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THE DEVELOPMENT OF HINTERLAND TRANSPORT BY RAIL -THE STORY OF SCANDINAVIA AND THE PORT OF GOTHENBURG

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ABSTRACT. This article analyses the phenomenon of hinterland transport by rail and the remarkable journey that has taken place during the last ten years in Europe, especially in Scandinavia. Furthermore, it includes a brief examination of how current trends affect the role and development of rail for hinterland transport. In fact, particularly in Scandinavia, most of the potential market for hinterland transport of maritime containers is already realised. Nevertheless, stakeholders face new challenges as a result of the current financial crisis and global recession. As a result, transport systems, such as the Scandinavian rail shuttle system, now show modest growth figures in comparison to the 15 to 20 percent of annual growth over the last ten years. Ultimately, rail shuttle services and dry ports will still play an important future role in ensuring competitive and sustainable logistics systems assuming that these companies are able to cope with the imminent challenges.

KEY WORDS: Dry port, Container shipping, Hinterland transport, Rail transport, Semitrailer.

Introduction

The challenges for liner shipping have moved inland from the sea, first to the ports and then to the hinterland (cf. Notteboom, 2002). The increased scale of ships and ports has not been matched by an increasing size in trucks and as in most other transport networks, costs and lead time are increasingly being generated in the smaller routes rather than in the arteries. The business model of maximising the revenue by filling the ships and then “fixing” the hinterland operations simply does not work anymore.

One way to increase the scale of hinterland transport conveyances is to use trains and barges rather than trucks. Compared to road, both rail and inland waterways offer distinct advantages, such as decreased environmental strain, decreased nuisance related to port city traffic, decreased transport distance costs, faster throughput in ports, and typically less sensitivity to delays from traffic congestion. The advantages can be felt by most participant categories, and each of them can find reasons for advocating the use of alternatives to road for hinterland transport (Roso *et al.*, 2009). For instance, the latter two of the previously mentioned advantages appeal to truckers since they are rarely compensated for standing in line at port gates and in congested traffic. Nevertheless, notable disadvantages include increased costs and lead times over short hinterland transport distances and rail congestion close to the ports.

Most main container ports in Continental Europe have experienced a modal shift away from road; however, this shift has mostly been to inland waterways rather than to rail. Nevertheless, such countries as the UK, Italy, Spain, and Sweden are merely confined to coastal shipping and use of rail as alternatives to road. In fact, in Sweden, the increase in rail shuttles to and from the Port of Gothenburg is a frequently cited example of rail competition and recapturing market shares from road transport.

The purpose of this article is to add to the understanding of hinterland transport by rail, particularly in the positive example of transport between Port of Gothenburg (PoG) and its Scandinavian hinterland. The scientific literature on the growing research field of hinterland transport of unitised cargo is reviewed in the next section and the following section illustrates the empirical development in the hinterland of PoG in Sweden. The effects of the current recession for hinterland transport by rail is then analysed and in the following section, the findings are discussed in the context of PoG.

Hinterland container transport by rail

Hinterland transport of vehicles and unit loads that are "cross-docked" in ports is a comparatively old phenomenon, but business activity and policy making has clearly intensified over the last 25 years. In 1982, the UN first used the term *Dry port*, underlining the integration of services with different traffic modes under one contract (Beresford and Dubey, 1990). Research on hinterland transport is also comprehensive. Examples of such studies including their main geographical context are as follows: Notteboom and Rodrigue (2005 - USA), Rodrigue (2008 - USA), IBI Group (2006 - Canada), Beavis *et al.* (2007 - Australia), Wang and Cullinane (2006 - Asia), Woodburn (2006 and 2007 - UK), Pettit and Beresford (2007 - UK), Debrie (2004 – southwest Europe), Gouvernal and Daydou (2005 – northwest Europe), van Klink and van den Berg (1998 - Rotterdam with hinterland), Bundesamt für Güterverkehr (2005 – Germany), Bergqvist *et al.* (2008– Sweden), and Roso (2006 - Sweden). All of these publications generally focus on the container segment, whereas semi-trailers are merely overlooked with exception to the study by Bundesamt für Güterverkehr (2005), which delves a little further than containers in scope.

