LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

# MESTRADO EM

## ECONOMIA E GESTÃO DE CIÊNCIA, TECNOLOGIA E INOVAÇÃO

## TRABALHO FINAL DE MESTRADO

DISSERTAÇÃO

# INNOVATION IN INFRASTRUCTURES: AN ANALYSIS OF SEAPORT INNOVATION WITH AN APPLICATION TO GOTHENBURG

NICOLÒ SCACCIANOCE

OUTUBRO - 2016

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**ORIENTAÇÃO:**

PROFESSOR DOUTOR SANDRO MIGUEL FERREIRA MENDONÇA

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## Abstract

Innovation has proven to be a leading force in world economies. Several authors have stressed its importance in disrupting the *status quo* and the complexity of its non-linear and multi-actor processes. Given this context, infrastructures have proven to be successful for developing and implementing new innovations, also thanks to the support of state investments. Keeping in mind these characteristics, this study focuses on seaports, one of the most ancient existing human infrastructures. In the last 60 years, thanks to the introduction of the container and ICTs, seaports have become the main hidden protagonists of a global logistics revolution. These developments are understood with recourse to the concepts of innovation and infrastructure as well as the evolution of seaports in the context of neo-Schumpeterian reasoned economic history. In this context, the aim of this study is twofold: on the one hand, the objective is to outline the state of the art of the existing scientific literature about seaport innovation; on the other hand, this dissertation appraise actual seaport innovation by unpacking a real case in the Port of Gothenburg. This analysis draws on two different approaches: 1) a systematic review of the existing literature; 2) and a case study approach. Results show that the field of innovation in seaports is still highly fragmented and little developed, although clusters of scholarship are emerging. Furthermore, the case of the Port of Gothenburg shows how the complexity of modern seaports requires a holistic, systemic approach in order to understand seaports' inner innovation processes.

**Keywords**: seaports; innovation; logistics; Gothenburg

## Resumo

A Inovação tem vindo a revelar-se como uma força de destaque nas economias mundiais. Muitos autores têm vindo a sublinhar a sua importância na rutura do *status quo* e da sua natureza não-linear e multi-actor. Perante este contexto, as infraestruturas mostraram ser bem-sucedidas para desenvolver e implementar novas inovações, graças também ao suporte dos investimentos estatais. Tendo em conta estas características, o presente estudo foca-se nos portos marítimos, umas das mais antigas infraestruturas existentes. Ao longo dos últimos 60 anos, graças à introdução dos contendores e das ICTs, os portos foram-se tornando protagonistas escondidos de uma revolução logística global. Estes desenvolvimentos podem ser compreendidos à luz dos conceitos de inovação e infraestruturas, assim como da evolução dos portos marítimos, no contexto da história económica baseada numa ótica neo-schumpeteriana. Neste contexto, o presente estudo tem um duplo objetivo: por um lado, fazer uma revisão geral sobre o estado da arte da literatura científica sobre a inovação portuária; por outro lado, deixar um contributo no âmbito da inovação portuária analisando o caso do Porto de Gotemburgo. A análise utiliza duas abordagens diferentes: 1) uma revisão sistemática da literatura existente; 2) e uma abordagem de caso de estudo. Os resultados sugerem que a área de estudo da inovação portuária está ainda muito fragmentada e pouco desenvolvida, embora estejam a emergir *clusters* de autores. Além disso, o caso do Porto de Gotemburgo mostra como a complexidade dos portos modernos exige uma abordagem holística e sistémica para que se possam interpretar os seus processos inovadores.

**Palavras-chave**: portos; inovação; logística; Gotemburgo

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## List of Abbreviations

CSI – Container Security Initiative

GDP – Gross Domestic Product

ICT – Information and Communications Technology

OECD – Organisation for Economic Co-operation and Development

RORO - Roll-on/roll-off

UNCTAD - United Nations Conference on Trade and Development

# 1. Introduction

Infrastructures are fundamental enabling complex assets with broad societal and economic value. However, they are not just static physical capital. Infrastructures change. Seaports, the most ancient of human infrastructures, have become in the last sixty year the key platform for globalization and the world's economies' main interface for bulky cargo (UNCTAD, 2015). This process resulted in a huge increase of inexpensive commercial transport and in a revolution in seaport efficiency (Bernhofen et al., 2016).

This study focuses on modern seaports, which have become central commercial hub and infrastructures characterised by a complex but reliable mix of technological and non-technological sophistication. However, as this research intends to prove, the analysis of the innovation processes occurring within seaports are scarce. Hence, the objective of this study is to contribute to the field of studies about innovation in seaports. Two interrelated research questions were posed: 1) What is the state of the art of the literature about innovation in seaports? 2) How innovation processes unfold in a practical case?

More specifically, the aim of this study is to outline and understand the key patterns and trends in port innovation. To do this a two-pronged strategy was followed. First, it was mapped and measured the evolution of the discussion surrounding port innovation in the specialised, peer-reviewed academic literature. Second, the specific case of the Port of Gothenburg (Sweden) was analysed, in order to unpack a real case of seaport innovation.

This dissertation is organised as follows. Chapter 2 will analyse the main literature about innovation studies and innovation in infrastructures and seaports. Chapter 3 outlines the methodology and sources used in this dissertation. Chapter 4 presents an analysis of the state of the art of the literature about innovation in seaports. Chapter 5 shows the

unfolding of innovation processes in the case of the Port of Gothenburg. The sixth and last chapter outlines the main conclusions, the limitations of the analysis and possible future development.

# 2. Literature review

## 2.1. Innovation literature

### 2.1.1. Ancient meaning of "innovation"

The cradle of the concept of *innovation* is Ancient Greece, where the word καινοτομία was used to indicate a subversive change of the *status quo* (Godin, 2015). Afterwards, the word was absorbed by Latin through the verb *innŏvāre* (*in*-'into' + *nŏvāre*-'make new'), whose meaning is *to renew, restore* (Oxford Dictionary, 2016). This positive meaning, which is consistent with the positive "soul-restoring" function of Christianity in the first centuries after Christ, turned into a negative one in the centuries immediately prior to Reformation (Godin, 2015). Indeed, according to the *Merriam-Webster* dictionary (2016), the first known modern use of the word dates back to the 15th Century, and had a negative destabilizing meaning. It took five centuries to reassess the meaning of the word in a positive way, through a slow process from the Reformation (early 16$^{th}$ century) through the Second World War (mid-20$^{th}$ century) (Godin, 2015, 2008)

Today's meaning of the word innovation is more neutral in tone and related to the introduction of novelties for economic purposes. According to the Oxford Dictionary (2016), the verb *to innovate* has a broader meaning of "making changes in something established, especially by introducing new methods, ideas, or products". This was already reflected in European Commission's (1995, p. 1) definition of innovation, considered "a synonym for the successful production, assimilation and exploitation of novelty in the economic and social spheres".

### 2.1.2. The (neo-)Schumpeterian view of innovation

Schumpeter's work has strongly influenced today's taxonomy of innovation (see Table 1). He focused on innovation cycles, led by entrepreneurs and organised corporate organisations, and considered innovation's "creative destruction" a force capable of disrupting entire economic cycles and their inertia (Fagerberg, 2004; McCraw, 2007).

Table 1 – Types of innovation

| Type of innovation | Main feature |
|---|---|
| Product innovation | "Introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses" (OECD, 2005, p. 48). It can also be related to the perception of novelty (Wang and Ahmed, 2004). |
| Process innovation | "Implementation of a new or significantly improved production or delivery method" (OECD, 2005, p. 49). |
| Marketing innovation | "Implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing" (OECD, 2005, p. 49). It can also be related with finding new markets, unfolding niches and new target users (Johne, 1999). |
| Organisational innovation | "Implementation of a new organisational method in the firm's business practices, workplace organisation or external relations" (OECD, 2005, p. 51). |

Nowadays, the Oslo Manual (OECD, 2005, p. 46) considers innovation:

> "as the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relation"

### 2.1.3. Innovation in a service-intensive economy

Such innovations may take place in any productive sector. In modern developed economies, the increasingly high "tertiarisation" of societies has turned services into the backbone of national economies. Their capability in absorbing computer and network technologies made them an object of analysis since the 1990s (Gallouj and Savona, 2008). However, services are more than just a compartmented sector, they are an emergent "business model" whatever the industry and this cross-cutting has been known as "servicisation" (Miles, 2012).

Traditionally, services have four peculiar properties: intangibility, heterogeneity, inseparability and perishability (Moeller, 2010). They are ubiquitous and generic actions characterised by a strong interaction (O'Sullivan et al., 2002). In fact, according to Gadrey (2000, p. 382):

> "Any purchase of services by an economic agent B (whether an individual or organization) would, therefore, be the purchase from organization A of the right to use, generally for a specified period, a technical and human capacity owned or controlled by A in order to produce useful effects on agent B or on goods C owned by agent B or for which he or she is responsible."

