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## Strategic port development: identifying a development approach for small and medium-sized ports

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**Abstract:** While large global ports are recognised as playing a central role in many supply chains as logistic gateways, smaller regional ports have been more stagnant and have not reached the same level of development as the larger ports. The research literature in relation to port development is also heavily focussed on larger ports. The smaller ports do not have the same resources and knowledge to implement the techniques that have been developed for the larger ports, as these methods often are very complex in nature. Smaller ports do not have the economics of scale to support more complex developments. This paper examines a series of models from the port development literature and then proposes an approach for conceptualizing the strategic development of a port's collaboration with local operators and the local hinterland based on connected development steps. The paper is based on a literature review relevant to international port development and a case study done in a Danish port as part of the main authors PhD project. The proposed model provides a strategic approach to control and improve the development of a port system and the connected hinterland. While the model is generic in its approach, the authors apply it to a Danish case study that illustrates its potential usage in determining port development.

**Keywords:** Port strategy, Danish port development, supply chain, hinterland development, port integration

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### 1 Introduction

Danish Ports play a central role in many regional supply chains as logistic gateways and intermodal hubs. Compared to other logistics hubs, ports are different as they often have several companies doing the same type of tasks such as shipping and support personnel. This presents some challenges in terms of creating common strategies and knowledge sharing in the port system. Furthermore, the volume of goods going to and from a ship requires coordination between the different actors involved, and, because of the lack of a common strategic approach coordination is difficult to achieve. The importance of the connection between ports and supply chains, require the ports to have a more proactive and integrated approach to the supply chains than they have had historically (Beresford et al. 2004). Bichou and Gray (2004) have described the concept of integrated port systems, as "the integration of supply chain partners in regards to cash flow, information flow and physical flow".

This paper will look at how a port can create a common strategic setup based on models from the research literature and previous work in other ports. Most of the published literature about port development, is

made in a context of the large global ports such as Rotterdam, Antwerp, Hong Kong and Shanghai, as exemplified by the work of Notteboom and Rodrigue, (2005) and Wang et al., (2006). Therefore the current port literature have a large focus on mathematical modelling and optimisation, because of more stable demand and a vastly larger quantity of cargo. For smaller ports, however, one of the main challenges is to engage in better supply chain development and integration. The focus on small percentage optimisation via mathematical modelling is not as relevant, at least not in the current state of development for smaller ports. Further the larger ports have already made the move from being gateways to integrators, as seen in the literature.

Pettit and Beresford (2009) describe different port roles in terms of demand characteristics and the transition of ports from simple gateways to larger and more complex logistic hubs. The role of the port depends on the type of supply chain in operation as well as overall supply and demand characteristics. Supply and demand characteristics define how short and long-term planning can be used to smooth the utilisation of resources. The characteristics are often dependent on the uncertainty between the different echelons as well as various product types. Demand and supply can be seasonal, stochastic, continuous or dependent (Slack et al., 2007). The different roles the port can take is dependent on the demand characteristics, which means a port has to provide different services depending on the nature of the supply chain, so it is essential for a port to define how the port environment is configured for the supply chains.

An example of strategic port development is presented by Van den Berg and De Langen (2011) showing the case of the Port of Barcelona in regional Spain. The case of Barcelona is used because it shows how a port can move from being a gateway to a supply chain integrator, by improving the infrastructure in land and building distributions centres. This is achieved by port managers understanding the need for servicing the users of the port with the correct mixture of efficiency and flexibility in the transport solutions. Barcelona's strategy moved from a very port-centric strategy to proactively supporting customers supply chain development. For the Port of Barcelona, the competitiveness of the supply chain is increased by integrating the hinterland and partners into the operation of the port so the services provided by the port are tailored for its users.

According to Brooks et al. (2010) small and medium-sized ports need to focus on developing their coordination competencies in their own operations and the collaboration competencies in relation to other ports and companies. This can be seen as the key driver in converting a port from a gateway to an integrated logistics hub. Bichou and Gray (2004) have previously described the concept of integrated port systems. An integrated port system is the integration of supply chain partners in regards to information flow, physical flow and cash flow. One of the main motivations for small and medium-sized ports is to improve the growth of the port's hinterland, both in terms of job creation and moving goods from land to sea. There is, however, a need for an approach that will support the process of choosing the strategic direction and collaboration initiatives for small and medium-sized ports.

To define small and medium-sized ports, the EU Commission's definition, for small and medium-sized companies is used. (EU Commission, 2003). The definition is that small companies have up to 50 employees, medium-sized companies have up to 250 employees. By this definition most ports in Denmark are small companies and a few are medium-sized, as most have under 50 employees. The Port of Aalborg which is used as an example here, has around 70 employees, and is therefore placed in the medium-sized ports category. The port is a medium-sized port, in Aalborg, a city of 150,000 people and 600.000 in the region. The port of Aalborg is in international context a small regional port, with around 100.000 TEU, compared to 800.000 TEU in the Port of Aarhus and 14.000.000 in Rotterdam. The port of Aalborg also have activity in bulk and special cargo. The port of Aalborg had a turnover of DKK 134.794.000 in 2012 compared to Aarhus with DKK 227.869.000 and again Rotterdam with € 615.300.000<sup>1</sup>.

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<sup>1</sup> Numbers taken from annual reports from the ports' websites. <http://www.aalborghavn.dk/>, <http://www.aarhushavn.dk/> and <http://www.portofrotterdam.com/>

The goal of this paper is then to examine if large port literature is relevant to small ports, and if this can be used to create a framework for organising the strategic development of the small pots.

## 2 Research methodology

The aim of this paper is to present methods for strategy development in small or medium-sized ports as part of a larger case study approach (Yin, 2008). The case study is part of the main author's PhD project. A literature study was used to describe the history and trends in port development in order to find an approach to define the development of the tasks and infrastructure of ports, especially the port authority. Strategic models from the port literature are presented and used to construct a framework, for how to structure the development of smaller ports. This framework is then evaluated against different projects at the case port, to analyse if there is correlation between the model and the real world. Interviews was undertaken to add a qualitative perspective to the Port of Aalborg case. The interviews were conducted with different companies at the Port of Aalborg to provide input for the position of the port in the development tree, and, provide examples of how supply chains have developed in a Danish ports.