The development of container rail shuttles was fuelled for many years by the seemingly unstoppable growth in deep sea container shipping. The current economic turmoil has shown that the increase in containerised shipping is no natural law and the industry currently face significant challenges, a topic being revisited later in the article. Nevertheless, trends supporting an increased use of rail freight transport can be distinguished even within the current economic climate. Factors within the industry include the rather general anticipation of long-term increasing costs of road haulage although the cost of fuel might be considered partly external to the industry. Still, fuel costs have shown to be highly volatile. Although container flows do not increase anymore, congestion at port gates and in port city traffic remains an issue. Rail and unit load technology is also evolving, and the image of road transport is undermined for environmental and quality reasons, thereby leading to recruitment problems for the road transport sector in the long run.

The image of road haulage also affects the factors that are external to the industry itself, implying that shippers increasingly demand rail rather than road transport. Political pressure for changes is also increasing, and if the industry does not respond at a satisfactory rate, potentially aggressive regulation waits around the corner. Another factor that is becoming increasingly important is the emission caps, which at least in Sweden, impedes process industries and logistics nodes from expanding unless the modal split is changed.

Van Klink (2000, p. 134) describes the importance of increased hinterland rail transport from a port perspective:

> Another way in which ports can exploit know-how in order to pursue their strategic goals is to participate in the development of a network of inland terminals within Europe. (…) By investing in inland terminals and participating in their operation, a sea port can establish itself in inland regions. Inland terminals may be considered as "extended gates" for sea ports, through which transport flows can be better controlled and adjusted to match conditions in the port itself. In this way, inland terminals can help to improve land access to ports in both physical and psychological terms.

Van Klink does not use the term dry port but refers to the same fundamental system. The term dry port is defined based on the following definition of Leveque and Roso (2001): "A dry port is an integrated intermodal terminal directly connected to the seaport(s) with high capacity transport mean(s) where customers can leave/pick up their standardised units as if directly to/from a seaport."

Furthermore, dry ports can be categorised and described based upon location and function. Roso *et al.*, (2009) categorised dry ports as distant, mid-range, and close dry ports. The *distant dry port* is the most common of the dry port types and was the first type to be established due to distance and the size of good flows that enabled a favourable cost structure. In comparison with traditional road-rail terminals, the dry port offers different functions and an interface that is closer to shippers. Another benefit related to the modal shift from road to rail is the relief of some stress on the main port and its surroundings. The modal shift decreases external effects from transportation since a rail shuttle can substitute for up to 40 trucks in Europe. Furthermore, a distant dry port can expand the competitive hinterland of the main port and offer shippers a lower cost structure and a higher level of service.

The *mid-range dry port* is characterised by its distance to the main port, which is a distance that is commonly served by road. This type of dry port serves as a consolidation point for different rail-related services that are too expensive or inefficient to implement and establish at all distant dry ports. In addition to the benefits of a distant dry port, the mid-range dry port can also serve as a buffer to relieve the main port of stacking areas.

As a result of last years' rapid containerisation and consolidation of good flows to fewer ports, these hubs and the surrounding cities have run out of land that is easily available for port expansion as well as efficient inland access. In order to deal with these challenges, a port can establish a *close dry port* in their immediate or close hinterland. The close dry port enables a modal shift, thereby relieving the stress and congestion on city streets and port gates. Compared to distant and mid-range dry ports, the close dry port offers greater possibilities for buffering containers and even synchronisation with the loading of an individual ship in the port.

The next section focuses on the substantial and fast developing rail shuttle system in Scandinavia. Scandinavia is regarded as an illustrative example of a rapidly evolving rail shuttle system as a result of a long continuous growth in container flows and exposure to most of the factors and trends that were previously elaborated.

An illustration: Port of Gothenburg

The development of dry port and rail shuttle services has been evident in Scandinavia over the last nine to ten years. The development originated at the PoG, which currently has rail shuttles to 25 different dry ports in Scandinavia, which are offered by ten different rail operators (Port of Gothenburg, 2009a). Over the years, shuttles have been added and subtracted, and the frequencies have varied over time. A few of the shuttles operate once or twice a week in each direction; however, the majority operates five to seven days a week, and the most frequent one, which supports H&M's central warehouse in Eskilstuna, operates 14 times a week in each direction.

Figure 1. The Port of Gothenburg rail shuttle system as of June 2009. (Source: Port of Gothenburg, 2009c).

