution network from a large power plant to the city of Kalundborg, utilizing the plant's waste heat (Richards & Pearson, 1998). Another illustrative initiative is the use of a largely pre-existing pipeline to transport industrial CO2 from firms in the port – including Abengoa and Shell – to over 550 greenhouses located between Rotterdam and Amsterdam so as to enhance crop growth. Besides, account managers and other employees of the Port of Rotterdam Authority invest energy and time in looking for potential new interfirm connections and synergies from an industrial ecology perspective, based on their accumulated information and knowledge.

The Port of Rotterdam Authority also co-creates and invests in strong linkages between the port of Rotterdam and knowledge and research institutes, including business schools, technical universities and centers of expertise. A key example is the initiation (in 2010) and subsequent long-term sponsoring of Erasmus Smart Port Rotterdam (SmartPort) by the Port Authority. SmartPort is a research collaboration between different disciplines – such as Economics, Management and Law – of the nearby Erasmus University Rotterdam aimed at providing firms and organizations in the port of Rotterdam with applicable knowledge from within this university related to, for instance, supply chains and logistics systems, legal issues, governance and strategic management, including industrial ecosystem development. Besides, the Port of Rotterdam Authority has had a supportive role – in terms of area redevelopment (from 2006 onwards), financial support and knowledge input – in establishing (in 2013) the sustainability- and innovation-oriented RDM Centre of Expertise in the port of Rotterdam. The latter enables, amongst others, multidisciplinary research into industrial ecology applications.

Also, the Port of Rotterdam Authority took an important initiating role in establishing Plant One, an open test facility for sustainable process innovation with around 10.000m2 floor space in the port of Rotterdam opened in 2011 (see also Hollen et al., 2013b). This role

pertains largely to investments in knowledge infrastructure, but also to investments – in terms of financial support – in physical infrastructure (e.g. equipped office, laboratory space and industrial utility infrastructure within Plant One) and land allocation (i.e. allocation to Plant One). The presence of Plant One, a limited-liability company, is beneficial for the development of industrial ecosystems as it enables firms in the port to test and develop new sustainable process technologies required for advancing eco-industrial collaboration without disrupting their existing processes. For example, an innovative membrane technology for improving the efficiency of separating chemical compounds in industrial processes has been tested at pilot-scale within Plane One. Also, in 2014, a so-called 'energy efficiency marketplace' has been established in Plant One. This initiative stimulates the implementation of innovative energy saving solutions – such as heat exchangers, water treatment technologies and degassing installations – in the port-industrial complex. The marketplace is part of a newly established open innovation platform for energy efficiency in the port, of which the Port of Rotterdam Authority is one of the initiators.

Regarding the *land allocation* policy instrument (see Table 4.1) the Port of Rotterdam Authority stimulates, among others, co-siting. One way it does so, as was mentioned by an interviewee from the Port Authority, is as follows:

> *"In renegotiating land lease contracts with established firms, my colleagues usually aim to persuade these firms to give back unused land. That is, land on which these firms have acquired an option to accommodate possible production growth, but which they have not used for a considerable time, nor expect to use in the short or medium term. This unused land can then be leased to other established firms in the port or to new firms, with whom residual energy or other by-products can subsequently be exchanged."* (Senior Advisor Corporate Strategy, Port of Rotterdam Authority, interview, November 2013)

Another way in which the Port Authority fosters the development of industrial ecosystems by using its land allocation policy, although not predominantly aimed at this goal, is by including sustainability criteria – in terms of environmental performance – for land lease contracts with respect to both new lease contracts and contract extensions. For example, with regard to firms' environmental footprint. Firms tend to be encouraged by these criteria to look beyond their firm-level boundaries for (further) possibilities to provide nearby firms with their residual energy and other by-products – to be used as input for these firms' production processes – and to use these firms' by-products for their own production.

4.5. Implications and Challenges for Port Authorities

For major ports that host large industrial complexes of chemical, petrochemical and other energy-intensive process industry firms, the formation and further development of industrial

ecosystems – in which these firms use one another's residual resources such as energy or chemical effluents for their own production process – is important for increasing both the international competitiveness and environmental performance of these ports. For example, by becoming part of one or more industrial ecosystems, prior stand-alone firms in a port can create added value, become more energy-efficient, reduce their feedstock costs and lower their emissions and waste disposal (Baas & Boons, 2004; Esty & Porter, 1998; Schwarz & Steininger, 1997; Shrivastava, 1995). Industrial firms in ports in developed countries where, for example, cheap shale gas is currently not exploited or even prohibited (such as in several European countries) face relatively high energy and feedstock costs. Cost reductions are important for these firms to survive and for not replacing their production to other regions in the world. Such relocation of production would imply not only loss of employment and value creation in the ports where these firms are located, but also lower demand in these ports for raw materials – resulting in less inward bound logistics streams – and a drop in demand for logistics services to the hinterland. Developing industrial ecosystems may be relevant for port-industrial complexes also for other reasons. For instance, the resulting gains in energy efficiency are important for ports that have taken up the increasingly crucial role of energy hubs (Acciaro et al., 2014). Also, process industry firms in ports nearby residential areas might need to become less polluting. This is especially important for port authorities that communicate their dedication to have an environmentally sustainable port to their clients and external stakeholders (Lam & Notteboom, 2014; Parola et al., 2013).

Our case study shows how the Port of Rotterdam Authority contributes to the development of industrial ecosystems by strategically making use of two types of generic policy instruments, that is, (i) investments in physical and knowledge infrastructure, and (ii) land allocation. On the basis of the theoretical background and empirical insights stemming from the case study, we can derive a set of important strategic levers for port authorities to foster the development of industrial ecosystems. These strategic levers, which we define as ways in which port authorities can deliberately turn their infrastructure investment and land allocation policies into instruments to foster this development, are summarized in Table 4.2. Accordingly, we distinguish strategic investment policy levers and strategic land allocation policy levers. As highlighted in the case study, these strategic levers can complement and thereby strengthen each other.

Investing in common carrier pipeline infrastructure, in cooperation with external parties through public-private partnerships (e.g. Min & Jun, 2014), seems to be a suitable strategic lever for port authorities to foster the formation of industrial ecosystems in their port-industrial areas. That is, to contribute to industrial ecosystem development by investing in the required physical interfirm linkages for the transport of residual energy and chemical effluents. Firms in ports tend to be unwilling to finance these investments only by themselves because of the high costs and uncertainties involved. Also land allocation can be a suitable policy instrument for port authorities to turn into strategic levers – such as actively stimulating co-siting of industrial firms that can use each other's residual resources – for

Table 4.2. *Illustrative strategic levers of port authorities to foster the development of industrial ecosystems and thereby improve a port's international competitiveness and environmental performance*

Strategic investment policy levers
- Physical infrastructure
▪ Investing, through public-private partnerships, in the construction of common carrier pipeline bundles.
▪ Investing, through public-private partnerships, in the realization of 'plug & play areas' where bundled utility services are readily available for industrial firms that establish themselves in these areas.
- Knowledge infrastructure
▪ Co-creating and investing in linkages with universities and other knowledge/research institutes in the proximity of the port through both knowledge-based involvement and financial support.
▪ Co-creating and investing in platforms for knowledge and information sharing and collaboration between established firms in the port concerning industrial ecology-related initiatives.
Strategic land allocation policy levers
▪ Actively stimulating co-siting of industrial firms that can use one another's residual energy/chemical effluents.
▪ Introducing more stringent environmental sustainability criteria for land lease contracts with respect to both new lease contracts and contract extensions.

Source: Based on literature review and case evidence

contributing to the formation of industrial ecosystems in their port area. As Korhonen et al. (2004: 300) already pointed out, local authorities can, in order to foster the development of industrial ecosystems, 'carry out land use planning and influence the locating of firms'.

Besides a formation stage of industrial ecosystem development, when firms become physically interconnected – usually by pipelines – and use one another's residual energy and chemical effluents as input for their own production process, also a post-formation stage can be identified (e.g. Baas & Boons, 2004; Doménech & Davies, 2011). In this latter stage, relational interconnectedness develops among these firms as they invest in relationship-specific human capital in order to further improve their energy efficiency or resource productivity. This means that their physical exchanges become complemented by sharing information and knowledge on relevant operational and managerial processes, with a particular focus on strategic renewal and innovation, implying an increased level of *strategic connectivity* (see Chapter 2 in this dissertation) between firms. Relational interconnectedness

includes interfirm trust-building and mutual adjustment, and is associated with the presence of collective action regimes in ports (cf. De Langen & Visser, 2005). Knowledge or research institutes in the proximity of the firms may influence and partly legitimize the development of the required new management practices (Birkinshaw et al., 2008).

To foster the post-formation stage in the development of industrial ecosystems, port authorities will usually have to play a more indirect role compared with their role in fostering these ecosystems' initial formation. To stimulate this post-formation stage over time, strategic levers pertaining to investments in knowledge infrastructure will be the most suitable levers. For example, the provision of platforms for interfirm exchange of information and knowledge on how to improve firms' current collaboration from an industrial ecology perspective. This suggests port authorities to invest in knowledge infrastructure that enables these authorities to help established firms by acting as a "knowledge broker" or "knowledge bank" (cf. Von Malmborg, 2004: 340) for these firms to tap into. In order to do so, it is particularly important for port authorities to recognize, through advanced account management, the specific difficulties that firms experience with regard to going beyond the formation stage in industrial ecosystem development – 'a good landlord knows his people'.

4.6. Future Research Directions

Various scholars have emphasized that port authorities need to strategize beyond their traditional landlord function in order to succeed under changing environmental circumstances (e.g. Haugstetter & Cahoon, 2010; Musso et al., 2014; Van Der Lugt et al., 2013; Verhoeven, 2010). To a certain extent, this will require innovation of the business model design (Zott & Amit, 2010) of these port authorities, implying changes in their value proposition, the development and introduction of new managerial practices – i.e. management innovation (Birkinshaw et al., 2008) – in the port authorities' organization (e.g. Parola et al., 2013) and possibly new co-creation activities with firms located in the port area (Hollen et al., 2013a). For instance, to enable at least some of the examined strategic levers for fostering the development of industrial ecosystems, a change is required from a traditional landlord business model to an extended landlord model. This change entails a transition toward a more ambidextrous port authority aimed at developing an "ambidextrous port" (Van Den Bosch et al., 2011: 35).

An *ambidextrous port authority* has a dual focus on both exploitation of its traditional landlord role and activities and exploration of new roles and activities; exploration contributes to the proactive creation of strategic value by improving the international competitiveness of firms in the port-industrial complex (Van Den Bosch et al., 2011). A port authority should always be prepared to adopt new roles to successfully address changing market circumstances (Notteboom & Winkelmans, 2001). An example of such a new role is

provided by Acciaro et al. (2014: 10), who argued that '[…] port authorities need to become more conscious players in the port energy system and should be capable of addressing the environmental concerns, energy efficiency and sustainability proactively'. In this study, we pointed out that changing market circumstances as regards competitiveness and environmental regulation require an active role of port authorities in fostering the development of industrial ecosystems in their port-industrial complex. Future research may further examine how business model innovation of port authorities can contribute to their ability to develop and utilize strategic levers to foster this development.

Furthermore, this study focused on how port authorities can foster the development of industrial ecosystems in their port-industrial areas so as to increase the competitiveness and environmental performance of these areas, implying a single-port-centric perspective. However, industrial ecosystems can also exist between ports in geographic proximity. As Notteboom and Winkelmans (2001: 85) pointed out: 'Gaining competitive advantage in the port industry more and more is a matter of extending the strategic scope beyond the geographical boundaries of the port area'. Therefore, an interesting direction for future research is how industrial ecosystems on an inter-port level – involving, for example, industrial firms in the already physically interconnected ports of Rotterdam and Antwerp – can be fostered by the port authorities involved. For instance, how can, in a context of competing ports, with different specificities of the local environment (Debrie et al., 2013), new ways of collaboration between port authorities contribute to the development of industrial ecosystems on an inter-port level? This study may provide a fruitful starting point for this and related important port research.

CHAPTER 5

Managing Organizational Interdependence for Enhanced Resource Productivity: The Role of Management Innovation in Industrial Ecosystems in Ports*

5.1. Introduction

Established firms are facing the challenges of more stringent environmental regulation, corporate environmentalism (Banerjee, 2001) and intensifying international competition, particularly in chemical and other energy-intensive process industries, requiring them to improve both their corporate environmental performance and their competitiveness (Bansal & Roth, 2000; Schaefer, 2007). Enhancing resource productivity helps to tackle this challenge (Porter & Van Der Linde, 1995). Resource productivity gains can be attained by, for example, investing in the development of new technological measures that require fewer inputs to achieve similar levels of production (Berrone et al., 2013) or that create added value by converting residual resources into useful product streams for other firms (Shrivastava, 1995; Tsvetkova & Gustafsson, 2012). New technological measures, however, might not be sufficient: if implementing these measures requires interorganizational collaboration, the associated interdependencies (e.g. Dougherty & Dunne, 2011; Newell et al., 2008) have to be properly managed by the firms involved (Casciaro & Piskorski, 2005; Gulati & Singh, 1998; Huemer, 2006). Hence, new forms of interorganizational interdependence associated with technological innovation require the development of new management practices,

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labelled by Birkinshaw et al. (2008) and other scholars (e.g. Damanpour & Aravind, 2012; Vaccaro et al., 2012; Volberda et al., 2013a, 2014) as management innovation.

Collaborating legally autonomous firms tend to initially manage their relationships by using formal management practices such as coordination by contractual arrangement (Das & Teng, 1998; Klein Woolthuis et al., 2005). In an interorganizational exchange of resources, this formalization is particularly important for firms facing high levels of asset specificity, behavioral uncertainty and transaction frequency (Poppo & Zenger, 2002). However, it may also be necessary to use less formal or informal management practices – e.g. to foster mutual adjustment and joint problem-solving (Huemer, 2006; Mesquita & Brush, 2008; Newell et al., 2008). In this connection, scholars have advocated a transition from managing interfirm interactions that is mainly transaction-oriented to one which is more relationship-oriented (Dyer & Chu, 2003; Elfenbein & Zenger, 2014; Lorenzoni & Lipparini, 1999; Ring & Van De Ven, 1994; Zajac & Olsen, 1993). This stream of literature suggests that such a transition arises mainly from recurrent interactions and the attendant building of trust among the firms involved. However, research has not yet addressed how to actively *manage* new interfirm interactions and the interdependencies involved in a way that enables performance gains over time. This research gap and consequent lack of focus on the potentially enabling role of human agency in the process, in terms of actively developing the required new management practices (Birkinshaw et al., 2008), is problematic and therefore deserves attention.

Our main purpose in this study is to address this gap by examining the enabling role of new management practices in managing interorganizational interdependence for enhanced resource productivity. In so doing, we aim to contribute primarily to the emerging management innovation literature. Our first contribution is that we present a longitudinal case study of an industrial ecosystem consisting of three established and interdependent firms that enables capturing empirically organizational and interorganizational dynamics, changes in contextual factors, and outcomes associated with the development of new management practices over time, which has hitherto been described mainly on a conceptual basis (Birkinshaw et al., 2008; Damanpour & Aravind, 2012). We find that the development of a joint performance indicator – preceded by a consensus on interorganizational goals – to measure and report on the extent of compliance with these goals is a complex and time-consuming process. We also find, however, that this joint performance indicator and complementary new management practices are needed to enhance resource productivity. Our study further shows how new formal and new informal management practices are largely interdependent in terms of their development, and how firms can operate as one another's external change agents with respect to developing these practices.

Another contribution of this study to the management innovation literature is that, whereas scholars have notably focused on a firm or dyadic level of analysis (Birkinshaw et al., 2008; Damanpour & Aravind, 2012; Meuer, 2014; Vaccaro et al., 2012), we focus on management innovation at the multilateral level. At that level of analysis, the development

and implementation can be considered as more radical, encompassing and, as our findings indicate, hence more complex to accomplish. One final contribution from the study is based on our findings and previous literature: we derive a set of propositions for future research that relate the persistent use of existing formal management practices and the development of new management practices to the resource productivity of interdependent firms over time.

The study is structured as follows. We begin by setting out the theoretical background that informed our research. We then present the methodology and case study findings before going on to discuss the theoretical implications, in particular for the management innovation literature. Next, based on our findings and previous literature, we advance three propositions to guide further inquiry and suggest additional directions for future research. We conclude by revisiting the study's main contributions.

5.2. Theoretical Background

The competitive and environmental performance of established firms is influenced largely by the interorganizational relationships in which these firms are embedded (e.g. Gulati, 2007; Lorenzoni & Lipparini, 1999). Collaboration up, down or outside their production and supply chain enables firms to organize for complex innovation (Dougherty & Dunne, 2011), improve corporate environmental performance in terms of reducing resource use, pollution and waste (Schaefer, 2007), or increase the value of by-products (Esty & Porter, 1998). These network forms of organizing, however, also result in a myriad of interdependencies with firms' external environments that need to be managed properly (Casciaro & Piskorski, 2005; Huemer, 2006; Newell et al., 2008). Firms and other social actors are interdependent when they do not fully control all of the conditions necessary for achieving certain actions or for obtaining the outcomes desired from these actions (Pfeffer & Salancik, 1978). Thompson (1967) identified three types of interdependence in increasing order of contingency: pooled, sequential and reciprocal interdependence. This classification was later applied to the interorganizational setting (e.g. Gulati, 2007; Huemer, 2006). In this study we focus on the development of new management practices in the context of *reciprocal* interdependence, which also contains aspects of pooled and sequential interdependence (Thompson, 1967).

Particularly interesting examples of organizational interdependence can be found in the context of industrial ecosystems. Industrial ecosystems are multilateral alliances of physically interlinked but autonomous firms that use one another's residual resources, such as chemical effluents and energy, as inputs for their own production process (Ehrenfeld & Gertler, 1997; Tsvetkova & Gustafsson, 2012; Shrivastava, 1995). Their linkages resemble symbiotic relationships in natural ecosystems. An industrial ecosystem well documented in the literature (e.g. Ehrenfeld & Gertler, 1997) is Kalundborg, an industrial area in Denmark where local production sites of multinational firms such as Novo Nordisk and Statoil as well

as those of smaller firms are connected by material or energy flows. In large industrial complexes, often located in or near major port areas, several industrial ecosystems may be located. The pipeline networks that typically connect the firms in an industrial ecosystem are built for continual point-to-point transport of residual resources with as few interruptions as possible. Consequently, incidents of manufacturing breakdown or output fluctuations can seriously affect all these firms and their resource productivity (Tsvetkova & Gustafsson, 2012). Their partner-specific tangible investments require them to collaborate for a considerable period of time before the investments become profitable. Hence, firms in an industrial ecosystem are considered interdependent (Ehrenfeld & Gertler 1997).

5.2.1. Management of organizational interdependence

In their seminal work on resource dependency theory, Pfeffer and Salancik (1978) mentioned several strategic options to alter interdependence to one's own advantage by manipulating or controlling resource flows. These options include mergers, forming joint ventures, using interlocking boards of directors, and joining centralized coordinating agencies. In this study, however, we focus on the development and use of *formal and informal management practices* to cope with the interdependencies involved in resource-based interactions in a multi-organizational setting.

Formal management practices, which can be aimed at outcome control or behavior control (Dekker, 2004), are generally geared toward adopting a structured approach to managing relationships. These practices include explicit contractual agreements, rules and procedures (Vlaar et al., 2007) – e.g. standard operating procedures, reporting and checking devices, performance standards and dispute resolution procedures (Gulati & Singh, 1998). Informal management practices, in contrast, include mechanisms for transacting and exchanging information and knowledge that have not been specified as part of a formal arrangement. Informal practices involve normative arrangements with regard to each party's contributions. These arrangements are laid down in 'psychological contracts' that firms develop between each other (Ring & Van De Ven, 1994; Sobrero & Schrader, 1998). Prior satisfactory interactions facilitate the underlying process of building trust (Das & Teng, 1998; Poppo & Zenger, 2002; Ring & Van De Ven, 1994).

In relation to the above, scholars have distinguished between using a predominantly transactional approach to managing organizational interactions and the interdependencies involved and an approach that is more relational in nature (e.g. Mahapatra et al., 2010; Ring & Van De Ven, 1992; Zajac & Olsen, 1993). A transactional approach, which prevails in studies taking a transaction cost economics perspective, entails focusing on using a firm's existing idiosyncratic formal management practices which seek to improve its competitive advantage. Activities consistent with this approach, motivated principally by the interests of a single firm, are embedded in "atomistic" network ties that lack social embeddedness (Uzzi, 1997: 36). The associated short-term focus is often reinforced by pressures from investors

(Newell et al., 2008). A transactional approach emphasizes the contractual aspects of inter-firm interactions and is directed principally at minimizing coordination costs and transaction risks. Closely related, if not identical, approaches have been labeled recurrent contracting (Ring & Van De Ven, 1992) and contractual coordination (Sobrero & Schrader, 1998).

A relational approach, on the other hand, encompasses a socially embedded orientation in which other firms in the network are perceived as partners with whom to create joint value (Madhok & Tallman, 1998; Ring & Van De Ven, 1994; Zajac & Olsen, 1993) so as to gain interorganizational competitive advantage (Dyer & Singh, 1998). The underlying rationale is that competitiveness depends in particular on "reaching positive-sum solutions to interfirm coordination problems" (Uzzi, 1997: 51). This approach, which has been variously labeled relational contracting (Ring & Van De Ven, 1992), relational governance (Poppo et al., 2008a) and procedural coordination (Sobrero & Schrader, 1998), implies that not all information required for task completion is contained within contractual agreements. Likewise, this approach emphasizes the use of informal management practices. Yet, it typically also requires formal practices that enable these informal practices to develop – e.g. to provide contractual safeguards against potential risks such as opportunistic behavior (Poppo & Zenger, 2002).

5.2.2. Developing new management practices: Management innovation

The development of new management practices aimed at improving performance has been referred to in the literature as *management innovation* (e.g. Birkinshaw et al., 2008; Damanpour & Aravind, 2012; Volberda et al., 2014). We follow Birkinshaw et al. (2008) in using the term management practices to cover the full range of management practices, processes, structures and techniques. Management innovation can be perceived either as new to the state of the art or as new to the adopting firms (Birkinshaw et al., 2008). In line with recent management innovation research (Damanpour et al., 2009; Mol & Birkinshaw, 2009; Vaccaro et al., 2012), we focus on the second of these perspectives of novelty.

Management innovation is argued to be positively associated with resource productivity gains (Mol & Birkinshaw, 2009; Nickell et al., 2001). Once it has been successfully implemented, it is usually difficult to replicate (Birkinshaw et al., 2008, Mol & Birkinshaw, 2006). However, generating and implementing new management practices is considered by most firms to be a complex process that may take a long time to achieve (Birkinshaw et al., 2008; Hamel, 2006). This applies in particular to established firms, which tend to have a preference for exploitation of current managerial practices rather than exploration (March, 1991). The development of new management practices may be inhibited by a firm's current internal rules, procedures and structures, and also by resistance to change (Birkinshaw et al., 2008; Mol & Birkinshaw, 2006). Management innovation between or among firms is even more complicated, as more factors in the external environment have to be taken into account (Meuer, 2014).

Birkinshaw et al. (2008) distinguished between internal and external change agents that drive management innovation. In their view, internal change agents include top managers and other organizational members who are proactively involved in "creating interest in, experimenting with, and validating the management innovation", whereas external change agents are entities outside a firm which influence and shape its management innovation process by providing "legitimacy and expertise" (ibid: 832). External change agents that have so far typically been mentioned in the literature are consultants and academics. Also, previous studies have focused mainly on management innovation *within* established firms (Birkinshaw et al., 2008; Damanpour & Aravind, 2012; Vaccaro et al., 2012) and, to a lesser extent, on *dyadic* interorganizational relations as the locus of innovation (Meuer, 2014). Studies which adopt a higher level of analysis have focused on the *diffusion* of management innovation (Fu, 2012, Schaefer, 2007). The development, rather than diffusion, of new formal and informal management practices in a multilateral context – the focus of this study – is largely underexplored.

5.3. Research Setting and Methods

Established firms in industrial complexes such as those in Houston (Texas, USA), Jurong Island (Singapore), Rotterdam (The Netherlands) and Kalundborg (Denmark) are energy-intensive and generally operate in highly competitive international environments. In order for these firms to survive and prosper, it is highly important that they are able to enhance their resource productivity (including energy efficiency) over time. Also, many of these firms are under growing regulatory and societal pressure to realize such gains in order to decrease their burden on the environment and, in turn, maintain their legitimacy (Berrone et al., 2013; Scherer et al., 2013). Although largely overlooked in the strategy and management literature as a research context, industrial ecosystems can enable industrial firms to obtain resource productivity gains (Esty & Porter, 1998). As pointed out before, however, established firms that become part of such ecosystems face a higher level of interorganizational interdependence, which may require developing new management practices in order that these gains can be realized. To examine how these interdependent firms enhance their resource productivity through management innovation, we conducted a longitudinal case study of an industrial ecosystem consisting of three leading chemical firms.

The case was selected by theoretical sampling (cf. Eisenhardt & Graebner, 2007) drawing on publicly available documents and interviews with informed experts (Hartley, 2004). The three focal firms were typified as being highly interdependent and as having made a clear transition in the management of their interdependence from an approach which was mainly transactionally oriented to one which is more relationally oriented. The case covers the period 2000–2012, and the data were collected between 2011 and 2013. The study's longitudinal nature is appropriate for capturing the (inter)organizational dynamics

with respect to the management innovation process and the performance outcomes in terms of resource productivity. Resource productivity is a suitable conceptual dependent variable because productivity growth relates most directly to the consequences of introducing new management practices (Mol & Birkinshaw, 2009) – i.e. compared to, for instance, stock market-based performance measures. We operationalized resource productivity as overall equipment effectiveness (OEE), a productivity measure used by the firms in our study as well as by many other process manufacturing firms (Dal et al., 2000).

5.3.1. Research setting

Since the early 2000s, three legally autonomous chemical firms – referred to in this study as Firm A, Firm B and Firm C – have been collaborating in a physical transaction network in a major industrial complex. Each of these firms was established more than three decades ago. They are all listed in the Fortune 500 ranking for their respective industries, and have annual revenues of between 8 and 24 billion dollars. As they compete in different markets, their collaboration has not raised antitrust concerns. The firms each employ 10,000–70,000 people worldwide, 200 to 500 of whom work in the local production sites that, being interconnected through an intricate, jointly financed pipeline network, form an industrial ecosystem in which two chemical compounds as well as basic utilities are exchanged. The firms' production processes are highly integrated, requiring them to collaborate on a round-the-clock basis. Relatively small disturbances in any part of this industrial ecosystem can cause shutdowns of the production of all three firms for up to a few days. To limit external security risks, the exchanged chemical compounds cannot be stored in large amounts, which limits the possibilities for buffering to mitigate against fluctuations in their supply or use. Environmental regulations limit non-pipeline transport of these chemical compounds.

5.3.2. Data collection

Data were collected from multiple sources (see also Box 5.1), and include both primary and secondary data. The primary data relate largely to a series of fifteen in-depth, semi-structured interviews carried out between early 2011 and late 2013 with ten managers from the three firms at three hierarchical levels: the site manager, plant manager, and planning/operations manager. The interviews averaged more than an hour each. Three respondents had been involved in the collaboration from the beginning, and most respondents had been extensively involved in the transition from a mainly firm-centric to a more relationally oriented approach to managing this collaboration. Drawing on findings from the literature and other secondary material, including publicly available archival data, we prepared an interview guide in advance that served as a checklist of the main issues to be explored during the interviews (Patton, 2002). The interviews were structured around issues related to, amongst others, (inter)organizational dynamics, the development of new formal and informal management

Box 5.1. *Data sources*

- Primary data sources

- ***Individual interviews****:* 15 semi-structured interviews with in total 10 managers from the focal firms (i.e. Firms A, B and C) – 4 to 6 interviews per firm – across the various hierarchical levels distinguished in the study, i.e. site manager; plant manager; functional (incl. planning/operations) manager level. In addition, semi-structured interviews with 3 external experts (one per interview) regarding both the case selection and the opportunities and challenges of the industries involved. All 18 interviews were conducted in the period January 2011 – November 2013. Most interviews were tape-recorded (i.e. when allowed) and transcribed, resulting in more than 180 single-spaced pages of transcriptions.
- ***Roundtable meeting*** (including presentation of the preliminary findings) in March 2013 with the plant managers from the focal firms and the designated coordinator of the interorganizational planner meetings.
- ***Attended interorganizational plant managers meetings*** in March and May 2013, with the plant managers and the designated coordinator of the planner meetings.

- Secondary data sources

Internal and intercompany documents (30 pages, e.g. on the development of the joint performance indicator); company magazines and websites; publicly available archival sources (e.g. annual reports).

practices, and performance outcomes. Some managers were interviewed more than once, depending on the need to clarify data.

To improve the data gathering and analysis, most interviews were conducted by two interviewers. Notes were taken to help formulate new questions during the interviews, facilitate later analysis and provide a signal to interviewees as to what type of issues were particularly noteworthy (Patton, 2002). To secure descriptive and interpretive validity, most interviews were audiotaped (i.e. when permission was given) and then transcribed. Some follow-up questions deemed necessary for further clarification were sent out to and answered by e-mail by a selection of interviewees. To systematically reduce retrospective errors and impression management during the data collection process, several procedures were employed (cf. Eisenhardt & Graebner, 2007, Golden, 1992). For instance, we focused on retrospective accounts of past concrete events and behaviors, rather than on past intentions and beliefs. Also, we triangulated interview data with secondary data from sources such as internal and intercompany documents (e.g. on the development of the new joint performance indicator), most of which are considered confidential, and publicly available archival

sources, including press releases. We used multiple respondents, including not only knowledgeable informants from the focal firms at three hierarchical levels but also three external experts. In that way, we were able to develop a broader view of the development of the interorganizational relations and to address concerns about single-informant bias regarding these relations (Kumar et al., 1993).

In addition, we were invited to be present at two interorganizational meetings for the plant managers (highlighted below as a new management practice to enhance resource productivity), which we were not allowed to tape-record. By attending these meetings as external observers, we were able to gather direct observation-derived data regarding, inter alia, discussed managerial problems, objectives, priorities and agreements. Also, we organized a roundtable meeting in which the plant managers of the three firms and the coordinator of the interorganizational planner meetings took part. During this meeting, preliminary case findings were presented and reflected upon, enabling additional validation. The resulting participant interaction was beneficial to the data quality as it provided checks and balances, allowing any comments that were incorrect or exaggerated to be weeded out (Krueger & Casey, 2000). Likewise, it was useful in assessing the extent to which the managers had a consistent, shared view (Patton, 2002). To enhance the methodological rigor of the study in terms of reliability, we built a case study database from our primary and secondary data, including over 180 single-spaced pages of interview transcriptions and notes.