Three examples of port development are used to evaluate presented framework, as part of the authors PhD project. The case is used because it illustrates that the development process of a smaller port resembles the development of larger ports, and therefore justifies the use of large port models in creating a smaller port strategic framework. The case of Aalborg is used to validate that smaller ports can use the presented framework.

## 3 Literature on Port development

This section will examine trends in the published literature on port development and related issues arising from those trends towards current developments in a port. Port strategy development, regionalisation, terminalisation and port system development are the general concepts that are referred to in much of the port logistics literature and they will be introduced in the following discussion. The literature review will form the basis of a new development approach.

Port development as a research focus which gained attention with the UNCTAD<sup>2</sup> commissioning of an investigation into how ports have developed historically and what level of maturity the ports are on, in regards to the different services it provides. UNCTAD commissioned the report in the 1990's and it showed that ports had been moving from a purely landlord based form of operations (and not participating in the logistic operations) to a more integrated form of operations. The UNCTAD model segments ports into three different generations, which signify a stage of development. The first generation is exemplified by no logistic involvement by the port, whereas the second generation involves some logistic involvement and in the third generation, ports act as logistic integrators. Between these generations there is a movement, which signify a development of the competencies required to become a more advanced port system.

Figure 1 presents the definition of the three generation port model from the UNCTAD. It is based on the historical development of the large global ports, and, it is also an attempt to show how ports on lower generations should develop in incremental steps. The model is highly focussed on how the port is involved in the cargo flow and illustrates that ports should focus on facilitating integrated cargo handling.

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<sup>2</sup> United Nations Conference on Trade and Development, <http://unctad.org/en/Pages/Home.aspx>

**Table 1. The UNCTAD Three Generation Port Model.**

Period of development	First generation	Second generation	Third generation
	Before 1960s	After 1960s	After 1980s
Main cargo	<ul style="list-style-type: none"> <li>• Break bulk cargo</li> </ul>	<ul style="list-style-type: none"> <li>• Break bulk and dry/liquid bulk cargo</li> </ul>	<ul style="list-style-type: none"> <li>• Bulk and unitized containerized cargo</li> </ul>
Attitude and strategy of port development	<ul style="list-style-type: none"> <li>• Conservative</li> <li>• Changing point of transport node</li> </ul>	<ul style="list-style-type: none"> <li>• Expansionist</li> <li>• Transport, industrial and commercial centre</li> </ul>	<ul style="list-style-type: none"> <li>• Commercially oriented</li> <li>• Integrated transport centre/ logistic platform for international trade</li> </ul>
Scope of activities	<ul style="list-style-type: none"> <li>• 1—Cargo loading, discharging, storage, navigational service</li> <li>• Quay and waterfront area</li> </ul>	<ul style="list-style-type: none"> <li>• 1+</li> <li>• 2—Cargo transformation; ship-related industrial and commercial services</li> <li>• Enlarged port area</li> </ul>	<ul style="list-style-type: none"> <li>• 1+2+</li> <li>• 3—Cargo and information distribution; logistics activities</li> <li>• Terminals and distribelt towards landside</li> </ul>
Organization characteristics	<ul style="list-style-type: none"> <li>• Independent activities within port</li> <li>• Informal relationship between port and port users</li> </ul>	<ul style="list-style-type: none"> <li>• Closer relationship between port and port users</li> <li>• Loose relationship between activities in port</li> <li>• Casual relationship between port and municipality</li> </ul>	<ul style="list-style-type: none"> <li>• United port community</li> <li>• Integration of port with trade and transport chain</li> <li>• Close relationship between port and municipality</li> <li>• Enlarged port organization</li> </ul>
Production characteristics	<ul style="list-style-type: none"> <li>• Cargo flow</li> <li>• Simple individual service</li> <li>• Low value added</li> </ul>	<ul style="list-style-type: none"> <li>• Cargo flow</li> <li>• Cargo transformation</li> <li>• Combined services</li> <li>• Improved value added</li> </ul>	<ul style="list-style-type: none"> <li>• Cargo/information flow</li> <li>• Cargo/information distribution</li> <li>• Multiple-service package</li> <li>• High value added</li> </ul>
Decisive factors	<ul style="list-style-type: none"> <li>• Labour/capital</li> </ul>	<ul style="list-style-type: none"> <li>• Capital</li> </ul>	<ul style="list-style-type: none"> <li>• Technology/know-how</li> </ul>

**Figure 1 is the definition of the three generation port development model from the UNCTAD report. (Beresford et al., 2004)**

The UNCTAD model was later followed by the WORKPORT model by Ninipoulos et al. (2000), which was the result of a project funded by the EU commission. The WORKPORT model is based on a research project investigating how new developing technologies and other external developments have played a role in the development of ports. One of the WORKPORT project's conclusions was that the three stage generation model of UNCTAD was too rigid in its approach to describe the real development of ports. Another conclusion was that that the port could be at different stages of development in different areas at the same time.

Later Beresford et al. (2004) review the UNCTAD model and the WORKPORT model. They also conclude that the UNCTAD model is too rigid and that port development is often more distributed between different areas. This is also confirmed by more conventional view as ports have systems that are highly developed, and some that are not. Furthermore, the point is made that the shift from one generation to another is not done in jumps but in a more continuous manner.

These models are the base of much of the literature on port development especially the continuous development described in the WORKPORT model and the review by Beresford et al. (2004), represents the historic development of ports and the increasing focus on a more integrated approach to port development. The developments have shown that it is important to look at the hinterland and foreland, when deciding on a strategic approach. Figure 2 illustrates how the WORKPORT model identifies the development of different areas of the ports operations. The expanding arrow indicates that this area is an increased focus or impact. The arrow can also be narrowing, e.g. with environmental impact, meaning that e.g. the environmental footprint becomes smaller. In relation to this paper, the interesting aspect of this model is that it can be used to describe the strategy for increased logistic involvement in the hinterland.