Although some of the shuttles travel distances that are typically dominated by road transport, most shuttles can be characterised as serving distant dry ports since they are confined to traditional hinterland transport. However, the shortest shuttle, about ten kms within Gothenburg, serves a stuffing and stripping terminal, and a previous service to Uddevalla, about 100 kms from Gothenburg, moved the stuffing and stripping activities out of the port area. These services are thus more in line with the definition of dry ports that is adopted in this work.

Current container rail shuttle services moved about 350,000 twenty-foot equivalent units (TEUs) in 2008 with a turnover of about €60 million. In 2007, the PoG handled 841,000 TEUs, which means that the container rail shuttle system handled about 40 percent of all containers to and from the PoG. The port also handles 686,000 Roll on/ Roll off (RoRo) units in terminals at both banks of the river Göta (Port of Gothenburg, 2009b) in the rail shuttle system.

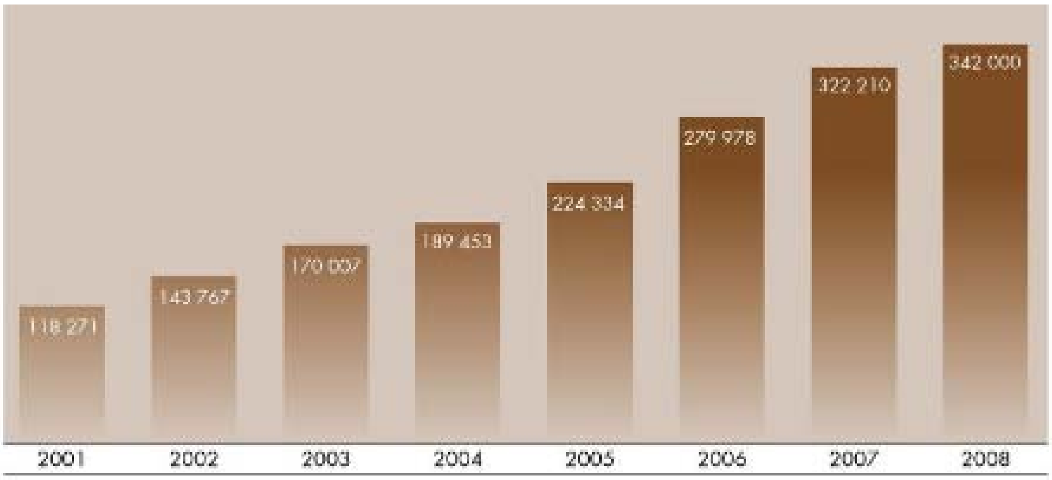

Figure 2. Rail volumes (TEUs) to and from Port of Gothenburg.
(Source: Port of Gothenburg, 2009a).

The cost savings for the industry includes an estimated ten percent decrease in its transport costs, implying that the current rail shuttle system saves about €6 million in business costs annually. The system also relieves the congestion on the streets of Gothenburg and decreases the carbon dioxide (CO_2) emissions by about 42,000 tons every year. Furthermore, the system employs about 400 persons (Bergqvist, 2008). In 2008, the PoG received the Schenker award, the oldest and most prestigious prize in the logistics industry in Sweden, for their achievements and innovations related to the rail shuttle system.

The growth has been driven by a systematic process that started with a decision by the board of directors at the PoG stating that half of the growth in the container segment should enter or leave the port by rail. The rail shuttle system has surpassed this goal and has achieved an annual growth of about 15 percent over the last seven to eight years.

Therefore, the container shuttles have evidently demonstrated a very stable and impressive growth in terms of the number of shuttles and transported volumes. However, this has occurred during a period of extraordinary growth in container liner shipping, and market shares have come from inland road haulage. In May 2009, the Scandinavian rail shuttle system recorded all-time high and the market share increased to 60 percent, which is up from 40 percent in 2008 (Port of Gothenburg, 2009c), and the PoG expects this share to grow even further (Thorén, interview, 2009). Nevertheless, with a wider and denser geographical coverage of the hinterland, the PoG's dry port concept is running out of potential destinations.

Effects of the current recession on hinterland transport by rail

Over the last ten years, hinterland transport of containers on rail has prospered due to favourable conditions regarding macro factors, like globalisation with increased trade, continued containerisation of commodities, environmental concerns, and high fuel prices. The competition in terms of road hauliers has been minimized by a shortage of trucks and truck drivers, congestion, and a worsening image. Productivity gains, investments, and deregulation in the railway sector have also fostered growth in flows although long delivery times for new rail wagons have hampered expansion.