5.4. The Industrial Ecosystem Case

In the period 2000–2010, the interfirm interactions in the industrial ecosystem depicted in Figure 5.1 (occasionally referred to as a 'chain' by the managers involved and in the remainder of this case) were dictated predominantly by formal and largely arm's-length contracts. Each of the three firms relied mainly on bilateral arrangements. Formally, communication between Firm B and Firm C took place only indirectly, i.e. through Firm A. Although there was some informal contact between the site managers of each of the firms, no structural informal management practices were in common usage. The firms stuck to their transactional approach with respect to managing their interdependent relationship, searching for resource productivity gains within their organizational boundaries using their firm-specific performance measures. Apart from occasional bilateral meetings and informal talks, little communication and sharing of operational know-how took place among the firms as corporate policy did not permit this. The understanding of one another's manufacturing processes in terms of strengths, weaknesses, preferences and concerns regarding the interfirm transactions at hand was very limited. One of the interviewees pointed out:

> *"If you don't talk and don't allow one another to take a look behind the scenes, you have no idea... We treated one another as a black box, even after such a long time of being interconnected. We were black boxes for each other."* (Site Manager, Firm C, interview, October 2012)

In that same period, the firms experienced numerous problems that severely restricted resource productivity gains. A significant number of these problems occurred because of maintenance stops that took longer than scheduled and manufacturing interruptions in one of the firms, and the resulting fluctuations in the supply of the chemical compounds or utilities shown in Figure 5.1. Absorbers and some buffer tanks with a limited capacity were installed to anticipate interruptions to the chain, yet these did not prevent breakdowns and slowdowns from occurring as a result of the interruptions. A preventive maintenance stop by one of the firms took about two weeks longer than was specified in the contract, severely affecting the operations of the other two firms who had to shut down their production processes for considerably longer than anticipated, during which time they could not supply their customers. In reaction, one of these two firms issued a financial claim. Some planned stops in production by one firm were not known in advance by the others. In one particular year, the chain was down many times. Downtime meant waste in terms of lost hours of production, and hence suboptimal utilization of the firms' production capacity, as well as waste of raw materials and energy. Due to the problems, all three firms had difficulties in reaching their plant's nameplate capacity and in increasing their resource productivity.

The reactions to these problems came mainly in the form of bilateral pressures and risk management from a firm-centric perspective. These appeared, however, to have little effect. Miscommunication and a lack of knowledge of each other's processes, dependencies and requirements seemed to be the principal causes of the recurring problems. For instance, it was not clearly understood by all that large fluctuations in throughput were considered problematic by the other firms. Based on their own firm-centric measures, the firms accused each other of being the chief 'efficiency-killer'. The bottlenecks in enhancing resource productivity remained unclear. Different perceptions of one another's performance led to ineffective solutions to the problems. Insufficient knowledge of one another made it difficult to discuss internally the need to adopt a more relational approach to managing their interdependence for enhanced resource productivity, as expressed in the following quote:

> *"The communication with the management team about the usefulness and necessity of further collaboration was hard, because how do you explain what you can do with a neighbor that you do not know?"* (Senior Process Engineer, Firm A, company document, October 2011)

Meanwhile, competitors in other countries were able to decrease their costs over time due to an increased availability of cheaper energy sources, for instance. Also, the economic crisis that began in 2008 heralded a period of capital constraints and shrinking margins,

requiring continuous gains in resource productivity. Corporate clients of the three firms, which were facing comparable competitive pressures, became less willing to accept production delays. The many operational breakdowns and the fluctuations in production and transfer of the mentioned chemical compounds and utilities, however, led to inefficient production and difficulties in supplying these clients. As reliability of supply to these customers had become increasingly important, downtime was considered as highly problematic. These external contextual changes triggered awareness among various managers that using their existing transactional approaches, with apparently limited gains in resource productivity, was no longer sufficient to compete. Driven by an increased sense of urgency to improve their collaboration, which was reinforced by demands from top management for performance improvement, in 2009 the plant managers from the three firms started to intensify communication with one another and to get together for some informal meetings. During these meetings, the plant managers discussed the imperative need for change and began to generate mutual insights into the consequences of firm-level events such as maintenance stops and power fluctuations for one another's performance. In the meantime, however, there were once again various significant problems, negatively affecting the firm's resource productivity and leading to increased frustration.

Near the end of 2010, the firms' top management, located in headquarters located elsewhere, urged the site and plant managers to come up with a plan to substantially improve resource productivity of their production sites. Capitalizing on the growing awareness that a more radical collaborative effort was needed to address the recurrent problems at hand and, the plant managers agreed to start a joint Lean Six Sigma project that included the disclosure and analysis of sensitive proprietary information about the production processes on these production sites. The initiative for this project was taken in particular by one of these firms. It was facing more demanding clients than the other two firms and its profit margins were decreasing slightly more sharply at that time, which prompted this firm in particular to look for new ways – including new management practices – to boost its resource productivity. To embed the initiative in the necessary trust-based environment, the three firms signed a confidentiality agreement. The project, in which an independent external consultant was also involved, started in early 2011 with a scan to evaluate, for each individual firm, firm-level resource productivity in terms of overall equipment effectiveness. A program was used to identify their major operating losses in the previous year. During the project's next phase, the root causes of these losses were identified, explicitly revealing the ways in which the firms were interdependent in terms of enhancing their resource productivity. A kick-off meeting was organized in the form of a joint event for a large group of the firms' employees to ensure there was greater shared understanding.

After having identified the root causes of the operating losses, attention shifted to developing validated and agreed new management practices at the chain level (i.e. at the level of the industrial ecosystem) to deal with these issues and improve resource productivity. Most importantly, within a few months after the start of the project, the firms

developed a primary key performance evaluation criterion at chain level, including complementary new management practices, which they labelled 'chain-level overall equipment effectiveness' (or chain-OEE). To shape the development of this new *joint performance indicator*, they drew on a key performance measure used by one of the three firms, which was quite different to those used by the other two. When discussing this new performance indicator, one interviewee commented:

> *"Joint resource productivity is our joint concern; it is the single most important objective we have in common."* (Plant Manager, Firm C, interview, May 2013)

The joint performance indicator was roughly defined as the sum of the actual production of Firms A, B and C divided by the sum of the so-called Maximum Sustainable Rates (MSR, i.e. the highest production capacity ever achieved over a certain period of time) of these firms. The difference between the firms' MSR and the actual production is labelled as their Overall Equipment Loss (i.e. the number of productive hours lost). In the case of Firm A, for instance, this loss is roughly determined by: (i) the equipment losses of Firm A; (ii) the process losses of Firm A; and (iii) the losses attributable to Firm B, Firm C and other suppliers. The same type of formula applies to Firm B and Firm C. Accordingly, the joint performance increases over time when the three firms cause less supplier loss for one another. Besides these reductions in supplier loss, the new performance indicator encouraged the firms to help one another by, for instance, sharing knowledge and expertise as to how each other's equipment and process losses could be reduced. Optimization of the chain-OEE and the related optimization of the production volumes for the products of the three firms in the chain became important interorganizational goals.

The development of the new joint performance indicator, including complementary new management practices such as incorporating chain-OEE in functional appraisal talks, marked a key turning point in how the firms managed their interdependence: from a transactional to a more relational approach. Subsequently, new formal management practices were developed to embed this new key indicator structurally in how their relationship was managed and evaluated. Standardized information on joint resource productivity and derived metrics was included in *new formal monthly status reports*, compiled and used by all three firms, allowing them to check each other's performance in this respect and to better understand one another's situation. Using language which was objective and neutral, these reports explicitly stated which firm(s) caused hold-ups, the reason(s) for the hold-ups, and the consequences for all three firms. By translating everything into operational hours, they avoided discussions of which firm lost the most money as a result of recurring problems. With the factual information provided, the firms were able to talk the same language and, in turn, to communicate better with each other about how to enhance joint resource productivity.

Alongside the new formal management practices of measuring and reporting on joint resource productivity, *new regular interorganizational meetings* were organized at the site

manager, plant manager and functional (maintenance and logistics) level. These meetings at three hierarchical levels, which were new for each of the three firms, function as a formal platform – with formal terms of reference – for discussions and mutual adjustment. The meetings at plant manager and functional level take place monthly. At the *planner/logistics and maintenance meetings*, operational firm-level planning (e.g. regarding production input required to meet customer demand) is discussed, maintenance stops and production volumes are aligned on paper, and problems or risks of productivity losses are brought up openly. The main issues and agreements are subsequently used as input for the plant manager meetings, which usually take place a week later. To facilitate the input process, a designated coordinator from the planner meetings is present at the plant manager meetings. At the new monthly *plant manager meetings*, which last between one and two hours, the chain-level OEE and the progress of joint projects to improve the firms' joint performance are reflected upon, new joint projects are proposed, and anticipated problems are openly communicated. Preferred behaviors and outcomes are signaled in order to align mutual expectations and eliminate misunderstanding, uncertainty and inefficiency. The location and chairing of the meetings both rotate between the firms. Additional people, such as a shutdown excellence manager, are invited whenever deemed necessary. The new *site manager meetings*, which take place less frequently, are principally aimed at providing direction and supporting joint initiatives. In that respect, the site managers, some of whom are responsible for operations in multiple countries, form a kind of steering committee. The directions provided are usually based on consultation with the plant managers.

The resulting new interorganizational communication and open interaction at and between different levels has led to concerted action to drive resource productivity gains across the three firms. This communication and interaction is made possible by the site managers from each of these firms being fully committed to using a more relational approach to managing their interrelationship. The new meetings illustrate a change from thinking in terms of individual compartments (i.e. within the single firm's boundaries) to thinking in terms of interorganizational processes, in which the interfaces between the three firms are taken more into account. The ensuing new insights have led to new formal measures to implement operational improvements and decrease downtime. For instance, the firms have started to work toward a new standardized plant maintenance procedure. This reconciliation has led to changes in the way that maintenance activities are prioritized: the order and timing of these activities, which had become increasingly (market) opportunity-based, are adjusted when it is clear that this will prevent the chain-OEE from being adversely affected. With regard to the contributions of and benefits for the firms, one of the managers involved said:

> *"We may not all contribute equally in creating the best maintenance procedures. One firm may have more knowledge to offer than others. But by bringing others to a higher level you help them to be more consistent in supplying you. Hence, in the end you benefit too."* (Process Excellence Manager, Firm B, interview, September 2011)

Table 5.1. *Narrative table of the main case study findings*

2000–2010: Predominantly *transactional approach* to managing interorganizational interdependence	
▪ Main managerial focus:	Improving firm-centric competitive advantage, i.e. enhancing resource productivity of the firm itself.
▪ Formal management practices for managing interdependence:	Formal bilateral contractual agreements; monitoring and pressuring the other firms based on own performance indicators and related criteria; arm's-length dispute settlement procedures, including financial claims.
▪ Informal management practices for managing interdependence:	(not applicable)
▪ Organizational outcome:	Organizational efforts to enhance resource productivity turned out to be largely ineffective.
2010–2012: Toward a *more relational approach* to managing interorganizational interdependence	
▪ Main triggers for the transition toward more relational approach	Sense of urgency to structurally improve the organizational outcome, driven by intensifying competitive pressures and more demanding customers, and ensuing interference/commitment of top management.
▪ Main managerial focus:	Improving interorganizational competitive advantage, i.e. enhancing resource productivity of both the firm *and* partner firms in the chain.
▪ Formal management practices for managing interdependence:	- Formal bilateral contractual agreements remain important but play a less prominent role in day-to-day operations. - Use of a newly developed joint performance indicator to assess joint resource productivity. - Inclusion of status updates on joint resource productivity and related metrics in new monthly reports, compiled and used by all three firms.

Table 5.1 (continued). *Narrative table of the main case study findings*

	- New structurally planned interorganizational meetings at three different hierarchical layers (including terms of reference). - New cross-functional interorganizational procedures (including joint maintenance procedure; joint emergency procedure).
▪ New informal management practices for managing interdependence:	- Mutual adjustment practices based on openly sharing knowledge and information beyond what is stated in contracts. - Constructive dispute resolution practices: avoidance of a claim culture.
▪ Complementarity between new formal and new informal management practices:	Informal interfirm discussions, mutual adjustment and disclosure of sensitive information in formal structured meetings in order to boost joint resource productivity, leading to formal joint procedures.
▪ Organizational outcome:	Significant gains in both the firms' own resource productivity and their joint resource productivity.

Another management innovation, initiated in 2012, was the *development of a new emergency procedure* for a critical utility. As a result of the site managers' explicit commitment to enhance joint resource productivity, employees at lower hierarchical levels within the firms felt they could come up with this new initiative. The initiators were a group of (mainly managerially oriented) operators from two of the firms, with lateral support from the firms' (technologically oriented) engineers. They suggested that, should there be a fall-off in the utility stream, they would immediately start reducing production until the situation was normalized. The extent to which production should be lowered differs according to the firm, each of them accepting maximum affordable losses in order to keep the chain running. The initiative was approved by the plant managers. The previous practice of renting expensive equipment that could be used in the event of a temporary fall-off in the utility stream could now be replaced by this new formal emergency procedure.

The development of the abovementioned new management practices was enabled largely by allocating considerably more dedicated managerial resources to this development from 2010 onwards. The new management practices resulted in noticeable improvements in the firms' individual and joint resource productivity, and this in turn enabled managers and other employees to become more intrinsically motivated to look for interfirm collaboration when seeking additional gains in resource productivity. Gradually, through accumulated trust but safeguarded also by confidentiality agreements, the firms chose to share detailed information with one another informally about anticipated OEE losses due to firm-level events, discuss the progress of important projects, and exchange primary process data and turn-around information. The three firms have been modernizing their factories and working toward higher safety levels by sharing best practices. Also, they are increasingly offering each other operational knowledge in order to improve their resource productivity. For instance, if there is an operational malfunction that appears difficult to solve internally, the other two firms tend to offer assistance where possible. One of the managers said:

> *"You come to interesting insights if you let someone from another industry see your processes. They look at it from a different perspective. You discover improved ways of doing things that you wouldn't have done if you had kept your walls up and the focus inwards."* (Production & Logistics Manager, Firm A, interview, August 2011)

In line with previous years, formal bilateral contractual agreement on the transactions of the residual resource streams remain important, and are still renegotiated every few years, but play a less prominent role in day-to-day operations and management. The previously used arm's-length dispute settlement procedures, including financial claims, which had resulted in a 'claim culture', has been gradually replaced by more constructive and informal dispute resolution practices aimed at continuity of the collaboration. The previous norm of monitoring and pressuring each other based on firm-specific performance indicators was no longer dominant once the firms had implemented a joint performance indicator. On the whole, as described above, the nature of the collaboration has become more relational over

time. This new way of managing their interdependence has resulted in significant gains in resource productivity for all three firms, strengthening their trust in being stronger together. These gains are largely the result of a significant reduction in downtime seen across all three firms. Table 5.1 provides a narrative table of the main case findings by comparing two phases in how the three firms managed their interdependence over time – i.e. (i) a predominantly transactional approach (2000–2010), and (ii) a more relational approach (2010–2012). It also highlights triggers for the transition process and how the new formal and informal management practices complement each other.

5.5. Discussion

5.5.1. Theoretical implications

The case carries important messages for the development of theory. A key finding is the importance for interdependent firms to develop a joint performance indicator. In the research context investigated, this enabled the firms to improve their joint resource productivity and, in turn, their own resource productivity. The newly developed joint performance indicator became their principal yardstick for judging how to make progress in managing their interactions. This particular management innovation and complementary new management practices – i.e. new to the firms involved – contributed greatly to the change from a firm-centric focus on competitive advantage to a more relational focus on *inter*organizational competitive advantage (Dyer & Singh, 1998). Poppo et al. (2008a) found that difficulties in measuring the performance contribution of partner firms weakens the connection between relational governance and performance. Our case study shows that this issue can largely be solved by developing a joint performance indicator. In particular, a joint performance indicator implies a "forward-thinking calculus", or "expectations of continuity", which is critical for generating trust between interacting firms "because it accounts for the positive relationship between prior history and trust" (Poppo et al., 2008b: 51).

Compared to management innovations such as capital budgeting, cost accounting, and cellular manufacturing (Hamel, 2006) that pertain mostly to one functional area, the development of a joint performance indicator, including complementary new management practices, is a more encompassing form of management innovation. As our case indicates, it is enabled by a combined change in planning, operations and maintenance management practices, for instance. Also, to be effective, these changes in multiple functional areas need to be implemented multilaterally through a concerted effort by the firms (Meuer, 2014). Compared to a stand-alone management innovation process within a single firm, these factors complicate the development of the new joint performance indicator. The three firms in our study could start this development only once they had sufficient understanding of each other's requirements, limitations and contingencies. In this connection, Thompson (1967)

pointed out that efficiency measurements can be valid only when effects can be attributed to the appropriate causal action and when the effects of causal action can be traced.

One of the three firms in particular was leading in the initiative to develop a joint performance indicator. Indeed, one of this firm's key performance indicators, which was significantly different to the indicators used by its two partner firms, was used to help shape the new joint performance indicator. This provides empirical illustration of the notion put forward by Volberda et al. (2013a) that learning from partners, including from their best practices, is a critical antecedent of management innovation. Also, this firm had the most urgent need to look for new ways of enhancing resource productivity, including new management practices, in order to cope quickly with the intensifying competition in its markets. These and related findings show how collaborating firms can *operate as one another's external change agents*. This observation suggests an additional category of external change agents besides consultants, gurus and academics (Birkinshaw et al., 2008) – i.e. partner firms from different industries, operating in different competitive environments and facing different regulatory and normative pressures to improve environmental performance. The firm in which the competitive and environmental pressures to enhance resource productivity are the greatest is the one most likely to function as external change agent for partner firms within its network.

The development of a new joint performance indicator triggered additional management practices that were new to the firms involved. For instance, the firms, becoming increasingly aware that they would all benefit from focusing on enhancing their joint resource productivity, chose to no longer take decisions about maintenance stops and throughput fluctuations in isolation. Instead, they started taking such decisions jointly at new interorganizational meetings that functioned as an interactive platform (cf. Lorenzoni & Lipparini, 1999). The new formal and informal management practices appeared to be not only complementary, but also largely *mutually interdependent* for their realization (see also Table 5.1). This empirical observation supports – in particular with respect to management practices – the suggestion by Newell et al. (2008: 52) that "[…] successful strategic interorganizational relationships depend on complex interactions between formal and informal mechanisms". For instance, without initially sharing sensitive information and knowledge (and at the same time guarding against potentially opportunistic behavior by means of a formal confidentiality agreement), the firms could not have developed a joint performance indicator. In turn, formally incorporating this indicator into how they managed their relationship encouraged the firms to voluntarily engage in more trust-based knowledge sharing and joint problem-solving. This finding is in line with the empirical support that Poppo & Zenger (2002) found for formalization having a positive effect on relational governance in the research context of information service exchanges.

It took the firms more than a decade (2000–2010) to start developing a joint performance indicator and related management innovations. In line with assertions made in conceptual contributions to the literature on management innovation at the firm level (e.g.

Birkinshaw et al., 2008; Mol & Birkinshaw, 2006), this shows that developing new management practices is indeed a complex process that may take a long time for established firms. Having traditionally been focused on enhancing their own competitiveness, the firms did not take one another's production processes and resource productivity into account once they became interdependent. They were initially reluctant to be more transparent about their own processes, as is often the case at an early stage of cooperation when trust levels are still low (Dyer & Chu, 2003).

Empirically investigating the development of new management practices by the three firms enabled us to identify changes in important contextual factors triggering this development. A change in an important *internal contextual factor* was the increasing commitment from the top management of each of the firms to develop a more relational approach to managing their relationship. A comparable observation has been made by other scholars (e.g. Marchington & Vincent, 2004). Our findings reveal that management innovation which is linked to enhanced multilateral communication and knowledge sharing is unlikely to happen without explicit consent from the top. In the same vein, Vaccaro et al. (2012) emphasized the capacity of top management to significantly influence management innovation. Changes in important *external contextual factors* were the intensifying international competitive pressures and more demanding customers in most of the non-overlapping markets where the firms were operating, which led to a growing realization among the three firms that they needed to step up their joint efforts to boost resource productivity. For instance, the firms increasingly had to cut their margins and, as the demanding customers in their markets became less willing to accept delays in production, the reliability of production and supply had become increasingly important. Hence, adaptation to external (i.e. client) expectations became the required strategy (cf. Scherer et al., 2013) to maintain their competiveness and legitimacy. Indeed, previous scholars have argued that the adoption or development of management innovation is triggered by challenging competitive conditions (e.g. Nickell et al., 2001) and institutional factors such as customer pressures (e.g. Schaefer, 2007).

5.5.2. Propositions

In the following sections, we draw on previous literature and our findings to develop a set of propositions. These propositions can be helpful to gain a better understanding of what will make interdependent firms more likely to succeed in managing their relationships for enhanced performance over time.

As argued by Pfeffer and Salancik (1978: 114), interdependent firms are faced with the problem that "the exchanges required for maintaining operations are uncertain and potentially unstable". Their interdependence implies vulnerability to one another's actions, which can be particularly problematic when there are few or no alternatives for procuring the resources that would normally be exchanged. When a firm considers these resources to

be important, it will attempt to reduce the uncertainty it is confronted with (Mahapatra et al., 2010; Thompson, 1967). Firms typically try to obtain more control over activities of other firms which they expect to affect their own operations (Casciaro & Piskorski, 2005; Dekker, 2004). Hence, interactions that are expected to involve greater interdependence tend to be organized with governance structures that are more hierarchical and often involve equity exchanges (Casciaro & Piskorski, 2005; Gulati & Singh, 1998; Gulati, 2007). When there is no overarching hierarchical structure through which control can be exercised, control over each other's activities tends to be confined to contractual agreements designed to deal with uncertainty (Das & Teng, 1998; Klein Woolthuis et al., 2005), complemented by other formalized practices such as pre-established plans and standard operating procedures (Gulati & Singh, 1998). For instance, in cases where long-term cooperation is needed in order to recover capital investments made in a resource-based interaction network, contract terms are usually drawn up to ensure that participating firms do not exit the network prematurely.

A high degree of formalization (Vlaar et al., 2007) is argued to be especially important when established firms face high levels of asset specificity, behavioral uncertainty and transaction frequency in their interorganizational environment (Poppo & Zenger, 2002). These particular transaction characteristics are inherent to many interdependent firms, as for instance found in industrial ecosystems. As our case findings demonstrate, established firms that have become interdependent tend to stick to a high degree of formalization to improve their competitiveness. However, the reciprocal nature of interdependence emphasizes the importance of coordination through mutual adjustment (Huemer, 2006; Thompson, 1967) so that firms can continuously anticipate each other's output streams and be proactive in communicating production schedules (Gulati & Singh, 1998; Mesquita & Brush, 2008). A transactional approach, characterized by a dominant orientation toward formal management practices to safeguard and improve firm-level competitiveness, leaves little room for mutual adjustment of this kind. After all, the codified blueprints for action that are commonly used in such management practices (Van De Ven & Delbecq, 1976) generally serve as a way of minimizing communication between task performers (Gulati & Singh, 1998).

Hence, whereas mutual adjustment requires information and knowledge to be transmitted (Huemer, 2006; Thompson, 1967) so that the actions of a firm can be brought into line with those of other network participants, such transmissions are limited for firms with a transactional approach. The firms in our study had virtually no non-contractual arrangements for exchanging knowledge and information in the first decade of their collaboration. Initial resource productivity gains are certainly to be expected at the point when firms become interconnected (Esty & Porter, 1998). Nonetheless, further gains in resource productivity appear to be difficult to attain unless the processes – and, related to that, resource productivity – of other firms with which there is a relationship of interdependence are taken into account. For instance, the persistent use of a transactional approach by the firms in our study resulted in multiple plant breakdowns and other problems,

as a result of which they were unable to reach the full design capacity of their plants and enhance their resource productivity over time. Hence, we advance the following proposition:

> **Proposition 5.1**: If established firms that have become interdependent keep managing their interdependence by using firm-idiosyncratic formal management practices aimed at enhancing only firm-level competitive advantage, their efforts to raise their own resource productivity will become less effective over time.

As signaled by the case findings, when contracts are being drawn up between firms remaining interdependent for a long period of time, these contracts as well as related formal management practices should not be focused predominantly on protecting a single firm's resource productivity at the expense of others. Instead, they ought to take account of how resource productivity will be affected for all firms involved, which entails focusing largely on enhancing interorganizational competitive advantage (Dyer & Singh, 1998). Contracts are then used, to quote Mayer (2006: 184), "in a more positive and constructive way to help develop a long, productive relationship – without sacrificing the legal protections that contracts provide". Such contracts help to create a common ground for building trust, mutual understanding, and interorganizational commitment (Blomqvist et al., 2005).

Our findings contain several examples of new formal management practices being developed that specifically sought to enhance *inter*organizational competitive advantage. For instance, the creation of a new joint performance indicator, standardized plant maintenance procedure, and joint emergence procedure (see Table 5.1). These management innovations led to further optimization of the production processes of the firms involved, resulting in enhanced resource productivity both at the firm level and jointly. On the basis of these observations and the literature referred to in our earlier section, we propose that:

> **Proposition 5.2**: If established firms manage their interdependence by developing new formal management practices aimed at enhancing interorganizational competitive advantage, both their own and their joint resource productivity will improve over time.

To enable firms to keep on anticipating each other's output streams, they have to be proactive in communicating with each other (Gulati, 2007) – as our case study shows with regard to operational schedules and maintenance stops. Formal management practices only allow for limited information processing (Galbraith, 1973). To enable interdependent firms to make the mutual operational adjustments, needed to ensure they can keep improving their performance (Mesquita & Brush, 2008), it will be essential to develop informal management practices that focus on achieving interorganizational competitive advantage (Poppo & Zenger, 2002; Van De Ven & Delbecq, 1976). Given the fact that firms do not always benefit equally from mutual adjustment to optimize joint performance, they will accept somewhat

unfavorable adjustments only if they trust their partner firms to reciprocate later on (Zaheer et al., 1998). This indicates the importance of developing informal norms of generalized reciprocity (Das & Teng, 2002) in order to generate relational rents (Dyer & Singh, 1998).

Developing new informal management practices that involve voluntarily disclosing sensitive information will increase firms' understanding of cause and effect with regard to key production performance metrics relating to resource productivity. This is needed because, as asserted by Thompson (1967: 160), "purpose without cause/effect understanding provides no basis for recognizing alternatives, no grounds for claiming credit for success or escaping blame for failure, no pattern for self-control". New informal management practices, however, need to be complemented by new formal management practices in order to give firms a platform for collaboration and a structural safeguard against potentially opportunistic behavior (Das & Rahman, 2010; Dekker, 2004; Mayer, 2006). In this regard, Newell et al. (2008) postulated that informal connections need to be complemented with formal management practices so as to provide the necessary ongoing support. Our findings showed that new informal management practices (e.g. mutual adjustment based on openly sharing knowledge and information), enabled by new formal management practices (e.g. interorganizational meetings at multiple hierarchical levels), in turn facilitate the implementation of other new formal practices (e.g. joint emergency procedure). Various scholars have provided evidence about the interaction between formal and informal management practices and their complementary value in interorganizational settings (Blomqvist et al., 2005; Das & Teng, 1998; Poppo & Zenger, 2002). It can likewise be argued that both types of management practices – when aimed at enhancing interorganizational competitive advantage – are required for realizing continuous gains in resource productivity. Hence, we propose that:

> **Proposition 5.3**: The more that established firms seek to manage their interdependence by developing new informal management practices that complement newly developed formal management practices aimed at enhancing interorganizational competitive advantage, the more both their own and their joint resource productivity will improve over time.

5.6. Contributions

This study combines concepts from the management innovation and interorganizational relationship literature with empirical insights in order to develop a better understanding of how management innovation can enable interdependent firms to enhance their resource productivity over time. By so doing, we contribute in particular to the management innovation literature in a number of interrelated ways. First, we presented a longitudinal case study that allows us to examine relevant process issues in managing interorganizational interdependence for enhanced resource productivity. The case study has demonstrated that

developing a joint performance indicator is a powerful, complex and indeed time-consuming management innovation by which interdependent firms seek to enhance their resource productivity. We have also shown how developing this management innovation and related new formal management practices goes hand in hand with developing new informal management practices such as voluntarily disclosing to one another information about important operational issues. In addition, we have demonstrated how changes in external contextual factors – referred to in Table 5.1 as 'triggers' – such as increased competitive pressures and increased demands from both clients and partner firms, as well as changes in internal contextual factors (including greater top management commitment), can push management innovation forward.

Furthermore, based on these findings and previous literature, we have derived propositions that relate the development of new management practices to resource productivity gains of established firms that have become interdependent. We have pointed out why such firms initially tend to manage this interdependence by using their current formal management practices which are directed at enhancing and protecting their own competitive advantage. As highlighted in the case study, however, this 'transactional' or 'firm-centric' approach is most likely to result in difficulties in achieving resource productivity gains over time. We argued that to enhance resource productivity these firms ought to develop formal and informal management practices designed largely to increase interorganizational competitive advantage (cf. Dyer & Singh, 1998) in terms of joint resource productivity, and that this would then enable them to make the transition toward a more relational approach to managing their interorganizational resource-based interactions.

Previous scholars have argued that this transition arises mainly from recurrent transactions (i.e. interactions) and the ensuing trust-building among the firms involved (Dyer & Chu, 2003; Dyer & Singh, 1998; Elfenbein & Zenger; Ring & Van De Ven, 1994; Zajac & Olsen, 1993). We complement this view by emphasizing the role of *active agency* (Birkinshaw et al., 2008), positing that this very process of transition requires developing new management practices, such as a new joint performance indicator and related new formal as well as informal management practices. For example, these particular new management practices contribute to drive expectations of continued interaction, which in turn, as found by Poppo et al. (2008b), mediates the positive relationship between prior history (i.e. prior interactions) and trust-building. Besides, these new management practices – which enable established firms to better deal with the dual challenge of improving both their competitiveness and their environmental performance – can complement or leverage technologically focused environmental innovations (Berrone et al., 2013) that these firms may already have developed for tackling this challenge. Our study therefore reinforces the conceptual statement made by scholars (e.g. Damanpour & Aravind, 2012) that technological innovation and management innovation are complementary and that both are required to sustain or increase competitive advantage.