	1960s	1970s	1980s	1990s	2000s
Ports role in global supply chain					
	Low value-added	Cargo transformation and improved value-added		High value-added	Lean and Agile logistics?

Figure 2 Increasing integration of ports into supply chain (Pettit and Beresford, 2009).

Most of the models and the research literature related to port development are made on the basis of case studies of larger ports such as Rotterdam and Antwerp. This presents some challenges in applying new strategies with smaller ports. There is a need for a modified approach that takes into account that smaller ports needs to be more actively engaged in the development of the various company supply chains and involvement in the port's hinterland, i.e. a focus on specific products or product types to find avenues of growth. To identify which product types to focus on, a method could be to investigate which products are eligible for a strategic push from a port.

### Regionalisation – Expand, specialise and organise into the region

Regionalisation is the process where a port develops into a defining transportation hub for an entire region, for example Hamburg, and Rotterdam. Regionalisation does, however, still apply for smaller ports because it describes how to influence the development of hinterland and the functionality of the port in order to create a greater need for the products delivered by the port. Notteboom and Rodrigue (2005) discuss some of the obstacles often present in this development such as governance issues, capital raising, and, the coordination and cooperation that is required between partners. To create a successful regionalisation strategy, it is necessary to improve the environment in the ports based on the obstacles or barriers (Notteboom and Rodrigue, 2005).

Successful regionalisation can result in the port becoming the primary logistics hub in a larger geographical area. This creates a situation where the entire region becomes more competitive and connected to the global trade channels (Van den Berg and De Langen, 2011). In Figure 3 regionalisation is defined as the gradual expansion of the geographical influence of the port. The main issue in moving towards regionalisation is to remove the hinterland's barriers for not using the port in question. The gradual process starts with removing the closest barriers in the port and the city and then move out in to the hinterland until the strategic goal is reached. In this process there is an expansion of activities in the port that attracts new cargo, which is followed by an increased specialisation of the port to service the customers and the utilising this specialisation to attract new cargo from a larger geographic area by also improving the access to the port.

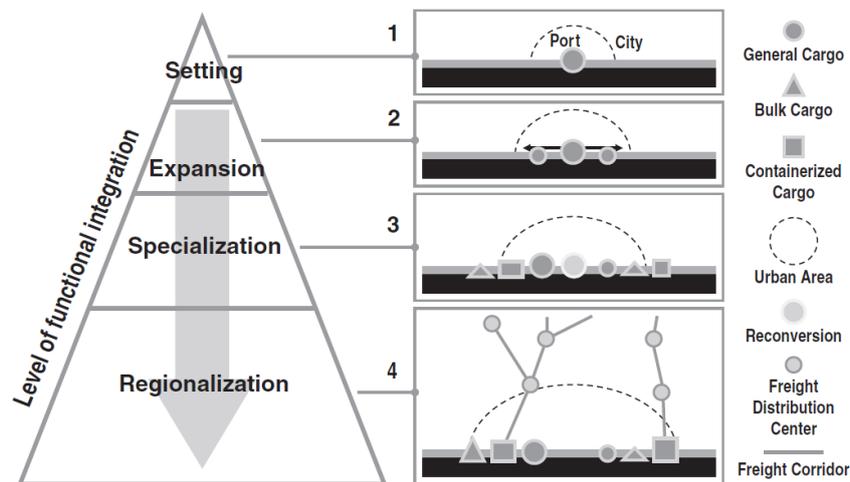


Figure 3 illustrates regionalisation which is defined as the gradual expansion of the geographical influence of a port (Notteboom and Rodrigue, 2005)

It is necessary to scale down the concepts of regionalisation to fit into small and medium-sized ports because of economies of scale and because smaller ports will never have the same natural attraction of cargo as large ports have. Instead, small and medium-sized ports should focus on single products or product types and form their strategy in a way that makes them a major player in a specific segment and in the local area. Whether port regionalisation also applies to single product or industry type e.g. windmill blades, needs to be addressed and explored. This is done by improving infrastructure that relates to the product in question, and facilitating contact to transporters and shipping agents.

### Terminalisation – Defining a port’s role in the supply chain

In connection with integrating and developing the port and its contiguous hinterland, there has been increased focus on the range of activities that could add value when goods pass through the port. The concept of terminalisation has been developed by Rodrigue and Notteboom (2009) by presenting two main forms. A Bottle-neck derived terminalisation is when the port is delaying part of the supply chain either by lack of resources or poor quality of planning and operations. The other form is warehouse- derived terminalisation, which is when distribution centres are placed in a port to increase service level and decrease delivery time to the local supply chain. This should be done as opposed to sending goods further into the supply chain, i.e. using many local warehouses.

Warehouse terminalisation status can add value because the inventory holdings in the supply chain are often reduced as inventory and safety stock is consolidated in one place. However, the warehouse- derived terminalisation concept mostly applies to large continental ports. Smaller ports have access to a much smaller hinterland and economies of scale are not large enough to support distribution centres on a broad sample of products, (but there will often be some special cases where it may prove a vital part of keeping a supply chain competitive). Rodrigue and Notteboom (2009) also point to the shift from the bottleneck view to the warehouse terminalisation view can be seen as a change from push to pull logistics. Warehouse terminalisation increases the perceived customer service level in the downstream of the supply chain, whereas bottleneck terminalisation reduces the competitiveness of both port and supply chain without a constant focus on effectiveness. Terminalisation is essentially a way of defining the port environment regarding product types and products as it defines how a supply chain is configured, and how it is controlled. This view is also known from the manufacturing sector with concepts such as make-to-stock, assemble-to-order, make-to-order etc. It can be described as a method for deciding how to react to demand and what the port systems role is within this.