Here, innovation is associated with innovations in internal routines and out of interactions with external customers (Gallouj and Weinstein, 1997; Sundbo, 1997; van der Aa and Elfring, 2002). A service innovation could entail either the solution of new problems through offering new formulas and services; or alternatively could consists in addressing the same problems with a renewed and more efficient internal organisation (Gadrey et al., 2013). Furthermore, the emerging of services based on social, institutional, technical and technological knowledges, such as the *knowledge-intensive business services* (KIBS), produces intermediate inputs which can be afterwards utilised by other industries and organisations (Fagerberg, 2004; Miles, 2004).

The complexity and large extent of innovation in services show that this type of innovation cannot be analysed without considering the interactions and the peculiar system[1] in which they take place. Services, adopting the advantages of network technologies, have acquired a network characterisation themselves. Furthermore, here

[1] In this regard, Freeman (1987) outlined the existence of national system of innovations (NSIs), made up of several actors which determine countries' technological frameworks. Furthermore, Malerba (2002) emphasised the existence of sectoral systems of innovation, in which (trans)national firms cooperate and compete.

innovation processes entail knowledge spill-overs that information technologies are contributing to disseminate and spread.

## 2.2. Ocean economy and seaports characterisation

### 2.2.1. Infrastructures

Albeit its importance in civilisation, it was only in the 19th century that the word *infrastructure* made its first appearance, and only with a military meaning (Lemer, 1992). According to Lewis (2008), the word was first listed in the Oxford Dictionary in 1927 as a loan from the French word *infrastructure*, referring to the structures used to build French railroads. In turn, the French word *infrastructure* comes from the Latin *infra* (below, underneath) and *structura* (structure, construction). After the Second World War, the word became more and more popular, finally referring to all the means necessary to carry on the human activities: hence, physical constructions, abstract entities and also institutional structures (Lewis, 2008; Markard, 2009).

In most economic literature infrastructure is not an elaborated concept (Smith, 1997). Following Smith (2005, p. 27), infrastructures may be defined as:

> "…large-scale indivisible capital goods producing products or services, which enter on a multiuser basis as inputs into most or all economic activities."

Infrastructures are also "social overhead capital" (von Tunzelmann, 1995). They can be considered a special kind of *capital good* since they are enabling equipment, require high levels of investment, have a long duration and represent an important pillar for producing new goods and offering new services in several different sectors (Rodrigue et al., 2013, p. 379; Smith, 2005, p. 27). Furthermore, infrastructures enable activities in secondary and tertiary sectors (Ridley et al., 2006; Riet and Turk, 2006). They are of substantial size, indivisible, multi-user; they operate as shared resources and also imply

comprehensive procedures, information management, and policy development (Bowker et al., 2010). Moreover, infrastructures are systems, a locus of specialised and reciprocally dependent inputs (Smith, 1997). More than just a one-off physical instalment they are a mix of tangible capital and intangible capabilities. They may be standing still when deployed in time and space, but they are in continuous interplay with the societal world, the economic process and regulatory demands (Prud'homme, 2005; Tassey, 1991).

Infrastructures rely on political initiative and often benefits from publicly funded projects since they require massive investment and are subjected to market failures (Freeman and Louçã, 2001, p. 150; Smith, 2005). Moreover, they create vast externalities for further investment in compatible and complementary innovations (Perez, 2002, p. 42). However, the research about the innovation processes within infrastructures is very little developed, and understanding who is managing them is often very difficult. Furthermore, infrastructures are not subjected to market rules, and therefore generally less prone to invest in research. These factors, along with other factors such as obsolete regulations, organisational inertia and high complexity, make innovation in infrastructures hard to implement and difficult to study (National Research Council, 1987).

### 2.2.2. Seaports as old socio-economic structures

Seaports are human spaces shaped by geophysical conditions and natural resource endowments, located by lakes, rivers, seas, oceans, and, more often, in the confluence of these (Polónia, 2016, p. 873). As distinct from natural ports (such as in bays), a seaport is one particular kind of physical infrastructure where vessels dock and goods and passengers are moved about over longer distances. In seaports, "ships are brought alongside land to load and discharge cargo" (Stopford, 2009, p. 106). As an infrastructural system they have "a cohesive, specificity and special character" (Smith, 1997). Seaports

provide many kinds of producer services and so they co-evolve with the broader economy. The study of seaports can thus benefit from an explicit "historical method approach" (Freeman and Soete, 1997, p. 17), and their cumulative evolution analysed relying on a Neo-Schumpeterian reasoned history perspective (Freeman and Louçã, 2001).

Until the 19th century, seaports' development has been marked by a strong integration with the surrounding built-up areas (Bailey, 2004; Driessen, 2005; Hoyle, 2001). In Europe, they were conglomerates that "signaled the power, scale, and value of city – or harbor – output" (Miller, 2014, p. 23). For instance, the succession of commercial powers can be seen as the rise and decay of port-cities such as, Venice, Lisbon, Amsterdam, London and New York (Findlay and O'Rourke, 2009; Friedel, 2007, pp. 96–97; Polónia, 2011). Port towns were privileged spaces where "cultures met and mixed" (Abulafia, 2011, p. xxiv) and their seaports became service centres, as points of imperial administration and government (Webster and Bosma, 2015, p. 8) but also offering services, from currency exchange to hotels, and handling information, drawing maps, brokering deals, offering language translation, etc. Hence, seaports also had a mediating and information integrating function (Broeze, 1997, p. 3).

### 2.2.3. Seaports in shifting techno-economic eras

Due to the manufacturing explosion and to the raw-material-based First Industrial Revolution, seaports became more and more mechanised and "absorbed" in the new paradigm, developing new waterways networks and new cranes and steam dredgers (Freeman and Louçã, 2001; Jackson, 1988). There were also noteworthy developments in steamships and iron ships, which led to the development of deeper and larger quays (Shepherd and Walton, 1972; Stopford, 2009). Soon enough, by mid-1800s, coal stations

needed to be provided as a basic new service (Craig, 1980, pp. 153–158). The increased capital costs impelled greater throughput and a new generation of equipment was now needed to guarantee rapid loading and discharging with greater time precision, cutting turn-around of faster and larger vessels (Robertson, 1974; see also Craig, 2003, pp. 142–143). Connections to railways were on demand, and many companies were set up to run and coordinate the operation of both steamers and trains (see, e.g., Body, 1971, p. 95).

Afterwards, in the Second Industrial Revolution, steel, electricity, new diesel engines and technology advancements revolutionised ships (Pollard and Robertson, 1979). Three new segments were formed, with passenger liners, cargo liners and tramp shipping (Stopford, 2009). Seaports had to adapt growing broader and constructing new docks and deep basins, which would have supported the diffusion of the cargo liner business until the 1960s (Palmer, 1999; Stopford, 2009, p. 506). Seaports became transportation hubs and, since the laying of the first deep-sea telegraph cables, started handling more and more data, contributing in shrinking the world (see Kaukiainen, 2001).

In short, seaports have a long history that is associated with the succession of dominant techno-economic paradigms. They are embedded in global trade networks and their internal techno-organisational configuration reflect broader societal patterns:

> "… if a seaport system exists at a national, international or global level, and it probably does, it exists according to geo-economic and geo-political frameworks that seem to determine the evolutionary position of a seaport in the overall system, a position that changes over time." (Polónia, 2011, p. 409)

### 2.2.4. The reconfiguration of modern-day seaports

Seaports are more than import-export platforms, they are shipping nodes between the foreland and the hinterland and between of global private traders and local state

authorities (Harlaftis et al., 2012, p. 6). Nowadays seaports have increased in importance in transportation and commerce networks, becoming international logistics and informational hubs, with strong ties with the surrounding urban systems (Wiese and Thierstein, 2014). In fact, according to the United Nations Conference on Trade and Development (UNCTAD, 1991), seaport have evolved from being mere links between hinterlands' goods to other countries (first generation, ports until 1960s) to become commercial focal points (second generation, ports built in the 1960s and the 1970s) and afterwards international distribution centres (third generation, from 1980s onwards). The growth of post-war seaborne trade made them leading places in world trade. Seaborne trade represents 90% of total world trade, with a fundamental role of cargo shipments and transportation through containers (International Chamber of Shipping, 2016). Seaborne transportation is now consisting in bulk shipping, specialised (cargo) shipping and container shipping (Bernhofen et al., 2016).

At the turn of the new century, the pervasive application of information and communication technologies (ICT) has proven to be essential in order to streamline port operations and to allow a better efficiency in logistics and information management (Gwilliam, 1993; Kia et al., 2000; Song and Panayides, 2008; The Economist Intelligence Unit, 2015). Logistics has become an essential service in 21$^{st}$ century economies (Potter and Mason, 2015). Seaport efficiency is nowadays more and more linked to efficiency goals and to the introduction of new technologies, which are highly network-base (Merk and Dang, 2012). Fourth generation seaports have emerged: they are part of globalising logistics and financial webs and in turn they are networks themselves. Terminals have intense activity but are almost desert. They are organisational complex public-private nests, as Port Authorities supervise cargo handling but not operate berths themselves.