Our main focus on the role of new management practices at the *multilateral* level, instead of at the firm level or dyadic level of analysis, sets this study apart from most management innovation research. Strategies for engaging in environmental innovation, increasingly part of the corporate agenda (Berrone et al., 2013), often require multilateral collaboration because of the interdependencies involved in effectively implementing such strategies (Dougherty & Dunne, 2011). The same applies to strategies for improving a firm's competitive advantage (Dyer & Singh, 1998). In this connection, we argue that established firms may need to develop and apply new-to-the-firm formal and informal management practices at the multilateral level so as to bring about resource productivity gains that would not be achievable via management innovation at the firm level only. These resource productivity gains in turn result in greater competitiveness and better corporate environmental performance (Porter & Van Der Linde, 1995). Accordingly, we theorize beyond a firm-level locus of management innovation. When new management practices are developed and implemented in an integrated network of idiosyncratic interorganizational relationships in which firms' operational boundaries become somewhat blurred, as in our case study, it becomes more difficult for competitors to imitate these practices successfully (Dyer & Singh, 1998; Shrivastava, 1995). In that way, management innovation at the multilateral level may strengthen interorganizational competitive advantage.

The case findings and the ensuing development of the above propositions, to be tested by further research in the form of periodic surveys and longitudinal comparative case studies of established industrial ecosystems, suggest various additional avenues for research. For instance, although formal hierarchy is missing in the multi-partner collaboration on which this study focused, power relations may play a considerable role (Mahapatra et al., 2010; Marchington & Vincent, 2004; Newell et al., 2008). Future research could explore the observation that an unequal balance of power in multi-organizational relationships tends to affect how interdependencies are managed (Blomqvist et al., 2005; Casciaro & Piskorski, 2005; Pfeffer & Salancik, 1978). Firms may have fewer incentives to communicate and share knowledge with more dominant partner firms because they have less trust that a win-win situation can be achieved, for example. In addition to power relations, it would be interesting to examine what influence the number of interdependent firms, the type of predominant interactions (involving, for instance, physical resources, information and/or knowledge), and their geographical proximity may have on our understanding of the developing of new management practices in the context of organizational interdependence and the role of these practices in enhancing resource productivity. For instance, geographic proximity of firms (e.g. Fu, 2012) may facilitate interpersonal knowledge sharing and communication, and, in turn, enable the development of new informal management practices over time.

Furthermore, a key finding of this study that deserves attention in future research is the apparent complexity and the time-consuming process involved in agreeing on interorganizational goals and subsequently developing a joint performance indicator to measure the extent to which they are being met. In their study on meta-organization design,

Gulati et al. (2012: 573) define a meta-organization as a network of firms or individuals "not bound by authority based on employment relationships, but characterized by a system-level goal". By developing a joint performance indicator, which implies having set a system-level goal, the partner firms in our case study started operating as a meta-organization. A promising avenue for future research would be to examine how making certain meta-organization design choices, such as those relating to boundary permeability or the degree of stratification (Gulati et al., 2012), enables managers of interdependent firms to speed up the development of new joint performance indicators. As our case findings suggest, this would improve firms' ability to enhance their resource productivity.

CHAPTER 6

The Role of Management Innovation in Enabling Technological Process Innovation: An Interorganizational Perspective*

6.1. Introduction

Competitive dynamics driven by technological, regulatory and economic changes have shaped an increasingly complex and turbulent business landscape. In order to cope with these dynamics and to secure future viability, innovation is imperative for established firms (Banbury & Mitchell, 1995; Crossan & Apaydin, 2010; Tidd et al., 2005). By focusing on the fact that firms organize their innovation efforts through R&D activities, many scholars have developed innovation theories from studies of technological innovation in the manufacturing sector (Damanpour & Aravind, 2012). Within the manufacturing sector, the pivotal importance of technological innovation to improve resource productivity and environmental performance has become particularly apparent in the context of the chemicals, aluminum, iron, steel, utility and other energy-intensive process manufacturing industries. Resource productivity improvements through fundamental technological process innovation are necessary due to many ecologically unsustainable practices in these industries in terms of pollution and consumption of scarce resources (Bhat, 1992; Shrivastava, 1995). As pointed out by Shrivastava (1995: 184), the regulatory and competitive landscape of these environmentally sensitive industries is "being shaped by numerous environmental regulations and standards that affect the costs of doing business". By enforcing reductions in greenhouse gas emissions, energy consumption and waste disposal, these regulations

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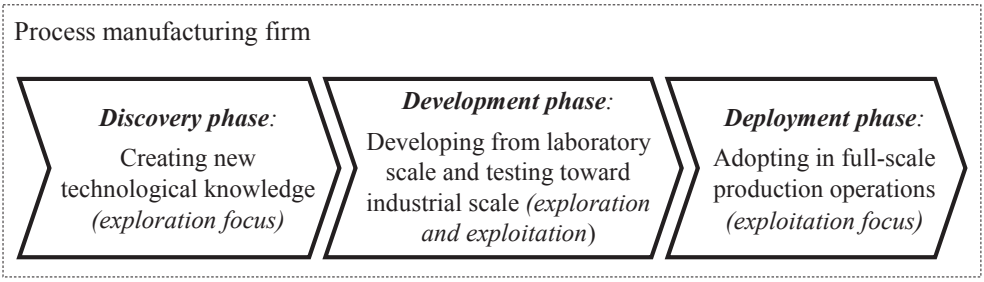
trigger established firms to embrace a shift toward proactive environmental management as part of their competitive strategies (Berry & Rondinelli, 1998).

Resource productivity improvements that lead to higher environmental performance also increase firms' competitiveness (Esty & Porter, 1998; Porter & Van Der Linde, 1995) by, for example, lowering production costs. This is particularly relevant for established energy-intensive process manufacturing firms to remain competitive in countries with increasing energy prices and environmental requirements, like countries in the European Union, and to be able to compete with, for instance, firms in the United States which, in contrast to many European firms, can often use cheap shale gas for their production processes. Established process manufacturing firms need, therefore, to come up with technological process innovations to switch to more sustainable and efficient modes of production that allow for a higher degree of reduction, reuse and recycling of raw materials, energy and residual streams in their full-scale production system.

Technological process innovation (i.e. innovation within a firm's production system) means that a firm has gone beyond the generation of a new idea and begins to apply (i.e. adopt) the resulting new technological process element(s) in manufacturing operations (Knight, 1967). Pisano (1997: 25) pointed out that technological process innovation "spans multiple functions, from research laboratories to pilot plants to full-scale commercial production environments." In line with this observation and with Malnight's (2001) process-based analysis, this study distinguishes *three phases* in technological process innovation: (1) discovery, (2) development and (3) deployment; see Figure 6.1. These phases are associated with what Li et al. (2008) refer to as, respectively, the science, technology and product market functions along firms' value chain.

Figure 6.1. *Intra-organizational perspective on technological process innovation: Three phases*



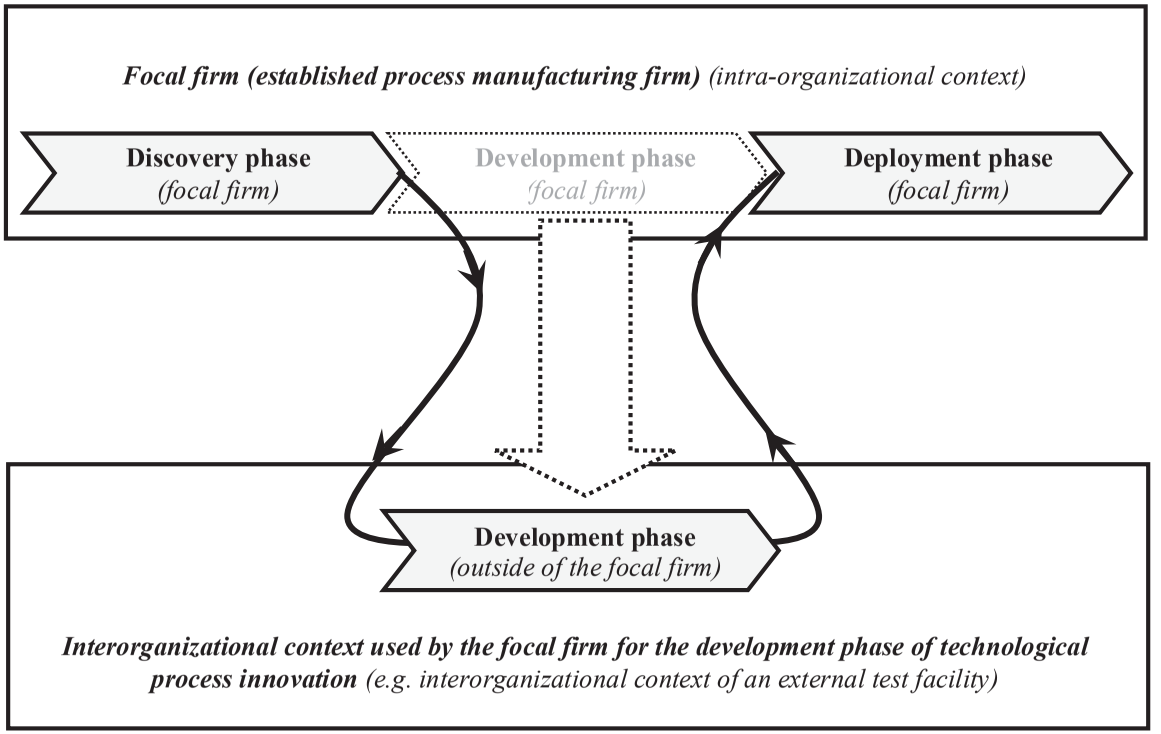
The *discovery phase*, which often takes place in the laboratory, refers to the discovery (including research) of new technological process elements by creating new technological

knowledge (Anderson & Tushman, 1990) or by combining existing technological knowledge in a new way (Henderson & Clark, 1990). An example is the creation of a new membrane separation technology as an alternative to distillation to separate chemical compounds in process manufacturing. In this phase, the focus is mainly on exploration (March, 1991). In the subsequent *development phase*, this new membrane technology has to be developed from laboratory scale and tested toward industrial scale. In this intermediate phase, the focus is on both exploration (new knowledge about how to scale up, e.g. from separating two liquids by membrane technology at laboratory scale to full-scale in the context of a new or existing chemical factory) and exploitation (using existing technological knowledge on scaling up). These foci are contradictory logics according to March's (1991) exploration/exploitation dichotomy. Finally, when scaled up and tested successfully, the newly developed membrane separation technology needs to become operational in the firm's full-scale production system. In this *deployment phase*, the focus is mainly on the exploitation of already acquired technological process knowledge and current production techniques (Li et al., 2008), requiring a significantly different nature of organizational knowledge creation – i.e. aimed at making existing processes more efficient – compared to earlier phases of technological process innovation (Hatch & Mowery, 1998).

The development phase hence functions as a bridge between an exploration-dominated (discovery) and an exploitation-dominated (deployment) mindset of process manufacturing firms. Various scholars have pointed out that established firms encounter difficulties in dealing with contradictory *intra-organizational pressures for exploration and exploitation* (Burgers et al., 2008; Jansen et al., 2009; March, 1991; O'Reilly & Tushman, 2008; Russo & Vurro, 2010). As a result, many promising technological process improvements do not pass the development phase, or are too time-consuming to be truly competitive (Collins et al., 1988; Hatch & Mowery, 1998; Macher, 2006; Pisano, 1997). Firms may overcome the associated exploration/exploitation paradox by partnering with other firms and organizations (Baden-Fuller & Volberda, 1997; Russo & Vurro, 2010). Hence, for technological process development efforts to be effective, these efforts may need to be conducted in an interorganizational context (i.e. beyond the organizational boundaries). This inclusion of parties external to the focal firm in its R&D process (e.g. Berchicci, 2013; Håkansson, 1987; Laage-Hellman, 1987; Russo & Vurro, 2010) may take place in the interorganizational context of an external test facility, as illustrated in Figure 6.2. Firms that make use of such an external test facility usually remain fully involved in and responsible for (i.e. in full control of) conducting the associated technological process development activities, while these activities take place outside their organizational boundaries.

This kind of external test facilities provides a context-neutral place (as it is not located within the organizational boundaries of the firms that use these test facilities), specialized technical support for technological process development and, as there are often multiple firms located in the same test facility, may enable firms to come easier in contact with (projects or engineers from) other innovative process manufacturing firms. Such external

Figure 6.2. *Technological process innovation with the development phase performed in the interorganizational context*



test facilities may be perceived as a key factor of change that enables established process manufacturing firms to perform the development phase of technological process innovation beyond their organizational boundaries.

Technological process innovation is rooted in technological problem-solving, yet it must be broadly integrated with other organizational processes (Pisano, 1997). Based on Meeus and Edquist's (2006) classification of innovation, Damanpour et al. (2009) distinguished two types of changes in organizational processes: technological process innovation and administrative process innovation. As the latter implies changes in the way firms are managed, it has also been labelled management innovation (e.g. Birkinshaw et al., 2008) or managerial innovation (e.g. Damanpour & Aravind, 2012). This study follows Birkinshaw et al. (2008) by using the term management innovation. Technological process innovation and management innovation are both organization-specific and are inextricably related to each other (Collins et al., 1988; Daft, 1978), being associated with the "dual core" processes of organizations (Daft, 1978: 209). In this study, we argue that successfully performing the development phase of technological process innovation in an external test facility requires management innovation. Previous literature has already emphasized the importance of realizing both management innovation and technological innovation in order to further organizational goals (Battisti & Stoneman, 2010; Camisón & Villar-López, 2014; Damanpour et al., 2009; Ettlie, 1988; Evangelista & Vezzani, 2010; Mol & Birkinshaw, 2006; Sapprasert & Clausen, 2012; Schmidt & Rammer, 2007). However, the role of management innovation in enabling technological (process) innovation beyond firm level remains largely unexplored in the literature.

The *aim* of this conceptual study is to address this gap by gaining a better understanding of the role of management innovation in enabling firms to perform the development phase of technological process innovation in the interorganizational context of an external test facility. To provide an empirical research context, the study uses illustrations from established process manufacturing firms that perform this development phase in an external dedicated development facility for sustainable process technology. This external dedicated development facility ('external test facility') is located in the Port of Rotterdam (The Netherlands), which has one of Europe's largest petrochemical complexes. It has been initiated by a consortium of various Dutch organizations and governmental agencies. By facilitating the development phase of technological process innovation of established process manufacturing firms, it fulfils a bridge function between the laboratory phase and the deployment phase. The test facility is a limited-liability company and is open to all firms aiming to develop technologies that contribute to a more sustainable society. The facility offers various industrial utilities and intermediates the storage and handling of chemicals. Besides these utilities and logistics facilities, there is a machine park and equipped office space. Support can be provided whenever necessary, including licensing and safety advice, maintenance and technical support. Moreover, the test facility has received an 'umbrella

license' from the regional environmental protection agency that reduces the permit procedure duration per pilot from several months or even years to less than six weeks.

We collected public and company documents and interviewed the facility's director as well as involved managers from three process manufacturing firms that started a project in this facility to scale up, test and/or demonstrate sustainable process technologies. All these firms encountered difficulties to internally develop technological process innovations, and were interviewed about new-to-the-firm changes in management activities needed to successfully develop technological process innovations by making use of this external test facility. The process research in this conceptual study builds on their narratives.

The contributions of this study to the literature are twofold. First, we contribute to an increased understanding of the relationship between management innovation and technological (process) innovation. Second, we extend and advance the management innovation theory and research by focusing on the *inter*organizational context. The remainder of the study is structured as follows. First, prior research on technological process innovation, management innovation and their interrelation is reviewed, and we elaborate on how established process manufacturing firms may be challenged to perform the development phase of technological process innovation in the interorganizational context of an external test facility. Taking this interorganizational perspective, we then develop propositions on the role of new-to-the-firm management activities, i.e. management innovation. We conclude with implications for theory, practice and future research.

6.2. Theoretical Background

6.2.1. Technological process innovation and intra-organizational tensions

Technological innovation can refer to both products and processes; see Box 6.1. Technological product innovation implies the creation of new products, based on new or combined technologies, which are being sold in the market (Meeus & Edquist, 2006; Utterback & Abernathy, 1975). In contrast, *technological process innovation* implies the introduction of new input materials, physical equipment or software systems in a firm's production or service operations that deliver products and services (Damanpour & Gopalakrishnan, 2001; Ettlie & Reza, 1992; Meeus & Edquist, 2006). In the context of process manufacturing, their introduction changes how products are produced (Meeus & Edquist, 2006). Whereas technological product innovation has received substantial attention in the literature, technological process innovation is still underexplored and requires additional research (Keupp et al., 2012; Reichstein & Salter, 2006).

Box 6.1. *Definition of technological product and technological process innovation*

- **Technological *product* innovation**: "new technology or combination of technologies introduced commercially to meet a user or a market need" (Utterback & Abernathy, 1975: 642).
- **Technological *process* innovation**: "new elements introduced into an organization's production system or service operation for producing its products or rendering its services to the clients" (Damanpour et al., 2009: 654).

Technological process innovation may lead to, among others, lower production costs, product quality improvements, lower disposal costs, and the ability to use cheaper raw materials (e.g. Hatch & Mowery, 1998; Laage-Hellman, 1987). These possible outcomes imply a more appropriate and efficient use of resources and are hence associated with enhanced resource productivity, which is "what makes companies truly competitive" (Esty & Porter, 1998: 36). Enhanced resource productivity, in turn, implies better environmental performance (e.g. Shrivastava, 1995), due to which firms can better cope with environmental regulations (Porter & Van Der Linde, 1995). Hence, technological process innovation is an important strategic response to environmental issues and the related need for regulatory compliance (Skea, 1994). Furthermore, technological process development may well be "the hidden leverage in product development performance" (Pisano, 1997: 4), as the speed and effectiveness of realizing technological process innovation shape the overall cost, timeliness and market performance of new product introductions (Calantone et al., 1995; Pisano, 1997; Zahra & Nielsen, 2002).

In order to enable technological process innovation, process manufacturing firms need to deal with tensions between contradictory pressures for exploration and exploitation encountered across the subsequent three phases of the innovation adoption process. The experimentation with and creation of new technological process elements in the discovery phase demands an exploratory mindset (March, 1991) that creates variety in experience (Holmqvist, 2004; Uotila et al., 2009) through revolutionary changes (Tushman & O'Reilly, 1996). In contrast, the deployment phase, in which these new process elements are used to produce products, demands an exploitative mindset and disciplined problem-solving (Anderson & Tushman, 1990; Smith & Tushman, 2005) in order to achieve high reliability, accountability and reproducibility (Hannan & Freeman, 1984) and to utilize complementary assets (Stieglitz & Heine, 2007; Tripsas & Gavetti, 2000). The development phase needs to bridge these contradictory pressures for change and stability, which seems problematic for most established firms (Burgers et al., 2008; Jansen et al., 2009; Macher, 2006).

The associated *intra-organizational tensions* (e.g. Russo & Vurro, 2010) stem partly from the fact that personnel involved with shaping new process technologies "range from

PhD scientists performing laboratory experiments and running esoteric computer simulations to shop-floor production workers who fine-tune equipment settings" (Pisano, 1997: 25). Laboratory workers are mainly focused on continuous renewal of the production process and on further optimizing it from a technological knowledge perspective, whereas operational managers prefer low-risk exploitative processes. As pointed out by managers of established process manufacturing firms associated with the test facility described in the introduction, technological process innovations – complex innovations aimed at improving environmental performance in particular – may take a long time to develop and, if proved successfully, may require large changes in the current production process in order to implement these innovations. Operational managers, however, usually prefer to only experiment with incremental innovations leading to short-term results in terms of optimization of current production processes. As the dominant mindset in established firms is often focused on these short-term results, long-term technological process innovation projects are usually perceived as problematic. Furthermore, operational managers often indicate that they do not want the complex development of new technological process elements to take away attention from current round-the-clock production operations, leaving limited room for process technology development activities. As pointed out by Hatch and Mowery (1998), it draws scarce engineering resources away to debug these new elements, disrupting the existing manufacturing process.

The involvement in the development phase of both laboratory and operational managers, with different objectives and mindsets in terms of exploration and exploitation, reinforces "'we versus they' thinking in regard to potential collaboration and knowledge development" (Miles et al., 2000: 317). Moreover, the exploitative processes and incentives of the deployment phase, used by established manufacturing firms to keep focused on their main customers (Christensen & Bower, 1996), work so well in the short term that most established firms tend to have a preference for exploitation of existing technology and routines over exploration (Anderson & Tushman, 1990; Flier et al., 2003; Uotila et al., 2009). As a result, project leaders involved in internal development projects of established process manufacturing firms may be confronted with the fact that pilot installations integrated in the factory are not given priority when problems arise in existing full-scale manufacturing process. Hence, when problems emerge in existing operations, engineers are often removed from new technological process development projects in order to spend their scarce time on fixing these problems, due to which the process development activities are delayed.

Furthermore, the extent to which established process manufacturing firms successfully realize pilot projects within the existing organizational context is generally limited due to a lack of autonomy for these projects from the current manufacturing environment, difficulties to obtain environmental permits for experiments within the firm, and restricting company rules, regulations and procedures that slow down or inhibit the projects' progress. Management may allow only minor changes in the production process out of fear that larger-scale changes cause regulatory problems (Pisano, 1997). In

environmentally sensitive process manufacturing industries such as the (petro)chemical industries, rigid rules and regulations do often not allow any adaptation to the regular manufacturing process unless the required permits are obtained from external regulatory agencies. This often results from the fact that established firms operate in a compliance-fostering regulatory environment in which 'doing the same in the same way' (i.e. exploitation) is strongly stimulated (Suchman, 1995). Timely realization of technological process innovation is often frustrated by this dominant exploitation-minded intra-organizational context and the associated internal restrictions to change.

6.2.2. Management innovation

Scholars have started emphasizing that, in order to capture the full benefits of innovation, technological innovation needs to be combined with management innovation (e.g. Damanpour & Aravind, 2012; Damanpour et al., 2009). Birkinshaw et al. (2008: 829) defined management innovation as "the generation and implementation of a management practice, process, structure, or technique that is new to the state of the art and is intended to further organizational goals". In this definition, 'new to the state of the art' implies management innovation without known precedents (Abrahamson, 1996). However, an "equally valid" (Birkinshaw et al., 2008: 828) point of view in the literature regarding the novelty of management innovation – the one chosen in this study – is that of being new to the adopting organization, i.e. new-to-the-firm (e.g. Damanpour et al., 2009; Stjernberg & Philips, 1993; Vaccaro et al., 2012; Walker et al., 2011; Zbaracki, 1998). At both levels of analysis, the innovation is seen as a significant departure from the past toward managerial activities and competencies that are better aligned with the competitive environment. New management practices, processes, structures and techniques imply changes in respectively the day-to-day activities of managers as part of their job in the organization (what managers do), the routines governing their work (how they do it), the organizational context in which their work is performed, and the associated techniques (Hamel, 2006, 2007; Mol & Birkinshaw, 2008; Vaccaro et al., 2012).

Birkinshaw et al. (2008: 828) noted, however, that "the distinctions among practice, process, structure, and technique are not clean, either conceptually or empirically" and that "there are important similarities across the different forms of management innovation". Therefore, this study chooses an alternative way of conceptualizing management innovation by discerning – in line with Birkinshaw and Goddard (2009), Birkinshaw (2010), and Van Den Bosch (2012) – four conceptually separate and context-neutral sets of management activities. These activities, which collectively enable firms to achieve their aims (Birkinshaw, 2010), are associated with (1) setting objectives, (2) motivating employees, (3) coordinating activities, and (4) decision-making. *Setting objectives* relates to management activities regarding determining where the firm is going. *Motivating employees* relates to management activities to get employees to agree to the set objectives. *Coordinating*

activities refers to the means by which managers organize and integrate activities of multiple groups or units. Finally, *decision-making* is about making and communicating decisions regarding resource allocation. Management innovation implies new-to-the-firm changes in these four sets of management activities; see Box 6.2.

Box 6.2. *Definition, levels of analysis, and conceptualization of management innovation*

- Definition of management innovation (Birkinshaw et al., 2008: 829): "the generation and implementation of a management practice, process, structure, or technique that is new to the state of the art and is intended to further organizational goals".
- Levels of analysis:
  - New to the state of the art, i.e. new-to-the-world
  - New-to-the-firm; the level of analysis chosen in this study
- Conceptualizing management innovation by four separate and context-neutral subsets of new-to-the-firm management activities (Birkinshaw & Goddard, 2009; Birkinshaw, 2010):
  - New-to-the-firm management activities associated with setting objectives
  - New-to-the-firm management activities associated with motivating employees
  - New-to-the-firm management activities associated with coordinating activities
  - New-to-the-firm management activities associated with decision-making

The level of analysis in management innovation research is, as asserted by Birkinshaw et al. (2008), mainly focused on the firm in interaction with the industry, country, individuals or the market for new ideas. However, these authors recommend future research to "give careful attention to the unit of analysis at which management innovation is studied, since there are several possible models that could be followed" (Birkinshaw et al., 2008: 840–841). In this study, we adopt an *interorganizational perspective of management innovation*, i.e. how new-to-the-firm management activities arise in the context of new interorganizational relations.

6.3. Enabling Technological Process Innovation through Management Innovation

To manage the mentioned intra-organizational tensions associated with technological process innovation, established firms may choose to structurally separate exploratory activities, which require different processes, structures and cultures (O'Reilly & Tushman,

2004), from the dominant exploitation activities. Scholars have stated that such separation can be realized both within the firm – by structurally separating business units (Birkinshaw & Gibson, 2004; Jansen et al., 2009) – and by locating exploratory activities outside its walls (Rothaermel & Deeds, 2004; Russo & Vurro, 2010). Dissatisfaction with intra-organizational tensions to reconcile pressures for exploration and exploitation, mainly caused by internal restrictions and restrained internal capabilities (e.g. Zahra & Nielsen, 2002), drives firms to interact and cooperate with other firms and organizations (Baden-Fuller & Volberda, 1997; Holmqvist, 2004). One way for top management to overcome these hurdles in technological process innovation is by using external test facilities. These test facilities provide firms the possibility to develop new technological processes in a neutral context, i.e. without dominant pressures for exploratory or exploitative behavior.

Performing technological process development in an external test facility in order to enable technological process innovation involves knowledge creation outside the firm's boundaries as well as the subsequent integration of this externally acquired knowledge within its boundaries. The associated knowledge flows require managerial coordination (Stieglitz & Heine, 2007). Putting in place new-to-the-firm management activities of coordinating these processes needs to be complemented with new-to-the-firm management activities associated with setting objectives (from intra- to interorganizational objectives), motivating employees (from intra- to interorganizational work motivation) and with decision-making (from intra- to interorganizational resource allocation). These new-to-the-firm management activities are provided by and enabled in a bundle of idiosyncratic resources and capabilities in the interorganizational context and, therefore, hard to imitate (Ritala & Ellonen, 2010), contributing to sustained competitive advantage for the focal firm (Mol & Birkinshaw, 2006). Extending the management innovation perspective of Birkinshaw and colleagues (Birkinshaw, 2010; Birkinshaw & Goddard, 2009; Birkinshaw et al., 2008), we define *management innovation in an interorganizational context* as firm-specific, new-to-the-firm management activities associated with setting objectives, motivating employees, coordinating activities and making decisions, which arise due to new interorganizational relations and are intended to further organizational goals.

6.3.1. New-to-the-firm management activities associated with setting objectives

Managers pursuing new activities need to build legitimacy of these activities to make them acceptable, or justifiable, to the various (inter)organizational constituencies (Birkinshaw et al., 2008; Stjernberg & Philips, 1993; Stone & Brush, 1996). Related new objectives need to be set and evaluated to change individual behavior toward the desired direction (Gruber & Niles, 1974; Suchman, 1995). Management innovation in a setting of new organizational interrelations – aimed at overcoming intra-organizational tensions – implies new-to-the-firm management activities associated with formulating new objectives (Birkinshaw, 2010) to get (1) managers and other involved employees of the focal firm to agree to perform activities

in an interorganizational context, (2) other firms within the interorganizational context to agree to optimally contribute to these activities, and (3) other relevant stakeholders to support the interorganizational approach.

By setting new objectives, a firm may legitimize the engagement in organizational interrelations in order to enable technological process innovation. For instance, established firms in the research context of the external test facility described before are often confronted with the fact that within the mindset of the people of the full-scale production department and according to internal firm standards, every pilot project that is initiated within the firm should be built for running a long time, e.g. thirty years. This might be caused by the dominant idea that such a project is a capital expenditure and therefore needs to be developed as a long-term asset. However, only about three years of scheduled running time could in fact be needed to test and demonstrate a new process technology. By setting the new objective that pilot installations should (e.g. to save unnecessary costs) be built fit-for-purpose only, the start of a new pilot project in an external test facility for technological process innovation – where fit-for-purpose is easier to attain – can be partly legitimized.

Managers also need to set objectives that motivate employees to acquire new technological process knowledge and experience in the interorganizational context. Additionally, new objectives serve to direct the terms of the interorganizational agreement (e.g. Vlaar et al., 2007; Zaheer & Venkatraman, 1995), which is needed to secure the cooperation of all interorganizational constituents in making an effort to enable technological process innovation. These arguments lead to the following proposition:

> **Proposition 6.1**: The performance of a firm's development phase of technological process innovation in an external test facility is likely to increase if new-to-the-firm management activities associated with *setting objectives* are realized that legitimize and enforce the involvement of other organizations.

6.3.2. New-to-the-firm management activities associated with motivating employees

Performing technological process development activities in an external test facility needs to be accompanied with putting in place new-to-the-firm management activities associated with motivating employees. New motivation schemes and incentives are needed that stimulate interorganizational cooperation (e.g. Ring & Van De Ven, 1992) and the overall pursuit of fostering technological process innovation of the focal firm. The motivation of employees in an interorganizational context, which can be based on extrinsic and intrinsic values, pertains to employees of the focal firm as well as to employees of other organizations involved in the development phase. The latter include staff under the payroll of test facilities, such as process operators, which might be working dedicated on a certain pilot project. These external employees (e.g. Lepak & Snell, 1999) need to be motivated to optimally contribute – based on procedures and a research program of what needs to be tested, as provided by the

focal firm – to the technological process development activities and purposes. This may require both behavioral and output control mechanisms (e.g. Dekker, 2004).