Figure 4 illustrates that terminalisation is either about getting goods directly to customers as fast as possible or providing a value adding activity inside the port system or the extended gate and distribution centre, this is why it is called bottle-neck and warehouse terminalisation. This is seen by cargo going

directly to customers from the gateway or through a warehouse facility. When the cargo approach the gateway and its associated distribution centres and warehouses it is, either moved directly to a terminal or consolidated with other cargo to fill containers. The cargo is then shipped, and often the cargo is transported to hubs and moved to another ship depending on the destination, this can be Asian cargo consolidated in Singapore for Europe or cargo sent from Aalborg to Rotterdam and further into the global system. The gateways have one task and that is to transform cargo from one transport form to the other, if cargo is pushed directly to and from customers and suppliers through gateways it is called bottleneck terminalisation as the capacity in the gateway can delay the transformation process. When goods are consolidated in distribution centres, customers and suppliers have a different perspective of how the port performs. The gateways and hubs is primarily about converting goods from sea too land, and this have to be effective as these are bottle-necks in the extended supply chain.

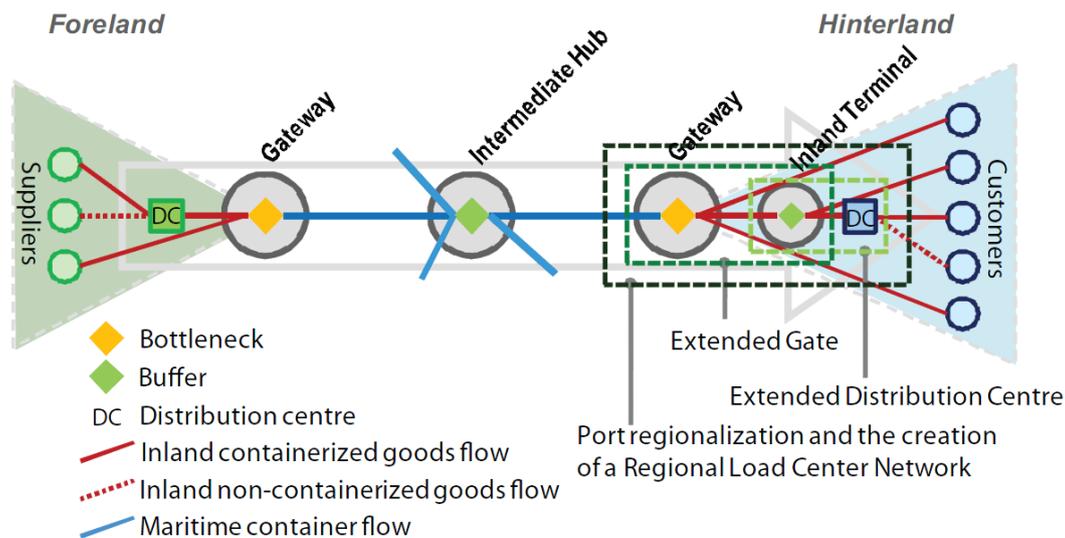


Figure 4 shows terminalisation in relation to the supply chain, either as a bottle-neck (gateway) or a warehouse (value adding). (Rodrigue and Notteboom, 2009)

Examples of the different types of terminalisation can be seen in all commercial ports. In Denmark there several small ports, that all provide slightly different services and therefore examples of terminalisation. In the port of Hirtshals the main business is ferry traffic to Norway, this is an example of gateway terminalisation as passengers are not stored for later distribution. In the port of Esbjerg there is a large off-shore community, where e.g. windmill projects are consolidated before being distributed to the project site, which is an example of warehouse terminalisation as seen from the supplier side. These examples show that terminalisation is about the port handling different products in the optimal way, and depending on the product type the nuances shift, as not all products are as clear cut as e.g. passengers for a ferry.

### Competitive advantage of Ports

Competitive advantage is introduced as a concept to add further depth to the development models and relate them to what is practical applicable in a smaller port context. The reason for this is that the small ports have to choose which functions to invest in, and this has to be based on their competencies and what creates value for the hinterland, if this is not part of the consideration the competitiveness of the port is not improved or the price for better performance might be too high for small ports to handle. The concepts introduced in this section are by no means unique to the port industry, but they are highly relevant as the ports are moving from being government owned to being competing companies, and they need to find their place in the free market.

### Core competencies

The competitive advantage is a key driver in converting a port from a gateway to an integrated logistics hub, which is in line with Prahalad and Hamel (1990) who stated that focusing on the organisation's core

competencies relates to the success of the business. Hafeez et al. (2002) show that the uniqueness of a company's competencies are key in how sustainable the competitive advantage is. In Figure 5 physical assets are considered resources that the capabilities are related to, but in a port system the physical asset can be part of the core competencies, as it can provide a sustainable competitive advantage in certain specialised supply chains. Therefore, ports need to ensure that the physical assets are seen as a driver for growth but at the same time ensure that the physical assets are strategically tied to a specific product or service.

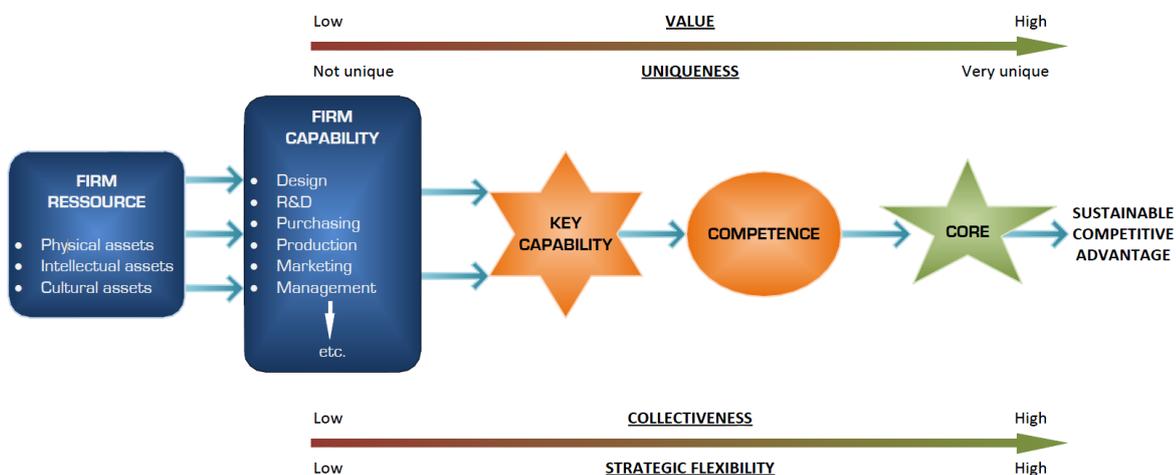


Figure 5 illustrates how the uniqueness of a product or a service contribute to the strategic and sustainable competitiveness, by defining the unique qualities of a company in relation to completion and the supply chain. (Hafeez et al., 2002).

