THE DRY PORT CONCEPT: MOVING SEAPORT ACTIVITIES INLAND?

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ABSTRACT

This paper aims to develop the dry port concept and to analyse and compare physical flows and administrative activities at the seaport terminal from the time perspective in the transport system with and without a dry port. The data for the analysis were obtained through literature review and interviews with relevant actors in the transport system. The conclusions indicate that the implementation of a dry port in the seaport's hinterland can enable the seaport to increase its terminal capacity and therefore manage the problem of lack of space. However, ports that do not face lack of space at their terminals will not gain anything by moving their storage area to an inland terminal; on the contrary, they might lose a significant portion of their profit.

Keywords: Virginia Inland Port, Falköping terminal

INTRODUCTION

Intermodal container transport is the dominant technology for container transport overseas. The shipping companies strive towards economies of scale for the maritime part of their transport chain and that derives a demand for efficiency, capacity and short lead time in the transit through the seaports (Culinane and Khanna, 2000; Mourão et al., 2002), and further transport to the seaports hinterland. To stimulate the development of those seamless intermodal transport chains and to meet market demands on seaports, the concept of dry ports is established. The dry port concept is based on a seaport directly connected by rail to inland intermodal terminals, where shippers can leave and/or collect their standardized units as if directly at the seaport (Roso, Woxenius and Lumsden, 2009). The incentive is to

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channel freight volumes to fewer transport corridors in order to enhance the opportunities to utilize economies of scale in the hinterland corridor and to increase the capacity in the system, as well as decreasing transit time through the seaport. This improves the seaport's access to areas outside its traditional hinterland and therefore expands its hinterland (Roso, Woxenius and Lumsden, 2009).

As container transport volume continues to grow, the links with the hinterland will become a critical factor for the seaports' competitive advantage; therefore, progress only in the maritime part of the transport chain and in seaport terminals, without improvements in seaport inland access, is not sufficient for the entire transport chain to function. The efficiency of the railway is increasingly needed for the execution of the constantly growing cargo quantities. The demand for seamless hinterland connections to the inland terminals is increasing with the steadily increasing container volumes in the European ports. European hinterland transport market share for road increased for about 5 per cent; while for rail it decreased for 4 per cent. Furthermore, with a 76 per cent market share, road transport dominates the inland freight transport market in EEA member countries (European Union Road Federation, 2008). The modal share of rail and road diverged due to the removal of trade barriers and liberalization of markets, which resulted in increased utilization of road transport. A change in the geographic orientation of trade (from east to west) has also contributed to the shift because the new markets are not suitably connected by rail links and offer much more flexible road transport connections (European Environmental Agency, 2003). Therefore, the only strategic decision would be the implementation of rail for connecting seaports with hinterland through inland terminals. Those inland terminals are of major importance for the efficiency of intermodal transport, as well as for efficient access to and from seaports. Transport policies at different levels advocate rail and barge as being more sustainable traffic modes than road (European Commission, 2001), and therefore propose a shift of volumes from road to more energy-efficient traffic modes, which are less harmful to the environment and reduce congestion at seaport terminals and in seaport cities. The problems related to the substantial growth of containerized maritime transport in the last 20 years should be approached from a joint seaport and hinterland perspective (Slack et al., 2002).

This paper emphasizes the importance of functional seaport inland access that might be obtained through implementation of advanced inland intermodal terminals - dry ports, which would make goods handling more efficient, and a shift of freight volumes from road to more energy efficient traffic modes that are less harmful to the environment. The purpose of the paper is to develop the dry port concept and to analyse the same through comparison of physical flows and administrative activities at the seaport terminal from time perspective in the transport system with and without a dry port, theoretically and through case studies. Consequently, the following research question is created: How does implementation of a dry port into a seaport's transport system influence physical and administrative flows at the seaport and, by that, the system?

The literature review allows analysing the concept and giving an overview of the same. However, the data for the analysis of physical and administrative flows at a seaport is obtained mainly through interviews with relevant actors of the transport system. The empirical evidence for the assessment of existing dry ports, i.e. advanced intermodal terminals that play a dry port role for their seaports, is based on case studies.