Much goes on in offices and data centres as many actors involved need communicate and exchange information in order to improve efficiency, speed, space utilisation and comply with waste management regulations (Paixão and Marlow, 2003). Furthermore, containerisation led also to geo-graphical re-orientations at the city level, moving away seaports from cities and leading to the developments of new terminals on the outskirts (Hein, 2013; Stopford, 2009).

Today's seaports utilise many resources, such as labour, energy, information harbour waterways, berths, infrastructures and mobile equipment (Talley, 2012, p. 474). The outputs can be variegated, e.g. handling of containers, liquid/solid/break bulks, general cargo and other ship and cargo-oriented services (Jara-Díaz et al., 2006; Suárez-Alemán et al., 2015). Furthermore, seaports increasingly offer services, such as warehousing and logistic services. Seaports have been the "dark side" of global increases in trade and logistics productivity (Dias, 2016). Since the 1950s sea trade growth has been steady and has almost perfectly reflected or outpaced the estimate of sea trade based on regression with world GDP (with the exception of the 1980s) (Stopford, 2015). Maritime commerce turned into one of the backbones of a globalised world economy. The continuous growth of trade put seaports' infrastructures under a great stress and, as pointed by Bernhofen et al. (2016), containerisation and globalisation have been the two intertwined phenomenon that simultaneously led to this growth (see also Grammenos, 2010 and Greenway, 2012, p. 157). To withstand this pressure seaports have been places of "creative accommodation" of globalisation forces.

### 2.2.5. Privatisation, liberalisation and deregulation of seaports

Seaports have been historically controlled by Port Authorities, public entities with landlord (infrastructures), regulator (environment and safety) and operator (port services)

functions (Verhoeven, 2010). However, they have been affected all over the world by the privatisation processes started in the 1980s with the aim of limiting the role of the public sector (Baird, 2002; Parker and Kirkpatrick, 2005; Roland, 2008; Young, 1986). UNCTAD (1998, p. 1) defines privatisation as

> "the transfer of ownership of assets from the public to the private sector or the application of private capital to fund investments in port facilities, equipment and systems".

In particular, seaports have progressively delegated the operator function to private operators, while they continued to hold a prominent regulator function (Verhoeven, 2010). The extent of privatisation processes can vary according to the assets and services transferred to private hands and according to the governance model (see Table 2). However, among the objectives of privatisation processes, the most relevant are: improving efficiency of services, stimulating competition, finding new resources, mitigating the costs for the State and minimising the influence of politics (Cullinane and Song, 2002; UNCTAD, 1998).

Table 2 – Forms of seaport privatization and seaport governance models

| **Form of privatisation** | **Objective** |
|---|---|
| Comprehensive privatisation | Seaport totally owned by private entities, including land and water areas |
| Partial privatisation | Some assets and services are transferred to private entities |
| Full privatisation | All facilities and services are transferred to private entities |
| Part privatisation | Public and private actors jointly manage facilities or services |
| **Governance model** | **Main features** |
| Landlord model | Port Authorities tied to central governments; concession agreements with private operators |
| Tool port model | Port Authorities own infrastructures; private operators rent them |
| Service port model | Port Authorities carry out all the commercial activities, own the infrastructures and have regulator functions |

Sources: UNCTAD (1998); Ferrari et al. (2015); Juhel (2001)

The landlord model is nowadays the dominant model in Europe, albeit with different nuances depending on the countries[2] (Ferrari and Musso, 2011; González and Trujillo, 2008; Lacoste and Douet, 2013; Marques and Fonseca, 2010; Ng and Pallis, 2010). European Commission has pushed European seaports towards the landlord model, implicitly supporting it and emphasising the autonomy of Port Authorities in choosing private operators and establishing appropriate concession periods to private operators (Verhoeven, 2009).

## 2.3. Framing innovation in seaports, in a nutshell

### 2.3.1. Seaports as an object of analysis

Seaport innovation, notwithstanding all its significance, is an underappreciated aspect of the global network era. Generally, services in developed countries are characterised by a low or even negative productivity growth (Uppenberg and Strauss, 2010). However, transportation has showed its dynamicity. Indeed, as Freeman and Louçã (2001, p. 165) point out, "Transport infrastructure is surprisingly neglected in many studies of the Industrial Revolution". Research on seaports as dynamic sites of techno-economic change is a large and vitally important gap in innovation studies. However, some of this work can be done by simply drawing on established neo-Schumpeterian templates and reconnecting innovation stylised facts already explored above. Given the paucity of literature, this study draws on "first principles" to flesh out what the key characteristics of seaport-related innovation processes may look like. Hence the relevance of etymology and the life cycle of words like innovation or infrastructure.

[2] A noteworthy exception is represented by the United Kingdom, where the privatisation processes unfolded in the 1980s entailed a complete privatisation of port services, land and also regulation (Baird, 1995; Baird and Valentine, 2006).

### 2.3.2. Innovation to modern seaports

The increasingly high competitive environment, caused by seaports' liberalisation and shipping companies' vertical and horizontal integration, is pushing seaport to test and implement *product innovations*. The "end-product", i.e. getting goods on the move (reliably, safely, efficiently, cleanly) is especially dependent on ICT elements and compliance with security and environmental standards (Cetin and Cerit, 2010; Hall et al., 2013; Jarillo and Peris, 2014; Notteboom, 2006a).

Product innovations are linked to *process innovations*, which are fundamental in order to deal with congestion and overturn the limitations caused by the seaports having reached its maximum expansion and capacity (Sánchez and Wilmsmeier, 2010). With this regard, the impetuous rise of containerisation has been part of the way of managing the physical spaces and resource constraints (Cullinane and Wilmsmeier, 2011).

Since modern seaports are logistics hubs offering a wide range of different services, they are also constantly struggling to attract customers. In order to do this, *marketing innovations* and customer attraction, management and retention represent an essential tool for keeping port services abreast with outside developments (Cahoon, 2007).

*Organisational innovations* inevitably share strong ties with other innovations, namely those entailing also internal reconfigurations. However, due to the existence of several stakeholders, seaports adaptation to outside challenges requires sophisticated solutions (Acciaro et al., 2014). In fact, as outlined by Cetin and Cerit (2010), seaports are subject to several external drivers of change, both at macro level (such as technologies, socio-political and economic factors) and at micro level (such as customers, suppliers, competitors, surrounding communities). In this regard, seaports' liberalisation and the

subsequent entrance of private entities in terminal and logistics-related functions can be considered as key an organisational innovation, followed by others.

### 2.3.3. Seaports in evolving techno-economic landscapes

Seaports are collections of actors and strategic assets that embody a high degree of complexity due to their multi-user and capital-intensity nature. Rich in intangible assets, not only physical facilities, seaports are increasingly characterised by their *service innovations*, since they are offering increasingly complex logistic solutions, such as parks and rail-based intermodal service. As noted by National Research Council (2009, p. 23)

> "Although infrastructure components and systems are often thought of as 'public goods', myriad public -and private- sector organizations are responsible for infrastructure investment, construction, operations, repair, and renewal."

In particular, a seaport today is a peculiar public-private institutional mix as the land and gear of a modern seaport are usually owned and controlled by the Port Authority (usually a publicly-owned institution) but the actual freight handling and other terminal-related business is carried out by private operators (of international outlook). They do not produce physical goods but are the supporting social capital which redirect goods all over the world drawing on a sophisticated and highly technologically-assisted organisation. In this context, it is not surprising to acknowledge that seaports' innovation capability is substantial (Blonigen and Wilson, 2007).

## 2.4. Preliminary conclusions

Innovation has proved to be one of the main leading forces in today's world. Both from an economic and social point of view, its continuous erosion of the *status quo* reshapes established market structures and technologies, moulds the future technical paths and affects our lives. Still, innovation is not a linear process and its uncertainty could deter

entrepreneurs and enterprises from pursuing new innovative projects. Hence the role of the state is fundamental, especially in the early stage of the process, which is often conducted in big infrastructures.

On the other hand, modern seaports are fundamental infrastructures upon which countries are increasingly relying on. Given their infrastructural nature, they are exploited by several public and private actors at the same time. The diffusion of ICT technologies has strongly moulded their role and they have become also an informational hub. Due to this, seaports have become a place in which innovations can arise. In order to better understand how this process has taken place, and to systematise the main findings about the processes entailed, an analysis of the main literature about innovation processes in seaport will be carried out in the next chapter.

# 3. Methodology and sources

## 3.1. Systematic review and bibliometric approach

The first approach adopted in this paper is the systematic review approach. A systematic review allows "identifying, assessing, and analysing published primary studies in order to investigate a specific research" (Staples and Niazi, 2007, p. 1425). Relying on databases such as Web of Science or Scopus, the objective is to systematise the existing knowledge about a specific topic through structured researches and analysis (Brereton et al., 2007; Cipriani and Barbui, 2006). Both statistical and qualitative methods can be used for synthetizing data (Magarey, 2001).