Employees of the focal firm that are involved in the externally performed development phase need to be motivated to cooperate by increasing their involvement in achieving the set objectives (e.g. Leufkens & Noorderhaven, 2011; Westphal & Shaw, 2005). Incentives should therefore be synchronized with the newly set objectives with regard to performing the development phase in the interorganizational context of an external dedicated development facility. It is important that they are willing to work in an external location, away from their colleagues, workplace and so on. This can, for instance, be attained by intrinsic motivation for working in the external test facility. One way to achieve this is by giving special importance to the entrepreneurial skills of a project leader in such a test facility. If project leaders are valued internally for what they have accomplished externally, they will be more motivated. They should also be motivated to learn how to effectively run innovative pilot projects inasmuch as this is valuable for their firm's competitiveness. Managers should stimulate them to exchange operational knowledge with technical experts (including process operators) from the external test facility itself and from other firms located in this facility. In this way, project leaders can gain experience in successfully setting up pilot projects. When multiple established firms are using the same external test facility, this facility becomes a potentially rich technological knowledge base area. The better project leaders and other employees can be motivated to communicate with and learn from other firms in the external test facility, the more knowledge can be gained by the focal firm to be used for additional technological process innovations. These arguments lead to the following proposition:

> **Proposition 6.2**: The performance of a firm's development phase of technological process innovation in an external test facility is likely to increase if new-to-the-firm management activities associated with *motivating employees* involved are realized.

6.3.3. New-to-the-firm management activities associated with coordinating activities

Performing development phase activities beyond the focal firm's boundaries has to be effectively coordinated (e.g. Håkansson, 1987). In particular, the existing activities of the firm need to be aligned with the new activities that are provided by and enabled in the new-to-the-firm interorganizational context. In this context, coordination might be focused on exploiting development experiences and/or resources of other organizations (Liebeskind et al., 1996) – which also include test facilities – and on producing new experiences jointly with these organizations by engaging in collective explorative undertakings (Holmqvist, 2004; Laage-Hellman, 1987; Powell et al., 1996; Santamaria & Surroca, 2011). In order to span organizational boundaries and to pull resources together, managers take on brokering roles (Hargadon & Sutton, 1997; Raisch et al., 2009). New-to-the-firm management

activities associated with coordinating activities regarding a firm's knowledge creation outside its boundaries include the means by which managers integrate intra-organizational knowledge related to the discovery phase with the interorganizational knowledge creation related to the development phase (e.g. Berchicci, 2013), as well as the means by which the latter phase is organized.

Managers of the focal firm need to learn to coordinate the activities in such a way that the interorganizational context provides incentives for both explorative and exploitative activities (e.g. Jansen et al., 2006, 2009). Combining exploration and exploitation within the same unit can best be realized by encouraging front-line managers to make their own choices as to how best divide their time between conflicting demands for adaptation-oriented (i.e. exploration-focused) and alignment-oriented (i.e. exploitation-focused) activities in their day-to-day work context (Gibson & Birkinshaw, 2004). Compared to the intra-organizational approach, making use of an external test facility as described in the introduction hence requires a more entrepreneurial, ambidextrous type of project manager (Mom et al., 2009) who bears a crucial responsibility for all interorganizational activities associated with the technological process development. This requires managerial skills and capabilities that are often new for the managers or project leaders from established manufacturing firms in the research context, as they are possibly not used to operate in such an interorganizational context. This context is often entails many challenges, as different day-to-day activities of and contracts with external parties need to be coordinated and brought in line with the focal firm's objectives. The above gives rise to the following proposition:

> **Proposition 6.3a**: The performance of a firm's development phase of technological process innovation in an external test facility is likely to increase if new-to-the-firm management activities associated with *coordinating activities* are realized regarding a firm's knowledge creation outside its boundaries.

After completing the development phase in an external test facility by having developed and tested a new technological process element toward industrial scale, the externally acquired knowledge and related experiences need to be absorbed and integrated in order to realize the innovation's potential (Cohen & Levinthal, 1990; Hatch & Mowery, 1998; Rothaermel & Alexandre, 2009; Van Den Bosch et al., 1999). This integration of externally acquired knowledge and experience within a firm's boundaries and the associated translation into intra-organizational knowledge (e.g. Simonin, 1999) enable the firm to deploy the newly developed technological process elements in its full-scale production operations. The acquired knowledge will be both project-specific and generic (e.g. in terms of general knowledge of how to manage pilot projects in an external environment), and its integration within the firm's boundaries will involve new-to-be-learned managerial

capabilities (e.g. Alcácer & Zhao, 2012). Schmidt and Rammer (2007) highlight that firms with the ability to incorporate externally sourced knowledge into their own innovation processes create more possibilities for realizing technological process innovation.

As pointed out by Hatch and Mowery (1998) and by managers of established process manufacturing firms making use of the external test facility as described in the introduction, the transfer of a newly developed technology from an external test facility to a firm's full-scale production environment may require the (temporal) transfer of the project leader involved and other development personnel to the manufacturing site in order to communicate the complex and tacit know-how associated with the new technology to the firm's operators, engineers and production managers. This is because a written manual of how to install the newly developed technology in the firm's production environment usually does not suffice. Furthermore, they state that the focal firm may need to acquire additional knowledge to operate the renewed production process at the conditions of the environment where the new technological elements were developed. When the new technology has been fully implemented in the firm's production process, the new activity patterns resulting from its implementation need to be monitored to see whether further changes are warranted (Gruber & Niles, 1974). In this research context, new-to-the-firm management activities associated with coordinating activities regarding the integration of externally acquired knowledge within the firm's boundaries refer to the means by which managers value, assimilate and utilize new knowledge (Cohen & Levinthal, 1990) that has been acquired in the interorganizational context of the external test facility. The above arguments give rise to the following proposition:

> **Proposition 6.3b**: The performance of a firm's development phase of technological process innovation in an external test facility is likely to increase if new-to-the-firm management activities associated with *coordinating activities* are realized regarding the integration of externally acquired knowledge within the firm's boundaries.

6.3.4. New-to-the-firm management activities associated with decision-making

Performing the development phase of technological process innovation in external test facilities also needs to be accompanied by putting in place new-to-the-firm management activities associated with decision-making about allocating resources, including human resources (e.g. Lepak & Snell, 1999). The responsible manager is required to find and allocate discretionary time for effectively managing this new endeavor (Gruber & Niles, 1974). Furthermore, the focal firm's resource base becomes enlarged with the external resources provided in the interorganizational context of the test facility that are made available for use by the focal firm. This extended resource base requires new or adapted decision-making activities that take the interaction with other organizations into account, e.g. by highlighting interorganizational decision-making (Tuite et al., 2009). In order to

promote interorganizational knowledge sharing (e.g. Soekijad & Andriessen, 2003) in collective explorative undertakings, decision-making in the interorganizational context may need to be less hierarchically structured than would be the case within the established process manufacturing firm itself (e.g. Kellogg et al., 2006).

Besides, in order to prevent tensions between pressures for exploration and exploitation within the external test facility, firms should be cautious in giving decision-making power over activities in this external context to its laboratory and production floor managers. After all, their conflicting pressures for respectively exploration and exploitation may have triggered these firms to make use of a context-neutral test facility to develop their technological innovations. Hence, although these managers should be somewhat involved – for instance, operational managers will have to implement the developed technologies in the existing production process – conflicting pressures due to their interrelationship problem (Gruber & Niles, 1974) should be avoided as much as possible. This will often require new skills from the project leaders that will be installed in external test facilities to oversee the effective realization of the development phase of technological process innovation. Based on these insights, we suggest the following proposition:

> **Proposition 6.4**: The performance of a firm's development phase of technological process innovation in an external test facility is likely to increase if new-to-the-firm management activities associated with *decision-making* about resource allocation are realized that take interorganizational relations and intra-organizational tensions into account.

6.4. Discussion and Conclusion

Triggered by environmental constraints and associated regulations that affect their cost function and competitive advantage, established process manufacturing firms continuously need to come up with technological process innovations that allow improved resource productivity of full-scale manufacturing operations (Reichstein & Salter, 2006; Skea, 1994; Tidd et al., 2005). However, these firms often encounter difficulties to internally develop technological process innovations. By performing the development phase of technological process innovation in external test facilities, firms may overcome these difficulties.

Whereas performing activities in an external location may also be related to the discovery phase (e.g. Hagedoorn, 2002) or the deployment phase (e.g. Strange, 2011), this study deliberately focused on the development phase (e.g. Håkansson, 1987; Macher, 2006) of technological process innovation. Indeed, it is particularly in this phase that most firms, and especially established process manufacturing firms, encounter difficulties (e.g. Burgers et al., 2008; Macher, 2006). We underlined that these difficulties result mainly from the intra-organizational dominance of exploitation pressures that inhibit internal development of technological process innovation. As performing the development phase in an external

test facility represents a large change for firms that are used to conduct the associated activities internally, we focused on the enabling role of new-to-the-firm management activities required in this interorganizational context. The propositions in this study regarding these so-called management innovations (e.g. Birkinshaw et al., 2008) have been developed from the perspective of the individual firm (Laage-Hellman, 1987). We have used illustrations from the research context of an external test facility in one of Europe's largest petrochemical complexes in which established process manufacturing firms can develop sustainable process technologies.

6.4.1. Contributions and theoretical implications

The importance of management innovation for enhancing and leveraging technological innovation and in building and sustaining a competitive advantage is increasingly being recognized in the literature (e.g. Damanpour & Aravind, 2012). The role of management innovation in enabling technological (process) innovation in an interorganizational context, however, has remained largely under-researched. By addressing this research gap, we have contributed in at least two ways to the literature, each with implications for theory.

First, by taking an interorganizational perspective, we have contributed to an increased understanding of the *relationship between management innovation and technological process innovation*. We developed propositions on how four separate and context-neutral subsets of new-to-the-firm management activities – i.e. new-to-the-firm management activities associated with (1) setting objectives, (2) motivating employees, (3) coordinating activities and (4) decision-making (Birkinshaw & Goddard, 2009; Birkinshaw, 2010; Van Den Bosch, 2012) – enable established process manufacturing firms to perform the development phase of technological process innovation in external test facilities. By conducting this phase outside the organizational boundaries, internal difficulties in developing new technological processes can be overcome.

Previous literature has emphasized the importance of realizing both technological and management innovation in order to further organizational goals (Battisti & Stoneman, 2010; Camisón & Villar-López, 2014; Damanpour et al., 2009; Ettlie, 1988; Evangelista & Vezzani, 2010; Mol & Birkinshaw, 2006; Sapprasert & Clausen, 2012; Schmidt & Rammer, 2007). The *relationship between both types of innovation*, however, is still debated in the literature (Damanpour & Aravind, 2012; Sanidas, 2005). On the one hand, scholars have referred to management innovation as a necessary adaptation to (and hence being triggered by) the introduction of technological innovation (e.g. Evan, 1966; Goldhar & Jelinek, 1983; Passmore et al., 1982). On the other hand, scholars have found evidence that management innovation tends to trigger technological process innovation "more readily than the reverse" (Damanpour & Evan, 1984: 392), suggesting that innovation in a firm's technical system may well be driven by innovation in its social system. In a related vein, Nelson (1991: 72) notes that technological advances would be limited "without development of new ways of

organization that can guide and support R&D and enable firms to profit from these investments". More recently, scholars have started to emphasize the need to introduce technological and management innovation combined over time in an orchestrated way – "instead of pursuing autonomous strategies of innovation types" (Damanpour & Aravind, 2012: 448) – in order to capture the full benefits of innovation (Damanpour & Aravind, 2012; Damanpour et al., 2009; Sapprasert & Clausen, 2012).

Table 6.1. *Three perspectives on the relationship between management innovation (MI) and technological innovation (TI)*

Perspective:	Illustrative references:
1. The realization (i.e. completion) of technological innovation mainly precedes the realization of management innovation: **TI → MI**	Evan (1966); Goldhar & Jelinek (1983); Passmore et al. (1982)
2. The realization of management innovation mainly precedes the realization of technological innovation: **MI → TI**	Camisón & Villar-López (2014); Damanpour & Evan (1984); Lam (2005)
3. Management innovation and technological innovation are mutually interdependent for their realization, i.e. combined relationship as highlighted in this study: **MI ↔ TI**	Damanpour & Aravind (2012); Damanpour et al. (2009); Ettlie (1988)

Hence, as also indicated in Table 6.1, *three perspectives* on the relationship between technological innovation and management innovation can be discerned. In the first two perspectives, either technological innovation or management innovation has to be realized (i.e. completed) before the other type of innovation takes place. In the third perspective, technological innovation and management innovation are mutually interdependent for their realization and, as a result, are combined over time in an intertwined way. By discerning three phases of technological process innovation and by focusing on one of these phases – the development phase – from an interorganizational perspective, this study illustrates how the processes of two innovation types, i.e. (1) technological process innovation and (2) management innovation, are integrated to enhance the effectiveness of this development phase. This points at a combined effect of these types of innovation on organizational performance. More specifically, management innovation associated with performing the development phase in the interorganizational context of an external test facility is initially preceded by the discovery of a new technological process element that needs further development and triggered by intra-organizational difficulties to realize this development. In turn, the management innovation precedes the subsequent internal deployment of the

externally developed technological process element in the full-production system (and hence enables this realization). This study emphasizes that performing part of the technological innovation process outside the organizational boundaries is an important contextual factor of the relationship between technological innovation and management innovation.

A *second* contribution is that we have *extended and advanced the management innovation theory* and research by developing propositions on management innovation in an interorganizational context – i.e. in the context of the interorganizational development of technological process innovation. As pointed out by Birkinshaw et al. (2008), key factors and actors identified in previous literature have mainly been limited to the institutional conditions and attitudes of major influencer groups that give rise to management innovation within firms (institutional perspective; e.g. Guillén, 1994), organizational culture (cultural perspective; e.g. McCabe, 2002), suppliers of new ideas – including consultants – and their legitimacy (fashion perspective; e.g. Abrahamson, 1996) and the actions of key individuals – including CEO's and their leadership style (Vaccaro et al., 2012) – within the firm (rational perspective; e.g. Chandler, 1962). Although scholars recognized the importance of paying attention to a locus of management innovation beyond firm level (Birkinshaw et al., 2008; Tether & Tajar, 2008a; Vaccaro et al., 2012), the current body of management innovation research is focusing primarily on an intrafirm level of analysis (e.g. Birkinshaw et al., 2008; Damanpour & Aravind, 2012; Mol & Birkinshaw, 2010; Vaccaro et al., 2012). By showing that management innovation may also be triggered by performing activities in the interorganizational context, this study takes the observation that management innovation seems to emerge "on the fringes of the organization rather than in the core" (Birkinshaw & Mol, 2006: 82) a step further.

The adoption of a focus on the interorganizational context enables a broader recognition of the role of interorganizational interactions and the associated external change agents in shaping and influencing the management innovation process. *External change agents* are perceived in the literature as having influence on the management innovation process mainly due to their role of providing legitimacy and expertise (Birkinshaw et al., 2008; Birkinshaw & Mol, 2006; Ginsberg & Abrahamson, 1991). We suggest that external change agents can also actively trigger new-to-the-firm management activities associated with setting objectives, motivating employees, coordinating activities and making decisions. In that way, also stakeholder dialogues can, as suggested by Ayuso et al. (2006), be a potentially powerful source of management innovation. The interorganizational level of analysis broadens the group of potential external change agents to include – besides consultants, academics and other so-called specialist knowledge providers (Tether & Tajar, 2008b) currently associated with the Birkinshaw et al. (2008) management innovation process framework – agents active in supplier and customer networks, platforms, consortiums or other alliances.

6.4.2. Managerial implications

The study highlights three important managerial implications. First, managers of established process manufacturing firms have to recognize to what extent intra-organizational tensions to reconcile pressures for exploration and exploitation (March, 1991) across subsequent phases of technological process innovation require the interorganizational context to enable technological process innovation, and create new-to-the-firm management activities accordingly. The higher the need to overcome these intra-organizational tensions, the more managers should consider performing the development phase in external test facilities. Established process manufacturing firms are increasingly confronted with the quest for more *sustainable process technologies*, which may entail long-term, complex, experimental and higher-risk development efforts. As operational managers, rules and regulations in established firms are often slowing down or limiting the extent in which these new process technologies can be developed internally, making use of the context of external test facilities for this objective might be increasingly important.

Second, we have suggested that performing the process technology development phase in external test facilities requires an ambidextrous, entrepreneurial type of project manager that bears responsibility for all related interorganizational activities. As many of these activities will be new for this project manager, who is used to operate within rather than beyond the organizational boundaries, this will require additional skills (e.g. Cummings, 1991) to be provided by experienced managers. The skills needed in this context deserve to be regarded as highly valuable for technological process innovation in established process manufacturing firms. In a similar vein, Gruber and Niles (1974: 40) point out that the utilization of skilled people should be accompanied by "a high level of sophisticated management" because these people are "the major resource in management innovation".

Third, we have provided managerial insights into how new-to-the-firm management activities associated with setting objectives, motivating employees, coordinating activities and making decisions – which can over time result in valuable managerial capabilities – are required to perform technological process development activities in external test facilities and, in turn, to enable technological process innovation. In line with this, we argue that managers of established firms in process manufacturing and other process industries should not focus exclusively on generating and implementing technological process innovation but on combining these efforts with new-to-the-firm management activities, i.e. management innovation. We suggest that this practice of combining technological process innovation and management innovation will possibly trigger and speed up the much needed innovation in the process industry.

6.4.3. Limitations and future research

Several limitations of this study, suggesting directions for future research, merit discussion. First, by emphasizing the role of managers in pursuing new-to-the-firm management

activities in an interorganizational context, our propositions reflect a rational perspective on management innovation (cf. Birkinshaw et al., 2008). Hence, we have focused on the actions and choices of key individuals, i.e. managers, regarding whether and how to manage the development phase of technological process innovation in an external test facility. Future research could also examine how institutional conditions and attitudes of major influencer groups (institutional perspective), suppliers of new ideas and their legitimacy (fashion perspective), and organizational culture (cultural perspective) play a role in this process.

Second, although the new-to-the-firm management activities needed for enabling technological process innovation in an interorganizational context are associated here with the context of the process manufacturing industry, future research may investigate other process industries in which firms encounter difficulties in enabling technological process innovation, such as firms in the fields of oil and gas as well as service industries. Miles (1994: 252–253) already pointed out that "with the growth of producer services, and the externalization of some service functions by firms in other sectors, manufacturing and services are becoming more intertwined", and noticed that, as a result, innovation in services frequently involves technological innovation. This intertwining of manufacturing and services is also highlighted by Sako (2006), who emphasized that services are increasingly 'productized' and products are increasingly 'servicized', thereby blurring their traditional distinction. Technological process innovation also includes new elements introduced into an organization's service operation for rendering its services to the clients (Damanpour et al., 2009). To enable such technological process innovation, firms in service industries may also need to consider performing the development phase of innovation in service delivery processes beyond the organizational boundaries (Tether & Tajar, 2008a), requiring new-to-the-firm management activities.

Third, future research is needed to test hypotheses inspired by the propositions that have been developed in this study. This could be achieved through, for instance, conducting surveys and comparative case studies of established external test facilities in the same country (e.g. the Bioprocess Pilot Facility and the Brightlands Chemelot Campus' Pilot Plant test facility located in The Netherlands) as well as in different countries. To further increase the generalizability of the propositions and implications of this study, future research may also address the effect of, among others, top management team support (Smith & Tushman, 2005), firms' market and technological environment (Damanpour & Evan, 1984), the business model of an external test facility, the level of capital investment, and firm size (Reichstein & Salter, 2006) on the role of management innovation beyond the level of the firm in enabling technological process innovation.

Fourth, in describing underlying factors that drive firms' decisions or considerations to opt for the development of new process technologies outside the organizational boundaries, this study focused on intra-organizational tensions to reconcile pressures for exploration and exploitation that prevent timely and effective technological process innovation. However, also other factors might drive managers to consider this option. For

instance, in the process manufacturing industry the waiting periods for obtaining a license to test innovative installations toward industrial scale are often long. This is an external barrier to technological process innovation, residing in the regulatory environment, which challenges firms to look for interorganizational solutions. Firms using the external test facility as described in the introduction gained access to an umbrella license from the regional environmental protection agency, strongly reducing the permit procedure duration per pilot. Another driving force for firms to use external test facilities may include benefiting from extending the breadth of knowledge sources "to counteract firms' natural cognitive tendencies to search narrowly along familiar avenues", as pointed out by Leiponen and Helfat (2010: 235). These authors found evidence that the breadth of knowledge sources (both intra- and interorganizational) positively influences innovation success.

Management innovations that increase this breadth of knowledge sources – such as management innovation associated with performing the development phase of technological process innovation in external test facilities – is hence intertwined with the realization of technological innovation, pointing toward the combined relationship between management innovation and technological innovation as highlighted in this study. Future research may further examine other contextual factors for the interplay between both types of innovation.

Fifth, we discerned discovery, development and deployment as the three phases associated with technological process innovation. Promising new technological process elements discovered by a firm have been assumed to be deployed in the production operations of that same firm, which is in line with the internal focus characteristic of process innovation as suggested by Damanpour and Gopalakrishnan (2001). Newly discovered and developed technological process elements, however, may also be externally commercialized by selling these new process elements to other firms (Athaide et al., 1996; Laage-Hellman, 1987; Slater & Mohr, 2006). In that case, process innovations turn into new products to be sold. An interesting venue for future research – also requiring a perspective beyond firm-level – is to examine the role of management innovation in fostering the commercialization of technological process innovation.

Sixth, this study does not address the impact on firm performance of management innovation (e.g. Birkinshaw et al., 2008; Walker et al., 2011) in an interorganizational context to enable technological process innovation. Future research may investigate how innovations in this way influence interdependencies (both intra- and interorganizational) and complexity of process innovation and, thereby, are likely to increase performance (Lenox et al., 2010; Rivkin, 2000).

Notwithstanding the discussed limitations, we would argue that the conceptualization of management innovation in an interorganizational setting advances the management innovation literature, and that this study contributes to a better understanding of the role of management innovation in enabling technological process innovation.

CHAPTER 7

How Changes in Organizing Meta-Organizations Contribute to Attaining Collective Port-Related Goals: A Case Study of Business Association Deltalinqs*

7.1. Introduction

Within the broad array of research on interorganizational networks (Grandori & Soda, 1995; Parmigiani & Rivera-Santos, 2011), an increasing number of scholars have focused on the activities and outcomes at the level of whole networks rather than that of the individual constituent organizations (Provan et al., 2007). The multi-organizational arrangements examined in this stream of network-level research have been variously referred to over time as, among others, interfirm organizations (Phillips, 1960), interorganizational collectivities (Astley & Fombrun, 1983), business groups (Orrù et al., 1989), collective organizations (Barnett, Mischke, & Ocasio, 2000), multilateral alliances (Doz & Hamel, 1998), alliance constellations (Das & Teng, 2002), and whole networks (Provan et al., 2007). In the present study we concentrate on a particular type of multi-organizational network where collective action (Barnett et al., 2000; Gould, 1993; Olson, 1965) is coordinated through a separate entity in the form of an association whose constituent members, in turn, are organizations in the network. Such an association, which has staff who are the agents of the bundle of relationships it represents (Leblebici & Salancik, 1989), has been labelled *meta-organization* (e.g. Ahrne & Brunsson, 2005; Gulati et al., 2012). Well-known examples of a meta-organization are the trade and industry association (e.g. Reveley & Ville, 2010).

The meta-organization constitutes an "increasingly important form of organizing" (König et al., 2012: 1325) that is relatively new to the field of organization studies (Gulati

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et al., 2012; Malets, 2010). Its members are autonomous organizations that are bound by one or more collective or system-level goals (Gulati et al., 2012). A meta-organization's purpose is to serve and represent their common interests by contributing to these goals using activities such as lobbying, facilitating member-interaction, and setting standards (e.g. Ahrne & Brunsson, 2005; Knoke, 1990; Oliver, 1990). Most meta-organization studies revolve around why meta-organizations exist, how they differ from "individual-based organizations" (Ahrne & Brunsson, 2005: 430) such as firms, and how their initial structural design choices (Gulati et al., 2012; Reveley & Ville, 2010) and idiosyncratic characteristics (Ahrne & Brunsson, 2008; König et al., 2012) shape the arena in which their goal-directed activities come about. However, there is a need to deepen our understanding of how established meta-organizations renew their current activities in order to keep fulfilling their purpose in the face of changing environmental conditions. Indeed, while the literature stresses the importance of such renewal over time for meta-organizations (König et al., 2012; Procassini, 1995; Reveley & Ville, 2010) and organizations in general (Agarwal & Helfat, 2009; Floyd & Lane, 2000; Huff et al., 1992), it has remained largely unclear *how* meta-organizations may renew their goal-directed activities. The extant literature on organizational renewal is predominantly centered on firms, which differ from meta-organizations with respect to important organizational antecedents of renewal, such as the role of managerial authority. For instance, in contrast to the members of firms, the members of meta-organizations are "not bound by authority based on employment relationships" (Gulati et al., 2012: 573).

Our purpose in this study is to advance understanding of how changes in organizing an established meta-organization contribute to the renewal of its goal-directed activities in order to adapt to changing environments. The contribution to meta-organization studies is twofold. First, through a case study of the business association that represents the interests of over 700 industrial and logistics organizations in Europe's largest port-complex, covering the period 2000–2015, we provide an empirical basis for enhanced theoretical insights into the role and influence of various changes in organizing as regards a meta-organization's internal structure and, related to this, the division of labor and integration of efforts (cf. Puranam et al., 2014) by its members, board and staff. These insights are interesting in particular in the light of studies indicating that renewing a meta-organization's activities is a particularly challenging endeavor (Ahrne & Brunsson, 2005; Kerwer, 2013; König et al., 2012) compared to renewing activities of a firm. Our study also shows why incorporating external parties into a meta-organization's decision-making process and fostering a norm of "generalized reciprocity" (Das & Teng, 2002: 449) among its members contribute to the renewal of its activities. Second, drawing on both previous literature and the case evidence, we develop propositions and a conceptual framework that provide directions in which the emerging body of meta-organization studies might be usefully enriched.

This study unfolds as follows. In the next section we set out the theoretical background that informed our study. We continue with the research design and setting, data collection and data analysis before moving on to our case study. We then discuss the main

findings, based on which we develop propositions and a conceptual framework. We conclude with the study's contributions and directions for further research.

7.2. Theoretical Background

The last decade has witnessed growing research interest in the meta-organization as an important yet under-researched form of organizing. Various types of meta-organizations, such as suppliers' associations (Sako, 1996), national manufacturing trade associations (Leblebici & Salancik, 1989; Staber, 1987), and industry (or trade) associations in general (Oliver, 1990; Olson, 1965; Procassini, 1995), have been studied for a longer time, though not very extensively (Gulati et al., 2012; Reveley & Ville, 2010). Ahrne and Brunsson, who were among the first to introduce the term 'meta-organization', define meta-organizations as "organizations-of-organizations that have assumed the form of associations" (2005: 431).

As is often the case in emerging fields of research, there is no scholarly consensus on the precise conceptualization of meta-organizations. In Gulati et al.'s (2012: 573) account, meta-organizations are comprised of "networks of firms or individuals not bound by authority based on employment relationships, but characterized by a system-level goal". Pursuant to this account, professional and mixed associations (Bennett, 2000) – whose members include individuals – are meta-organizations. Most scholars, however, denote that the members of meta-organizations are limited to other organizations (e.g. Ahrne & Brunsson, 2008; Kerwer, 2013; König et al., 2012; Reveley & Ville, 2010). The definition of meta-organizations by König et al. (2012: 1327, italics added), "associations whose members are organizations, *rather than* individuals", is a case in point. Based on the overlap between the aforementioned studies, our main focus is on *meta-organizations whose members are other organizations*.

Meta-organizations are formally established organizational entities that have come into existence as a result of joint efforts to facilitate the interactions in organizational fields and these fields' interactions with their external environment (Ahrne & Brunsson, 2005, 2008). Their general *purpose* is to serve the collective interest of their members, and to represent and promote this interest to external parties, by engaging in activities that contribute to one or more collectively defined long-term goals. These goals, which may resemble a meta-organization's "ideological foundations" (Gulati et al., 2012: 581) and hence have an unlimited time horizon, serve as points of reference for collective sensemaking. Each meta-organization represents a bundle of associative relationships that are directed toward one or more of such goals. This bundle's agents are the *staff* (Leblebici & Salancik, 1989), who are empowered to perform secretarial or administrative tasks in the best interests of the members and act or speak on their behalf (König et al., 2012; Sako, 1996). The elected officials in a meta-organization's *board*, who are expected to decide the basic policy and set the agenda, are, instead, the "agents of the members" (Leblebici &

Salancik, 1989: 322). Besides staff and a board, a meta-organization can be comprised of several committees to host discussion and interaction among its members (e.g. Staber, 1987). The *members* remain autonomous entities – i.e. legally independent – within the meta-organization and retain their own identity (Gulati et al., 2012). Membership decisions range from self-selected membership to being subject to approval by a membership committee, the board, or all members (Gulati et al., 2012; Leblebici & Salancik, 1989).

The *goal-directed activities* of meta-organizations typically include lobbying for members' common interests (e.g. in favor of a level playing field), informing and educating members (e.g. through newsletters and seminars), facilitating member-interaction (Ahrne & Brunsson, 2005; Knoke, 1990; Oliver, 1990), and standard setting (Brunsson et al., 2012). The services offered may be particularistic and of interest to a subset of members, for which an additional fee may need to be paid, or benefit all members (Leblebici & Salancik, 1989). The extant literature on organizational renewal (e.g. Agarwal & Helfat, 2009; Floyd & Lane, 2000; Huff et al., 1992) highlights that firms need to continuously co-align their competences and associated goal-directed activities with dynamic environments. In line with this literature, several scholars have suggested that also meta-organizations might be required to renew their activities as a response to regulatory and other pressures from their external environment (König et al., 2012; Procassini, 1995; Reveley & Ville, 2010). Such *renewal of goal-directed activities* may entail some adjustments decreasing a meta-organization's current scope of activity, as well as an extension of this scope of activity by developing activities that are new to the meta-organization.

König et al. (2012) found that inertial forces within a meta-organization that limit such renewal can be partially overcome by institutionalizing a rotation principle for member representatives in the board and in committees, enabling them to use their time efficiently, simplifying the decision-making process, prioritizing systematic environmental observation, and ensuring a moderate meeting frequency. Although these findings provide useful starting points for our understanding of how changes in organizing established meta-organizations may contribute to the renewal of their goal-directed activities and, in turn, their adaptation to changing environmental demands or conditions, such understanding still remains limited. Prior studies on renewal at the organizational level of analysis provide useful insights regarding the need for co-alignment with dynamic environments. However, due to these studies' predominant focus on firms and associated managerial authority (e.g. Agarwal & Helfat, 2009; Floyd & Lane, 2000), their findings regarding organizational changes to realize such co-alignment are restricted in their applicability to meta-organizations. As is partly elaborated next, this limited applicability is attributable to important differences between the idiosyncratic characteristics of meta-organizations and those of most firms.