This model fits well with the development trends presented in Figure 2, as the development towards integration as well as regionalisation and terminalisation of the port environment, is about focusing on the special needs and barriers that are between the hinterland and the port. Developing the core competencies based on this knowledge can lead to a sustainable competitive advantage. A port can use the model in Figure 5 to define what competencies it needs to develop, in order to improve its competitiveness in regards to the hinterland and the different supply chains. Based on the core requirement, a set of competencies needed to support the core can be defined. Further, the competencies are based on capabilities, and these capabilities have an organisational rooting. The development of core competencies should be viewed from a port system level to include port authority and companies involved in the supply chains.

To exemplify how a port can view this model: A resource could be the docks which are administrated by the port authority and operated by support personnel. The capability could be the ability to handle the transformation of goods from land to sea on this dock, and the competence is to have a skilled team of operators that ensures superior quality. The core competency could then be having the ability to handle a special type of cargo that requires special resources and special skills.

### Identifying value adding activities

When focusing on the core competencies of a port, it is also important to consider if these competencies create value for the goods' owner, or, if the port can contribute additional value adding by offering additional services. There are several ways of creating value in a port, also exemplified by the concept of terminalisation that identify the type of solution the port should provide for a certain supply chain.

Further the concept of regionalisation where the port breaks down the infrastructural barriers, by improving the access to the port, either by improved transport connections or by improving the services offered in the port system towards the specific supply chains. To identify if activities are value adding, a framework is used, which describes value adding activities in logistic centres. Figure 6 shows how ECOSOC<sup>3</sup>

<sup>3</sup> United Nations and Economics and Social Counsel - <http://www.un.org/en/ecosoc/>

has defined value-adding in logistics centres in port areas (United Nations and Economic and Social Commission for Asia and the Pacific, 2002). In general, the value-adding activities are either what the customer wants or, something that improves what the customer wants, which is in line with the Lean terminology's first principal of "customer value" from (Womack and Jones, 2003). It is also in line with the seven wastes presented in (Ōno, 1988). In the report that led to Figure 6 inventory, packing, order picking and customizing are named as activities that are value adding in a port. However, this would depend on the requirements of the specific supply chain, relating this to the concept of terminalisation where the correct handling of goods is decided based on configuration and needs of the supply chains, ensuring specific supply chains are serviced most optimal. Figure 6 can apply to many other situations than ports, but it is made with ports in mind. The model presented is equally applicable to other transport hubs, as the mechanics are the same, i.e. the transformation and terminalisation of cargo. The difference for ports as compared to other nodes in a supply chain, especially smaller ports, is the fragmentation of the ownership of activities in a port. In smaller ports there can be anywhere from 1 to 20 companies involved in activities. This means the consideration of value adding activities will be on a more strategic level, as practical implementation is spread across numerous actors.

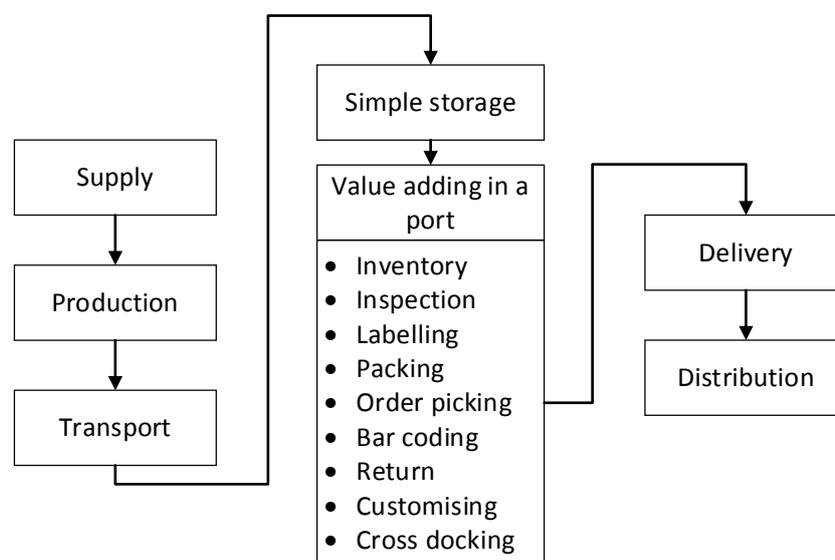


Figure 6 based on United Nations and Economic and Social Commission for Asia and the Pacific (2002). The port is between transport and delivery, and have the opportunity to add value to the supply chain with a series of different activities.

By introducing new value-adding activities in the ports, a more competitive situation is created within the port system as there is focus on what the different supply chains benefit from. By including the different aspects described in this paper, it is possible to describe the process of developing a port's hinterland and how the port can be more effective in its current operations. This is in line with terminalisation where the port environment is defined for product types, making the addition of value adding activities that supplement the core activity for the specific product type. In terminalisation, warehousing is mentioned as value adding, what this model does is to expand this to include a more detailed model to describe what activities can be counted under warehouse derived terminalisation.

The theories presented here are all developed based on the actual development of these large ports, and therefore there might be some concerns whether these apply to smaller ports. The issue at hand here is the economics of scale, and the ability to support all types of supply chains. That is why the author introduce the concept of core competencies and value adding activities, because that only by defining these are the smaller ports able to commit investments to remove barriers. The limitation is economics of scale and possible activity levels. The next step in this paper is then to attempt to create a framework that can support small port development based on this literature.