The scope of the paper is the seaports' inland access with dry ports, i.e. advanced intermodal terminals, as a part of the intermodal transport chain. Considering intermodal transport as transport of standardized units involving at least two different traffic modes, only transport processes involving containers were analysed in the studies.

I. FRAME OF REFERENCE

Transport systems are characterized by transfers of goods between points of origin and destinations through the transport network. The transport network is made of links and nodes where links represent transport and transfer activities connecting nodes. Activities such as consolidation, sorting, storage and trans-shipment between vehicles and traffic modes, are carried out in nodes. From this point of view a node is equivalent to a stop in the flow or to a point where the flow can be stopped. To ensure that the network will function when it comes to exchanging goods between the different links it is necessary that the links converge in a specific node at certain times or within certain time intervals.

Transport systems have always been designed according to geographical conditions, as well as the demand for the transport, which is determined by the goods quantity and service quality. Currently, environmental issues play an important role in the design as well. One way to accomplish those demands is to employ rail through intermodality. There is no generally accepted definition of intermodality. Intermodal transport, according to the European Commission (2000), is defined as the following: "There is a consensus that intermodal transport constitutes a transport process in which two following conditions are fulfilled: Two or more different transport modes are deployed; and the goods remain in one and the same transport unit for the entire journey." Reduced energy consumption, optimization of the usage of the main strength of different modes, reduction of congestion on road networks, and low environmental impacts are considered as the advantages of intermodal (road-rail) transport (European Commission, 2000; Rutten, 1998).

Seaports are important nodes in the intermodal transport; their earlier narrow focus on cargo handling has been replaced with a wide range of logistic activities giving the seaports a more active role in the transport chain. However, there has been a trend in organizational and technological changes towards offering door-to-door transport solutions rather than port-to-port (Robinson, 2002; Paixão and Marlow, 2003). This has enlarged the seaports hinterland and therefore created a competition among neighbouring seaports.

The main problems seaports face today, as a result of growing containerized transport, are lack of space at seaport terminals and increased bottlenecks in the land-side transport system serving the seaports. For some seaports the weakest link in their transport chain is their back door, where congested roads or inadequate connections cause delays and raise transport costs. Therefore, the strategic decision would be the implementation of rail and improved inland intermodal terminals serving seaports.

The concept of hinterland changes constantly and it is generally accepted today that serving seaport hinterlands is more competitive than before containerization and intermodality (McCalla, 1999). There is a strong interdependency between a seaport’s foreland and hinterland, which is particularly apparent in intermodal transport. Seaports are not competing only with seaports in their local area but also with distant seaports attempting to serve the same hinterland. Many seaports, as well as shipping lines, also integrate vertically to control hinterland transport (Notteboom, 2001; van Klink and van den Berg, 1998).

Inland intermodal terminals have gained substantial attention in transport literature; considerable research has been conducted on how to find the optimal location for inland intermodal terminals (Rutten, 1998) and how to improve the efficiency of road-rail terminals (Ballis and Golias, 2002). Earlier research by Slack (1990) on inland load centres shows the importance of their development for intermodal transport; in the later research (Slack, 1999), the author emphasizes the inland terminal’s—the satellite terminal’s—role in reducing environmental effects. Seaports are among the most space-extensive consumers of land in metropolitan areas and their expansion often generates environmental and land use conflicts; therefore, satellite terminals (inland intermodal terminals in remote areas) are seen as an alternative to seaport expansions (Slack, 1999). Despite their important role in transport networks, terminals sometimes impede the development of intermodal transport with additional trans-shipment costs at road-rail terminals or due to a shipper’s lack of freedom in choosing traffic modes once they move their business to intermodal freight centres (Woxenius, 1997).

The basic problem of differentiation between “conventional” trans-shipment terminals and the various types of large-scale intermodal logistics centres is addressed by Höltgen (1995). The problem is that the concept of intermodal logistics centres varies from country to country, although there is a common background: they should contribute to intermodal transport, promote regional economic activity, and improve land use and local goods distribution. Furthermore, the author suggests classification of intermodal terminals according to some basic functional criteria like traffic modes, trans-shipment techniques, and position in the network or geographical location. Nevertheless, the trans-shipment between traffic modes is the characterising activity.