The macro-economic events starting in autumn of 2008 to date have obviously changed the situation dramatically. Container shipping lines are not the only entities caught by surprise with a continued supply of capacity meeting a falling demand. The situation is particularly dramatic for shipping lines calling Europe that cannot use the classic tool for balancing supply and demand by agreements within liner conferences anymore. Container shuttle operators also utilise economies of scale and need large flows to maintain financial health and frequencies.

Analysing the effects of the crisis in the midst of it is obviously a delicate task, and industry leaders are rather reluctant to predict the immediate economic future. Nevertheless, this article must address the current situation instead of assuming that business as usual prevails in the container shipping industry. Hence, the following text is an attempt to analyse the effects of the recession on hinterland rail transport.

The *immediate effect* is a drop in the overall volume, e.g., by 15 percent for the Asia-Europe container trade lane in the fourth quarter of 2008 (Dahllöf, 2009), which obviously also affects the hinterland volumes. Transport volumes have also dropped domestically and within continents (ibid.), adding spare transport capacity to the market. Road transport is a good example of an efficient market, particularly the segment for full container loads to and from ports, and the price is rapidly adjusted to the lower demand. Some hinterland rail operators might follow with lower prices, and all will experience a tougher competitive situation, thereby affecting the revenues. Often, road hauliers or forwarders are the direct customers of hinterland rail services. If these customers also control trucks, they will be tempted to first commission their own spare truck capacity. Shippers, on the other hand, might be careful with expenditures and turn to railways on routes where the prices for rail services are still competitive.

One *short run effect* of the slow-down is the provision of breathing space and opportunities for reflection. Operating logistics systems that are working close to maximum capacity easily result in less efficient operations and a constant focus on temporary bottlenecks. Rail transport is definitely no exemption from this issue, and with the steep growth that was experienced over many years, the hinterland rail system operated at far from optimum efficiency at the peak of the business cycle. Wise managers will now use this time for consolidation through improved internal processes, evaluating the robustness of the business model, and assessing new businesses or alliances. If the drop in volumes is severe, the operators will suffer due to the high degree of fixed costs in the shuttle operations and might have to adjust frequencies of operating runs.

The *long run effect* of the current recession is particularly hard to analyse. More recent recessions have been limited to certain economic regions or to certain industries. The root causes and the counter-measures have also been easier to evaluate and thus making the severity and duration of the recessions easier to evaluate as well. However, in this current climate, the globalisation that fostered the growth of the hinterland rail transport system has also meant that economic activities are much more interconnected, thereby amplifying the economic peaks and troughs. Despite some coordinated actions, public stimulation packages that have been presented thus far clearly prioritise domestic employment before stimulating further trade, which indicates signs of recurring protectionism. Hesse and Rodrigue (2004) stated that trade is more volatile than industry production over business cycles, which seems to be applicable in this recession as well.

Even with the belief that a volume recovery will occur in the long run, operators might encounter problems surviving if the revenues remain low for an extended period with issues like raising capital for new rolling stock. On the other hand, investments in infrastructure, like tracks and terminals, are likely to be hastened through government stimulation packages because they offer the political advantage of also benefitting the battle against CO_2.

This phase of the business cycle presents severe challenges for operators to maintain the momentum of hinterland rail transport growth.

Consequences and options for Port of Gothenburg

Despite the historically successful development and the currently uncertain conditions, the PoG still has the potential to develop its hinterland rail system further. Adding the segment of semi-trailers to the system is an obvious possibility that could substantially increase the scale of the Scandinavian rail shuttle systems. This also presents a significant challenge since the semi-trailers that are used in transport systems are very different from containers (Woxenius and Bergqvist, 2008). To date, few mid-range dry ports have moved the main port interface inland to the greatest extent possible by developing and offering a greater variety of services, such as storage of containers, customs clearance, and track and trace. Furthermore, the PoG is close to the large manufacturing plants for Volvo Cars and Volvo Truck, and the good flows basically share the same road and rail infrastructure. The capacity of the rail infrastructure and management system is continuously an issue although the automotive industry demands have decreased to the point that the infrastructure seems to be relieved from some congestion. Still, in the context of rail infrastructure capacity, the close dry ports play a key role. Establishing close dry ports can help revive the rail infrastructure by improving the utilisation through means of coordination and consolidation. In sum, these are important aspects whose potential will be addressed further in the following sections.