## The Port of Barcelona

This case is described by Van den Berg and De Langen (2011), Van den Berg et al (2012) and is further elaborated on the Port of Barcelona's website<sup>4</sup>. It is one of the better examples of logistics development which are discussed in the UNCTAD and WORKPORT models. The Port of Barcelona started its current progressive strategies in 1998, where they improved the gateway terminalisation of the port thereby improving the basic infrastructure in the port for the benefit of its customers. In 2003 they started developing their hinterland involvement to make the port more attractive. They did this in part by developing the services they provide according to the needs of the hinterland. This was further refined by a new strategy adjustment in 2009 that meant an even larger focus on the needs of the hinterland and reducing the barriers towards using the port. In recent years the port has undertaken further development of its hinterland, in terms of connected inland terminals and effective transport corridors to several surrounding cities as far away as Zaragoza, Madrid and Lyon. This was done in order to make Barcelona part of a natural transport network used in the region. Not only did the authorities create railroad connections to these cities, but they also helped create cross docking centres in these inland transport centres that would further attract cargo from the local area of each city, indirectly moving the port closer to the customer.

The Barcelona case is also an example of how a port with a strategic direction can facilitate and drive development although none of the industry partners were interested in building the new infrastructure which was seen to be too expensive and risky. However, Barcelona saw the opportunity to invest in the rail network and to reduce the barriers towards using the port and have succeeded in attracting more goods, almost doubling the goods from Zaragoza (Van den Berg and De Langen, 2011).

The Barcelona case also shows how companies in the port hinterland can change their transport habits if a different solution is presented. It also shows that in order to drive such a development it is necessary to invest in improving the infrastructure for port managers to be conscious about overall strategic direction. The port development literature also suggests ports will move towards more integrated and ICT based directions, where actions and transactions are supported by a planning and execution system, (Keceli, 2011) and (Perego et al., 2011). Therefore the Barcelona case is an example of active port development based on recognised models and shows it is possible for ports to be the facilitator.

There are other examples in literature on how ports have developed based on similar use of models and an active approach. The Port of Gothenburg in Sweden have created a setup where they are connected to a number of inland terminals creating an integrated transport solution for much of the Swedish hinterland. The term used for describing this development process is called "dry ports", and is the establishment of inland terminals that consolidate the cargo before it arrives at the port enabling an effective cargo transformation in the port. In this example the terminalisation in the port is mostly the gateway approach, while the warehouse approach have been moved inland. The Gothenburg case is taken from (Roso, 2007) and (Roso and Lumsden, 2010).

## 4 Port development framework

The port development in larger port as seen in the literature, shows that the development of ports is an activity of integration. Integration with the hinterland in an effort to improve the attractiveness of the ports as a transport hub, to an increasingly active hinterland. This process is done by removing barriers, the term used in regionalisation by (Notteboom and Rodrigue, 2005), for companies in the hinterland in order to use the specific port. The approach for removing barriers and improving competitiveness is done in accordance with the theory, by taking the main messages from the presented models:

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<sup>4</sup> <http://www.portdebarcelona.cat/>

- Provide infrastructure and access
- Configure the port system to support the hinterland
  - Specialisation of the ports resources and infrastructure
- Define the port functions in relations to specific supply chains
  - Gateway or distribution
- Define core competencies
  - To invest and specialise in cargo that have strategic importance
- Improve existing port services
  - Based on customer value and removal of waste
- Find new port services
  - Identify value creating activities for different supply chains

Based on these points the framework model is created, it has four core activities based on regionalisation, terminalisation, core competencies and value adding, see Figure 7. These are put in a cyclic pattern that starts with regionalisation. The reason behind this is that regionalisation is the core activity in reaching out to the hinterland, and is the strategic decision that starts the activities. Terminalisation is second as the decision to handle a product in a certain way is important to make the port competitive in a new supply chain setup. Core competencies are included as third as smaller port needs to define very carefully what tasks they can do and want to invest in, both in terms of investments and profitability. Value adding activities are essential to any company or supply chain, as all existing activities needs to be evaluated and new have to be made. The reason value adding is included here is that ports, in Denmark especially, have gone from being government owned ports, that only provided a gateway and landlord function, to becoming an active supply chain partner with focus on competitiveness and service creation.

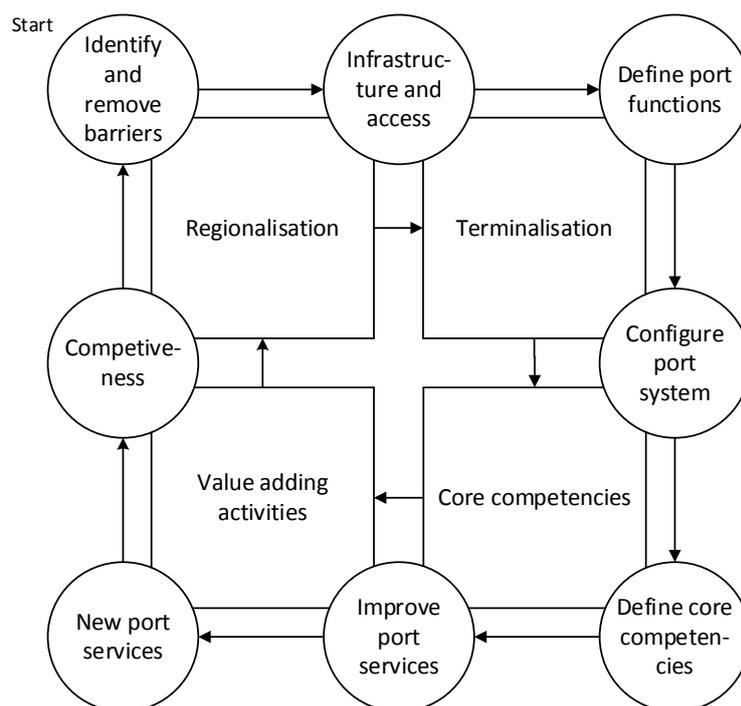


Figure 7 shows the process of configuring the port system to improve competitiveness and integration of the port and hinterland. The process showed in the outer ring is based on the concepts in the inner ring. .