A dry port definition by Roso, Woxenius and Lumsden (2009) is: “A dry port is an inland intermodal terminal directly connected to a seaport, with high capacity traffic modes, preferably rail, where customers can leave and/or collect their goods in intermodal loading units, as if directly to the seaport.” Moreover, the authors state that services such as trans-shipment, consolidation, depot, track and trace, maintenance of containers, and customs clearance should be available at dry ports. The authors’ simplified interpretation of the concept of dry port would be “a movement of seaport interface further inland”. Dry ports are distinguished from conventional inland terminals by the services offered at dry ports, as well as by their functionality (Roso, Woxenius and Lumsden, 2009). Furthermore, the authors divide them into three different categories: close, mid-range and distant dry ports.

Implementation of a dry port in a seaport’s immediate hinterland increases the seaport’s terminal capacity and with it comes the potential to increase productivity since bigger container ships will be able to call at the seaport. With dry port implementation, a seaport’s congestion from numerous trucks is avoided because one train can substitute for some 35 trucks in Europe. With a reduced number of trucks on the roads, congestion, accidents, road maintenance costs and local pollution are reduced as well. A dry port may also serve as a depot, empty containers storage. Road carriers would lose some market share but in some countries where long trailers are not allowed to pass through cities for safety reasons, a dry port implementation is a good solution, if not indispensable, from their perspective as well. The benefits of distant dry ports derive from the modal shift from road to rail, resulting in reduced congestion at seaport gates and their surroundings, as well as reduced external environmental effects along the route. Apart from environmental benefits, a distant dry port also brings a competitive advantage to a seaport since it expands the seaport’s hinterland to the area outside its traditional hinterland by offering shippers quality services. New logistics solutions created by the establishment of dry ports in rural areas make the areas more attractive for the establishment of new businesses, resulting directly in the development of the area and in new job opportunities for the local inhabitants (Roso, Woxenius and Lumsden, 2009). The benefits of dry ports are summarized in table 1.

Table 1. Potential benefits from a dry port implementation

	Potential benefits from dry ports
Seaports	1). Less congestion, 2). Increased capacity, and 3). Expanded hinterland
Seaport cities	1). Lower road congestion, and 2). Land use opportunities
Rail operators	1). Economies of scale, and 2). Gain market share
Road operators	Less time in congested roads and terminals
Shippers	1). Improved seaport access, and 2). Green marketing
society	1). Lower environmental impact, and 2). Job opportunities

Source: Adapted from Roso (2009).

II. METHODOLOGY

The data collection method for this paper was a literature study on seaports and their inland access as well as on inland intermodal terminals. The primary purpose of the literature studies was to generate an understanding of the research field, to provide insight into the research that has already been done related to the problem being studied and to identify areas of interest for further investigation. Observation as a data collection method was also used, mainly through unstructured participant observation and interviews. The interviews were mainly face-to-face, open-ended interviews with people directly involved in terminal management, at both inland and seaport terminals. The interviews were of crucial importance in understanding the cases; however, data collection also included secondary sources, such as internal reports and archival records, which, according to Stuart et al. (2002), should strengthen the reliability. Two case studies were done primarily to draw conclusions from their comparison, not to generalize, which would not have been appropriate based only on two cases. However, the conclusions make a very good base for further research that might lead to generalization.

The choice of these two case studies is a result of the previous research on dry ports. Virginia Inland Port was chosen due to its reputation as a successful inland port for the Port of Virginia but also because it fits into the concept of dry port according to Roso, Woxenius and Lumsden (2009). On the other hand, Falköping terminal is still in the process of developing into a dry port for the Port of Göteborg, and therefore is still not in its full bloom. The idea behind the study is, partially, to learn from the best and apply locally. This may be described as best practice case versus beginner. According to Abrahamson (2003), in logistics, proof that a certain case is a best practice case can be done both in qualitative descriptions of what they have done and with quantitative key figures such as logistics cost or delivery service. In this study, cases are discussed from both perspectives, qualitative and quantitative. The study took a systems approach to understand the whole picture as well as the components. This approach is often used in logistics to understand how the different components in the system interact in order to improve the effectiveness and efficiency for the system as a whole; the content of the each element and how they are put together is important (Abrahamson, 2003). The system is a seaport transport system consisting of different actors-elements of the system such as seaport terminals, rail and road operators and inland terminals; however, the same is the subsystem of a whole origin-to-destination transport system. The attention here is on one node in this transport chain, i.e. the element named “inland terminal interface”, whose development would influence the system.

