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The role of dry ports in solving seaport disruptions: A Swedish case study

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ABSTRACT

This paper analyzes the effects on Swedish hinterland logistics of a port labor disruption that occurred in the Port of Gothenburg's container terminal in 2016–2017. Because of this dispute, several companies initiated mitigation strategies by moving their cargo by truck or rail in the area, thus utilizing the inherent advantages of hinterland locations and dry ports. Researching hinterland logistics in Sweden, this article conducts a case study on a dry port and the warehouse industry. The results show that the traffic share of inland terminals was higher during and soon after the conflict. Thus, this study suggests that dry ports are significant as potential solutions for this kind of disruption.

1. Introduction

Globalization and containerization have led to increased freight traffic. Consequently, integration between maritime and inland transportation systems has become fundamental in order to guarantee an efficient supply chain. Although supply-chain operations link producing and consuming markets, any disturbance such as port conflict[1] can result in serious negative impacts on these markets and hinterland logistics (Blackhurst et al., 2005).

In a context of international markets, a hinterland[2] transportation system allows cargo units to be transferred between seaports, inland destinations, and final consumers. Hinterland logistics includes the hinterland transportation system and logistics activities. Consequently, efficient collaboration and connectivity between several actors and activities are necessary (Jensen and Bergqvist, 2013; Bergqvist, 2015). Furthermore, the expansion of connectivity by means of integrating the seaport more with its hinterland can be seen as a strategic step for extending the life cycle of the seaport (Monios and Bergqvist, 2016; Notteboom and Rodrigue, 2009; Leitner and Harrison, 2001).

From a regional perspective, Scandinavia has been developing an integrated hinterland transport system during recent years. Since 2006, the national, government-funded infrastructure strategy has focused on the Port of Gothenburg.[3] This policy focused on capacity as well as the risk of underutilization of facilities by improving maritime access, hinterland connectivity, and direct cargo-vessel services (OECD, 2016).

The Port of Gothenburg, located on Sweden's western coast, is the country's largest seaport, and it is of significant importance for Scandinavian economies. The Port of Gothenburg has a market share of about 45% of the containers in Swedish ports. (The Swedish Confederation of Transport Enterprises, 2018). The seaport recognizes the significance of a strong hinterland transport system with regular direct connections (Portopia Report, 2014) and efficient hinterland connections through the Swedish railway network, which reaches most major regions in the country (Monios et al., 2018; Roso, 2009). Regarding management, the port authority of Port of Gothenburg is an autonomous individual organization owned by the local government.

Since 2012, APM Terminals has operated Gothenburg's container terminal through a 25-year concession contract. The company's objectives have focused on increased operational productivity for containers, enhanced gate access for trucks, and improved rail services[4] (APM Terminals, 2017).

However, since 2016, the Port of Gothenburg's container terminal

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[1] Risks of port disruption can be caused not only by anticipated circumstances such as port labor conflicts (Galvao et al., 2016) but also by unexpected events such as natural disasters and accidents (Lam and Su, 2015).

[2] Hinterland is defined as the adequate market in which the port sells its operations (Slack, 1993) or "the interior region served by the port" (Van Klink and Van den Berg, 1998).

[3] The Port Strategy Commission selected ten main ports for the Swedish industry: Gothenburg, Helsingborg, Malmö, Trelleborg, Karlshamn in co-operation with Karlskrona, Norrkoping, Stockholm (Kapellskär), Gävle, Sundsvall and Luleå (OECD, 2016).

[4] APM Terminals is a global port terminal operator and cargo inland services provider. It operates in 59 countries, and it serves around 60 shipping lines. It is associated with Maersk Group (APM Terminals, 2018).

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has suffered a labor-related dispute with one of the stevedores' unions.[5] Consequently, its relationship with several customers has deteriorated (Gonzalez-Aregall, 2018), and the port's container traffic has decreased. Several companies have initiated mitigation strategies such as switching their shipments to other seaports in Sweden or in Northern Europe and moving their cargo by truck or rail due to efficient hinterland connections.[6]

This paper aims to analyze, by means of case study analysis, the effects on hinterland logistics resulting from the port conflict in Gothenburg and to evaluate dry ports as a potential solution for this kind of disruption. In the literature, several studies have evaluated the consequences of supply-chain disruptions as well as companies' mitigation strategies (Jüttner et al., 2003; Tang, 2006; Stecke and Kumar, 2009; Micheli et al., 2014; Lam and Su, 2015; Maghsoudi et al., 2018). Therefore, the study focused on analyzing the consequences of disruptions at ports for hinterland logistics and their impacts on dry ports and supply chains as a whole. As a result, the paper contributes to existing literature by providing evidence that the combination of intermodal transport and a dry port setup can act as a powerful strategy to mitigate disturbances in supply chains.

Although the analysis focused on Sweden, its findings are relevant to other countries as well, since any port can suffer labor conflicts. Thus, the paper's results can valuably inform stakeholders' decisions on managing the consequences of disruptions at ports.

In the study, we undertook a methodological approach based a longitudinal study of the evolution of port disruptions and its consequences on dry ports and intermodal services during a specific case study of a labor conflict at a port of Gothenburg.