The framework in Figure 7 provides the steps that will allow smaller ports to follow and modify the development of the larger ports in a structured iterative process. This model is very interesting in the small port segment as it will give the ports a tool for going from an ad-hoc type approach to development of the hinterland, to a more structured repeatable process, which is not found in literature or directly present in the industry. This is a process that is ongoing, and especially the services and competencies are something

the port can work with continuously and improving value adding activities. Terminalisation and regionalisation have a longer time horizon, but influence heavily on the day to day performance.

To validate this framework it is tried against existing examples of port development in the port of Aalborg. In order to verify the framework it is necessary to show that the development fits the underlying models.

## 5 Port development in the Port of Aalborg

The Port of Aalborg has started the development of a more integrated and proactive approach to the logistic offerings available at the port. There are several examples at the port on how to acknowledge the needs of the industry when configuring the infrastructure as well as changing the supply chain setup. These reconfigurations have not been done according to any model or framework plan, and the port authority is not directly involved in all projects, however the examples below illustrate how the port indirectly make use of the concepts presented in the framework in Figure 7.

The examples in this section is based on interviews and observation, the interviewed are all employees in companies operating in the port, they are not mentioned here as a courtesy, but the main author will provide the relevant information if requested.

### Container feeder line

Container transport has historically been handled by two or three ports in Denmark, from the introduction of unitised (containerised) cargo in the 1960s. For a long time truck-transport has been the only attractive transport form in Aalborg because of slow service and stagnant development generally in Danish ports. The Port of Aalborg has started a weekly container feeder service that sails between Rotterdam, Aalborg and Gothenburg. This is the result of intense collaborative work with shipping lines, freight operators and other involved partners in Northern Jutland to ensure there would be enough containers to maintain such a route. This route gives Aalborg direct access to the international container network via Rotterdam and also access to other ports in the Baltic and Scandinavian region. This has led to an increase in the container traffic going out of Aalborg, where it previously only had a Denmark – Greenland route. This is a good example of how a port can break barriers by creating new alternatives and by doing so move closer to the companies in the hinterland. Relating the container feeder line project with the presented framework in Figure 7, the introduction of the feeder line is an example of removing barriers for companies in the hinterland. The barrier in this example is the possibility to ship containers through Aalborg to the international container network via Rotterdam. It is also an example of making use of competencies already in place, and making these stronger.

### Distribution centres

As a consequence of the container feeder line, distribution centres now operate out of the Port of Aalborg. There are at least two examples of importers and distributors who have chosen to remain and expand their business in Aalborg. One company with outsourced production and which is still primarily operating in the European home market, received most of their goods via containers from the Far East. Previously the company had all the containers delivered at their own inventory in the city. This meant they were moving the goods from the port, to the inventory and then to an inland distributor. While this solution was still in place the company was actually considering to move their inventory to a more central location in the country. However, they found that if they undertook collaboration with a freight company to handle the inventory and distribution of their products, they would reduce the number of inventory handlings, reducing the cost. They moved their inventory to the freight company's inventory hotel situated at the port and completely outsourced all logistic activities. Now they only need to focus on design and sales. Another example is a company which import and distributes products from USA to Europe, Middle East and Africa on license. They have also chosen to remain in Aalborg because of the arrival of the feeder line. This company and the previous company were some of the main motivations behind the feeder line in the first place. Distribution centres are a good example of how a port can become more than a gateway by providing facilities that allows companies to change their supply chain setup. One of the benefits of distribution centres for cargo coming from the international trade channels is that the perceived services

level of hinterland based customers becomes better, when they order from the distribution centre. Further, the inventory needs in the hinterland are lowered because the inventory is consolidated in the distribution centre. This is a good example of how terminalisation can be utilised to improve the competitiveness of the port and the supply chain.

### Windmill components

Sea windmill production is unique as windmills are typically produced for large projects with several hundred windmills in use and these materials require a lot of space for construction and transportation. The equipment for installing windmills at sea is very expensive and so windmill manufacturers seek continuous production facilities on land. Close to the case port is a large windmill producer which has a windmill blade factory and they need to bundle these blades for the different windmill parks. Previously the blades were transported via truck to different locations where they were stored for bundling. However as the blades have become larger, and the truck transport more difficult and expensive, the producer, together with the port authority have created new storage areas near the port where it is possible to collect enough blades for several projects. This is an example on how a port can add value for a customer by understanding their product and industry needs. Further, the possibility for the blades being transported by ship has increased dramatically as they can be sailed directly to the seaborne project site.

Another company heavily focussed on offshore activities is also a good example of how the port can assist companies based on their specific needs. The company was expanding and short of space, so the port offered to build and rent out buildings and land area to company, so they could focus on expanding their business. To further support the company's activities the port have also expanded the capacity of a nearby heavy duty dock that can handle the very heavy products from the company. The port has provided buildings for several companies in an effort to attract businesses to the Port of Aalborg, and most of the land and buildings in the port is owned by the port but operated by external companies. The buildings are however, to a large degree non-specific so they can be used for other purposes than what they were originally built for. This means the port can, if company fails or moves, rent the buildings to other companies, and with relatively small investments reconfigure the buildings to a new specification. Maintaining companies at the port requires constant development of the offerings the port supply to its customers that being activities that are directly tied to the cargo transformation process or other support functions. In this perspective, providing buildings and land may not seem advanced, but in reality the port are doing this not only to get rent, but also to increase the demand for other products provided at the port. The context of sea windmills is also special because of the project based production and distribution, where all equipment have to be ready exactly when the onsite construction begins. The offshore activities in Aalborg are an example of regionalisation and terminalisation on the supplier side to consolidate cargo before shipment. Further, it is also the Port of Aalborg developing on one of its core competencies which is the availability of land area in vicinity to the port. Examples of value adding activities are also found in the construction of special transport roads from the windmill wing factory to the docks and storage areas.