III. SEAPORT ACTIVITIES SHOWN ON AN EXPORT CASE

A container’s physical and administrative flows at a seaport’s container terminal may be divided into three interfaces: land-side interface (delivery/receipt), container terminal interface (transfer, storage and internal transport) and marine-side interface (ship/shore transfer) (Holguin-Veras and Walton, 1997), where the effectiveness of one interface affects the performance of another. Delivery/receipt represents movements of containers through the gate, i.e. land gate entrance and external vehicle transport. The gate is an interface between external modes of transport and a container terminal. Movement of containers from the gate to the storage area, usually with straddle carriers or fork-lifts, is identified as loading/unloading and internal vehicle transport. Storage is the area for short or long time storing of units waiting to be loaded on a ship or a train; in the case of ship loading/unloading the same may be identified as transfer ship/shore.

Regarding customs clearance, the same is done almost entirely on line; in other words, physical inspection of the goods is rarely performed. Within the European Union, a special customs clearance IT system is implemented in order to simplify the activity.

IV. CASES

A. Virginia Inland Port for the Port of Virginia

The Port of Virginia, state-owned and established in 1952, is the second largest volume port on the east coast of the United States in terms of general cargo, with more than 2 million TEUs handled in 2006. The seaport inland access is divided into three different traffic modes; 65 per cent of the cargo is moved by trucks, 25 per cent by rail and 10 per cent by barge (Virginia Port Authority, 2007).

The idea of expanding into new market areas, in particular to capture the Ohio Valley area through an inland port, came about in 1984. An inland port was supposed to be an extension of the seaport's existing way of handling cargo and the first and most important step was the selection of the site. After numerous studies, the site was chosen due to its connectivity and potential new market. To adjust the terminal into the surrounding area, the site was dug so that the terminal was not noticeable from the roads nearby and therefore did not destroy the landscape. Virginia Inland Port (VIP) started operations in 1989 on a facility on 65 ha, with 5,346 m of on-site rail. Rail service operates five times a week between the facility and the seaport; however, Mondays and Tuesdays are the busiest. VIP is situated 350 km from the seaport and the total transit time is 12 hours. The procedure at the seaport terminal is rather fast from a vessel by straddle carrier to rail crane to rail. At the beginning, 9,000 TEUs a year were carried by the Detroit train from the seaport but also for other destinations. With increased volumes and involvement of new customers, another train was introduced. In 2006 the facility handled approximately 30,000 TEUs (Virginia Port Authority, 2007) although the preliminary study showed potential for 100,000 TEUs.

VIP is also known as a United States customs designated port of entry where a full range of customs services is available to customers. However, a physical inspection of containers, only 5 per cent of the total TEUs, is currently done at the seaport. Customs clearance does not take long time since customs receives information about containers for import about 24 hours prior to unloading of the ship and therefore decides about inspections in advance. There is a so-called 24-hour manifest rule for the clearance but officially, customs has 10 days to do the clearance.

B. Falköping terminal for the Port of Göteborg

The Port of Göteborg is the largest container seaport in Scandinavia, handling more than 840,000 TEUs a year, about 60 per cent of which was transported by truck to inland destinations in 2007 compared to 70 per cent in 2006 (Port of Göteborg, 2008). The Port works on increase of its container rail volumes by cooperating with other actors of the transport systems; today, there are 24 rail shuttles for different destinations that run daily services to/from the port.

In early 2000, the Falköping municipality submitted a proposal for the implementation of an intermodal terminal in the area at a rail distance of 124 km from the port due to existing volumes already being transported to the port by trucks. The very first and expected problem, apart from financing, which always seems to be a problem, was a suitable location for the terminal. However, it was not until the end of 2006, when the largest Swedish forest products company, StoraEnso, showed an interest in establishing a terminal in the area, that tangible work on building the terminal started. Once the location was chosen and the terminal built, in 2007, new problems—this time unexpected—arrived. Such problems were deficient volumes, further development issues, competition with another terminal in the area and collaboration with the Port.