Unlike established firms, meta-organizations' very existence is contingent on agreements between their constituent members about their activities, due to which any attempt to renew these activities may need to be negotiated (Ahrne & Brunsson, 2005). This may not only require lengthy decision-procedures but possibly also unsatisfactory "lowest

common denominator decisions" (Kerwer, 2013: 44). The board and staff have no formal authority over the members. The latter's collective adherence to envisioned common directions is regulated by associational agreements rather than legally enforceable contracts (Grandori & Soda, 1995; König et al., 2012). Approval of important matters commonly takes place through voting in a General Assembly. Accordingly, staff and members, including those with a board position, have to collectively work toward advancing a meta-organization's goals without recourse to binding directives associated with hierarchical and contractual control – which are modes of governance generally used by firms. The members are thus not hierarchically or contractually bound to enable the renewal of a meta-organization's goal-directed activities (Oliver, 1990). Since these activities benefit all interested members, free-riding behavior by members may be prone to occur (Olson, 1965; Staber, 1987). Yet, renewal of the activities of established meta-organizations depends largely on members' resource commitments (Bennett, 2000; König et al., 2012). In the remainder of this study we examine how, given these challenges to renew these activities, such renewal may be attained by changes in organizing an established meta-organization.

7.3. Methods

7.3.1. Research design and setting

Given the exploratory nature of our inquiry and the importance of investigating processes of change with regards to organizing meta-organizations in a real-life context, a case study approach was considered appropriate (Yin, 2013) and adopted. Our research setting is the regional business association that promotes the common interests of over 700 registered logistic and industrial organizations in the port of Rotterdam, Europe's largest port-industrial complex. This established meta-organization, Deltalinqs, was selected through theoretical sampling (Eisenhardt & Graebner, 2007) for several reasons. First, from theory we expected that the dynamic and demanding environments within which its members operate require renewal over time to keep serving their needs. Second, Deltalinqs is not only involved in representative terms (e.g. lobbying), but also serves its members' needs through activities related to standard setting and service provision. Third, Deltalinqs' member collective, which includes subsidiaries of Fortune 500 firms such as Air Liquide, E.ON, Maersk and Shin-Etsu, is active in many industries and contributes to a large part of the Netherlands' gross national product. The manifold of represented industries and, therefore, heterogeneous interests make that the renewal of its activities was expected to be a complex endeavor. Lastly, we were granted access to a variety of rich primary and secondary data sources, covering the period 2001–2015, which allowed for proper examination of how changes in organizing an established meta-organization contribute to the renewal of its goal-directed activities and, in turn, its adaptation to changing environmental demands or conditions.

Table 7.1. *Data sources*

Data sources	***Type of data***	***Use in the analysis***
Interviews	21 semi-structured interviews held between February 2014 and April 2015 with knowledgeable persons involved with Deltalinqs. Average length per interview: 90 minutes. All but two recorded and transcribed, resulting in 537 pages of transcripts.	Understand, deepen and – later in the analysis – verify the meaning of and interrelationship between key events, i.e. (i) changes in organizing; (ii) renewal of goal-directed activities; and (iii) changing environmental demands/conditions.
	▪ Board members: 5 interviews with current (4) and former (1) representatives of industrial or logistics clusters in Deltalinqs' board.	Gather data on the influence and interrelationships of key events, discuss members' motivation, understand general decision-making and task allocation, and challenge specifics of the emerging analysis.
	▪ Staff: 11 interviews with staff including the staff director (5), deputy staff director (1), secretary of the Deltalinqs board (2), coordinators of DU (1) respectively DEF (1), and a project coordinator (1).	Gather data to create a case narrative, triangulate data on the influence and interrelationships of key events, understand the role of staff in key events, broaden understanding of the division of labor and the integration of efforts, and challenge specifics of the emerging analysis.
	▪ Members: two interviews with different representatives of members not part of the board.	Triangulate data on the earlier identified relationships between key events from a perspective different from that of board members and staff.
	▪ Outside experts: three interviews with experts with a senior position in the Port of Rotterdam Authority (2) and the Rotterdam municipality (1).	Triangulate data on the involvement of external stakeholders and the outcomes of this involvement; triangulate data on the earlier identified relationships between key events from a perspective different from that of board members and staff.

Table 7.1 (continued). *Data sources*

Data sources	***Type of data***	***Use in the analysis***
Direct observations	10 hours of direct observation of two DU workshops, held in respectively April 2014 and 2015, on (i) improving members' safety culture, and (ii) improving cooperation between members and external stakeholders.	Triangulate data on the influence of and interrelationship between key events as evidenced in practice.
Roundtable meeting with the board	One-hour roundtable meeting held in November 2014 with the members of Deltalinqs' board and the research team where preliminary findings were presented followed by a question-and-answer session.	Triangulate data on the influence of and interrelationship between key events identified in the emerging analysis.
Internal documents	Statutes, bylaws, internal (member) presentations (8), board documents (4), board presentations (2), member circulars (240), protocols (3), and research reports (1): Total number of pages: 1675.	Triangulate data on the influence of and interrelationship between key events, increase validity of the case narrative, and create understanding of the division of labor and the integration of efforts iteratively.
Public documents	Books (3), annual reports (14), policy plans (3), program booklets (6), public presentations (5), government reports (3), Letter of Cooperation (12), and industry journal articles (5). Total number of pages: 589.	Triangulate data on the influence of and interrelationship between key events, increase validity of the case narrative, and create understanding of the division of labor and the integration of efforts iteratively.

7.3.2. Data collection

Data were obtained through in-depth interviews, event observations, a roundtable meeting with the board, and studies of internal and public documents (see Table 7.1). In a period of 15 months (February 2014 to April 2015), 21 interviews were conducted, each averaging around 90 minutes, with a total of 16 knowledgeable interviewees. Six interviewees, including the staff director, were employed as staff, and five were current or former representatives of industrial or logistics clusters in the board. We selected in particular interviewees that were part of the staff or board as these two constituencies represent the network-level perspective (Provan et al., 2007). In addition, to control for the possibility that staff and board directors provided a perception deviating from that of the majority of members and external parties (Bennett, 2000), we interviewed two knowledgeable and engaged managers of members not part of the board, and three outside experts that held a senior position in the Port of Rotterdam Authority or the Rotterdam municipality.

In all interviews a semi-structured interview template was used asking the interviewees, among other things, about previous and recent changes in the organizing of Deltalinqs, newly developed activities, and the relationship between the two. Interviewees were asked to provide information on why and how these new organizing practices and activities were developed, and their effects on the ability to contribute to Deltalinqs' long-term goals. The questions related to distinct past behaviors and events rather than past beliefs and intentions in order to reduce interviewees' retrospective sensemaking and impression management (Eisenhardt & Graebner, 2007). Most of the interviews were held in the composition of one interviewee to two interviewers to enhance investigator triangulation (Yin, 2013). Notes were taken to help formulate follow-up questions during the interviews and facilitate subsequent data analysis (Patton, 2002). All but two of the interviews were tape-recorded and then transcribed, which resulted in over 500 pages of transcripts, to enhance descriptive and interpretive validity (ibid.).

Besides the interviews, a roundtable meeting with members of the board was organized. This meeting, during which preliminary findings were presented, followed by a question-and-answer session, expanded our data collection and validated our analysis. Further, data from about 10 hours of direct observation was collected in April 2014 and 2015 by attending two workshops on improving members' safety-culture. The primary data were triangulated with rich secondary data from both publicly available and internal documents, thereby enhancing the reliability and validity of the findings (Welch, 2000). These data sources included Deltalinqs' statutes, by-laws, protocols, board documents, annual reports, member circulars, program booklets, and government reports. In total, more than 300 documents, with an average of 7 pages each, were collected and investigated in the period from October 2013 to April 2015.

7.3.3. Data analysis

As a first analytical step we used data from interviews with staff and secondary data sources (see Table 7.1) to create a case narrative describing and visualizing a chronological overview of key events regarding Deltalinqs' history. To enhance the study's reliability, we used a desktop search engine to index our data sources and create a case study database (Gibbert et al., 2008). Hardcopy records were scanned and we used optical character recognition software to make them searchable. Starting by reading Deltalinqs' first annual report published in 2001 and triangulating data sources going forward, we identified and coded key events regarding: (i) changes in the organizing of Deltalinqs as regards its internal structure and, related to this, the division of labor (i.e. the division and allocation of tasks) and the integration of efforts (i.e. the provision of information and rewards) (cf. Puranam et al., 2014: 165); (ii) additions or modifications (i.e. renewal) to its portfolio of purposeful activities; and (iii) developments and changes in the external environment that pushed Deltalinqs toward making changes in how it was organized or in its portfolio of activities. After identifying a key event we searched our database on corresponding terms to assess its value for Deltalinqs' purpose of serving its members' common interests.

For our next analytical step, we used the case narrative as an analytic tool throughout further data collection (e.g. Eisenhardt, 1989) to verify with interviewees whether the listed events were of critical importance to the renewal of Deltalinqs' activities. Often they suggested only minor modifications. This data triangulation enhanced the representative strength of our interpretation and encompassing understanding of the changes in organizing.

The final analytical step was to extend our understanding of *which* events happened *when* toward questioning *how* and *why* (Van De Ven & Huber, 1990) changes in organizing have been distinctive to Deltalinqs' performance in terms of serving its envisioned long-term goals. Triangulating data sources, we pattern-coded interview quotations and chunks of verbatim text to find thematic content related to our inquiry (Miles & Huberman, 1984). During multiple sessions we interpreted, checked, and refined pattern codes to develop a shared understanding of how changes in organizing were of influence to the renewal of Deltalinqs' goal-directed activities and its adaptation to changing environmental demands. Data collection and analysis were performed simultaneously, and were of an iterative nature accordingly. In line with previous meta-organization research (e.g. König et al., 2012), our data analysis was continuously informed by the extant literature. We continuously updated our case study database with newly attracted data sources – e.g. by initiating new interviews to increase validity of earlier coded patterns. As we realized that our interpretation of the data could be influenced by prior studies and theoretical prepossessions, we repetitively discussed interpretative differences and asked for input from interviewees until consensus was reached. The roundtable meeting with the board provided additional triangulation of our findings. Table 7.1 indicates how the different data sources were used in the analysis.

7.4. Case Study Deltalinqs

Business association Deltalinqs was established in 2001 as a bundling of forces between two prior associations in the port. Its mission is to proactively promote the collective interests of its members, including firms and associations of firms, by contributing to three explicitly stated long-term goals: (i) strengthening the international competitiveness of the Rotterdam port-complex; (ii) enhancing the complex' sustainable development; and (iii) increasing political and social support for its members' activities. The number of members grew from approximately 600 in 2001 to more than 700 in 2015. The diversity among the members is formally arranged into 14 homogeneous member subsets, including seven logistics clusters (e.g. container handling and port services) and an equal number of industrial clusters (e.g. chemicals and energy). In contributing to these three long-term goals, collective focus is put toward six domains of common interest, such as safety and labor market. The latter domain, for instance, covers the shared interest in the long-term sustainable availability of qualified personnel. For each of the domains of common interest there is a full-time coordinator part of the staff. In addition, four of these domains have a Steering Committee comprised of members from different clusters and chaired by one board member, who discuss structural and emergent domain-related topics and advise the board on respective decisions.

In 2015, Deltalinqs' staff consisted of a full-time director, 6 FTE domain coordinators and 10.5 FTE other personnel. The total staff size, which was 21.5 FTE in 2001, has slightly decreased over time as the amount of staff's secretarial tasks reduced. Yet, the number of FTE allocated to coordinative roles increased. Staff's main tasks are, among other things, to accumulate knowledge on – and look for alignment of – members' individual interests, inform members on matters of common interest, facilitate and coordinate interaction among members, represent their common interest in lobbying and communicating with external parties, and prepare and take part in meetings. A General Assembly is held at least twice a year, with equally distributed voting rights among the members. There is an elected board of directors that consists of 14 individuals from different members who represent the common interests of the members in their respective cluster. Accordingly, members' interests in each cluster are proportionally represented. The board has quarterly meetings. Its tasks, as stated in the statutes, include decision-making and the governance of Deltalinqs' activities in general, defining the staff director's responsibilities, and proposing budgets.

To a large extent, renewal of Deltalinqs' goal-directed activities appeared to have taken place in relation to two major changes in how it is organized – that is, the establishment of two internal coordination platforms for enhanced member-interaction and standard setting efforts: (1) Deltalinqs 'University' in 2003 and (2) Deltalinqs Energy Forum in 2007. Hence, the remainder of our case study is structured around these two coexisting coordination platforms and subsequent follow-up changes in organizing, revealing both comparable and complementary ways in how changes in organizing Deltalinqs enabled renewal of its goal-directed activities and, in turn, adaptation to changing environments.

7.4.1. Deltalinqs 'University' (DU)

Over the period 2001–2003 a series of serious safety-incidents took place in the Rotterdam port-complex, part of which happened in member firms of Deltalinqs. This resulted in growing pressures from powerful external stakeholders, including the Rotterdam municipality and Port of Rotterdam Authority, for a more proactive stance of the complex' businesses toward improving regional safety-levels and reduce the yearly number of incidents accordingly. Subsequent discussions in and between the board and staff on how to address these pressures resulted in the decision to develop a coordination platform in Deltalinqs to facilitate knowledge exchanges among members, and between members and external parties, about safety-related process improvements. This internal coordination platform labelled *Deltalinqs 'University'* (henceforth 'DU') – to reflect its focus on learning – was structured around one specific goal: *"collaboratively enhancing safety-levels in the port-complex and its surroundings"* (Annual Report Deltalinqs 2003).

In 2003 a kick-off workshop was held where, besides an explanation of DU, the principal causes of several large incidents were discussed. Encouraged by the participants' positive reactions, workshops and masterclasses on preventing incidents were organized as part of DU in subsequent years. These educational undertakings, which required additional annual or single-event membership fees, were new to Deltalinqs' portfolio of activities. DU's main value proposition is to enhance consultation and deliberation among members on what caused incidents or accidents to happen, thereby cultivating increased awareness of the importance of and learning about various safety measures. Members' knowledge contributions to DU – e.g. in workshops – are part of a process informally governed by three core values: *"(i) for and by members; (ii) transparency between members; and (iii) the right to collect and the duty to contribute"* (Annual Report Deltalinqs 2003; DU Program 2013).

The discussions held in DU led to more pragmatic ideas for new activities to enhance safety-levels in the port-complex. Evaluation of such ideas was placed under the mandate of the Safety-domain's Steering Committee and concerned external stakeholders, who, if confirmed sufficient justification of the relevance of an idea, put the coordinative responsibility for its implementation to staff. This created a larger role for staff to coordinate and develop new activities, and consequently a DU-coordinator – part of the staff – was appointed. In 2003, the DU Safety Management System (henceforth 'DU-SMS') was developed, in which this staff-coordinator played a particular role. DU-SMS promotes harmonization of safety measures and instructions used by members by enabling them to learn by benchmarking. This new activity revolves around 17 safety-management procedures (SMPs) which, captured in learning statements, describe generic safety-standards and guidelines for enhancing safety with respect to several aspects of members' operations. For the development and maintenance of DU-SMS, SMPs were linked to new-created contact groups. Committed members in these groups meet at least twice a year to evaluate the content of one or multiple SMPs and decide on adding or adapting temporal objectives to these SMPs if needed. A case in point is a contact group in which members meet four to

six times a year to discuss the SMP concerning working conditions. As part of DU-SMS' development, structural cooperation extended with external stakeholders like the Labor Inspectorate, who became in charge of educating members and monitoring their progress.

In the period 2006–2008, external stakeholders increasingly judged that the urge of Deltalinqs' members toward enhancing safety-levels had reduced, which led to growing pressures for renewal of the activities in DU. Accordingly, staff's dedication toward renewing these activities increased. Specifically, the safety-domain coordinator became more involved – complementing the DU-coordinator – with a particular focus on driving renewal of safety-related activities beyond or adding to DU-SMS. As a result thereof, the DU-Toolbox was introduced to the members in 2008, and further developed in subsequent years, to enhance knowledge sharing on safety-topics and provide an overview of SMPs-related knowledge to help members improve their operational processes. Such knowledge could stem, for instance, from lessons learned following discussions of firm-level incidents in contact groups and workshops. The potential value of the knowledge shared in the DU-Toolbox is verified per contact group and overseen by DU's staff-coordinator. Members are encouraged to share 'inspiring working practices', using the DU-Toolbox' transparent interface, to complement SMPs-related knowledge in DU-SMS. Regarding the motivation to share safety-related knowledge, one interviewee said:

> "*Of course you can take a somewhat stupid – in my opinion – position thinking that if there are less safety-accidents at your plant than at your neighbors that is a competitive advantage. I think that is definitely an advantage but not one that you would want to have. You just do not want more accidents at the neighbor's place because there is an ethical edge to it right? In the end it is about people. But also, we have recently witnessed that it damages the reputation of the industry itself. In that sense we are all on the same boat, which signifies the importance of collective safety-awareness. Besides, there is the inherent economic interest to help each other as a collective in moving forward toward a next level of regional safety. […] These are small contributions, but in the end that will result in that the entire industry will keep its license to operate. If we are all going to do nothing, it will result in that we all lose.*" (Board member A, interview, May 2014)

In an attempt to more directly enhance front-office safety-levels, following 2008's pressures from external stakeholders, staff and board developed, in collaboration with an external non-profit organization, the Digital Safety Passport (DSP). The DSP was introduced in 2010, and further developed in subsequent years, as a reliable and strictly personal digital card – based on biometric identification – specifying the safety-related qualifications of a contractor firm's individual employees. DSP-scanning facilities, installed at the plants of industrial firms, enable registering and verifying their readiness – in terms of up-to-date training and knowledge of safety procedures – to work at these plants before granted access. Members that decide to participate need to make a small payment for the cards or installation

of the scanning facilities. Employees of participating contractors need to take part in a standardized safety training, coordinated by staff and based on input from members and external stakeholders, and pass a subsequent exam. The procurement of DSP, which was preceded by pilot studies in various member firms, implied harmonization of the members' safety norms, enabling contractors to work more efficiently without the need to train for different norms at different plants.

The DSP initiative arose as an outcome of discussions that took place in Deltalinqs' Committee of Harmonization. This committee was established in 2009 for the purpose of discussing and finding new ways to overcome language barriers between contractors and industrial firms. It was coordinated by staff and placed under the mandate of the Safety-domain's Steering Committee. As one of its first tasks, the Committee of Harmonization assessed the efficiency-outlook of DSP for replacing the traditional paper safety passport. As it was convinced that DSP could deliver efficiency benefits in safety-procurement and considered the reliability of the paper safety passport insufficient, it decided favoring its replacement by DSP. Indeed, contractors were frustrated to continuously deal with the different safety systems and associated trainings of different industrial firms in the port-complex. As one interviewee commented:

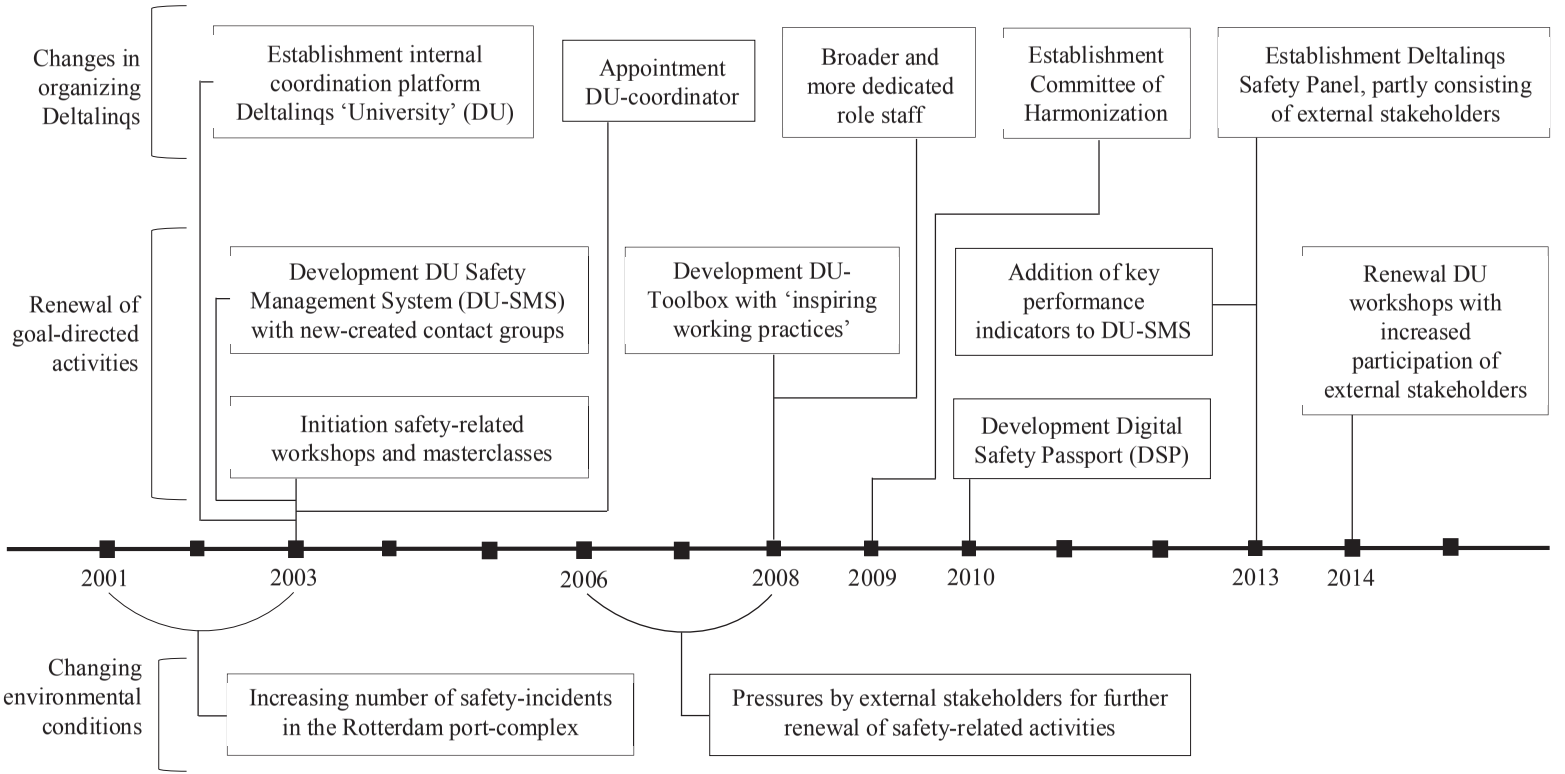
> "*There was a point in time where members said: 'everywhere our employees go they need to take a similar but different training before they can enter the plant, it's driving us crazy! Isn't there a possibility for having a uniform training, developed by Deltalinqs, since we are all active in this port and agree on what the training should contain of?"*" (Board member C, interview, July 2014)

The establishment of DU marked an era of increased involvement of external stakeholders in Deltalinqs' activities, which had been very limited up until then. Confronted by the severity of foregoing incidents, Deltalinqs and external stakeholders became aware of their interdependence for enhancing safety in the port-complex. From that point in time, multiple external stakeholders, like the regional environmental protection agency and fire department, provided recurring workshops on topics such as what incidents need to be reported and how to communicate with residents of areas surrounding port-industrial activities when incidents happen. Moreover, an advisory panel consisting partly of individuals from external organizations – active in the aircraft, educational, financial, public management, and healthcare sector – was established in 2013. The staff director commented:

> *"We thought it would be good to have an advisory panel [Deltalinqs Safety Panel] that includes not only members but also individuals from external parties. Otherwise, it would be like: 'the butcher inspects its own meat'.*" (Interview, July 2014)

The Deltalinqs Safety Panel discusses and reflects on the effectiveness of DU twice a year, the outcomes of which are reported to the board as a formal advice. Its main responsibility is to keep making progress on the DU goal of enhancing safety-levels in the

Figure 7.1. *Timeline Deltalinqs 'University' (DU)-related events*



Rotterdam port-complex. Noticeable outcomes of this change in organizing were the addition of key performance indicators to DU-SMS in 2013 and the more active participation of external stakeholders in DU workshops over 2014–2015, which both resulted from that year's formal advice of the Deltalinqs Safety Panel.

Figure 7.1 provides a timeline of the changing environmental conditions, changes in the organizing of Deltalinqs, and the renewal of goal-directed activities associated with Deltalinqs 'University'.

7.4.2. Deltalinqs Energy Forum (DEF)

Over time, Deltalinqs' members were facing increasing pressures from external stakeholders to enhance their environmental performance so as to improve the sustainability of the port-complex. As a reaction to these pressures, Deltalinqs decided to initiate the Rotterdam Climate Initiative in collaboration with the regional environmental protection agency, the Port of Rotterdam Authority, and Rotterdam's municipality. This initiative, which started in 2007, aimed at reducing carbon emissions in the port-complex and the surrounding urban areas with 50 percent in 2025 compared to 1990 levels. That same year, in order to engage in this initiative and thereby contribute to Deltalinqs' long-term sustainability goal, the board and staff developed a new internal coordination platform – i.e. *Deltalinqs Energy Forum* ('DEF') – for cooperation among members with respect to enhancing energy-efficiency and the sustainability of their operations. Similar to DU, participation in this platform requires paying an additional fee. DEF is structurally divided into six component Business Platforms, such as the Business Platforms Biobased Economy and LNG. Each of the Business Platforms has its own discussion groups and activities such as workshops, facilitated by staff, for sharing best practices and initiating potentially valuable business cases.

Over 2009–2010 the estimated and final three-year outcomes of DEF regarding the reduction of carbon emissions were below expectation, leading to growing pressures from external stakeholders for more favorable outcomes. The causes of the less than satisfactory outcomes mainly lay with insufficient coordination and decision-making mandate in DEF as regards the execution of business cases. Consequently, two changes in organizing were made. First, a newly hired DEF-coordinator – part of the staff – was appointed responsible for the coordination of current and new activities and business cases. Second, the DEF Taskforce was established, which is a committee, assisted by the DEF-coordinator and the staff director, that consists of senior managers from members and external stakeholders (e.g. the Port of Rotterdam Authority). The DEF Taskforce decides four times a year on the Business Platforms' objectives and activities, and discusses the progress that has been made. Decisions are being made using the members' knowledge contributions in workshops as sources of input.

Various temporal objectives were set in 2010 – targeted to be attained in 2015 – by the DEF Taskforce in concurrence with Deltalinqs' long-term goal of enhancing the

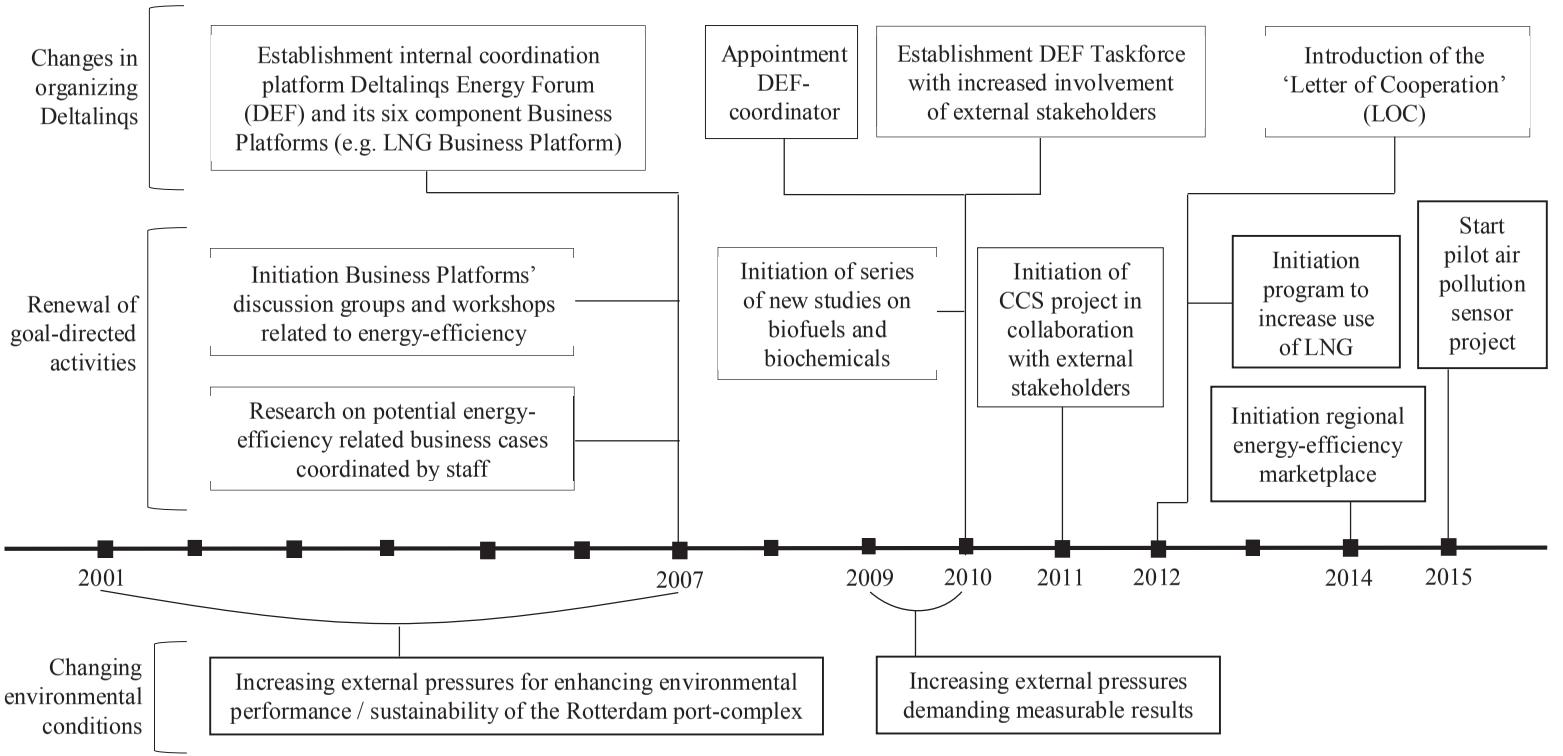
sustainable development of the Rotterdam port-complex. These objectives related to specific amounts of CO_2 reductions in certain target areas, including product-efficiency, usage of sustainable energy, and the capture and storage of CO_2. In turn, the decided-on objectives were co-aligned with the introduction of new studies and business cases. An example of a series of new studies initiated in 2010 pertained to the possibilities of producing biofuels and biochemicals in the port-complex. Some of the new business cases, such as the carbon capture and storage (CCS) business case initiated in 2011 in collaboration with external stakeholders, directly related to the core business of members, which motivated in particular these members to contribute to the critical mass needed to progress a business case's energy-efficiency objectives.