On the other hand, according to the pioneering definition of Alan Pritchardy (as cited by de Bellis, 2009, p. 3), bibliometrics focuses "on any statistically significant manifestation of recorded information". One of the main assumptions of bibliometrics is that the most

relevant literature is published in generally available scientific peer-reviewed journals (van Leeuwen, 2004). Elements like journal title, author, references, keywords, abstract and number of citations allow the generation of an accountable picture of the existing contributions to a specific topic. Furthermore, it is also possible to detect trends, discontinuities, clusters of themes and groups of author, as well as to outline emerging research directions.

In this dissertation, it was firstly conducted a systematic review[3] about the existing literature about innovation in seaports using a four-pronged approach[4] (see Table 3). The research relies on secondary sources and Scopus,[5] focusing on peer-reviewed journals, which is a limitation it was tried to mitigate.

Table 3 – Questions, sources, methods and results of the systematic review conducted in this work

| **Question** | **Sources** | **Method** | **Results** |
|---|---|---|---|
| 1) Are seaports cited in generic innovation literature? | Fagerberg et al. (2012): list of the 130 most influential documents in innovation field | Focusing only on peer-reviewed articles, 56 items were internally analysed using the keywords "maritime", "port(s)", "harbor(s)" and "harbour(s)". | One article cites seaports. See section 4.1. |
| 2) Academic journals that most address seaport-related topics have published innovation-related articles? | Woo et al. (2012): list of 840 papers about seaports published in 125 academic journals from 1980 to 2009 | Analysis of the top 100 most-cited papers of the first 5 journals[6] (Scopus). | Two articles address innovation-related topics. See Section 4.2. |
| 3) What is the state of the art of scientific literature about seaport | Scopus | Research in Scopus using the Boolean operators "innovation AND ports", "innovation AND seaports", "innovation AND | The results were consolidated into a single list of 63 articles[7]. After some |

[3] See Appendix 1 for the list of previous reviews on maritime economics and seaport-related topics.
[4] All final searches were carried out on May 2nd 2016, after month of preliminary searchers.
[5] Other approaches rely on *Google Scholar* by Google, which can track citations and full text in the whole internet, while WoS or Scopus are focused on a pre-determined database of final academic publications. WoS and Scopus' results are correlated, with the latter providing more detailed citations and the disciplinary profiles of the outlets (Archambault et al., 2009; Yang and Meho, 2007).
[6] This is a common procedure used in bibliometric studies to give a better picture of a specific journal and the main trends in its publications (Fardi et al., 2011; Ho, 2012; Shuaib et al., 2015). The Scopus database resulted to have a better coverage of the five journals if compared with WoS.
[7] A first exclusion criteria was applied choosing to restrict the research only to articles published in peer-reviewed journals. As a second criteria, were excluded off-topic articles, since the keyword "port" is very common in many different areas. A third criteria consisted in excluding articles merely addressing the

| | | | |
|---|---|---|---|
| innovation in Scopus? | | harbors" and "innovation AND harbours". ". The research was restricted to the document type "Article". | cleaning, this original sample was reduced to 22[8]. See Section 4.3. |
| 4) Is there, among the 500 articles analysed in the second question, any other article indirectly addressing innovation in seaports? | Woo et al. (2012): list of 840 papers about seaports published in 125 academic journals from 1980 to 2009 | Sensitivity analysis of the same top 100 most-cited articles analysed in the second step, extending the research to articles' keywords and titles using words which can be possibly related to innovation topics: "productivity", efficiency", "learning", "modernisation", "modernization", "technological" and "technical" (Scopus). | Eight new articles were found. See Section 4.4. |

## 3.2. Case study approach

According to Yin (2013, p. 4) a case study "allows investigators to focus on a 'case' and retain a holistic and real-world perspective". A broader definition by Gerring (2004, p. 342) defines the case study as "an intensive study of a single unit for the purpose of understanding a larger class of (similar) units". The observer must not control the environment studied nor affect data and information (Crowe et al., 2011; Yin, 2013). Furthermore, case study must satisfy a number of criteria for ensuring their validity; they can take different approaches and be of a number of types depending on depth, extent and scale of the study itself (see Table 4 and 5). Given the complexity of today seaports' setting, this case study is intended to be exploratory and with an interpretative approach. Recurring to qualitative tools such as *in loco* structured interviews[9], primary sources and

technical side of innovations: notwithstanding the fact that technical innovations could induce policy innovations, articles with explicit policy implications or with a broader view about the innovation processes occurring in seaports were selected, hence excluding solely technically-geared articles.

[8] To minimise the liability of bias the acknowledgements of the papers were checked: 15 of the papers contained no acknowledgements section (absence of evidence), whereas the examination of the 7 papers referring to debts found three papers thanking general institutions for support. As such, no reasons surface as to cast particular scepticism concerning the existence of conflicts of interest biasing specific seaports coverage.

[9] In particular, were interviewed the Senior Manager Business Development at PoG (April 14th, PoG1), a Professor of Logistics and Transport Economics at University of Gothenburg (April 25th, Uni1), the Vice President of Sales & Marketing at PoG (June 2nd, PoG2), a General Manager at SCT Transport (June 20th,

secondary source, and therefore by applying triangulation, it was conducted an instrumental and intrinsic case study, for the main objective is to analyse the peculiar case Gothenburg and also obtain a better picture of the phenomenon of innovation in seaports. Results were also consolidated by recurring to the available, although scarce, academic literature on port innovation cases.

Table 4 – Main case study criteria

| **Design test** | **Characteristic** |
|---|---|
| Construct validity | Triangulation of different sources and clarifying the chain of evidence |
| Internal validity | Clear research framework and comparison with previous studies |
| External validity | Selecting a specific population and proving that the results can be "generalised" |
| Reliability | Outlining standardised procedures and ensuring their transparency |

Sources: Gibbert and Ruigrok (2010) and Beverland and Lindgreen (2010)

Table 5 – Types and approaches for case studies

| **Type of case study** | **Objective** |
|---|---|
| Intrinsic | To better understand a peculiar case |
| Instrumental | To understand a wider phenomenon analysing a specific case |
| Collective | To understand a wider phenomenon analysing several cases |
| **Case study approach** | **Objective** |
| Critical approach | To challenge pre-existing assumptions |
| Interpretative approach | To take into account different perspectives and focus on theory building |
| Positivist approach | To assess whether a specific variable fits in the theories elaborated from previous findings |

Sources: elaborated from Stake (1995) and Crowe et al. (2011)

# 4. What do we know about innovation in seaports

## 4.1. Seaport innovation in innovation studies

As a result, 4 articles out of 56 resulted to contain seaport or maritime related keywords. This is a very little number, considering that represents less than 10% of articles in the

Sct1), an Environmental & Safety Advisor at Transportforetagen (June 23rd, Tf1) and the Business Development Manager and Commercial Manager Rail at APM Terminals Gothenburg (June 30th, Apm1). All the interviews were recorded. A tour in Port of Gothenburg's terminals and facilities held on April 14th contributed to a better understanding of PoG's geography and its internal processes.

sample. Furthermore, among the four articles, three contain seaport or maritime wordage only accidentally.[10]

However, one article resulted to be especially relevant: "Networks of innovators: A synthesis of research issues", by Chris Freeman (1991).[11] Freeman is considered one of the main contributors to the "Renaissance" of innovation studies from the 1970s onwards and, in particular, one of the fathers of the concept of "systems of innovation". In this paper he analysed the then emerging topic of regional and systemic collaborative networks and their relationship with (inter)national innovation systems. Addressing the relationship between ICT and systemic innovations, Freeman focused on the transport sector in the period 1940s-1980s. For the period 1940s-1960s he included containerisation and the subsequent scaling-up of seaport facilities among the systemic innovations in the transport sector, entailing that seaports can be seen through a system framework.

### 4.2. Seaport innovation in maritime journals

As a second step, relying on the list elaborated by Woo et al. (2012) and analysing the 100 top-cited articles of the first five journals, it was found that 27% of all articles have seaport-related content, but also that only a thin minority of these focus on innovation (Table 6). *Maritime Policy & Management* resulted to be the only journal with seaport-related research among the most influential articles. It contains only two articles with innovation as keyword, and these can be traced back to a single scholar. "Innovation, capabilities and competitive advantage in Norwegian shipping" (Jenssen, 2003) performed an analysis Norwegian shipping industry and its innovation capability,

[10] For example, the word "harbour" is also a verb and is not necessarily related to maritime topics.
[11] This article is very relevant in innovation field. This is confirmed by the very high number of documents citing it at the date (more the 600 to date) and by the fact that is the second most-cited article of Chris Freeman (this journal piece is only second to his 1995 review of the innovation systems concept in the *Cambridge Journal of Economics*).

focusing on the opportunities in ICT development, information management and inter-modal solutions. Afterwards, a new article titled "The performance effect of innovation in shipping companies" (Jenssen and Randøy, 2006) continued the previous work on Norwegian shipping, emphasising the role of organisational factors in influencing innovation and a different innovation capability associated to each shipping sector.