The initiatives in Aalborg are therefore in line with what has been described in the theory section, albeit on a smaller scale, but it makes it apparent that the path towards regionalisation through improved infrastructure and services is appropriate. The solutions provided in Aalborg also show how terminalisation can be used by reconfiguring the supply chain setup to allow more value added activities, as well as further defining the core competencies required to maintain or attract companies to a port.

## 6 Discussion

To improve collaboration between a regional port and the companies within its contiguous hinterland, port managers need to understand the importance and configuration of the local supply chain. The Port Authority needs to understand what the capabilities of port system are, as well as know what the barriers against collaboration are, particularly for those industries located in the immediate hinterland. With an understanding of these factors it will be possible for the port managers to help create new transport solutions by acting as a facilitator, establishing contact between land-based agents and industry. Port managers need to have a knowledge of the different capacity requirements and of the different transport

solutions. When the port is considering handling a certain product in the port system, it is necessary to analyse the port system in regards to that product. This should identify where to optimize and where to develop new functionality in the port system.

The concept of port regionalisation suggests focusing on developing and supporting the various productive activities of the hinterland, drawing activities to the port from the hinterland by a clear strategic focus on the needs of the hinterland. The needs of the hinterland companies will result in a series of requirements, which the port needs to identify, prioritise and accommodate. This leads to the concept of terminalisation, and it is essential to provide the most appropriate form of the terminalisation model in order to provide an attractive solution for existing and potential customers. In this paper regionalisation has been used as an overall approach for port managers to attract and consolidating types of industry to a port based on creating infrastructure. The terminalisation approach has focused on creating value-adding activities while decreasing non value adding activities in the port system. The Terminalisation approach can be used by port planners to inquire about various client companies and their supply chains about their requirements and helping them to configure their setup at the port to fit their needs. Competencies will need to be developed to approach the hinterland companies, understand their needs and then attempt to remove any logistical barriers. This will lead to a more sustainable competitive platform with a wider variety of solutions available. It will also provide port managers with the ability to target solutions to a specific product. To further develop its competitive advantage, the port managers need to approach all activities from a value adding perspective, and always try to develop products that accommodate the specific supply chains. However, value adding viewed from the port's perspective might differ from value as the owner of the goods being shipped sees it.

These models fit well together and provide a solid framework for identifying new business opportunities for small and medium-sized ports, building on the possibilities in the hinterland. Port development is increasingly focusing on supply chain integration where the terms regionalisation, and terminalisation are being used and the use of industry type methods for planning and control are beginning to influence port development. Connecting the various models discussed in this paper, offers an opportunity to present a combined framework to help develop smaller ports. This will provide the smaller ports with a more accessible approach to develop their operations.

To begin regionalisation the Barcelona case showed us that identifying barriers is the first step in regionalisation, and to do this it is necessary to define the port's role as well as specialise it to handle the new tasks. This leads to a configuration and investment in core competencies and resources. To further improve this finding new value adding services will improve the overall competitiveness of the port. Further, the examples show that if ports are to develop, it is necessary to collaborate with other companies and other ports, as a port is only a small part of a larger supply chain. It is further shown that if a port should have a dominating role in the hinterland it needs to remove the structural barriers and provide a solution that accommodates the different goods and industry types with the prospect of adding increased value. The examples from the Port of Aalborg further illustrate how understanding local companies supply chains and logistics needs can help the port or other partners provide a better and more competitive solution.

Relating the case to the framework, it can be seen that a smaller port as Aalborg, have been using some of the models present in port literature even without using the models directly. This makes sense as these models are based on the study of port development as seen in the large ports. But confirming the use of these models gives the presented framework a validity in including the models. The order of the models can however be discussed. The reason they are sorted as seen in Figure 7 is because it moves from strategic infrastructure decisions to daily activities. The reason core competencies are presented after terminalisation is because the core competency is dependent on the terminalisation type. Based on the case the framework is a plausible tool to implement in smaller ports that need a more focussed approach to their development.

Specifically the container feeder from Aalborg shows that the port can actively create opportunities based on regionalisation, terminalisation, core competencies and value adding. Regionalisation is achieved with

the integration of the hinterland, terminalisation is achieved with warehouses consolidating cargo. Core competencies are identified and developed by investing in this activity as well as creating an increased amount of value adding activities.

## **7 Conclusion and further work**

The authors examined the UNCTAD port generations model and the WORKPORT model, which both describe the development of larger ports with different granularity. Both models describe how the ports have developed from largely unconnected elements in various supply chains to becoming more and more integrated within specific supply chains. The development is described in part by the models of regionalisation and terminalisation, where the focus on hinterland and port operations in relation to industry and product, have been instrumental in removing barriers. This paper expands on these models and state that this development is required in smaller ports if they are to have any impact on their local hinterland. Smaller ports also need to focus upon value adding activities to make the port system more competitive and attractive to hinterland. The authors suggest a framework that would be appropriate for use by managers in smaller (Danish) ports in order to develop their engagement with the hinterland. The existing research literature provides a segmented, specific and detailed array of models and methods, but these do not offer a combined holistic approach and are developed mostly for large ports.

Through a case study, done as part of the author's PhD project, at the Port of Aalborg, in Denmark, the authors show that this type of praxis is already happening, with value adding in creating warehouses and storage spaces, removing barriers and creating container feeder lines. The models presented in this paper will make it possible for port managers to take a more structured approach to this development and so ensure a more rapid development in the smaller ports. The framework developed jointly with the port management in Aalborg, see Figure 7, will be used to develop the Port of Aalborg and to improve hinterland integration and product offerings.

One of the implications of introducing this framework to small ports would be that smaller ports would have access to the framework in their strategy creation process and be better able to focus this strategy towards the hinterland and the general competitiveness of the port system.

To validate the framework in praxis would further require several projects, where the framework is utilised and the results of this process evaluated. This will not be done within this project as the time horizon for these activities can be longer than the PhD project. Further research would also expand on the effectiveness and competitiveness of the logistic activities, where one of the main challenges for smaller ports is resource utilisation and segmentation of activities amongst several companies. Therefore it is essential to focus on planning and coordination in the port environment, to ensure an effective cargo handling and transformation, focusing on all involved partners.

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