Entering the semi-trailer segment

A market-share of twenty percent for the semi-trailer segment could double the volumes of the rail shuttle system. Recent research has shown that if the rail shuttle system can continue to expand, also including the segment of semi-trailers, the level of CO_2-emissions for Sweden could be lowered by as much as 1 percent in 2025 as compared to levels in 2004 (Bergqvist, 2008). Up to now, the system has focused on transportation and increased volumes, and surprisingly few value-added services have been transferred from the main port to the hinterland dry ports despite the ambitions of the PoG.

Nevertheless, the PoG faces a challenge in meeting the demand for handling rail shuttles loaded with semi-trailers. The setup can either be a dedicated service or a combination of services with containers and swap-bodies. The risk faced by the PoG if they do not ensure sufficient infrastructure and quality is stagnation in the growth of rail shuttle services and volumes. In addition to challenges related to the quality of services at the PoG, other challenging factors are related to the potential for intermodal RoRo units, such as market expectations, customer requirements, attitudes, and “old habits.” To a large extent, these are the same type of factors that were highlighted to explain why achieving growth in the traditional intermodal railroad segment was previously so difficult. However, the rail shuttle system of the PoG has demonstrated that these factors can be managed. Likely, the development of the semi-trailer segment will show the same “threshold” pattern as the container segment, and substantial growth will be facilitated by the existence of representative success-stories.

The need of a system conductor

The need for a “superior” level of management and control is increasing as the system of dry ports expands (cf. Van der Horst and de Langen, 2008). For the main port, this requires a new and more complex role, i.e., being commercially involved outside the port gates, as compared to the traditional role of signing contracts and expanding the network of rail shuttles. The need for greater control and management requires main ports to take on much larger administrative and commercial responsibilities, especially in the case of the PoG. This challenge becomes even greater considering the scope of the network, i.e., with 25 inland terminals and dry ports that sometimes have separated roles and entities for terminal operations and commercial responsibility and as many as ten different train operators. Furthermore, each dry port can offer multiple services and activities in collaboration with the PoG. In total, the PoG has more than 50 different interfaces and business situations to manage and control. The need for standardised communication is urgent.

Close dry ports can play a very important role in the future as a result of expanding rail shuttle systems. The primary reason for this is that the close dry port is often located on a main railway line that is used by many of the rail shuttles in a dry port system. With increased coordination of different rail shuttle services, the need for system leadership becomes more obvious.

As the system expands and includes more shuttles with increased volumes and maybe a combination of load units, handling the growth may become challenging for the main port. As the number of shuttles expands, the close dry port has the opportunity to utilise shuttles from distant dry ports using the same main railway line. This arrangement enables the management to balance the unutilised capacity of different rail shuttles and improve the profitability of the entire rail shuttle system. Moreover, this framework facilitates attractive and profitable intermodal road-rail solutions for short distances where intermodal services are normally unprofitable.

Scheduling and planning the time-schedule and production plan for the shuttles are essential from both a short and long term perspective. A close dry port that has efficient and semi-automated handling equipment can help ameliorate buffering emergencies and problems in the main port. Through synchronisation of load units on the rail shuttles, the setup can be optimised with regard to the handling equipment and the current status at the main port. Examples include sending blocks of rail shuttles instead of full length ones; separately sending different types of load units, e.g., semi-trailers and containers; and consolidating load units for a specific destination or individual ship (cf. Bärthel and Woxenius 2004).

Another area in which the conductor can play an important role is security and inspections. Current and future demands set by laws, regulations, standards, and customer requirements concerning security drives much of the development that is currently taking place in ports. The overall goal to guarantee that goods handled at one port will not impose any threat or danger to other ports, carriers, etc. is being actively pursued at all ports today. Security checks and inspections are very expensive and consume a lot of time and space. Indeed, few ports have enough space and resources to adequately conduct these activities to a satisfying extent and level. In this sense, the conductor can relieve some of the stress on the main port by carrying out these activities at the dry ports and then guaranteeing safe transport to the main port by geofencing.[1] An example of this development as related to the Scandinavian rail shuttle system can be found at the dry port located only 130 kms from the PoG in Falköping, which has focused intensely on this development (Bigsten, interview, 2009).