Table 6 – Journals analysed and main topics of their 100 top-cited articles

| **Journal** | **Articles** | **Main topics addressed by the 100 top-cited articles** | **Main research aims of the journal** | **Seaport-related articles** | **Seaport innovation-related articles** |
|---|---|---|---|---|---|
| *Maritime Policy & Management* | 100 | Shipping, port operations, container ship, cargo handling, container terminals, freight transportation, port development | Organisational, economic, socio-legal and management topics at port community, shipping company and shipboard levels | 51 | 2 |
| *Maritime Economics and Logistics* | 100 | Liner shipping, efficiency, competition, simulation, container port, container terminal, regulation | Ocean transportation, ports, marine terminals and maritime logistics | 51 | 0 |
| *Journal of Transport Geography* | 100 | Accessibility, transport, climate change, sustainability | Transport policies, transportation infrastructures and mobility | 13 | 0 |
| *International Journal of Transport Economics* | 100 | Efficiency measurement, freight transport, data envelopment analysis, technical efficiency, public transport | Transport economics and management | 17 | 0 |
| *Transportation Research Part A: Policy and Practice* | 100 | Travel behaviour, urban planning, road pricing, land use, traffic management, transportation planning | Policy analyses, planning and management of transportation systems | 3 | 0 |
| *Total* | 500 | - | | 135 | 2 |

### 4.3. Mapping seaport innovation in the literature as a whole

Conducting a keyword-driven search for the whole of the social sciences, a list of 22 scholarly articles is the result[12]. One can notice in Figure 1 that it was only in 2002 that a first article addressing innovation in seaports surfaced. A visible positive slope seems to emerge at around 2008, indicating that a body of emergent studies about innovation in seaports was taking hold.

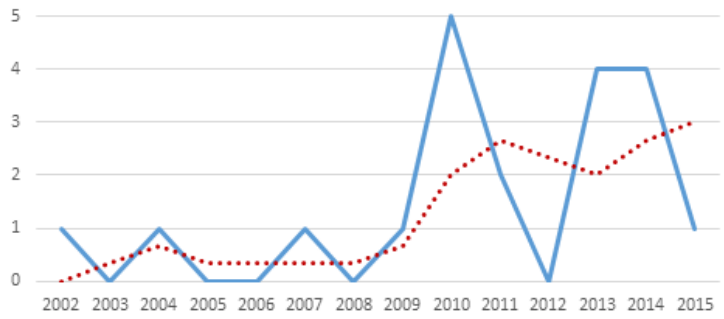


Figure 1 – Articles published per year between 2002 and 2015 (and moving average line, 3 years period)

Netherlands is the first country in terms of research output (Figure 2)[13]: this is not surprising, since Rotterdam is one the largest and busiest seaports in the world (Berend, 2013, p. 145). As a result, the country appears in the data as a centre of expertise through the commitment of institutions such as Delft University of Technology, Erasmus University and Utrecht University. Overall, Europe is the continent with more affiliations (25), followed by Asia, America (5) and Australia (4). It is also remarkable that the five

[12] See Appendix 2 for the list and the analysis of each article.
[13] Checking the acknowledgments and other signals of the funding details of each paper, no traces of conflicts of interest were found.

documents affiliated to Asia have been published in 2014, 2015 and 2016, and are the result of a Sino-European collaboration between several scholars.

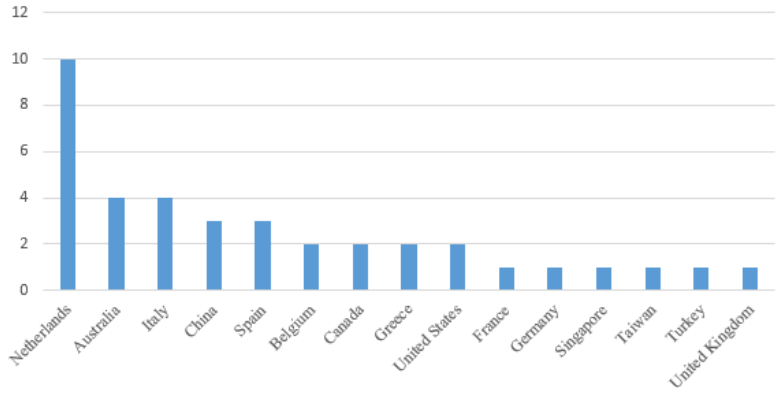


Figure 2 – Articles per country of residence of researcher

The sample comprises 58 authors, with Stephen Cahoon (Australia) and Wim Ravesteijn (Netherlands) as the ones with more occurrences (3). On average, each article involves the cooperation of 3.2 authors: only five articles out of 22 have a single authorship, signalling a very high degree of cooperation.[14] A further analysis of the webpages of the authors appearing in the sample more than one time shows that many scholars have profiles involved with innovation agendas or have an expertise in innovation and logistics.

The academic journal with more publications (Table 7) is *Research in Transportation Economics* (3), followed by *Journal of Maritime Research* and *Maritime Policy and Management* (2). Predictably, most of the journals specialise in areas related to transportation, shipping, logistics and maritime issues. However, the presence of journals such as *International Journal of Sustainable Development* and *Journal of Environmental Protection and Ecology* shows also an interest in addressing seaport innovation through environmental and green economy perspectives.

[14] In particular one article comprises 15 authors (Arduino et al., 2013) while another 8 (Acciaro et al., 2014).

Table 7 – Academic journals with more publications about innovation in seaports

| Number of publications | Journal |
|---|---|
| 3 each | *Research in Transportation Economics* |
| 2 each | *Journal of Maritime Research, Maritime Policy & Management* |
| 1 each | *Contributions to Economics, Geojournal, International Journal of Critical Infrastructures, International Journal of Global Environmental Issues, International Journal of Logistics Research and Applications, International Journal of Shipping and Transport Logistics, International Journal of Sustainable Development, Journal of Environmental Protection and Ecology, Journal of Transport Geography, Ocean and Coastal Management, Regional Studies, Research in Transportation Business and Management, Revista de Obras Publicas, Water Science and Technology, World Review of Intermodal Transportation Research* |

### 4.3.1. Characterisation of the sample and analysis of the articles

All the 22 selected articles share the view of seaports as complex systems characterised by heterogeneous stakeholders performing specialised but related functions (see Table 8)[15]. Stakeholder and organizational dynamics influence the innovation implemented (Hall et al., 2013). As stated by Girard (2010, p. 161), seaports areas are "the product of a complex system in which socio-cultural, economic and ecological systems are dynamically intertwined." In fact, according to De Martino et al. (2013, p. 123):

> "seaports provide an interesting research context to understanding the interactive and systemic nature of innovation through an analytical focus on interdependences and relationships existing between local firms operating in the hinterland, private and public port operators".

Regarding the specificities of seaport dynamics 7 articles also emphasise the need for a clear geographical and proximity approach in addressing innovation in seaports, while 6 focus on the peculiar role of Port Authorities in the seaport scene. Another 6 give priority to environmentally-sound innovations whereas 3 are especially focused on the topic of responsible innovation.

[15] A more detailed table, not inserted for space constraints, is available upon request.

Table 8 – Overview of prevailing frameworks in the articles of the sample (=22)

| Framework | Number of articles |
|---|---|
| Seaports as complex systems | 22 |
| Spatial characterisation of seaports | 7 |
| Port Authority focus | 6 |
| Sustainable innovations in seaports | 6 |
| Responsible innovation in seaports | 3 |

Given the complexity of the processes underlying seaport innovations and the prevalent inductiveness of the approaches, all the articles share a qualitative nature (see Table 9). In fact, most of the papers are based on case studies, sometimes conducted through direct interviews and surveys with the main seaports' stakeholders. For this reason, there are no specific recurring empirical indicators or statistical tools; with the exception of the Delphi method (used as technique to conduct panel interviews) and the Rasch methodology (used to assess questionnaires).

Table 9 – Overview of prevailing types of publication in the sample (=22)

| Type of publication | Number of articles |
|---|---|
| Qualitative research | 17 |
| Qualitative review | 5 |

Depending on the granularity of the article, the actors considered with regard to innovation processes in seaports can be variegated. However, port managers, terminal operators and local communities (both with a social and political meaning) appear to be the most recurring and relevant constituencies. In fact,

> "when a Port Authority becomes aware of the strategic role of inter-organizational relationships as new sources of value creation and competitiveness, it can set a systematic evaluation of their nature and contribute to improve and sustain port's innovation". (De Martino et al., 2013, p. 132)

It is fundamental to involve all the actors in the innovation process and to ensure their technological/organisational capabilities, in order to successfully implement a new innovation (Arduino et al., 2013).