Over time, staff considered it important to increase individual member's commitment to coordinate business cases, partly to strengthen public legitimacy but also to, for instance, enhance lateral communication in the Business Platforms and tap into members' resources. Subsequently, the so-called 'Letter of Cooperation' (LOC) was introduced in 2012, in which a particular business case or theme, such as the use of LNG in the port-complex, is attached to short-term objectives. For instance, one LOC signed in 2014 aimed at having 50 coastal vessels, 50 inland vessels, and 500 trucks in the port-complex using LNG before the end of 2015. After the content of a LOC is drafted by the DEF-coordinator and verified by the DEF Taskforce, it is signed by one or more senior managers of Deltalinqs members or external parties. By signing, these 'LOC representatives' and their respective organizations commit formally, but not in a legally binding way, to engage actively in pursuing the objectives stated in the LOC, assisted by staff, and become responsible for the progression made on the activities involved. The staff director explained:

> "*In terms of organizing we [staff] do a lot of the work, but of course much of the content origins from the member firms and the stakeholders with which we cooperate. And for many topics my colleagues have developed knowledge over time. To that extent we are also a learning organization. So then we have all cooperating parties set but the real driving force is the representative person of that one organization. Subsequently, it becomes a question of honor to that person, since he is the [LOC] representative, to see whether or not any progress has been made after a year. Basically, we organize to make members create their own incentives.*" (Director of Deltalinqs, interview, February 2014)

New LOC's are signed each year in December for an initial duration of one year after which the DEF Taskforce reassesses their relevance and feasibility. A total of 25 LOC's were drafted and signed in the period 2012–2014, some of which were renewed each year. Although a LOC may strongly relate to the representative's core business, this is not always the case. For example, the representative of a LOC concerning the development in the port-complex of a location to grow algae, as a source of biofuels, said:

Figure 7.2. *Timeline Deltalinqs Energy Forum (DEF)-related events*



"*For my business it is irrelevant whether or not we create this algae inlet. If it works out it would be a 'nice to have', but it is not part of our strategy. […] You cannot just look at yourself, you also need to think in terms of: 'This is me in the industrial area and how can we [members] collectively increase its value?' And from my role in renewables and in DEF, I contribute resources to initiatives that are not directly beneficial to my own business but for which I think: 'It would be beneficial to the region if the algae inlet gets developed.*"' (Board member B, interview, June 2014)

In all, the newly developed DEF Taskforce and LOC's enhanced the coordinative strength of DEF and its component Business Platforms owing to the more decisive decision-making procedures of the DEF Taskforce and the greater sense of commitment toward initiated activities of LOC representatives. These changes in organizing led to a routinized approach toward contributing to part of Deltalinqs' long-term goals which contributed, in turn, to the realization of, among others, an infrastructure for the distribution of excess heat from certain members' plants to households in the city of Rotterdam, a pilot project with sensors intended to detect air pollution in the port-complex, and a regional marketplace for energy efficiency where external organizations were attracted to demonstrate innovative energy-efficient products and technologies to interested Deltalinqs members.

Figure 7.2 provides a timeline of the changing environmental conditions, changes in the organizing of Deltalinqs, and the renewal of goal-directed activities associated with Deltalinqs Energy Forum.

7.5. Discussion

Our case study shows how a series of different changes in organizing the established meta-organization Deltalinqs contributed to the renewal of its goal-directed activities and, thereby, its adaptation to different changing environmental demands faced by the members. First, governmental agencies and public expectations increasingly pressured members to enhance the safety of their operations in order to reduce the number of incidents in the Rotterdam port-complex. Second, Deltalinqs' members started facing pressures from external parties to increase the complex' sustainability by enhancing their environmental performance. Gains in workplace safety and regional sustainability are partly contingent on outcomes such as a port-wide digital safety passport and air pollution-sensor network, respectively. The extent to which single members could realize such outcomes was very limited. Accordingly, Deltalinqs, whose activities at that time were deemed insufficient to improve safety and sustainability levels in the port-complex, was expected to serve its members' interests by renewing its activities.

As for most meta-organizations, Deltalinqs' general long-term goals, to which its current and future activities are directed, are formulated rather broad and with an undefined time span. The newly established internal coordination platforms Deltalinqs 'University'

(DU) and Deltalinqs Energy Forum (DEF) are structured around the more specific goals of improving safety and energy-efficiency levels in the port-complex, respectively. Both platforms function as an arena for sensemaking by a subset of members, whose composition changes dynamically over time, and facilitates coordination of their efforts toward furthering Deltalinqs' long-term goals. In particular, this type of internal structural differentiation, providing "subgoal clarity" (Staber, 1987: 256) to the members, enabled more fine-grained discussions of cases to help set goal-directed temporal objectives and foster the subsequent short-term renewal of goal-directed activities. For instance, in DEF and its six component Business Platforms, members collaborate to define and realize energy-efficiency objectives related to new activities such as the initiation of a marketplace for energy-efficiency and the realization of a collective heat distribution network in and beyond the port-complex.

According to the cognitive view on organizational platforms (Ciborra, 1996: 104), "[…] the platform works as a collective, cognitive engine enacted by a pool of flexible human resources for exploring and trying out multiple combinations of old and new organizational arrangements." The fact that we find a comparable role for coordination platforms in meta-organizations would imply an additional level of analysis (i.e. the meta-organization level) to be considered in the extant platform literature (Thomas, Autio, & Gann, 2014). As argued above, our case study shows that establishing such platforms contribute to the renewal of goal-directed activities by helping to set new temporal objectives. Such objectives, which might be seen as operationalized outcomes of the meta-organization, are more actionable and measurable than the long-term goals to which they are associated (Hollen et al., 2014). Besides DEF, also the establishment of DU is worthwhile mentioning. DU's main goal is to enhance safety-levels in the Rotterdam port-complex, which is more specific than Deltalinqs' three long-term goals. The collective focus on this more specific goal by the board, staff, and members contributed to the setting and realization of goal-directed temporal objectives related to new activities such as the introduction of the DU Safety Management System (SMS), the DU-Toolbox, and the Digital Safety Passport (DSP). Hence, we suggest the following proposition:

> **Proposition 7.1**: Creating coordination platforms in an established meta-organization that foster the setting and realization of goal-directed temporal objectives contributes to the renewal of its goal-directed activities.

A meta-organization is essentially created based on the assumption that its members have some common interests that are united in its long-term goals (Gulati et al., 2012). Their practical interests, however, often differ (Ahrne & Brunsson, 2005). Accordingly, staff have to creatively act upon the differences and similarities between not only the members and the meta-organization itself but also between the various members (Ahrne & Brunsson, 2008). Related to this, members' commitment and involvement need to be coordinated on a continuous basis (Gulati et al., 2012; Hollen et al., 2014). Staff have a key role in

coordinating members' activities and contributions that align to the long-term goals, thereby achieving integration of effort at the level of the meta-organization, for which the provision of information is important (Puranam et al., 2014).

Our case study shows a central role of staff in the development of DU, which required the appointment of a DU-coordinator, and subsequent efforts to foster commitment of members with regard to the renewal of Deltalinqs' activities. This is exemplified by the development of the DSP, where the different degrees of members' interest for regional harmonization of safety-practices made that its success was not given up-front. Rather, to create sufficient legitimacy among the members for DSP's procurement, staff had to: (i) coordinate the Committee of Harmonization in assessing DSP's potential value for the members and the Rotterdam port-complex in general; (ii) develop a set of safety-standards satisfactory to all concerned members; and (iii) develop a workable pilot version tested and supported by the board members. Our case study also shows the enhanced deliberate role of staff – e.g. the appointment of a DEF-coordinator – in evaluating business cases in DEF and developing alignment among members of their contributions to energy-efficiency objectives. By creatively thinking about desirable changes in organizing, staff managed to foster members' commitment to renew Deltalinqs' goal-directed activities by initiating, for instance, LOC's and the DEF Taskforce. The individual efforts of members to contribute to new activities could subsequently be mutually adjusted in line with the three general or the more specific long-term goals. This line of reasoning gives rise to the following proposition:

> **Proposition 7.2**: Broadening the role of staff in an established meta-organization to include not only facilitative support but also coordination of new initiatives contributes to the renewal of its goal-directed activities.

In contrast to "individual-based organizations" (Ahrne & Brunsson, 2005: 430) such as firms, resource commitment in a meta-organization is mostly dependent on its members, as the staff's own access to human and financial resources is typically limited (Bennett, 2000; König et al., 2012). Besides, most resources used by a meta-organization to further its long-term goals are "merely borrowed" from the collective of members (Traxler, Brandl, & Pernicka, 2007: 403). Hence, it is important to incentivize members to commit resources to the renewal of goal-directed activities, for which a meta-organization can use different not legally binding instruments and other types of 'soft law' (Mörth, 2004). Our case study shows how Deltalinqs' staff introduced the Letter of Cooperation (LOC) to activate or encourage members to become formally – but not legally – responsible for coordinating different temporal objectives related to energy-efficiency. Such objectives became linked to clear coordinative responsibilities of members and the associated use of these members' own financial or human resources, implying a change in organizing.

Becoming a LOC representative (by signing such a letter) emits a reputational signal – as is also the case with taking on a position in a meta-organization' board or committee –

and enables a member to exercise greater influence over a collective initiative (Bennett, 2000). Moreover, it enhances a member's sense of ownership of and inherent commitment to such an initiative and the meta-organization in general (Gulati et al., 2012). In this vein, LOC representatives can be perceived as "champions" of renewal (König et al., 2012: 1334). In Deltalinqs these representatives were particularly directors or senior-managers of multinational firms. Their inherent status created wider attention for the DEF energy-efficiency objectives and associated initiatives, attracting others to participate. As Barnett et al. (2000: 328) argued, "[…] the process of joining into collective action will take place contagiously among organizations, because organizations are more likely to join when they are exposed to others who join." Hence, we propose:

> **Proposition 7.3**: Encouraging members to become formally committed to realize new temporal objectives of an established meta-organization contributes to the renewal of its goal-directed activities.

As pointed out above, the resources that staff have at their disposal for coordinating and renewing a meta-organization's goal-directed activities are relatively limited. Next to formally committing individual members with respect to coordination efforts, such as by means of LOC's, the establishment of additional coordinative bodies within the meta-organization may reduce coordinative complexity. As exemplified in our case, such bodies can be committees dedicated to initiate and coordinate collaborative efforts toward new temporal objectives. Establishing such committees, consisting of member representatives and facilitated by the meta-organization's staff, results in a partial subdivision of responsibilities and more focused discussions on and efforts toward renewing goal-directed activities. For example, our case study pointed out how the creation of a Committee of Harmonization to deliberately monitor the development of the DSP from a practical viewpoint on potential efficiency gains subsequently improved this product's final functionalities and the economic benefits to the members.

While discussion in committees may foster member commitment toward specific goals, having a larger number of committees might also imply more complex internal communication processes and associated bureaucracy-kind heterarchical structures with interdependencies in decision-making, which require increased information processing by members. To overcome protracted decision-making and resulting inertia in response to environmental changes (König et al., 2012), committees should have some formal or informal decision-making power aligned to their objectives and tasks (Zhou, 2013). An example from our case study is the establishment of the DEF Taskforce in 2010, which led to more centralized decision-making by members regarding energy-efficiency objectives and subsequent new goal-directed activities. Before this change in organizing, staff were mainly responsible for coordinating these activities but lacked the mandate to make decisions on behalf of the concerned members. For every decision in DEF concerning

member collaboration staff required approval from both the board and members engaged in the DEF Business Platforms. Overall, this increased the lengthiness of decision-making procedures and slowed progression of the renewal of goal-directed activities. The establishment of the DEF Taskforce meant that decision-making could take place largely without the intervening of the board and members not part of this taskforce, thereby enhancing the decisiveness in DEF. Hence, we suggest the following proposition:

> **Proposition 7.4**: Introducing committees in an established meta-organization that are given the mandate to initiate and coordinate collaborative efforts toward specific goals contributes to the renewal of its goal-directed activities.

Established meta-organizations tend to have a culture of consensus and an accompanying elitist identity, thereby causing behavioral inertia (König et al., 2012). Our case study highlights that this tendency for inertia can be reduced by involving external parties in a meta-organization's decision-making and evaluation processes and, moreover, routinely sourcing information and knowledge from outside the meta-organization's boundaries. For example, external stakeholders, such as the Labor Inspectorate, were requested to educate members on implementing new standardized safety-management procedures and monitor their subsequent progress. Another case example is the Deltalinqs Safety Panel. This newly created advisory committee, which partly consists of individuals from external organizations active in, for instance, the aircraft, educational and healthcare sector, provided new insights regarding DU's effectiveness and influenced decision-making outcomes in the board accordingly. Similarly, a case study by Reveley and Ville (2010) revealed that the effectiveness with which a meta-organization can pursue its goals is consistent with seeking ideas and solutions from outside the meta-organization. Next to the benefits stemming from knowledge appropriation of external stakeholders in decision-making processes, however, our case study suggests that including external actors in the decision-making about the renewal of goal-directed activities reciprocates through the legitimacy of these same actors, which contributes to ensuring that the collective of members would maintain its license to operate. Hence, in line with König et al.'s (2012: 1336) view that "[…] external actors can provide crucial information on the future of a field and on appropriate adaptation strategies", we propose as follows:

> **Proposition 7.5**: The degree to which changes in organizing an established meta-organization foster the incorporation of external stakeholder advice into its decision-making process is positively related to their contribution to the renewal of its goal-directed activities.

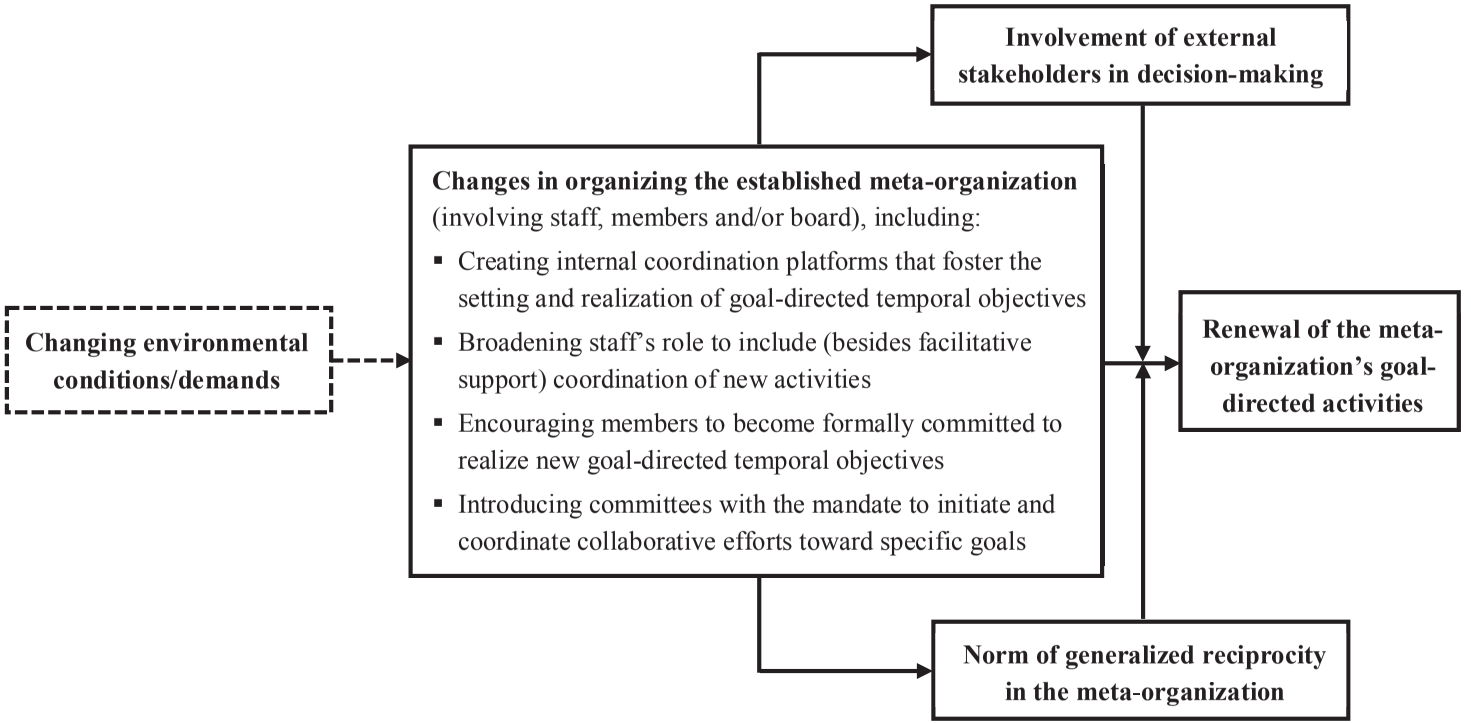
The renewal of a meta-organization's goal-directed activities typically requires cooperation among its members. Since the cooperative benefits are based on voluntary efforts rather than legal obligations, most of these 'exchanges' are of a social rather than

economic nature (Blau, 1964). In meta-organizations and other multi-organizational networks, which consist of at least three members, social exchanges are generalized, meaning that there is no direct reciprocity between each of the members (Das & Teng, 2002). This absence of direct reciprocity makes meta-organizations vulnerable to freeriding or opportunistic behavior by members (Reveley & Ville, 2010). The cultivation of what Gouldner (1960: 161) called a "generalized moral norm of reciprocity", resulting partly from recurrent interactions in a meta-organization and the attendant building of trust among its members (Bennett, 2000), implies the development of a self-sustaining "[…] group-based exchange relationship in which members expect quid pro quo exchanges within the group but not necessarily with any specific member" (Das & Teng, 2002: 449).

A norm of generalized reciprocity might imply that members who make certain unilateral contributions – in the form of services and social or economic resources – in favor of a meta-organization's long-term goals can expect to retrieve mutually beneficial contributions from other members. However, it may also entail expectations that members' contributions are reciprocated by the meta-organization's overall progress in a direction beneficial to their particular interests. Such "net generalized reciprocity" (Das & Teng, 2002: 451) means they contribute to the meta-organization as a whole, thereby 'pooling' their contributions, and are then reciprocated by the collective benefits generated by this pooling. For example, our case study shows that group-based knowledge sharing by the members in DU was reciprocated by higher safety-levels in the port-complex and, in turn, contributed to prolongation of the complex' license to operate. Transparency about members' knowledge sharing efforts offers compensation for the relative difficulty to audit the parity of the exchanges of fellow members. Visibility of each member's contributions may motivate members to voluntarily contribute their share in order to not be seen as exploitative (Gould, 1993). In DU, transparency was increased by providing new online monitoring tools and communicating the contributions to members during workshops and in member circulars.

Without a collectively shared norm of generalized reciprocity, members may, in fact, lack the motivation or intent to contribute to the renewal of activities that do not provide direct individual benefits. Likewise, König et al. (2012: 1335) contend that members share knowledge within the meta-organization "only when they are sure to receive some sort of an equivalent benefit either from other members or the meta-organization". Our case study indeed shows that a collective norm of generalized reciprocity persuaded members to be involved in the renewal of Deltalinqs' activities by, for example, exchanging safety-related knowledge in DU or putting in time-efforts for new energy-efficiency projects in DEF beyond the scope of a member's core business. Willing to adhere to this collective norm, the members are encouraged to overcome differences in practical interests and to make concessions to one another – e.g. to pay an additional participation fee for DEF despite it being used to explore business cases with potentially unequal business value for the member collective. We therefore propose as follows:

Figure 7.3. *Conceptual framework: Adaptation of established meta-organizations to changing environmental conditions*



Source: Based on literature review and case evidence

Proposition 7.6: The degree to which changes in organizing an established meta-organization foster a norm of generalized reciprocity in the meta-organization is positively related to their contribution to the renewal of its goal-directed activities.

Based on the above propositions, we suggest a conceptual framework, depicted in Figure 7.3, regarding an established meta-organization's adaptation to changing conditions (or demands) in its external environment. These changing conditions may require an established meta-organization to deliberately make changes in how it is organized so as to contribute to renewal of its purposive activities and consequently adapt to the new conditions. These changes in organizing (see the middle box in Figure 7.3) include (i) the creation of internal coordination platforms that foster the setting and realization of goal-directed temporal objectives; (ii) the broadening of the role of staff to include not only facilitative support but also coordination of new initiatives; (iii) the encouraging of members to become formally committed to realize new temporal objectives; and (iv) the introduction of committees that are given the mandate to initiate and coordinate collaborative efforts toward specific goals (see respectively Propositions 7.1–7.4). The members, board, and staff might all play a role in directing, or be subject to, these organizational changes. The degree to which these changes in organizing foster the incorporation of the advice of external stakeholders into the meta-organization's decision-making process (see Proposition 7.5) and a norm of generalized reciprocity among its members (see Proposition 7.6) moderates the contribution of these changes to the renewal of its goal-directed activities.

7.6. Conclusion

Just like for individual-based organizations and other networks of associative relationships (Scott, 1964), the efforts in meta-organizations are directed at producing certain outcomes. In particular, meta-organizations have come into existence to perform a range of activities that contribute to their long-term goals for the collective benefit of their members. Established meta-organizations that operate in the face of changing environmental conditions have to renew their goal-directed activities in order to adapt to these conditions (e.g. König et al., 2012; Reveley & Ville, 2010). In this study we explored how changes in the organizing of an established meta-organization may advance such renewal. The extant organizational renewal literature (e.g. Agarwal & Helfat, 2009; Floyd & Lane, 2000; Huff et al., 1992) offers insufficient understanding of the antecedents and moderators of renewal in the meta-organizational context as this literature is largely centered on firms, which differ from meta-organizations in several relevant aspects, such as the role of managerial authority and staff's access to resources (Ahrne & Brunsson, 2008; Gulati et al., 2012; König et al., 2012). Our contribution to the existing body of literature on meta-organizations, whose understanding is still in the early stages (Gulati et al., 2012; Malets, 2010), is twofold.

First, our findings provide an empirical basis for improved theoretical insights into the role and influence of various changes in how a meta-organization is organized as regards its structure and the division of labor and integration of efforts (cf. Puranam et al., 2014) by its members, board, and staff. These include changes related to decision-making process (e.g. by introducing new committees with a mandate to initiate and coordinate collaborative efforts in the meta-organization), changes in motivating its autonomous members to commit to the set directions (e.g. by introducing LOC's), and changes in how and by whom these efforts are coordinated (e.g. by creating internal coordination platforms). Our findings also highlight that the degree to which these changes in organizing foster the involvement of external parties into the meta-organization's decision-making process and a norm of generalized reciprocity among its members is positively related to the renewal of a meta-organization's goal-directed activities.

Second, this study adds to the current conceptual understanding of meta-organizations by developing a set of theoretically and empirically informed propositions, which may guide further inquiry. Based on these propositions, we also proposed a conceptual framework of meta-organizational adaptation to changing environmental conditions. Although meta-organizations in many aspects cannot be compared to firms (Ahrne & Brunsson, 2008), organizing may play an equally vital role for their performance (in terms of serving their long-term goals). Established meta-organizations that timely anticipate or react to changing environmental demands by making organizational changes in ways that contribute to the renewal of their goal-directed activities – as indicated in our propositions and conceptual framework – improve their performance. Our propositions may be used in different meta-organizational settings.

Clearly, the "fertile ground" for further inquiry on meta-organizations (Gulati et al., 2012: 582) is not limited to the propositions developed here. A more systematic study of meta-organizations entails investigating various types of meta-organizations (Malets, 2010). For instance, whereas our study revolved around a meta-organization with members that are geographically proximate and heterogeneous, members may also be spatially dispersed and operating in the same industry (Traxler et al., 2007). Furthermore, the members are not necessarily commercial organizations, as in the case of Deltalinqs. Instead, or in addition, meta-organizations may have members that are states or non-profit organizations (Ahrne & Brunsson, 2008; Kerwer, 2013). Other avenues worthy of further research concern membership size (Leblebici & Salancik, 1989), the speed in which choices are made regarding changes in organizing, the sequence of these choices, and the influence of internal power distribution (Gulati et al., 2012; Staber, 1987). In addition, it would be interesting to investigate the influence of social governance mechanisms other than a norm of generalized reciprocity, such as social sanctions and a cooperative macroculture (Das & Teng, 2002). We hope that scholars who engage in these or related research directions benefit from this study's contribution to the understanding of meta-organizational adaptation to changing environmental conditions.

CHAPTER 8

Conclusion: Contributions, Implications, and Future Research Agenda

Research on ambidexterity has emphasized that in order for organizations to remain competitive over time, exploitation-directed activities need to be balanced with exploration-directed activities (e.g. Birkinshaw & Gupta, 2013; Jansen et al., 2009; Lubatkin et al., 2006; Simsek, 2009; Tushman & O'Reilly, 1996). Scholars have been studying the antecedents, forms, and performance outcomes of such balancing at the firm, business unit, manager, and interfirm (i.e. dyadic) level of analysis. Taking the concept of ambidexterity up to a higher level of analysis, the studies in this dissertation have illuminated in different ways *how ports in economically advanced countries may become more ambidextrous, thereby strengthening their innovation-driven sustainable international competitiveness*. In relation to this central research question posited in the introductory chapter, this eighth and final chapter starts with a discussion of the dissertation's overall scientific contributions and several limitations. Next, implications are discussed for port authorities, firms and business associations in ports. Finally, an agenda for future research into ambidextrous ports is presented.

8.1. Overall Scientific Contributions of the Dissertation

The overall scientific contributions of the dissertation, which include both theoretical and empirical contributions, can be structured around the seven subthemes that were presented in Chapter 1 – that is, (i) management innovation; (ii) strategic connectivity; (iii) industrial ecosystems; (iv) meta-organizations; (v) business model innovation of port authorities; (vi) strategic value creation; and (vii) port authority strategies. As the studies in this dissertation have shown, there are several interlinkages between these subthemes, which will be reflected upon in the following discussion of the main contributions (see also Table 8.1).

The dissertation's first overall scientific contribution, which relates to all subthemes, is that it examines ambidexterity at the multi-organizational level in the context of ports. In doing so, it adds to the extant literature on ambidexterity – for an overview, see O'Reilly & Tushman (2013) and Simsek (2009) – in which this level of analysis is underexplored, as well as to the port-related literature, which has remained remarkably silent on the challenge of ambidexterity. 'Ambidextrous ports' have been conceptualized as ports that (are able to)

Table 8.1. *Overall scientific contributions of the dissertation and the associated gaps in the literature*

Overall scientific contributions	*Associated literature gaps*
1. Conceptualization and empirical examination of ambidexterity at the multi-organizational level in the context of ports, and the relation between a port's ambidexterity and its innovation-driven international competitiveness. Given ports' predominant focus on exploitation-directed activities, the main focus is on how to foster exploration-directed activities.	- Prior ambidexterity studies have mainly focused on the level of the manager (e.g. Mom et al., 2009; Jasmand et al., 2012), business unit (e.g. Hill & Birkinshaw, 2014; Jansen et al., 2005), firm (e.g. He & Wong, 2004; Lubatkin et al., 2006), and the dyad/bilateral alliance (e.g. Lavie & Rosenkopf, 2006; Russo & Vurro, 2010). - The port-related literature remained silent on the topic of ambidexterity.
2. Identification and empirical examination of management innovation at the multi-organizational level, focusing in particular on the development of new management practices in the multi-organizational settings of industrial ecosystems, external dedicated test facilities and business associations, and the outcome in terms of joint resource productivity, technological process innovation, safety procedures, and environmental performance in ports.	- Prior management innovation literature (e.g. Birkinshaw et al., 2008; Damanpour & Aravind, 2012; Vaccaro et al., 2012; Volberda et al., 2014) has mainly focused on the firm and dyadic level of analysis; the multi-organizational level has hitherto been underexplored. In this connection, it has remained unclear how new management practices are developed and implemented in the context of, for instance, industrial ecosystems, external test facilities, and business associations.
3. Exploration and identification of new ways in which the development of industrial ecosystems may be influenced both by firms that make up these ecosystems ('inside view') and by port authorities ('outside view'). Regarding the latter, the dissertation illuminates how port authorities may use investments in physical and knowledge infrastructure and their land allocation policy as strategic levers to foster different stages of industrial ecosystem development. Regarding the 'insider view', the dissertation points toward the importance of introducing new management practices in favor of the relational dimension of such ecosystems.	- The importance of developing new management practices in favor of the relational dimension of industrial ecosystems (complementary to their physical dimension) is largely overlooked by industrial ecology scholars. - The role of (landlord) port authorities in fostering subsequent stages in the development of industrial ecosystems (e.g. Baas & Huisingh, 2008; Ehrenfeld & Gertler, 1997; Yu et al., 2014) has not been covered by prior port-related and industrial ecology literature. The latter is largely focused on the historical background of industrial ecosystems and on the role of both business associations and the participants of an industrial ecosystem.

Table 8.1 (continued). *Overall scientific contributions of the dissertation and the associated gaps in the literature*

4. Illumination of the importance for port authorities to exploit and renew their existing business model in such a way as to enhance a port's strategic connectivity and, in connection to this, create strategic value for the country. Drawing on prior research, such illumination is achieved partly by distinguishing between strategic and structural connectivity, by presenting and elaborating on a conceptual framework of multi-level strategic connectivity, and by comparing two recent methods for assessing ports' strategic value for their country. Also, it is empirically illustrated how renewal of a port authority's business model may facilitate the enhancement of both a port's strategic connectivity and a port's strategic value.	- The existing body of business model literature (e.g. Baden-Fuller & Mangematin, 2013; Casadesus-Masanell & Ricart, 2010; Teece, 2010) has remained largely silent on business model innovation of organizations with a (semi-)public character (such as port authorities), which (partially) have a different logic of value creation/appropriation than firms. In port-related journals, studies on business model innovation of port authorities (e.g. Haugstetter & Cahoon, 2010; Van Der Lugt et al., 2013; Verhoeven, 2010) are scarce.

reconcile and balance exploitation- and exploration-directed activities (cf. March, 1991) so as to strengthen their competitiveness (see Chapter 1). In advancing this conceptualization, we highlighted that a predominant focus on sustainable international competitiveness that is *innovation-driven* is especially important for ports in economically advanced countries (see Chapter 2), which are "innovation-driven" (Schwab, 2014: 10). A limitation of this research is that it has not examined how different modes of balancing exploitation and exploration (i.e. structural, contextual, temporal, and domain ambidexterity; see Table 1.2) may have an influence on a port's innovation-driven sustainable international competitiveness.