The need for improved processes and support systems

The growth in volume for many dry port systems has been remarkable, especially in Scandinavia, but the profitability of the Scandinavian system has not developed at the same pace. In the past with steeply rising demand, the focus has been directed towards ensuring service quality and function of the rail shuttle system, and less focus has been directed to-

[1] Geofencing refers to a virtual fence surrounding the transport that is made possible by monitoring the transport using modern surveillance and telecommunication.

wards efficiency and profitability. The current economic situation forces all stakeholders to switch focus; thus, the system has entered a phase of “consolidation” where the roles of stakeholders in the system are more complex and the interdependence has become greater. This requires business models that are capable of handling complexity.

Currently, a lack of suitable business models are available that can facilitate the development of dry ports with more sophisticated services, thereby increasing the prospects for greater profitability. The reason for this in the case of Scandinavia is mostly related to the main port, i.e., the PoG. The system participants have set ambitious goals regarding what services should be developed at the dry ports. However, those services require investments and commitment between the dry ports and the main port. So far, PoG has strategically decided to not own any of the dry ports. Instead, they have implemented the concept of a franchise, meaning that the business concept, IT-system and quality standards are set by PoG. This may facilitate the organisation of the system and rapid expansion, but it creates some challenges related to profit-sharing and investment-sharing.

Many of the additional services, such as track and trace and storage of containers, require substantial investments in information and communication technology (ICT) systems. The challenge here is that no existing ICT system can be easily and cost-efficiently implemented; therefore, a tailored system that can communicate with all involved participants and their respective business systems is needed. The issue remains regarding how this investment should be shared among the stakeholders in the system since estimating how and to what extent each member will benefit from the ICT system, especially smaller dry ports, is difficult. The underlying reason for this issue is that a common business platform has not been developed. Currently the main port gets revenues from load unit storage, which is an activity that is supposed to be transferred to the dry ports to free up space and boost efficiency at the main port. The questions remaining to be addressed are how revenue should be attained in the future and how revenues should be fairly distributed. In total, these are difficult issues that must be addressed in order for the system to develop further. Basically, the number of contact surfaces for the PoG is too high. For example, a separate terminal operator, train operator, and a third company that has commercial responsibility for the service can exist at one dry port. At the moment, a dry port commitment is a highly local concern, but logic suggests that mergers and acquisitions in the market will improve the efficiency. This would mirror the port container terminal industry, which was reshaped with the emergence of global operators rather than just a number of local ports. Still, a single conductor maintaining system leadership is needed.

Conclusions

Many of the world’s dry ports and rail shuttle services have developed and prospered during the booming demand of the recent past, which was supported by macro trends, such as outsourcing and globalisation. The current financial crisis poses new challenges for the future development and setup of dry port systems. The impact so far has not yet resulted in decreased transport volumes, but such systems as the Scandinavian rail shuttle system are now experiencing a growth rate close to zero. As the immediate need to supply transport capacity for increased demand is reduced, more focus can be directed at improving the existing business. Consequently, the development of the scope of business has expanded as an attempt to increase revenues and balance the effects of the current financial crisis. By expanding the scope of service, more efforts are focused on efficiency as a tool for increased profitability. In total, the change of focus has resulted in different strategic diversifications for close, mid-range, and distant dry ports.

Distant and mid-range dry ports have invested in new handling equipment and rail operators for rolling stock in order to penetrate the market segment of the semi-trailer. This trend is generally evident in Europe and particularly in Scandinavia as an attempt to increase volumes and revenue. Close dry ports, however, face difficulties in penetrating this segment due to its cost structure and the need for long distance haulage in order to compete with road haulage.

Instead, close dry ports have focused on exploiting their advantage of being closely located to the main port and often at a main railway infrastructure. Close dry ports have identified the need for coordination and consolidation in the system of rail shuttles. By coordinating and consolidating different rail shuttles that traffic the same main railway line, the close dry port can improve its efficiency at the main port through production planning of shuttles; separating different load units; sorting according to geographical market; and acting as a general production support, buffer, and backup system to the main port.

This factor becomes increasingly important as the capacity of many ports is strained. Many ports were surprised by the strong demand and development of rail shuttle services and have not been able to develop their rail infrastructure accordingly. Another positive aspect of the close dry port setup is the possibility to improve the utilisation of rolling stock, e.g., by combining a long night-leap with a short day-leap instead of using different equipment for the services. This would further decrease the production cost for short distance rail shuttle service.

Combining all of the previous observations, rail shuttle services and dry ports will clearly play an important future role in ensuring a competitive and sustainable logistics system assuming that it is able to grow and develop according to market demand.

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