Most of the articles have an explicit definition of innovation generally in line with the modern Oslo Manual. For example, according to Arduino et al. (2013, p. 98):

> "innovation in transportation and logistics is "a technological or organisational (including cultural, including marketing, as a separate sub-set) change to the product (or service) or production process that either reduces the cost of product (or service) or production process or increases the quality of the product (or service) to the consumer."

Another definition, adopted by Blanco et al. (2010, p. 72), states that innovation is

> "the introduction of a new product, a new production method, a new market, the discovery of new supplies of raw materials in manufactured products, and even the emergence of a new sector or redirection of an existing one".

In particular, Schumpeter himself is called to support the innovation definition or to outline its characteristics in 5 papers (Blanco et al., 2010, 2011, Arduino et al., 2013, van Driel 2002, and Wiegmans and Geerlings 2010).

The sample also shows a wide-ranging array of types of innovation (Table 10). Process innovation stands out (16) but also service innovation (13). Other innovations such equipment upgrades (12), such as new cranes or vessels, and environmental innovations also figure high (12).[16] Moreover, it is significant that organisational innovation appears to be more noteworthy than straightforward embodied technical changes. In some cases, the analysis is focused on so-called "logistics innovations", which is seen by the work of

[16] A green or sustainable innovation is a quite recent and horizontal definition, and it is related to ecological regulatory pressures. According to Oltra and Jean (2009, p. 567), "can be defined as innovations that consist of new or modified processes, practices, systems and products which benefit the environment and so contribute to environmental sustainability".

de Martino et al. (2013, p. 124) as "any logistics related service from the basic to the complex that is seen as new and helpful to a particular focal audience."[17]

Moreover, in terms of subject matter, countries with developed seaport systems such as the Netherlands, USA, China and Spain are the more studied (Table 11). It is interesting to notice the emergence of Asia as a whole, something expected given the fact that among the top 10 world container seaports, seven are located in China, one in Singapore and one in Hong Kong (World Shipping Council, 2014). This shift is remarkable, and reflects the shift occurred in the last decades: indeed, today two-thirds of total world seaborne import world commerce is going towards non-OECD countries (Stopford, 2015).

Table 10 – Overview of types of innovations analysed by the articles of the sample (=22)

| **Type of innovations** | **Number of articles** |
|---|---|
| Process innovation | 16 |
| Service innovations | 13 |
| Equipment innovations | 12 |
| Environmental innovations | 12 |
| Organisational innovations | 10 |
| Technological innovations | 8 |
| Logistics innovations | 3 |

Table 11 – Overview of specific countries analysed by the articles of the sample (=22)

| **Countries** | **Occurrences** |
|---|---|
| Netherlands | 6 |
| USA | 4 |
| China, Spain | 3 |
| Australia, Germany, Italy, UK | 2 |
| Belgium, Canada, Croatia, Greece, Japan, Singapore, Sweden, Taiwan, Turkey | 1 |

In conclusion, a close reading of each paper supports that: 1) modern seaports are complex environments; 2) their actors operate on a global scale; 3) seaports are still linked to their cities and local communities; 4) most innovations are developed externally, and then adapted by each seaport; 5) seaports privatisation generated new intra-port cooperation

[17] This is in line with the definition coined by Flint et al. (2005, p. 114), which stress that novel customer value is dependent on "oriented social processes."

and competition dynamics; 6) Port Authorities are emerging with a new role of coordinators and facilitators; 7) stricter regulations are pushing for eco-innovations and new "responsible innovation" frameworks.

### 4.4. Sensitivity analysis

A further analysis of the articles analysed in Section 4.2, relaxing innovation terminology including terms such as "productivity" or "learning", yields the results showed in Table 12.

Table 12 – Number of articles containing the words "efficiency", "learning", "modernisation", "modernization", "productivity", "technical" and "technological" among the title, abstract or keywords

| | *Maritime Policy & Management* | *Maritime Economics and Logistics* | *Journal of Transport Geography* | *International Journal of Transport Economics* | *Transportation Research Part A: Policy and Practice* | **Total** |
|---|---|---|---|---|---|---|
| Efficiency | 5 | 15 | 0 | 23 | 7 | **50** |
| Learning | 0 | 0 | 0 | 0 | 1 | **1** |
| Modernis(z)ation | 0 | 0 | 0 | 0 | 0 | **0** |
| Productivity | 5 | 4 | 0 | 7 | 2 | **18** |
| Technical | 0 | 3 | 0 | 9 | 1 | **13** |
| Technological | 3 | 0 | 1 | 3 | 1 | **7** |
| **Innovation-related articles** | **2** | **4** | **0** | **2** | **0** | **8** |

A further 8 articles were selected after content-check and included since they address leading to productive change in seaports (Table 13). These new complementary articles that can be considered (indirectly) related to the innovation agenda and yield some insights.

This last research step confirms the scarcity of attention allocated to innovation in seaports. Despite not having a specific or explicit focus on innovation, the 8 new papers show the (mostly) positive effects of technological change in improving seaports performance, emphasising that investing and managing the optimal levels of capacity is a crucial issue in port management. On the other hand, managerial practices and excessive

organisational rigidities represent lagging variables when it comes to benefit from improvements in technology and technical efficiency. As a consequence, one can infer that introducing new technologies is not sufficient condition for productive change if not placed side by side with other, wider, softer changes. Furthermore, the research stresses the evolutionary nature of seaports, showing that they are not static autonomous entities but that they evolve according to the surrounding conditions.

Table 13 – Articles found through the sensitivity analysis

| Journal | Article | Main conclusions |
|---|---|---|
| *Maritime Policy & Management* | Beresford et al. (2004) | Seaports have an evolutionary nature |
| *Maritime Economics and Logistics* | Petit and Beresford (2009) | Seaports have an evolutionary nature |
| | Managi (2007) | New technologies and organisational change are the factors that most might explain the productivity growth in three major Japanese shipping firms |
| | Barros and Peypoch (2007) | Technological change entailed productivity growth in Italian and Portuguese Seaports. Internal and external rigidities can hinder the improvements in operational efficiency |
| | Barros (2005) | Technical innovations in seaports are fundamental in order to stimulate technical change and hence improvements in efficiency |
| | Bichou (2011) | Container terminals benefited from technological investments in security |
| *International Journal of Transport Economics* | Haralambides et al. (2010) | Internal organisation and rigid managerial practices could impede the reaching of new technological frontiers in Middle East and East African seaports |
| | Barros (2003) | Renewed policy actions and emulation of proven efficient seaports' best practice are necessary in the context of Portuguese seaports |

## 4.5. Discussion of results

Several articles stress the systemic context of seaports by emphasising the role of interactions and networks. Second, it emerges that Port Authorities can have a role of coordinating actors in the seaports innovation phenomenon. Third, innovation by seaports

has been mostly non-technological responses to external change, i.e. organisational, process and service innovations. Fourth, seaport dynamics is increasingly linked to Asia and to emerging global challenges, such as sustainability, safety and security.

The first conclusion is that seaports has not been a priority. Therefore, their innovation capabilities and inner innovation processes remain seriously under researched. A second finding is that, however little, one can notice a growing interest by scholars about the topic of innovation in seaports. Despite the small size of the sample, one can observe that this is an emerging field of study with a growing interest taking shape in the last few years. This growth has become particularly marked since the late 2000s and can be linked with the increasingly challenging operational, economic and regulatory environments surrounding seaport business.

# 5. The case of The Port of Gothenburg (PoG)

## 5.1. The making of the major Scandinavian seaport

Located in Gothenburg, Sweden, the history of the Port has very strong ties with its city, founded in 1621 (see Table 14).

Table 14 – PoG in history.

| Century | Main features |
|---|---|
| 1600 | Iron and timber exports |
| 1700 | Birth of Swedish East India Company; textiles, porcelains and drugs imported from China |
| 1800 | Expansion of the port, mechanisation of operations |
| 1900 | New structural adaptation due to Swedish emigration, establishment of shipping companies, oil terminals, containerisation, automation |
| 2015 | 820.000 TEUs; 38.2 million tonnes; 21.1 tonnes of oil; 1.7 million of passengers; 11.000 vessel calls per year; intermodal transport solutions |

Sources: Port of Gothenburg (2016a, 2016b, 2016c); PortNews (2016)

Before 2010 PoG was owned by the Gothenburg Municipality, in charge of the RoRo area (for intra-European traffic), the Container Terminal area (for containers and oversea traffic) and the Car Terminal area. This was done employing about 1200 people (PoG1, 2016, face-to-face interview). After 2010, PoG's operations were externalised to private operators in order to improve efficiency and capitalise private operators' networks (PoG1, 2016, face-to-face interview; see also Barnard, 2010 and Notteboom, 2006b).