It was noted that, notwithstanding this importance of innovation, most ports tend to focus primarily on optimizing integral chain systems, minimizing the (generalized) costs of freight flows and, in this connection, on exploiting existing assets, capabilities, and market positions. Given this emphasis on exploitation (related to efficiency), the quest for ports in economically advanced countries to become more ambidextrous largely revolves around engaging more in *exploration-directed activities*, including innovation. The case findings presented in this dissertation (see Chapters 3–7 in particular) provide evidence of how such activities can be fostered in port-complexes, thereby contributing empirically to existing general and port-related research on innovation in multi-organizational settings.

Regarding the second overall scientific contribution of the dissertation, innovation can be looked at from both a technological and a managerial lens. The latter lens, which has been adopted throughout the dissertation, entails a focus on management innovation, i.e. the development and implementation of new management practices, processes and structures (e.g. Birkinshaw et al., 2008; Damanpour & Aravind, 2012; Vaccaro et al., 2012; Van Den Bosch, 2012; Volberda et al., 2014). Management innovation is one of the dissertation's main subthemes (see also Box 1.4 and Table 1.5). Just like for the ambidexterity literature, the multi-organizational level of analysis is underexplored in the management innovation literature. Part of the dissertation contributes theoretically and empirically to this research void by examining the development and implementation of new management practices in the multi-organizational settings of industrial ecosystems (e.g. Yu et al., 2014) (see Chapter 5), external test facilities (Hollen et al., 2013b) (see Chapter 6) and, regarding the subtheme 'meta-organizations', business associations (e.g. Reveley & Ville, 2010) (see Chapter 7).

In particular, it was shown how management innovation – triggered by, for instance, internal and external change agents (Birkinshaw et al., 2008; Vaccaro et al., 2012), changing environmental conditions and internal tensions – may contribute to improvements in joint resource productivity, environmental performance, technological process innovation and safety procedures in ports. A limitation of this research is that, by largely focusing on the actions and choices of key actors (i.e. managers) in management innovation processes, a rational perspective was adopted. However, as pointed out by Birkinshaw et al. (2008), key factors/actors in this analysis may also include suppliers of new ideas and their legitimacy (implying a fashion perspective), institutional conditions and attitudes of major influencer groups (institutional perspective) and organizational culture (cultural perspective).

The third overall scientific contribution, which is related to the aforementioned ones (see also Table 8.1), is about industrial ecosystems, which constitute one of the dissertation's subthemes (see Box 1.4). More specifically, the dissertation has explored and identified new ways in which the development of industrial ecosystems (see e.g. Baas & Huisingh, 2008; Ehrenfeld & Gertler, 1997; Yu et al., 2014) may be influenced by port authorities ('outside view') and by firms that make up the industrial ecosystems ('inside view'). Regarding the 'outside view', the study in Chapter 4 illuminates how landlord port authorities may use their land allocation policy and their investments in physical and knowledge infrastructure as strategic levers to foster different stages of industrial ecosystem development in ports. This role of port authorities has not been covered by prior studies. One limitation regarding this contribution is that it has not been taken into account how port authorities may facilitate or encourage the growth of industrial ecosystems that include firms in a nearby port-complex.

Regarding the 'inside view', the study in Chapter 5 of the dissertation points toward the importance of introducing new multi-organizational management practices in favor of the relational dimension of industrial ecosystems, which has been largely overlooked by industrial ecology scholars. These new management practices include the development of joint performance indicators, the planning of structural interorganizational meetings at different hierarchical levels, the initiation of cross-functional interorganizational procedures, and the development of complementary informal management practices. One limitation regarding this contribution is that the study pertains to an industrial ecosystem consisting of three firms. If this number would be higher, additional management practices might become relevant, and the ones mentioned above could be less applicable.

The dissertation's fourth overall scientific contribution, as mentioned in Table 8.1, is that it offers enhanced understanding of the importance for a port authority to exploit and renew its existing business model in such a way as to enhance a port's strategic connectivity and, in turn, create strategic value for the country. This contribution particularly relates to the subthemes 'strategic connectivity', 'strategic value creation', 'business model innovation of port authorities', and 'port authority strategies'. Drawing on prior research (e.g. Van Den Bosch et al., 2011), we contribute to such enhanced understanding partly by distinguishing between strategic and structural connectivity, developing a conceptual framework of multi-level strategic connectivity, and comparing two recent methods (Van Den Bosch et al., 2011; Vonck & Notteboom, 2015) for the assessment of a port's strategic value for its country (see Chapter 2). A limitation regarding this contribution is that it has not been examined how a port authority's efforts to enhance a port's international strategic connectivity is affected by the fact that different countries are characterized by different institutional environments (e.g. Scott, 1995; Van Den Bosch & Hollen, 2015). Furthermore, it is empirically illustrated how renewal of a port authority's business model may facilitate the enhancement of both strategic connectivity and strategic value (see Chapter 3). In doing so, the dissertation adds not only to port-related studies on business model innovation of port authorities (e.g. Haugstetter & Cahoon, 2010; Van Der Lugt et al., 2013; Verhoeven, 2010) but also to the existing body of

general business model literature (e.g. Baden-Fuller & Mangematin, 2013; Casadesus-Masanell & Ricart, 2010; Teece, 2010). The latter has remained largely silent on business model innovation of organizations with a (semi-)public character, such as port authorities. A limitation regarding this contribution is that the dissertation has not taken account of the influence of governments at various levels – i.e. municipal/local, provincial, national, and supra-national – on the renewal of a port authority's business model.

8.2. Management Implications

The preceding chapters suggest several management implications with respect to enhancing ambidexterity in ports. Below, these management implications are grouped into implications for (i) port authorities and (ii) port-related firms and business associations.

8.2.1. Implications for port authorities

Van De Voorde and Winkelmans (2002b: 133) pointed out that since ports' international competitiveness is no longer determined by their own performance only, but also by aspects like their network connections with their foreland and hinterland, there is a clear need for a "dynamic and proactive port management and policy". In that vein, as elaborated in this dissertation, port authorities are urged to contribute to a port's national and international strategic connectivity with other logistic and industrial hubs; see the first bullet point in Box 8.1. One of the multiple ways in which port authorities may do so is by participating in the development or management of other seaports (e.g. Dooms et al., 2013) or to invest in (strategic relationships with) new or existing inland hubs (e.g. Notteboom & Winkelmans, 2001). Examples provided in this dissertation include the Port of Rotterdam Authority's participation in the Port of Sohar and its investment in the Dutch inland terminal Alpherium.

Another way in which port authorities may contribute to enhance a port's national and international strategic connectivity is by collaborating more intensively with other port authorities (e.g. Wortelboer-Van Donselaar & Kolkman, 2010), including port authorities of competing ports – as long as there is more to win than to lose. For instance, geographically proximate port authorities, such as those of Rotterdam and Antwerp, may investigate (new) ways to jointly facilitate or coordinate logistics flows toward their shared hinterland, create value-added synergies between their port-complexes, and enhance cyber security. Other stakeholders can possibly be involved in such initiatives. As asserted by Haezendonck and Notteboom (2002: 68), the development of an 'integrated approach to logistics chains' (Notteboom & Rodrigue, 2005), being an important source of international competitiveness of a port, demands "the creation of a platform in which port authorities work together with various stakeholders […] to identify and address issues affecting logistics performance."

In order to enhance a port's sustainable international competitiveness, port authorities are urged also to contribute to intra-port strategic connectivity; see the second bullet point

Box 8.1. *Toward ambidextrous ports: Management implications for port authorities*

- Port authorities are urged to contribute to a port's enhanced strategic connectivity with other logistic and industrial hubs on both a national and international level by participating in the development and/or management of these hubs and by increasing collaboration with other port authorities; *see in particular Chapter 2.*
- Port authorities are urged to contribute to enhanced intra-port strategic connectivity by using investments in physical and knowledge infrastructure – possibly realized on the basis of co-creation – and their land allocation policy in such a way as to facilitate and foster exploration-directed forms of interorganizational collaboration in ports; *see in particular Chapter 2, 3, 4, and 6.*
- Strategic connectivity-related efforts of port authorities aimed at innovation so as to realize a more ambidextrous port are important in particular for port authorities in economically advanced countries (e.g. Belgium, Germany, Netherlands, Singapore, US), whose international competitiveness is innovation-driven; *see Chapter 2.*
- An ambidextrous port requires an ambidextrous port authority. In order to become ambidextrous, port authorities – particularly those with an exploitation-dominated landlord governance model – may need to renew their business model by means of changes in organization, management and co-creation; *see in particular Chapter 3.*
- In balancing exploitation- and exploration-directed activities, port authorities need to ensure that strategic value is created for both the port and the country in which the port is located; *see in particular Chapter 2.*

in Box 8.1. For instance, port authorities may use their generic policy instruments, including their land allocation policy and investments in infrastructure (see Chapter 4), in such a way as to foster by-product and waste exchanges – and the accompanying relational exchanges (see Chapter 5) – between industrial firms, thereby contributing to the formation of industrial ecosystems. Examples include investments in constructing common carrier pipeline bundles and the realization of 'plug and play areas' in the port (see Chapter 4), which may be realized on the basis of co-creation with the private sector.

The same generic policy instruments may also be used to contribute to other types of collaboration in a port, such as between logistic service providers and/or terminal operators. Investing in, for instance, data infrastructure, open test facilities (see Chapter 6), innovation labs for start-ups and students, and centers of excellence may foster innovation ecosystems (e.g. Adner & Kapoor, 2010). Port authorities may also need to serve more as brokers (see e.g. Von Malmborg, 2004) between different firms and organizations in and around the port. In order to foster port-level innovation, such a new brokerage role could be directed at, for instance, improving the link between start-ups and large established firms. In order to secure a port's long-term license to operate, grow and lead, for which environmental sustainability

is a key issue, port authorities need to pay due attention to fostering and facilitating those (inter)organizational activities that enhance this port's environmental performance.

Enhancing intra-port strategic connectivity implies a focus on strengthening existing and emerging value-adding (integrated) clusters in ports. Accordingly, port authorities' land allocation policies need to aim in particular at attracting and keeping those firms that are most valuable to these clusters – for instance, because these firms are (missing) key elements in port-wide integrated industrial/logistics value systems. Such an aim can be at odds with commercial goals to attract and keep those firms that are willing to pay the highest rents for available land regardless of the added value these firms bring to the port (and the country). Hence, port authorities should be wary of an exploitation mindset with regard to their land allocation policies. Furthermore, the repertoire of possibilities in designing land lease or rental contracts may be used more intelligently so as to foster innovation and strategic value creation of established firms and new entrants in the port. For instance, innovative firms that generate much added value for the port could be rewarded with reduced lease or rental prices per square meter. A comparable logic might be applied by port authorities to the harbor dues.

In economically advanced countries, whose competitiveness is innovation-driven (cf. Schwab, 2014), port authorities need to particularly focus their strategic connectivity-related efforts on enhancing a port's *innovation-driven* international competitiveness; see the third bullet point in Box 8.1. That is, although strong factor conditions combined with world-class efficiency remain highly important for the competitive position of a port in a developed country, eventually this position will be determined largely by the port's capacity to engage in exploration-directed activities – from a technological and managerial stance – so as to keep up with and influence new developments in its external environment. In that vein, port performance measures should not only be about efficiency (e.g. Park & De, 2004) but also about innovation. Hence, an ambidextrous focus is of great importance for port development strategies of port authorities located in economically advanced countries. These strategies need to be particularly directed at 'outsmarting', rather than 'outspending', competing ports. For authorities in less developed countries the main focus should rather be on strengthening a port's efficiency or factor conditions (Porter, 1990; Schwab, 2014); see also Table 2.2.

According to the strategic management philosophy, external environmental changes need to be accompanied by changes in the internal organization (e.g. Ben-Menahem et al., 2013; Volberda & Lewin, 2003). In a similar vein, it was posited in this dissertation that port authorities that aim at contributing to a more ambidextrous port will need to become more ambidextrous themselves as well. This means that port authorities need to be able to balance exploitation- and exploration-directed activities – see the fourth bullet point in Box 8.1. Most port authority operate as a 'landlord' (World Bank, 2007), which is an exploitation-directed governance model (e.g. Notteboom & Winkelmans, 2001). In order for port authorities to become more ambidextrous and, in line with an extended landlord governance model (see Chapter 3), engage more in exploration-directed activities in the port, their business model may have to be renewed. In this connection, port authorities need to timely evaluate whether

their current managerial practices, organizational forms and qualitative collaborations (on the basis of co-creation) with external parties are suitable for becoming more ambidextrous. Changing these 'levers' of business model innovation (cf. Volberda et al., 2013b) might be a complex, time-consuming process. In a port authority's internal decision-making regarding new types of activities in line with its renewed business model, due account should be taken of the strategic value that these activities are expected to create for both the port and country; see the last bullet point in Box 8.1. In doing so, port authorities can draw on previously developed methods (see Table 2.3) for assessing their strategic value creation.

8.2.2. Implications for port-related firms and business associations

The balance between exploration- and exploitation-directed activities in the various clusters within ambidextrous ports depends largely on the dynamism and complexity of the external environment in which the constituent firms operate and compete. For instance, firms active in creating markets for renewables may need to be more explorative than firms in the oil-refining industry. Overall, however, exploration- and exploitation-directed activities both need to be sufficiently present in order for a port in an economically advanced country to maintain its innovation-driven sustainable internationally competitiveness. Firms operating in the port, in turn, benefit from a port's strong competitive position thanks to, for example, the volumes of transport cargoes it attracts; see also the first bullet point in Box 8.2.

The performance of established firms is influenced largely by the interorganizational relationships in which they are embedded (Gulati, 2007; Lorenzoni & Lipparini, 1999). The dissertation has illustrated different ways in which new collaborations among firms in ports may result in new value-creating activities for the benefit of ports' sustainable innovation-driven international competitiveness. For instance, established firms in energy-intensive process industries may collaborate in industrial ecosystems to convert waste products into product streams for one another, thereby reducing their energy use and their emissions (see Chapter 5), and the members of a business association – a type of meta-organization (e.g. Reveley & Ville, 2010) – can decide to jointly work toward the realization of a port-wide innovative practices (see Chapter 7). Other possibly interesting examples of innovative multi-partner collaborations are initiatives around the development of intelligent intermodal networks (e.g. as part of the trans-European transport network) and, in relation to this, the application of synchromodal transport in supply chains by terminal operators. Intermodal and synchromodal transport networks, which thrive on the integral exchange of information and knowledge between organizations, can be seen as logistics ecosystems.

Overall, the findings suggest that managers of port-related firms that face challenging competitive conditions should explore new types of interorganizational collaboration so as to improve their innovation-driven competitiveness; see the second bullet point in Box 8.2. The following quote from a managing director of a large chemical firm located in the port of Rotterdam is illustrative in this respect:

Box 8.2. *Toward ambidextrous ports: Management implications for port-related firms and business associations*

- Port-related firms and their business associations need to focus on both exploration- and exploitation-directed activities, thereby contributing to strengthening the long-term international competitiveness position of the port and – directly and indirectly – their own performance; *see in particular Chapter 1.*
- Managers of port-related firms in competitive challenging environments should look for new opportunities to enhance their innovative performance through establishing new types of interorganizational cooperation and developing new interorganizational management practices; *see in particular Chapters 4, 5, 6, and 7.*
- Managers of collaborating firms have to become fully adept at thinking in terms of enhancing their interorganizational competitiveness (highlighting a relational view), instead of focusing solely on enhancing their own competitiveness (i.e. transactional view). This is especially important for interorganizational relationships characterized by a high degree of interdependence; *see in particular Chapters 5 and 7.*
- Realizing a higher level of ambidexterity due to enhanced innovative performance requires firms to examine how this performance is influenced by both technological innovation and management innovation; *see in particular Chapter 6.*
- Business associations have a strategic role in enhancing ports' level of ambidexterity by carrying out activities for their existing and new members that result in innovative port-level outcomes. To keep fulfilling this role in times of environmental dynamics, changes may be required in how they are managed and organized; *see Chapter 7.*

> *"We have to compete with regions where the possibilities of winning shale gas as an alternative energy source are being fully exploited. In Europe there is no support for winning shale gas and our gas remains, for the time being, much more expensive than in the US and the Middle East. Hence, we will have to operate smarter and put more focus on sustainability and collaboration with the firms around us. A by-product of one firm may be a feedstock for another."* (*Spreekbuis*, October 2012: p. 3).

It has been examined in the dissertation how established firms can become more ambidextrous in their relation with partner firms by realizing new ways of organizing and managing their collaborations. It deserves emphasis to point out that multi-organizational collaboration, which implies that there is an alliance consisting of at least three partners, represents an entirely different ball game than bilateral (i.e. dyadic) types of collaboration, in which there are just two parties involved. Accordingly, the set of management/governance practices, processes and structures that can effectively be employed by the partners involved differs for dyadic and multi-organizational collaboration. For instance, as argued by Das and

Teng (2002), the latter requires particular emphasis on social control mechanisms such as a collective macroculture, social sanctions and – as shown also in this dissertation (see Chapter 7) – a norm of generalized reciprocity.

One of the implications that can be drawn from the dissertation is that managers of collaborating firms must become adept at thinking in terms of enhancing interorganizational competitive advantage (cf. Dyer & Singh, 1998) (i.e. relational view), instead of focusing solely on enhancing their own competitiveness (i.e. transactional view); see the third bullet point in Box 8.2. The transactional view is associated with structural connectivity between firms and, related to that, with efficiency, cost minimization, low levels of communication and a reluctance to make commitments not specified in contracts (e.g. Crook et al., 2013; Uzzi, 1997). In contrast, the relational view is associated with strategic connectivity and, in relation to this, with renewal, added value creation, high levels of communication and a willingness to exchange information beyond contractual terms (Day et al., 2013; Dyer & Singh, 1998; Ring & Van De Ven, 1994; Zajac & Olsen). In particular in settings that are characterized by a high degree of interdependence between partners, such as in industrial ecosystems, management practices have to be developed in accordance with the latter view, facilitating joint performance gains (see Chapter 5).

Renewal in managing interorganizational relations may also include business model innovation. One example of business model innovation in an interorganizational setting that may take place in port-industrial complexes is the introduction of chemical leasing (Jakl et al., 2004), meaning that chemical suppliers turn into service providers that ensure optimal performance of a supplied chemical compound within their clients' production process, and take back residues to then process these into the original specifications.

Firms that are looking for new ways to enhance their innovative performance – and in turn become more ambidextrous – have to examine how this performance is influenced by both technological innovation and management innovation; see the fourth bullet point in Box 8.2. As clarified in this dissertation, technological process innovation (e.g. Meeus & Edquist, 2006) and management innovation (e.g. Volberda et al., 2014) can be mutually interdependent for their realization and, as a result, may be combined in an intertwined way: for instance, technological process innovation may be accelerated by performing part of the innovation process outside the organizational boundaries, which in turn is facilitated by new ways of setting objectives, decision-making, motivating, and coordination.

Many firms in ports are a member of one or more established business associations. These associations may play a strategic role in enhancing ports' level of ambidexterity by carrying out activities for their members that result in innovative port-level outcomes in different domains, such as safety and environmental performance. In order to keep fulfilling this role in the face of changing environmental demands, established business associations may need to introduce changes in how they are organized. As elaborated in Chapter 7, such changes may include, for instance, the creation of internal coordination platforms around specific goals, the introduction of committees that are given the mandate to initiate and

coordinate collaborative efforts toward these goals, the broadening of staff's role to include the coordination of new initiatives, and the incorporation of external stakeholder advice into internal decision-making process. Business associations at the port level (e.g. Deltalinqs in the port of Rotterdam), national level (e.g. Netherlands Association for Forwarding and Logistics [FENEX]) and supranational level (e.g. European Sea Ports Organisation [ESPO]) need to evaluate if their internal structure and the associated division of labor and integration of efforts are still suitable for the environmental context to which their activities have been directed; see the last bullet point in Box 8.2.

8.3. Agenda for Future Research into Ambidextrous Ports

Based on aforementioned scientific contributions, limitations, and managerial implications, at least six fruitful directions for future research into the theme of ambidextrous ports can be identified (see also Box 8.3), as elaborated upon in the remainder of this chapter.

Box 8.3. *Agenda for future research into ambidextrous ports*

- How to assess and monitor progress toward becoming a more ambidextrous port?
- How to compare different strategic options as regards a port authority's use of its policy instruments aimed at making a port more ambidextrous?
- How to deal with fundamental transition processes in port-related industries in a way that contributes to a more ambidextrous port?
- How can port authorities and business associations with overlapping long-term goals enhance collaboration aimed at contributing to a more ambidextrous port?
- How to deal with institutional complexities inherent in efforts to increase a port's level of ambidexterity through international strategic connectivity?
- How can governments play a role in making ports more ambidextrous?

One avenue worthy of future research is how port authorities and other organizations may assess and periodically monitor a port's progress toward becoming more ambidextrous; 'what gets measured gets done'. Such an assessment could take account of, for instance, the extent and radicalness of innovation in a port, different types of innovation (i.e. technological and management innovation), the pace of innovation (including the pace of business model innovation), the involvement of firms of different sizes (large established firms, SME's) in innovative activities, and the spread of innovation across and within the different port-related industries and clusters. Periodic large-scale surveys in the port may be used to provide these data for consecutive years, based on which evidence may be found – based on particular

indicators – of its development toward an ambidextrous port. Progress in this development can subsequently be monitored. National and international surveys might be conducted for benchmark purposes. Combined with qualitative data, scholars could then go on to identify the main factors that trigger and inhibit ports, and the constituent clusters or firms, to become more ambidextrous and, based on such insights, develop conceptual frameworks specifying how port authorities and other organizations may foster ambidexterity in ports.

A second promising direction for future research would be to examine if and how port authorities, which can be considered as important "external change agents" (Birkinshaw et al., 2008: 832), decide on the use of their generic policy instruments – such as investments in infrastructure and land allocation – to increase the level of ambidexterity in a port. Port authorities face different strategic options as regards how to employ these instruments, each of which implies a different expected use of its financial, managerial, and human resources, a different use of space, transport capacity, and environmental resources in the port, and different expected outcomes in terms of, for instance, volumes, innovation, and strategic value creation for the region and country (Van Den Bosch et al., 2011). What are the main criteria based on which it is decided by port authorities whether to invest in constructing common carrier pipeline bundles, in developing an inland port or in extending an inter-port communication system? Does it allocate land to one firm or to another? Does it opt for co-creating new businesses with large firms or with SMEs? Future research may explore the influence of their decision-making criteria and processes on ports' ambidexterity.

As mentioned in the third bullet point in Box 8.3, it would also be interesting to examine how fundamental transition processes in port-related sectors are coped with. The radical, episodic changes associated with these processes (Weick & Quinn, 1999) may result in a series of site closures and subsequent redevelopment challenges (Chapman, 2005), and inherently cause an urgency to attract and develop new types of business activities (e.g. Boons et al., 2013; Foxon, 2013). Hence, in periods of time characterized by transition processes, exploration-directed activities are particularly valuable. Further research is needed to clarify to what extent port authorities are able to take a leading role in orchestrating ports' transition processes, whether this should be largely a role as developer or as facilitator, and to what extent a sophisticated balance between exploitation- and exploration-directed activities will still be strategically important during disruptive periods of time.

Next, future research could explore how port authorities and business associations with overlapping long-term goals can mutually strengthen each other – and overcome powerful vested interests in maintaining the status quo that slow down progress toward a more ambidextrous port – by enhancing their collaborative efforts; see the fourth bullet point in Box 8.3. The Port of Rotterdam Authority and the Rotterdam-based business association Deltalinqs in The Netherlands, for instance, are both directed toward the long-term goal of strengthening the sustainable international competitiveness of the port of Rotterdam. Since both play an important role in balancing the port's exploitation- with exploration-directed activities, enhanced collaboration may well be advantageous for such balancing over time.

In examining strategic connectivity as a way for ports to become more ambidextrous, this dissertation has mainly focused on strategic connectivity at port level – i.e. in the context of industrial ecosystems, open test facilities, and business associations. For future research it may be particularly interesting to investigate the *international level,* as this might be the most complex level on which to accomplish strategic connectivity since collaboration across national boundaries requires the organizations involved to conform to regulatory, normative and cultural pressures of other institutional environments (Scott, 1995). Internationalizing organizations often need to overcome a 'liability of foreignness' (Nachum, 2010; Zaheer, 1995; Zhou & Guillén, 2015), which implies additional costs (i.e. above those incurred by local organizations) originating in, for instance, knowledge disadvantages and discriminatory attitudes of local, regional and/or national stakeholders. Landlord port authorities that have successfully participated in the development and management of a foreign port – such as the Port of Rotterdam Authority in the Port of Sohar (Dooms et al., 2013; Van Den Bosch et al., 2011) – may not be able to use the very same international strategy in another country with a different institutional environment. That is, in order to fit the regulatory and socio-cultural demands in a different institutional environment, adaptation of this strategy may be required.

For scholars that adopt an institutional lens to examine ambidextrous ports, it is also interesting to study institutional innovation (e.g. Hargrave & Van De Ven, 2006). Examples of institutional innovations are the development of Free Trade Zones and innovative customs control mechanisms (Van Den Bosch & Hollen, 2015). In addition, future research is needed to examine how governments at the municipal, provincial, national and supranational level (such as the EU-level), which are key players in the institutional landscape, may play a role in helping ports to become more ambidextrous (see the final bullet point in Box 8.3) – for instance, by changing rules and regulations that affect the ability and motivation of firms and organizations to develop and implement technological and organizational innovations. The focus in this dissertation is limited to the role of port authorities, port-related firms, and business associations. Future studies may examine how the European Committee influences ports' exploration-directed activities by fostering international strategic connectivity within the EU, and how municipal and national governments can facilitate and encourage enhanced regional and national strategic connectivity. Illustrative example of the latter can be found in several countries, including the People's Republic of China (Wang et al., 2012) and The Netherlands (Merk & Notteboom, 2013). In examining the role of governments, it is interesting to investigate how governments may differ in their underlying rationale for being proactive in enhancing inter-port collaboration, and the extent to which governments on various levels impose binding and enforceable obligations.

In conclusion, studying how ports in economically advanced countries may become more ambidextrous so as to strengthen their innovation-driven international competitiveness offers important insights for scholars and practitioners, and promises to be a fertile ground for further research into balancing exploitation and exploration at the multi-organizational level in the rich and dynamic context of ports.

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Summary of the Dissertation

From a strategic management perspective, seaport complexes, henceforth 'ports', constitute an interesting research setting. Ports are important junctions in international integrated chain systems that handle the large majority of global merchandise trade, and comprise firms from a variety of different clusters that operate in highly competitive and dynamic environments. Building on prior literature, the central tenet of this dissertation is that ports have to become more *ambidextrous* in order to sustainably strengthen their international competitiveness. The term ambidexterity ('right on both sides') as used in the academic management literature denotes the ability or state of balancing exploitation- and exploration-directed activities. Ports tend to be focused primarily on minimizing the generalized costs of freight flows and production and, in relation to that, the exploitation of existing assets, capabilities, and market positions. Hence, a port's quest to become more ambidextrous, thereby strengthening its international competitiveness, largely revolves around increasing the level of exploration, i.e. innovation. It is argued in the dissertation that this is particularly important for ports in economically advanced countries that are considered as innovation-driven economies.

The core of the dissertation consists of six exploratory studies into how efficiency-dominated ports can become more ambidextrous, thereby enhancing their innovation-driven sustainable international competitiveness. The *first study* focuses on the interorganizational knowledge-intensive ties within and between ports that enable the organizations involved to enhance their competitiveness. These ties are referred to as strategic connectivity, which is further explicated through both illustrative examples and an extension of Porter's Diamond Framework. A distinction is made between three levels of strategic connectivity – leading to a conceptual framework of multi-level strategic connectivity – as well as between three competitive foci. In addition, drawing on prior literature, the study underlines the importance for port authorities to contribute to the competitiveness of both port and country. Two recent methods for assessing the strategic value of ports for their country are compared.

The *second study* focuses on business model innovation of port authorities. For port authorities and other organizations with a (semi-)public character, which have remained underexplored in the business model literature, the purpose of business model innovation includes strategic value creation for society. To illustrate and increase our understanding of how port authorities may renew their business model, the study presents a longitudinal case study of the Port of Rotterdam Authority in the period 2000–2012. The case particularly examines how four levers of business model innovation – i.e. organization, management, technology, and co-creation with external parties – have contributed to a transition from a landlord business model to an extended landlord ('port developer') business model, leading to the development of several new businesses with strategic value for port and country.

The *third study* examines how port authorities may improve both the international competitiveness and environmental performance of a port-industrial complex by fostering the development of industrial ecosystems – i.e. networks of physically connected firms that use one another's residual output as input for their production. A case study of the port of Rotterdam reveals a set of strategic levers of port authorities to foster this development by strategically making use of two generic policy instruments: investments in physical and knowledge infrastructure, and land allocation policy. These strategic levers include, among others, constructing common carrier pipeline bundles, co-creating collaboration platforms, intensifying ties with knowledge institutes, and sustainability criteria in land lease contracts.

The *fourth study* examines how firms in an industrial ecosystem may enhance their resource productivity through changes in managing their interdependence. A case study is presented of an industrial ecosystem consisting of three established chemical firms that have benefitted from actively developing and implementing a set of new management practices (i.e. management innovation) directed at enhancing joint resource productivity. The case study shows the importance of measuring and reporting on joint performance, introducing cross-functional interorganizational procedures, structurally planning interorganizational meetings, and other practices to improve mutual adjustment. Moreover, the study highlights the complex and time-consuming process involved, and points out contextual triggers.

The *fifth study* examines how management innovation may enable firms to speed up technological process innovation. Many established firms face intra-organizational tensions to reconcile pressures for exploration and exploitation across subsequent phases (discovery, development, and deployment) of technological process innovation. They might therefore benefit from performing the development phase, being the most sensitive to these tensions, in an external development facility. Using illustrative examples from the port of Rotterdam, it is proposed that this requires new-to-the-firm ways of coordinating activities, motivating employees, setting objectives, and decision-making. It is argued how technological process innovation and management innovation may be combined over time in an intertwined way.