The rail shuttle operates four times a week in both directions, reaching up to 11,000 TEUs a year. After further development and extension of rail sidings, an increase in volumes is expected and therefore one more shuttle a week should be introduced. So far, the terminal offers services of trans-shipment between rail and road, road haulage and storage of containers. Future plans are to develop the terminal from a conventional one to one serving as a dry port, which means offering further services, such as customs clearance, maintenance of containers, warehousing and some extra services for the forest products company. Customs clearance is feasible since there is usually no need for physical inspections of containers and, therefore, no need for the presence of customs officers at the site, except in special circumstances. However, extra security measures must be provided at the terminal.

C. Synthesis

Two ports, very different in size but very similar when it comes to their road market share, transport containers to inland destinations—about 60 per cent of the total TEUs. One big difference is in ownership of their inland terminals. While the Port of Virginia initiated and financed the implementation, and also owns and operates VIP, the Port of Göteborg had no influence on implementation of Falköping terminal, neither financially or by initiative.

Table 2 shows that the average time needed to handle one container does not differ significantly between the ports in the study. Average internal transport and loading/unloading times at the seaports' terminals are rather short, are measured in minutes, and therefore cannot influence the internal flow significantly, and by that the whole transport chain.

Table 2. Average time needed to handle one container at the seaports' terminals

Activities	Average time for container handled at:	
	Port of Gothenburg	Port of Virginia
Land gate entrance/exit	Varies	Varies
Loading/unloading truck or train	1.5 minutes	2 minutes
Internal vehicle transport	1.5 minutes	2 minutes
storing	5.5 days	3.5 days
Internal vehicle transport	1.5 minutes	2 minutes
Loading/unloading ship/shore	1 minute	2 minutes

Source: the authors

However, land gate entrance time varies notably, from a few minutes to a few hours, depending on both the day and the time of day. Although a few hours are only a small part of the whole transport chain time scale that might take up to a few weeks, one should keep in mind that those are queuing hours for road carriers which, apart from financial loss for the road carriers, also increase the risk of road accidents (Roso, 2007). On the other hand, storage takes up to a few days, on average 5.5 days at the Port of Göteborg and 3.5 days at the Port of Virginia. This segment of the transport chain might be influenced by moving the storage further inland closer to the final customer, leaving valuable space at the seaport terminal. The storage of containers would not be eliminated by that, but could possibly shortened due to faster administration inland (Roso et al., 2008), and it would be at a lower cost.

V. DISCUSSION

A. Cases

Ports that do not face lack of space at their terminals will not gain anything by moving their storage area to an inland terminal; on the contrary, they might lose a significant portion of their profit, as in the case of the Port of Göteborg. The Port of Göteborg is located outside the city centre and has a sufficiently large storage area with the possibility for expansion and, at present, the storage of containers brings in significant revenue for the Port. This usually is not the case with big container ports, and using a dry port as a depot is seen as the solution for the problem of lack of space (Roso, 2008). Since Falköping terminal is not owned by the Port, moving the storage from the Port to the dry port would imply giving away the profit. Therefore, the Port was not involved financially in the establishment of Falköping terminal; however, the administrative part of the establishment and some adaptations at the port terminals were necessary in order to introduce one extra shuttle train. This is not the case with the Port of Virginia, which owns the inland terminal; therefore, moving activities inland does not imply loss of profit, but the contrary. An inland port with direct rail to the seaport means gaining valuable space at the seaport terminals, i.e. increased capacity that results in increased productivity. There were no obstacles prior to VIP implementation; the infrastructure and market existed, and the municipality approved the arrangement since the implementation of the terminal implied new jobs in the area.