Table 15 – Main operators in PoG

| Terminal/Activity | Company/Institution | Country of origin | Duration of the concession | Employees |
|---|---|---|---|---|
| Car terminal | Logent Gothenburg Car & RoRo | Sweden and Norway | 10 years | 60 |
| RoRo Terminal | DFDS and C.RO Ports | Denmark and Luxembourg | 25 years | 220 |
| Container terminal | APM Terminal | Denmark | 25 years | 320 blue collar, 110 white collar |
| Towage | Svitzer | Denmark | N/A | N/A |
| Pilotage | Swedish Maritime Administration | Sweden | N/A | N/A |

Sources: PoG1, PoG2 (2016, face-to-face interview); Logent (2016); World Cargo News (2011); European Commission (2012); Mannheimer Swartling (2010); Gothenburg RORO Terminal (2016); Barnard (2011)

Table 16 – Private operators and relationships with stakeholders in PoG.

| Private operators | Relationship with Stakeholders |
|---|---|
| Logent | 3-year joint customer projects; Port Authority attracts costumers, then Logent makes the final contract |
| Stena Line | Port authority attracts new costumers, then Stena Line makes the final contract |
| APM Terminal | Autonomously managing its terminal, with a $115 million plan investment. Direct interaction with neighbouring terminals about operations and future strategies. Direct interaction with rail operators, while Port Authority manages the marketing part. Lack of standardised communication procedures with Port Authority. |
| SCT Transport | Rail operator. Daily interactions with APM Terminals. Direct contacts with institutional actors. Little collaboration with Port Authority |

Sources: PoG2 (2016, face-to-face interview); Apm1 (2016, face-to-face interview); Sct1 (2016, face-to-face interview); Desormeaux (2016); APM Terminals (2014a, 2014b, 2013)

The privatisation processes entailed a renewed role for the Port Authority, in line with a world trend in this direction (see Verhoeven, 2010; Haugstetter and Cahoon, 2010; Cahoon, Pateman, and Chen 2013). Gothenburg's Port Authority assumed a new position, no longer managing daily operations and instead placing itself in a "central position"

(PoG1, 2016, face-to-face interview). The peculiarity of the new seaport environment is represented by the networks upon which private operators relay. The privatisation process:

> "…is a good thing, because each company can say: this is my business, this is my area. Before, the process was a bit more "all over the place", and one day the port could sell some trailers, the following day some containers, and so on. Today, the private operators can be more focused on their area. The processes are more structured, and it is easier to handle small units." (Apm1, 2016, face-to-face interview)

The shift to private operators was followed by a greater focus on efficiency, flexibility and lay-offs, causing agitations in the terminal by the local dockworkers union (see also *World Maritime News*, 2016).

## 5.2. A logistics service provider

PoG has turned into a logistics service provider overtime. One of the cornerstone is The RailPort Scandinavia system, a railway-bases intermodal system introduced in 2000 handling half of the containers which enters or leaves the seaport. The system is based on 25 daily shuttles bound for terminals concentrated around Jönköping and Stockholm (PoG1, 2016, face-to-face interview). The development of the network was aided by many factors, e.g. industry and costumers demands of a flexible and cost efficient logistic infrastructure, seaport's strategical geographical position, inland infrastructures already existing and an increasingly environmental-friendly awareness (Uni1, PoG1, 2016, face-to-face interview). Moving goods by rail entails an extra charge of about 150 SEK, so that for every container the Port receive an additional revenue (Uni1, 2016, face-to-face interview). Beside trailers and containers handling, the system also manages storage, customs, security and logistics in a broad prospective.

The RailPort Scandinavia system is strategical, because "without the vessels there would be no railway system and without a railway system there would be no vessels" (PoG2, 2016, face-to-face interview). PoG also offers a tool for measuring the performances of inland terminals so that customers can identify the terminal which better fits their needs, allowing to compare different terminals using a five-star ranking system (PoG1, 2016, face-to-face interview). However, the increasingly high demand of commuters' train could hinder the system itself (PoG1, 2016, face-to-face interview; see also Göteborgs Stad, 2014); and the shuttles handle containers and trailers separately, increasing complexity and lessening efficiency (Uni1, 2016, face-to-face interview).

Another kingpin of PoG logistics "servicisation" process is represented by the creation of new logistics centres. Along with a warehouse leased to DB Schenker Logistics in 2014 (PortNews, 2014a), PoG is investing about 4 billion SEK for building the so called Gothenburg logistics park (expected year of end 2025), a 1 million square meters area whose owners will be the Port Authority along with four other private companies (Port of Gothenburg, 2015). In addition, PoG is planning to build other facilities, such as warehouses for Swedish paper producers, with the possibility of just leasing lands and let someone else build the warehouses through a long term lease.

### 5.3. Port Authority as facilitator and marketing player

Nowadays, Port Authority focuses on facilitating cooperation and creating some new "thinking around logistics" (PoG1, 2016, face-to-face interview). Port Authority defines itself as a "central player in the network of Port Community, but on a higher level" (PoG2, 2016, face-to-face interview), e.g. organising workshops, cooperating with the Swedish Rail Administration or working with all the stakeholders when a new dryport proposal is considered viable. It is especially crucial the cooperation with Chalmers University and

University of Gothenburg, whose scholars are considered “the theoretical-thinking part of the Port” (PoG2, 2016, face-to-face interview).

Port Authority is also adopting an increasingly prominent marketing role, seen as an essential tool for growth (see also Cahoon, 2007), e.g. it organises a transport logistic trade fair in Munich every two years along with RailPort Scandinavia’s inland terminals (PoG1, 2016, face-to-face interview); it is member of Port of Hamburg Marketing (Port of Hamburg, 2015); it promotes container traffic in Far East, also using social media (PoG2, 2016, face-to-face interview); or it cooperates with other seaports, especially on environmental issues, as in the case of the Port of Shanghai, Port of Hamburg, Port of Zeebrugge and Finnish (*PortNews*, 2014a; PoG1, PoG2, 2016, face-to-face interview).

### 5.4. Innovation within PoG

Port Authority does not patent nor is involved in creating IT solutions. However, there is a number of joint projects with several actors involved in seaport operations (PoG1, PoG2, face-to-face interview, 2006). The attention is especially focused on green technologies, e.g. implementing a 30.000 cubic metres liquefied natural gas (LNG) terminal for making LNG available for ship bunkering (LNG-Terminal Gothenburg, 2016); introducing pioneering on-shore power supply technologies (Merk, 2013); developing onshore electricity systems to connect ferries when they are in the port, or to connect them to the local heating system in PoG (ABB, 2012); installing wind turbines (WPCI, 2016); introducing differentiated environmental port charges, favouring low polluting vessels (Port of Gothenburg, 2016d); implementing a unified vessels traffic controller system; testing of Collaborative Decision-Making (CDM) systems (Lind et al., 2016; Merkel, 2015) or implementing x-ray technologies becoming a Container Security Initiative (CSI) seaport (SAFETY4SEA, 2014). The Swedish Confederation of Transport

Enterprises (*Transportföretagen*) can also offer environmental and safety consulting services (Tf1, email interview, 2016).

However, private operators deal with complex decisional processes, given their presence in several terminals around the world, the number of stakeholders they have to interact with and the seeking of economic returns (Uni1, 206, face-to-face interview). Furthermore, private operators could concentrate the investments in the first years of the concession in order to have enough time to capitalise the gains coming from them. Since there is no certainty about the renewal of the concession, one can expect a greater focus on costs minimisation rather than on investments (see also Pallis et al., 2015). With regard to PoG's container terminal, APM Terminals is not involved in specific R&D projects since is more focused on finding new customers and capitalising its size on the market; for the innovation, it relies on its own multinational structure and purchasing power.

# 6. Conclusions, limitations and the agenda ahead

In terms of policy implications, seaports can be seen as innovation buffers or innovation multipliers. On the one hand, they are sites of "creative accommodation" of developments such as containerisation, inter-modality and ICT. On the other, they are increasingly strategic as informational and logistical hubs in today's world web of trade. Seaports are frontline sites where societal challenges related to climate change are dealt with, and this is confirmed by an emerging cluster of studies about innovation and sustainability. Their proximity to urban centres makes them big contributors in local air, water and noise pollution. Investing in clean technologies can make a difference and contribute to the wellbeing of local communities; political and social legitimacy are increasingly factors integral to ports selection environments. However, in this dissertation, a lack of studies about seaports innovation capability has emerged. The choice of specific secondary

sources, keywords and the author's discretion could represent a limitation of this study. Future researches could saturate the research and better focus on emerging technologies and environmental issues. With regard to Port of Gothenburg, it is clearly emerging the strategical marketing role of its Port Authority, whose managers are also specialised in marketing and development. With the ongoing liberalisation processes, Port Authority ceased to manage the daily operations and started promoting the seaport and facilitating its relationships. Furthermore, Port of Gothenburg is increasingly offering a high-value, high-tech, information-intensive, business-to-business, territorially-rooted and also environmental-friendly assemble of equipment and intangible assets that is customised for an individual user site but intended for standardised logistics service. Finally, economies of scale, environmental restrictions and regulations represent at the moment a strong source of innovation in seaports and in the shipping industry. In this regard, it will be essential the role of public sector: in fact, targeted regulations and tailored public policies can strongly contribute in shaping seaport innovation. Environmental-friendly innovations can constitute a leading factor in seaport innovation; in this regard, future wider researches, taking into account more stakeholders and actors, could better deepen Port Authorities' role in testing, implementing and spreading their diffusion.