Finally, *the sixth study* examines how several consecutive changes in organizing an established meta-organization, such as a business association in ports, may contribute to the renewal of its goal-directed activities and, in turn, adaptation to changing environments. The study present a case study of Deltalinqs, a business association of over 700 organizations in the port of Rotterdam. The findings show how changes in Deltalinqs' internal structure and, concurrently, in the roles of its members, staff, board, and external stakeholders, have contributed to the renewal of its activities in the domains of environmental performance and safety in the port. Also the enabling role of a norm of generalized reciprocity is highlighted. Based on prior literature and the case evidence, a conceptual framework is developed that provides directions in which meta-organization studies may be usefully enriched.

The overall *contributions* of the dissertation are as follows. First, ambidexterity is examined at the multi-organizational level in the context of ports. In doing so, it adds to the literature on ambidexterity, in which this level of analysis is underexplored, as well as to the

port-related literature, which has remained remarkably silent on the ambidexterity challenge. Second, the dissertation contributes to the management innovation literature by examining the introduction of new management practices on a multi-organizational level in the context of industrial ecosystems, external test facilities, and business associations. This level of analysis is underexplored in the management innovation literature. The dissertation explains and illustrates how management innovation at this level – triggered by, for instance, internal and external change agents – may contribute to resource productivity gains, technological process innovation, and improved safety procedures in ports. Third, the dissertation suggests new ways in which the development of industrial ecosystems in ports can be influenced by both the firms that make up these ecosystems – through interorganizational management innovation – and port authorities. Regarding the latter, it shows how a port authority's land allocation policy and infrastructure investments can be turned into important strategic levers. Finally, the dissertation clarifies how port authorities may renew their business model and enhance their port's strategic connectivity in such a way as to enhance the innovation-driven international competitiveness of both the port and the country in which the port is located.

The findings presented in the dissertation suggest several *management implications* for port authorities, firms, and business associations in ports. For instance, port authorities play an important role in contributing to a port's enhanced strategic connectivity with other logistic hubs on a national and international level by participating in the development and/or management of these hubs and by increasing collaboration with other port authorities. Also, port authorities are in a suitable position to contribute to intra-port strategic connectivity by using their generic policy instruments in such a way as to facilitate and foster multi-partner collaboration. Ambidextrous ports require ambidextrous port authorities, firms and business association. For port authorities to become ambidextrous and create more strategic value for port and country, their business model might need to be renewed through changes in co-creation, organization, and management. Firms in competitive challenging environments need to look for opportunities to enhance their innovative performance through new types of knowledge-intensive collaboration. In that connection, firms have to become more adept at thinking in terms of interorganizational competitiveness, rather than focusing solely on their own competitive position. Business associations can play a strategic role in enhancing a port's level of ambidexterity by carrying out new activities for their members that result in innovative port-level outcomes. To keep fulfilling this role in the face of environmental dynamics, changes may be required in how these associations are organized.

In conclusion, studying how ports in economically advanced countries may become more ambidextrous so as to strengthen their innovation-driven international competitiveness while generating strategic value for their country offers important insights for scholars and practitioners, and promises to be fertile ground for future research into balancing exploration and exploitation activities at the multi-organizational level in the rich context of ports.

Samenvatting (Dutch Summary)

Vanuit een strategisch management perspectief bezien zijn zeehavencomplexen ('havens') een interessante onderzoeksetting. Het zijn veelal belangrijke knooppunten in internationale integrale ketensystemen die een grote rol spelen in wereldwijde handelsstromen, en bestaan uit diverse clusters van bedrijven die doorgaans opereren in een competitieve en dynamische omgeving. De centrale stelling van deze dissertatie, die voortbouwt op eerdere literatuur, is dat havens hun duurzame internationale concurrentiepositievermogen kunnen versterken door meer *ambidexter* te worden. De term 'ambidexter' zoals gebruikt in de academische management literatuur duidt op het organisatorisch vermogen om een balans te realiseren in exploitatie- en exploratie-gerichte activiteiten. Havens zijn over het algemeen voornamelijk gefocust op efficiencyverbeteringen, kostenreducties in goederen- en productiestromen en, in dat kader, het exploiteren van bestaande activa, capaciteiten en marktposities. Dit houdt in dat een grotere mate van ambidexteriteit in havens hoofdzakelijk bereikt kan worden door óók in te zetten op exploratieve activiteiten, oftewel innovatie. Dit is met name van belang voor havens die zijn gevestigd in zogenaamde innovatie-gedreven economieën.

De kern van de dissertatie bestaat uit een zestal verkennende studies naar strategieën ter versterking van het innovatie-gedreven internationaal concurrentievermogen van havens in economische geavanceerde landen, met 'ambidexter havens' als overkoepelende thema. De *eerste studie* focust op de interorganisationele kennisintensieve relaties binnen en tussen havens die de betrokken organisaties in staat stellen hun concurrentievermogen te vergroten. De bundel van dergelijke relaties, waarvan illustratieve voorbeelden worden gegeven, wordt strategische connectiviteit genoemd. Er wordt onderscheid gemaakt tussen drie niveaus van strategische connectiviteit – resulterend in een multi-level conceptueel raamwerk – alsmede tussen drie competitieve foci. Daarnaast wordt het belang benadrukt dat havenautoriteiten bijdragen aan het internationale concurrentievermogen van haven èn land, en worden twee bestaande methodes voor het vaststellen van de strategische waarde van havens vergeleken.

De *tweede studie* focust op business model innovatie van havenautoriteiten. Voor deze en andere typen organisaties met een (semi)publiek karakter – welke onderbelicht zijn in de business model literatuur – is het creëren van strategische waarde (naast economische waarde) voor regio en land een belangrijk doel van business model innovatie. Teneinde de antecedenten, hefbomen en uitkomsten van business model innovatie van havenautoriteiten te illustreren, analyseren en zodoende beter te begrijpen wordt een case studie gepresenteerd van het Havenbedrijf Rotterdam (2000–2012). Deze studie gaat met name in op de rol van de hefbomen organisatie, management, en co-creatie met externe partijen in de transitie van een landlord business model naar een landlord-plus ('havenontwikkelaar') model, hetgeen heeft geleid tot de realisatie van diverse strategische waarde-creërende nieuwe businesses.

In de *derde studie* wordt onderzocht hoe havenbedrijven kunnen bijdragen aan zowel het internationale concurrentievermogen als de vergroening van havenindustriële complexen door de ontwikkeling van industriële ecosystemen te bevorderen. Dit zijn netwerken van fysiek aan elkaar verbonden bedrijven die elkaars restproducten gebruiken als input voor het eigen productieproces. Aan de hand van een case studie van de Rotterdamse haven wordt vastgesteld hoe een havenbedrijf de ontwikkeling van dergelijke netwerken kan bevorderen door strategisch gebruik te maken van twee generieke instrumenten: investeringen in fysieke en kennis infrastructuur (bijvoorbeeld door te investeren in pijpleidingbundels en in relaties met kennisinstituten zoals SmartPort) en het gronduitgiftebeleid (bijvoorbeeld door co-siting te stimuleren en strikte duurzaamheidscriteria op te nemen in nieuwe contracten).

De *vierde studie* focust op hoe bedrijven in een industrieel ecosysteem hun resource productiviteit kunnen verhogen door hun wederzijdse afhankelijkheid anders te managen. Daarbij staat een case studie van een industrieel ecosysteem centraal waarin na een relatief lange aanloopperiode diverse interorganisationele management innovaties zijn doorgevoerd zijn die hun resource productiviteit ten goede is gekomen. Deze studie laat met name het belang zien van het ontwikkelen van een gezamenlijke performance indicator, het structureel plannen van interorganisationele meetings op verschillende hiërarchische niveaus, en het introduceren van cross-functionele interorganisationele procedures. Daarnaast geeft deze exploratieve studie inzicht in een aantal contextuele triggers en in het complexe proces dat met deze ontwikkeling is gemoeid.

In de *vijfde studie* wordt vanuit een nieuw interorganisationeel perspectief onder de loep genomen hoe management innovatie het gevestigde industriële bedrijven mogelijk maakt om sneller technologische procesinnovaties te realiseren. Deze bedrijven worden in de ontwikkelingsfase van dit type innovaties mogelijk geconfronteerd met problematische intra-organisationele spanningen om zowel te exploreren als exploiteren. De studie stelt dat het fysiek verplaatsen van deze fase naar een faciliteit buiten het bedrijf uitkomst kan bieden, maar dat een dergelijke verplaatsing dan wel gepaard zal moeten gaan met nieuwe manieren van managen met betrekking tot coördineren, doelen stellen, besluitvorming en motiveren. Deze inzichten worden ondersteund door illustratieve voorbeelden. Een en ander laat zien hoe technologische en management innovatie strategisch met elkaar zijn verbonden.

Tot slot wordt in de *zesde studie* ingegaan op hoe verschillende veranderingen in het organiseren van een gevestigde meta-organisatie, zoals een ondernemersvereniging, kunnen bijdragen aan het vernieuwen van doelgerichte activiteiten van die organisatie, teneinde zich aan te kunnen passen aan een veranderende omgeving. Een case studie van Deltalinqs, de ondernemersvereniging (>700 leden) van de Rotterdamse haven, laat zien hoe veranderingen in de interne meta-organisatiestructuur, alsmede in de rol van staf, bestuur, leden en externe stakeholders, hebben bijgedragen aan de vernieuwing van activiteiten in de domeinen milieu en veiligheid. Ook wordt de faciliterende rol van een norm van gegeneraliseerde reciprociteit benadrukt. Voortbouwend op de bevindingen en literatuur wordt vervolgens een conceptueel raamwerk gepresenteerd omtrent het organiseren van meta-organisationele vernieuwing.

De dissertatie heeft diverse wetenschappelijke *bijdragen*. Een van die bijdragen is dat ambidexteriteit wordt onderzocht op multi-organisationeel niveau – wat onderbelicht is in de ambidexteriteit literatuur – in een havencontext. Door te richten op dit analyseniveau (met een specifieke focus op industriële ecosystemen, externe ontwikkelingsfaciliteiten en meta-organisaties in havens) wordt tevens bijgedragen aan de literatuur over management innovatie. Er wordt beargumenteerd en geïllustreerd hoe management innovatie op multi-organisationeel niveau – getriggerd door bijvoorbeeld externe factoren en interne entiteiten – bij kan dragen aan een hogere resource productiviteit, technologische procesinnovatie en verbeterde veiligheidsprocedures in havens. Een andere bijdrage van de dissertatie is dat het diverse manieren belicht waarop de ontwikkeling van industriële ecosystemen kan worden beïnvloed door zowel de bedrijven die deze ecosystemen vormen – namelijk door nieuwe interorganisationele management praktijken te introduceren – als door de havenautoriteit. Met betrekking tot laatstgenoemde entiteit is onderbouwd hoe haar gronduitgiftebeleid en investeringen in fysieke en kennis infrastructuur kunnen worden gebruikt als belangrijke hefboom om deze ontwikkeling te stimuleren. Daarnaast wordt in de dissertatie verduidelijkt hoe havenautoriteiten hun business model kunnen vernieuwen en strategische connectiviteit kunnen bevorderen op een manier die bijdraagt aan het internationale concurrentievermogen van zowel de haven als het land waarin deze is gevestigd.

De bevindingen die worden gepresenteerd in de dissertatie suggereren verschillende *management implicaties* voor havenautoriteiten, bedrijven en meta-organisaties in havens. Havenautoriteiten worden bijvoorbeeld een belangrijke rol toebedeeld in het bijdragen aan het vergroten van de strategische connectiviteit van een haven met andere logistieke hubs – op nationaal en internationaal niveau – door te participeren in de ontwikkeling danwel het management van die hubs en door intensievere samenwerking met andere havenautoriteiten. Door het strategisch inzetten van beschikbare beleidsinstrumenten kunnen havenautoriteiten tevens bijdragen aan een grotere mate van multi-organisationale samenwerking binnen de haven. Ambidexter havens behoeven een ambidexter havenautoriteit, alsmede ambidexter opererende bedrijven en belangenverenigingen. Innovatie van het business model van deze partijen is daarbij mogelijk noodzakelijk voor het vergroten van dergelijke ambidexteriteit. Nieuwe kennisintensieve samenwerkingsrelaties en nieuwe manieren om bestaande relaties te managen zullen regelmatig verkend moeten worden door de havenautoriteit èn bedrijven in de haven. Exploiteren van bestaande activiteiten blijft belangrijk voor het versterken van de internationale concurrentiepositie op de korte termijn, maar om ook op de lange termijn succesvol te kunnen concurreren is innovatie noodzakelijk. Belangenverenigingen kunnen een strategische rol vervullen in een transitieproces richting een meer ambidexter haven.

Concluderend kan worden gesteld dat wetenschappelijk onderzoek naar hoe havens in economisch geavanceerde landen meer ambidexter kunnen worden om zo hun innovatie-gedreven internationale concurrentiepositie te versterken een vruchtbare grond vormt voor nieuwe belangwekkende inzichten voor zowel de academisch wereld als de (haven)praktijk.

Resumen (Spanish Summary)

Desde una perspectiva de la gestión estratégica, los puertos marítimos constituyen una línea de investigación interesante. Son intersecciones importantes en cadenas integradas de transporte que facilitan la mayoría del comercio global y consisten en empresas de una variedad de grupos diferentes que operan en entornos competitivos y dinámicos. Construyendo sobre la literatura previa, en esta tesis se postula que para que los puertos puedan fortalecer de forma sostenible su posición competitiva internacional, deben ser más ambidiestros. El término ambidiestro (‘correcto en ambos lados') en la literatura académica denota la capacidad o estado de equilibrar las actividades de explotación y exploración. Los puertos tienden a estar principalmente centrados en mejorar la eficiencia, minimizar los costes de flujos de bienes y producción y explotar los activos existentes y capacidades. Por lo tanto, la búsqueda de un puerto más ambidiestro en gran parte se trata de incrementar su nivel de exploración – es decir, innovación. En esta tesis se argumenta que esto es especialmente importante para los puertos ubicados en países desarrollados que son considerados como conductores de la innovación en las economías.

El núcleo de la tesis consta de seis estudios exploratorios basados en entender cómo los puertos dominados por la eficacia se pueden convertir en puertos ambidiestros y, por lo tanto, fortalecer su competitividad internacional sostenible. El *primer estudio* se basa en las redes interorganizativas intensivas en conocimiento dentro y entre puertos que permiten a las organizaciones incrementar la competitividad interorganizativa. Estas redes son referidas como conectividad estratégica. Este concepto está explicado a través de ejemplos ilustrativos y el Diamante de Porter extendido. Se realiza una distinción de la conectividad estratégica entre tres niveles – llegando a un marco conceptual de conectividad estratégica multinivel. Además, el estudio describe la importancia de las autoridades portuarias en la contribución de la competitividad internacional del puerto y el país. Comparamos dos métodos recientes para evaluar el valor estratégico de los puertos para su país (es decir, la sociedad).

El *segundo estudio* explora la innovación en el modelo de negocio de las autoridades portuarias. Para éstas y otras organizaciones de carácter (semi)público, el propósito de este tipo de innovación incluye la creación de valor estratégico para el proprio puerto y el país. Para incrementar nuestra comprensión de cómo las autoridades portuarias pueden renovar sus modelos de negocio, el estudio presenta un caso de estudio de la autoridad portuaria del mayor puerto de Europa – la Autoridad Portuaria de Rotterdam – en el periodo 2000–2012. El caso muestra cómo cambios en organización, dirección y co-creación con partes externas han contribuido a la transición desde un modelo de negocio arrendador (‘landlord’) a un desarrollador portuario (‘extended landlord’) de modelo de negocio, liderando el desarrollo de negocios nuevos con valor estratégico para el puerto de Rotterdam y su país.

El *tercer estudio* examina cómo las autoridades portuarias pueden contribuir al desarrollo de ecosistemas industriales y, de esta manera, mejorar no sólo la competitividad internacional, sino también el desempeño ambiental de un complejo portuario-industrial establecido. Los ecosistemas industriales son redes de empresas conectadas físicamente que intercambian residuos para utilizarlos como insumo para su producción. Un caso de estudio del puerto de Rotterdam revela cómo su autoridad portuaria ha contribuido al desarrollo de ecosistemas industriales mediante el uso estratégico de dos instrumentos: (i) inversiones en infraestructura física y de conocimiento, y (ii) asignación de la tierra. En relación con estos instrumentos, este estudio identifica un conjunto de impulsores estratégicos, así como la construcción de sistemas de tuberías, inversiones en lazos con grupos de investigación y la introducción de criterios de sostenibilidad en contratos de arrendamiento de la tierra.

El *cuarto estudio* analiza cómo las empresas pertenecientes a un ecosistema industrial pueden realzar la productividad de sus recursos a través de cambios en la gestión de su interdependencia. Para realizar esto, el estudio se basa en el desarrollo e implementación de prácticas de gestión nuevas para estas empresas. Se presenta un caso de estudio de un ecosistema industrial que consiste en tres empresas químicas establecidas que se han visto beneficiadas de prácticas de gestión nuevas dirigidas a la mejora de la productividad de sus recursos. Estas prácticas incluyen la introducción de un indicador de desempeño en conjunto (utilizado para medir y reportar), la introducción de procedimientos interorganizativos y la planificación estructural de encuentros interorganizativos en niveles jerárquicos diferentes. El estudio resalta que el proceso de desarrollar estos tipos de prácticas nuevas en ecosistemas industriales es complejo, además de señalar detonantes contextuales.

El *quinto estudio* analiza cómo la innovación de gestión puede facilitar a las empresas ser más rápidas en la innovación tecnológica de procesos. Muchas empresas establecidas encuentran tensiones intra-organizativas para reconciliar presiones para explorar y explotar a través de las subsiguientes fases (descubrimiento, desarrollo y utilización) de innovación tecnológica. Ellas podrían beneficiarse de realizar el desarrollo – siendo la fase más sensible a estas tensiones – dentro de una empresa externa encargada de realizar las pruebas. En este estudio se propone que para poder ser esto posible estas empresas necesitan nuevas vías en la coordinación de actividades, en la motivación a los empleados, en la toma de decisiones y en el establecimiento de objetivos. Se muestra cómo la innovación tecnológica de procesos y la innovación de gestión pueden combinarse de una manera entrelazada.

Finalmente, *el sexto estudio* examina cómo varios cambios consecutivos en una meta-organización establecida, como una asociación empresarial, puede contribuir a la renovación de sus actividades dirigidas a determinados objetivos a fin de adaptarse a los cambios del entorno. El estudio presenta un caso de estudio de Deltalinqs, una asociación empresarial de más de 700 organizaciones en el puerto de Rotterdam. Los resultados muestran cómo los cambios en la estructura interna de Deltalinqs y en los roles de sus miembros, directivos, personal, así como grupos de interés externos, han contribuido a renovar sus actividades en los ámbitos de desempeño y la seguridad del medio ambiente en el puerto. También resaltan

la función facilitadora de la norma de reciprocidad generalizada. Basado en los resultados del caso de estudio y literatura previa, se desarrolla un marco conceptual que proporciona direcciones en los que podrían contribuir nuevos estudios sobre meta-organizaciones.

La tesis contiene diversas *contribuciones científicas globales*. En primer lugar, se examina ambidiestria en el nivel multi-organizativo en puertos, con un enfoque principal en la innovación de gestión. Realizando esto, se añade a la literatura de ambidiestria así como a la literatura de innovación de gestión, en las cuales este nivel de análisis ha permanecido relativamente poco explorado. Se explica e ilustra cómo la realización de un mayor grado de ambidiestria mediante el desarrollo de nuevas prácticas de gestión – desencadenado por agentes internos y externos – puede contribuir a mejorar, entre otros, la productividad de recursos, la innovación tecnológica y los procedimientos de seguridad en puertos. Además, la tesis sugiere nuevos caminos en los cuales el desarrollo de ecosistemas industriales dentro de un complejo portuario-industrial puede ser influenciado por las empresas que conforman estos ecosistemas y las autoridades portuarias. Finalmente, se clarifica cómo las autoridades portuarias pueden renovar sus modelos de negocio y mejorar la conectividad estratégica de un puerto de tal manera que mejoren la competitividad internacional del puerto y el país.

Los hallazgos presentados en esta tesis sugieren varias *implicaciones prácticas* para las autoridades portuarias, empresas y asociaciones empresariales en puertos. Por ejemplo, las autoridades portuarias juegan un papel importante en la contribución a la conectividad estratégica con otros puertos (así como otros núcleos logísticos) nacionales e internacionales mediante la participación en el desarrollo y/o la gestión de estos núcleos y por el incremento en la colaboración con otras autoridades portuarias. Las autoridades portuarias están situadas en una posición sostenible también para contribuir a la conectividad estratégica dentro del puerto mediante el uso de instrumentos genéricos de tal forma que faciliten la interacción entre múltiples colaboradores. Para que las autoridades portuarias contribuyan a un puerto más ambidiestro y creen más valor estratégico para este puerto y el país en que está ubicado, sus modelos de negocio necesitan ser renovados a través de cambios en la organización, co-creación y gestión. Las empresas de entornos competitivos necesitan buscar oportunidades para la mejora de su desempeño innovador a través de innovación de gestión y nuevos tipos de colaboración. Se debe pensar más en términos de competencia interorganizativa, en vez de esforzarse únicamente en su propia posición competitiva. Las asociaciones empresariales pueden jugar un rol estratégico en la mejora del nivel de ambidiestria del puerto mediante la realización de nuevas actividades que resultan en incrementos de innovación a nivel puerto.

En conclusión, estudiar cómo los puertos pueden volverse ambidiestros así como el refuerzo de su competitividad internacional a través de la innovación ofrece importantes ideas tanto para académicos como directivos y promete ser una línea de investigación interesante para estudios futuros basados en cómo gestionar el equilibrio entre actividades de exploración y explotación en el nivel multi-organizativo en el rico contexto portuario.

概要 (Chinese Summary)

从战略的角度来看，海港是一个非常重要而有意义的研究对象。港口是国际供应链的重要枢纽，处理着大量的国际货物贸易，容纳了各行各业的组织。基于以往的研究，本论文的中心论点是，港口想要持续地增强其国际竞争力，必须实现二元性。在学术上，二元性指的是平衡地掌握探索和开发的能力。一般地，港口主要侧重于降低货物运输和生产成本，即开发现有的资产、能力和市场地位。而实现二元性从而进一步提高国际竞争力，则要求港口同时注重提高其探索的能力，比如创新。本论文认为，这对位于发达国家（尤其是创新驱动的国家）的港口尤为重要。

本论文主要包括六个探索性研究，来了解效率优先的港口如何实现二元性，以增强他们的创新驱动的可持续国际竞争力。研究一聚焦于港口之间和港口内部促进相关组织增强竞争力的知识网。通过典型的案例分析和对波特钻石模型的拓展，它展示知识网络的战略连接。此研究区分了三个层次的战略连接，建立了多层次战略连接的概念模型，并且区分了三种战略情景。此外，根据以往文献，本研究还强调了港口管理者对港口和国家发展的重要作用，比较了两种最新的评估港口对国家贡献的方法。

研究二探讨港口的商业模式创新。对港口以及其他（半）公共部门来说，商业模式的创新还需要为社会创造战略价值。为了深入探讨港口如何进行商业模式创新，本研究对鹿特丹港 2000 年到 2012 年的实践进行了深入的分析。此案例研究着重检验四个层次的商业模式创新，即组织、管理、技术以及与外部组织的共同创造，来了解他们如何推动港口的商业模式转型，以创造港口和国家的战略价值。

研究三检验港口如何通过发展产业生态系统来提高国际竞争力和环境绩效，比如建立上下游企业的网络。通过对鹿特丹港口的案例分析，本研究发现港口可以通过两个基本的政策手段来推动发展：投资实体和知识基础设施建设，土地配置政策。具体的战略手段包括：建立共同的运输管道、共同建立合作平台、加强与智库的合作、以及在租赁合同中增加可持续的条款。

研究四探讨产业生态系统中的企业如何通过管理相互依赖性，来增强他们的资源生产力。本研究采用案例研究方法，展示了一个由三家化工企业组成的产业生态系统如何通过开发并且施行一系列新型管理政策（即管理创新）受益。研究显示，评估和汇报共同绩效、引入跨部门工作流程、定期举行组织间会议、以及其他可以提高相互协调能力的实践在提高资源生产力方面起着非常重要的作用。此外，本研究还强调了其复杂性，以及环境的触发作用。

研究五检验管理创新如何使企业加快技术创新的步伐。许多在位企业在技术流程创新过程中面临如何处理好组织内部探索和开发的矛盾。处理得当的话，他们也许会因此从中获益。通过对鹿特丹港的案例研究，本研究认为，这需要新的协调活动、激励员工、建立目标以及做好决策。此外，本研究还强调技术流程的创新和组织创新可以相互融合。

最后，研究六将还检验港口内的企业协会对其战略创新的影响。研究对 Deltalinqs 进行了案例研究。它是港口内部一个由七百多个企业组成的协会。研究表明，它内部结构、员工、成员等的变化会对港口安全以及环境绩效有所贡献。此外，形成互惠的关系也是非常重要的。根据以往文献，此研究还建立了相关的概念模型，对以后的相关研究指出了方向。

本论文的主要贡献如下。第一，检验了港口内部多组织的二元性，这是以往二元性研究所忽略的。同时，港口的研究也没有关注二元性的问题。第二，本研究通过检验产业生态系统情境下多组织层次的新型管理实践，也贡献于管理创新的研究，因为以往的管理创新研究并没有关注这一个层次。本研究解释了这一层次的管理创新如何提高港口的资源生产力、技术流程创新和安全操作。第三，本论文指出了发展产业生态系统的新方法，即生态系统中的企业通过组织间管理创新与港口共同作用于产业生态系统的发展。同时，它还指出了港口管理者的土地租赁政策和基础设施建设的重要战略意义。最后，本论文理清了港口管理者如何更新其商业模式和战略连接，来增强港口和国家的创新驱动国际竞争力。

本论文的发现有很多管理启示。例如，港口管理者通过参与国内、国际物流枢纽的建设以及加强与其它港口的合作，对本港口与其它物流枢纽建立合作伙伴关系和战略连接起着重要的作用。港口管理者对港口内部企业的互联互通也很重要。二元性的港口需要二元性企业、管理者和协会。港口需要持续的更新其商业模式，以实现二元性和提高战略价值。在激烈竞争环境下的企业，需要找到机会来通过战略性的知识合作，来增强他们的创新绩效。企业也许要更多的思考如何建立组织间的竞争力，而不是仅仅关注自身的绩效。商业协会可以通过实施其成员的新实践，来对港口的二元性发展发挥重要的战略作用。想要应对持续变化的环境，企业协会必须持续的创新。

总之，研究发达国家的港口是如何通过实现二元性来增强他们的创新驱动的国际竞争力，对学术和实践都很重要。未来的研究可以继续探讨在港口的动态环境下以及多组织层次情景里，如何平衡探索和开发，以实现二元性。

About the Author

Rick M.A. Hollen (born July 4th, 1984, in Leidschendam, The Netherlands) started his PhD-candidacy in late 2011 at the Department of Strategic Management and Entrepreneurship, Rotterdam School of Management, Erasmus University, after having worked at this department as a Project Coordinator and, for about two years, at a global information and technology services company as a Project Manager Business Development. He obtained a Master of Science (MSc) degree in Strategic Management (cum laude) and Bachelor of Science (BSc) degree in Business Administration at the Rotterdam School of Management. As part of these studies he participated in semester exchange programs at three internationally renowned universities abroad: Copenhagen Business School in Denmark, HEC Montréal in Canada, and Pontificia Universidad Católica in Chile. His current research interests revolve largely around the managerial and organizational factors that contribute to the strengthening of the innovation-driven international competitiveness of firms, multi-organizational alliances, and logistic and industrial hubs, with a special interest in port-complexes. His PhD research has been supervised by Prof.dr. Frans A.J. Van Den Bosch and Prof.dr. Henk W. Volberda, and funded by the Port of Rotterdam Authority. At the time of his doctoral defense his research was published in the peer-reviewed scholarly journals European Management Review and Maritime Economics & Logistics and in several book chapters. He presented his research at leading academic conferences of the Academy of Management (AoM), European Group for Organizational Studies (EGOS), International Association of Maritime Economists (IAME) and Strategic Management Society (SMS) that were being held in Canada, France, Israel, Switzerland, The Netherlands, and the United States. He was one of the few selected PhD Candidates in Europe to participate in the Emerging Scholar Workshop at the University of Pennsylvania Wharton School in 2013. He has been in the Organizing Committee of port-related (sub)tracks at conferences of the European Academy of Management (EURAM) in 2012–2015 in Poland, Spain, Turkey and The Netherlands (as co-chairman). He is affiliated with the Department of Strategic Management & Entrepreneurship at the Rotterdam School of Management, Erasmus Research Institute of Management (ERIM), INSCOPE, SmartPort, and the Department of Corporate Strategy at the Port of Rotterdam Authority.

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EXPLORATORY STUDIES INTO STRATEGIES TO ENHANCE INNOVATION-DRIVEN INTERNATIONAL COMPETITIVENESS IN A PORT CONTEXT

TOWARD AMBIDEXTROUS PORTS

Research has highlighted that firms competing in complex, dynamic environments have to balance exploitative (efficiency-directed) activities with explorative (innovation-directed) ones in order to remain internationally competitive. In economically advanced countries, whose competitiveness is innovation-driven, this prerequisite of ambidexterity also holds at the aggregate level of (sea)ports. Ports, being important junctions in international integrated chain systems, however, appear to focus primarily on exploiting existing capabilities and assets, minimizing freight flow costs, and enhancing overall efficiency levels.

This dissertation contains six different exploratory studies into how efficiency-dominated ports in economically advanced countries can become more ambidextrous and, in turn, strengthen their innovation-driven international competitiveness. These studies clarify and illustrate how firms, business associations and, in particular, port authorities can play a role in this endeavor. Drawing on case study findings and prior literature, it is shown how new ways of organizing and managing – i.e. management innovation – introduced by these organizations at the intra-, inter- or multi-organizational level may contribute to enhanced resource productivity, greater environmental performance, advancements in technological innovation and improved safety levels in ports, and to a more innovative business climate in general. Also, it is elaborated how the business model of port authorities and, in relation to this, their strategic use of generic policy instruments are related to a port's strategic connectivity and strategic value creation for its country. Several conceptual frameworks and propositions are developed that provide interesting directions in which future studies on management innovation, multi-organizational collaboration and port authority strategies may be usefully enriched.

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