When it comes to the time savings that result from the implementation of a dry port into a seaport transport system, one can see that the same can be obtained by eliminating queues at the seaport's gates or by eliminating storage at the seaport. The latter does not represent a certain gain for the actors of the system since the containers need to be stored anyway; whether at the seaport terminal or at the dry port makes no difference as long as seaport does not face a lack of storage space. The former, on the other hand, makes significant gains, not only for the seaport that would perform better with no congestion at the terminals, but for the carriers who suffer from financial loss due to delays caused by the congestion. At the Port of Göteborg gates there are several hours of long queues at peak times (Roso, 2007). Furthermore, there is an increased risk of road accidents since truck drivers become anxious and might also avoid regular rests during transport in order to arrive at the destination on time. VIP can have trucks in and out in just 30 minutes; truck drivers never have to leave their vehicles.

Society gains from the movement of containers from road to rail through reduced environmental impact. In Sweden, approximately 95 per cent of state railway transport is by electric trains; as the electricity used for the trains comes from hydro power, emissions from the electric trains are reduced to an absolute minimum (Roso, 2007). One train substitutes for about 35 trucks in Sweden; consequently there are 35 fewer trucks on the roads per full train and there are more than 70 trains a day passing through the Port (Port of Göteborg, 2008), resulting in approximately 2400 trucks less on the roads daily. However, in the United States, trains are run by diesel locomotives, but double stacking of containers is feasible and widespread. Double-stack container trains consist of 20 to 25 cars, each carrying 10 TEUs, with a total train length of 2,000 to 2,500 metres, not counting the locomotives (DeBoer, 1992). Currently, about 25 per cent of 2 million TEUs a year are transported by train from the Port of Virginia to inland destinations; considering double-stacking it might result in up to 2,000 fewer trucks on the roads daily.

B. Deduction

In the transport system, the node is equivalent to a stop in the flow and although a dry port is a node in the system, the idea behind the concept is to make the flow smooth; in other words, not to stop the flow in the node but to make all node activates seamless, and by that to make the intermodal transport chain seamless.

Features of a dry port concept:

- Seamless transport and trans-shipment points
- Scheduled and reliable rail connection between a seaport and a dry port
- Dry port equipped for the handling of standardized units
- Services at a dry port: trans-shipment between road and rail, customs clearance, maintenance of containers and long and short time storage

Finally, to summarize how the implementation of a dry port into a seaport's transport system influences physical and administrative flows at the seaport and by that system, one does not need a case study to realize that some activities like ship loading/unloading cannot be moved to an inland terminal. However, there is a whole range of administrative activities that would be moved inland with the implementation of a dry port, specifically those related to handling truck related paperwork. Moreover, some physical activities would take less time, such as storage, while some could be reduced completely, such as inevitable queuing at the seaport gates. Implementation of a dry port could create seamless seaport inland intermodal access, i.e. smooth transport flow with one interface in the form of dry port concept instead of two, one at the seaport and the other one at the inland destination.

CONCLUSION

Regarding the assumption on which seaport activities could or should be moved to an inland terminal, there is no general answer. The Port of Virginia is ready to invest in development of inland terminals because the competition between neighbouring ports is the fact, and expansion inland into new markets brings competitive advantage. Faster movement of containers from the port to the final destination also increases the port's capacity. On the other hand, the Port of Göteborg has sufficient volume with no fierce competition and does not strive towards the expansion of its hinterland; problems of congestion at seaport gates and potential delays have not reached a critical point yet. Therefore, the port does not invest in inland transport development as long as there are others such as rail operators, terminal operators and belonging municipalities eager to do so. However, the Port of Göteborg's role is of a supportive nature when it comes to the development of inland terminals and rail shuttles by other actors of the transport system.

Implementation of a dry port into a seaport transport system, that is the seaport's hinterland, should create a seamless transport chain, smooth transport flow with one interface in the form of dry port concept instead of two interfaces, one at the seaport and the other one at inland destination. In other words two nodes in the transport chain, seaport and inland terminal, should be replaced with one "dry port concept" node. However, significant time savings, as well as financial savings, could be made only by avoiding the queues at seaport gates and by moving container storage inland. Evidently, expansion inland into new markets improves seaport's access to areas outside its traditional hinterland, resulting in new customers generating more profit and promoting the regional economic activity. The question is whether this expansion is going to be in the form of ownership or collaboration; if it is the latter, then on which level? Therefore, this paper also serves as a basis for further research on the concept, focusing on practical experience of the concept in the world.

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