# Appendix

Appendix 1 - Previous reviews on maritime economics and seaport-related topics

| Authors | Main conclusions |
|---|---|
| Metaxas (1983) | Emphasised the importance of analysing trade cycles, transportation costs and maritime evolution |
| Heaver (1993) | There exists a lack of literature in maritime economics and environmental-related topics |
| Suykens and van de Voorde (1998) | There exist an ongoing pressure on Port Authorities and seaports' emerging nature as logistics platforms. |
| Steenken et al. (2004) | Concluded that topics such as integrated optimisation and security should be investigated more |
| Heaver (2006) | Noticed an increasingly high interests in seaports, whose complexity increased since the Second World War |
| Stahlbock and Voß (2007) | Emphasised the lack of studies about integrated optimisation in container terminal operations |
| Pallis et al. (2010, 2011) | Analysed articles in seaport economics, policy and management published in the period 1997-2008 and concluded that, despite an increasingly interest in seaport economics and management, the seaport academic community is not homogeneous and remained scattered in several small communities |
| Woo et al. (2011, 2012) | Reviewed seaport research published in the period 1980-2009, stating that the topic is becoming more and more complex, multi-sectoral and multidisciplinary. |
| Lam and Gu (2013) | Analysing container terminal operations, concluded that exists a lack of studies about container flow optimisation and "green" containers. |
| Lau et al. (2013) | Carried out an extensive analysis of peer-reviewed articles about container shipping in the period 1967-2012, raising again the issue of paucity of research concerning the relationship between international trades and shipping line performances. |
| Woo et al. (2013) | Focused on the analysis of the articles published in *Maritime Policy & Management* in the period 1973-2012, noticing as well that seaport research has become more multidisciplinary and emphasising the "dramatic" rise of Asian countries (such as Honk Hong, South Korea, Singapore and Taiwan) in terms of academic contribution since the 2000s. |
| Notteboom et al. (2013) | Focused on the analysis of the articles published in *Maritime Policy & Management* in the period 1973-2012, noticing a geographical concentration of researchers, a high fragmentation in seaport research topics and an overall existence of over-specialised and little multidisciplinary researches |
| Talley (2013) | Focused on the articles published in *Maritime Policy & Management* in the period 2001-2012 and *Maritime Economics & Logistics* in the period 2002-2012, identifying in both the journals the little attention given to seaports and the prevalence of topics such as shipping performance/management and shipping finance. |
| Hidalgo-Gallego et al. (2016) | Stressed the need to better understand intra-port and inter-port cooperation and competition, and especially non-price behaviour and emergence of port specialisation. |

Appendix 2 – Main findings of the articles in the sample (=22)

| Authors | Main findings |
|---|---|
| van Driel (2002) | Analysed the innovation patterns in the mechanisation processes occurred in the Port of Rotterdam in the period 1886-1923, highlighting the importance of the municipality of Rotterdam and service users in spurring the innovativeness of its seaport during the first years. However, the private operators became afterwards the leading actors in seaport operations (stevedoring), thanks to their interaction with other firms in supply chain and vertical integration. |
| Sabrás (2004) | Outlined the progressive organisational and technological change of Spanish seaports since the 1990s, considering them a private enterprise offering high added value services. |
| Visser (2007) | Outlined the existence of fourth-party logistics, which consists in logistics service providers taking care of the entire configuration of the supply-chain and also managing R&D along with costumers. According to the author, fourth-party services are more likely to develop in dynamic, interactive and multi-actor environments, such as port area. |
| de Langen and Chouly (2009) | Analysed Dutch terminal operating companies (TOC) and concluded that in a context in which seaport are becoming service providers, TOC are also gradually becoming service operators on an international scale. |
| Haugstetter and Cahoon (2010) | Emphasised Port Authorities' strategic role in allowing coordination and dissemination of knowledge within seaports. They can intercept a huge amount of information and ensure its circulation among the cluster. |
| Blanco et al. (2010) | Analysed the Spanish seaport system, conclude that Port Authorities are leading actors in innovation, despite their little efforts and most of innovation are taken from outside and adopted by private enterprises. |
| Wiegmans and Geerlings (2010) | Identified the main Sustainable Port Innovation (SPI) and emphasise, in the framework of the Port of Amsterdam, the importance of general sustainability-related innovations, which are mostly implemented thanks to regulators and Port Authority's efforts. |
| Girard (2010) | Highlighted seaports' role as leading innovators in the regional framework. Seaports are seen as a complex system influenced by several socio-economic and cultural aspects. Furthermore, seaports are seen as places of creativity and capable of architecturally and environmentally shaping the surrounding areas. |
| Hall and Jacobs (2010) | Emphasised the proximity as important factor in seaport innovation, where collaboration between supply chain actors can bring competitive advantage. However, proximity is less and less relevant due to globalisation processes which led to the existence of global private operators vertically and horizontally integrated with the supply chain. Therefore, the authors wish that new policies will be implemented for improving a modern institutional proximity. |
| Keceli (2011) | Conducted a SWOT analysis about the port community system in Turkey, warning that a renewed role is required for Port Authorities in order to guarantee the exchange of information between the actors, to develop infrastructures and ICT and to improve collaboration with regional and local stakeholders. |
| Blanco et al. (2011) | With the aim of understanding who finances innovation in Spanish seaports, conducted a survey with all the existing Spanish Port Authorities, concluding that most of innovation are developed externally. Furthermore, they concluded that Spanish Port Authorities do not finance directly the innovations, but have a strategic guide role in stimulating their adoption. |
| Cahoon et al. (2013) | Port Authorities' central position in the network make them innovation leaders and an ideal intermediate layer, since they intercept knowledge which could be translated and redistributed among the other actors. |
| Arduino et al. (2013) | Identified the involvement of all the actors in seaport networks as the promoter of organizational and managerial innovations; in particular, they analysed three port-related cases of innovations implementation, emphasizing the role of the public intervention for a successful implementation of new technologies and innovations. |
| Hall et al. (2013) | Showed how new technologies and logistics innovation in seaports emerge as a result of social interactions and interdependency between several actors and interests involved in seaports' clusters. |
| de Martino et al. (2013) | Analysed the implementation of logistics innovations in seaports, developing a possible framework in which Port Authorities are the cornerstone in fostering the adoption of innovations. Albeit considering innovation as a result of different interactions, the authors considered to be very complex to estimate to what extent the different interests of the many actors involved in seaports could conflict and thus weaken the direct relationship between innovation and interaction. In this context, Port Authorities can contribute in reducing conflicts and facilitating the interaction. |

| | |
|---|---|
| Maritz et al. (2014) | Outlined the so-called green ports and the role of technical innovations in reducing the negative externalities of port operations on the environment, such the adoption of low-sulphur fuel, reducing the use of high-polluting trucks optimising energy consumption and waste management. |
| Hein (2014) | Addressed the relationship between seaports and their cities, emphasizing the strategical role of the formers in accumulating wealth and innovation. In particular, seaports are seen as "spatial embodiment of global economic flows between sea and land" (p.356). |
| Acciaro et al. (2014) | Conducting a study on environmental green innovation projects adopted in 7 different seaports, emphasised the existence of a mismatch and a misalignment between the objectives stated in environmental innovation policies and the real outcomes obtained. This is due to the prevailing of regulatory policies and landlord port functions. |
| Ravesteijn et al. (2014) | Tackled the theme of Responsible Innovation in seaports conducting a case study on the Nansha Port Railway Project (China). Emerges the necessity of a multi-level approach, given the existence of several different actors requires a strong coordination. In this direction, focusing on Process Management or implementing institutions such as the Multi-stakeholder Advisory Committee could blend more harmoniously the complex innovation process in seaports. |
| Song and Ravesteijn (2015) | Took into account the socio-economic-environmental impacts of the development of an innovative project for the expansion of the Port of Shanghai, emphasising the importance of involving all the stakeholder and implementing process management measures. |
| Ravesteijn et al. (2015) | Conducted two case studies about the construction of the Rotterdam Maasvlakte 2 Port (Netherlands) and the expansion of the Dayao Bay in the Port of Dalian (China), introducing a multi-level approach for implementing a Responsible Innovation. This approach aims to involve all the possible actors and stakeholders in the introduction of a Responsible Innovation. |
| Sakalayen et al. (2016) | Focused on the Australian maritime system, analysing regional seaports and emphasising their critical role in the Regional Innovation System (RIS) for the development of the surrounding region as a whole. |

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