The Port of Gothenburg is an interesting case study as this dispute occurred solely within the container terminal and did not affect other terminals, and the port has a high share of hinterland rail transport, moving almost 48% of the seaport's container freight (OECD, 2016). This system, called Railport Scandinavia,[7] facilitates daily rail shuttles to inland locations and rail terminals (Bergqvist and Cullinane, 2017).

The paper is organized as follows: Section 2 describes the transport framework of hinterland logistics in Sweden. Section 3 explains the main consequences of this specific conflict on the dry ports as well as a case study of the company, Jula; and the last section is devoted to summarizing the main findings and discussing the policy implications.

2. Hinterland logistics in Sweden

This section aims to describe the main characteristics of hinterland logistics and transportation in Sweden.

In the case of international trade, maritime transportation moves almost 90% of the country's worldwide commerce, which is one of the main factors in the development of the Swedish economy (Svensk Sjöfart, 2019). Specifically, the Port of Gothenburg, located on the west coast of Sweden, moves almost 30% of Swedish foreign trade, being the principal port in Scandinavia (The Port of Gothenburg, 2019).

In the case of regional transport systems, due to inland waterways, systems are very limited in Sweden, and the development of an integrated hinterland transport structure has focused on rail-based intermodal transportation (Bergqvist and Woxenius, 2011). According to Bergqvist (2015), this system is based on 24 rail shuttles and more than 8 different rail operators to dry ports in the region.[8] As a result, this process enables the reduction of transportation costs by nearly 10% compared to direct road transportation (Bergqvist, 2009; Bergqvist, 2015). See Fig. 1 for the current structure of the “Railport Scandinavia” system of rail shuttles.

The achievement of hinterland rail connections can be explained by competition in cargo rail services and customized services offered by railway companies, as well as the integration of railway and trucking services by individual logistics operators[9] (OECD, 2016). Since the deregulation of the rail system in Sweden in 1988, competition related to rail operations has increased, thus creating a more favorable situation for tendering rail haulage services.

As mentioned previously, a dynamic hinterland transport system is vital to ensuring integration between maritime and inland transportation. Therefore, the Port of Gothenburg has developed a plan to guarantee that half of the growth in the container sector will enter or leave the port by rail (Bergqvist, 2015). Through Railport Scandinavia, the Port of Gothenburg connects inland terminals all over Sweden and Norway by an efficient railway network (Port of Gothenburg, 2018a). About 50% of the containers handled at the port are conveyed through the hinterland transport system to inland terminals by daily rail shuttles. See Fig. 2 for the development of the number of containers handled by rail at the Port of Gothenburg.

Although containers dominate the system, there has been a strong market interest in integrating more semi-trailers into the system (Bergqvist, 2015). Thus, since 2017 the new intermodal terminal at the Port of Gothenburg has allowed the operation of six trains simultaneously, and more trailer traffic is being initiated into the system (The Port of Gothenburg, 2017).

The Port of Gothenburg has developed the hinterland transport system with its rail shuttles and inland terminals without any real competition from other ports (Bergqvist, 2015). Furthermore, the port offers value-added services in the integration of intermodal transport (Bask et al., 2014), and it provides new information technologies for better rail service and communication among actors in the supply chain (Mirzabeiki et al., 2016). However, since the beginning of this port dispute in the middle of 2016, volume at the container terminal has declined. As a result, the uncertainty introduced by this port dispute has been reflected in a reduction of port activity and has modified the port's customers' decisions, with many of them re-routing their cargo to other ports (Gonzalez-Aregall, 2018). However, in addition to the port's labor union dispute, the reduction of the port traffic and carriers' dissatisfaction were also related to the uncertainty associated with the upgrading of the rail terminal facilities, as well as the announced increase in the port terminals' tariff by APM Terminals in 2013 (Bergqvist and Cullinane, 2017).

Fig. 3 shows the evolution of container cargo movements at the Port of Gothenburg. The volume of containers has increased over the entire period. Nevertheless, there were decreases in movement in 2009 due to the economic crisis and in 2012 coinciding with the entrance of APM Terminals Company as the terminal operator.

3. Logistics consequences of the Port of Gothenburg conflict

This section aims to describe the logistical consequences resulting from the port disruption that occurred in the container terminal at the Port of Gothenburg in 2016–2017, with a method focused on a

[5] In the Port of Gothenburg's container terminal, there are two labor unions. However, according to Swedish labor regulations, only one stevedoring syndicate can have a collective bargaining agreement with the terminal operator. For a detailed analysis of the Port of Gothenburg's conflict, see Gonzalez-Aregall (2018).

[6] Around 25% of 478 Swedish firms have been affected by the port conflict, and 51% of them have undertaken plans to alleviate the adverse consequences (Svenskt Näringsliv, 2017).

[7] According to the Port of Gothenburg (2017), the Railport system includes the following: Railport Intermodal, an efficient railway network; Railport Terminal, which connects 20 inland terminals to the Port of Gothenburg; and Railport Conventional, which uses conventional freight wagons.

[8] Rail shuttles operate mainly for distances between 250 and 450 km (Bergqvist, 2015).

[9] In the case of inland terminals, large ones are operated by independent terminal operators, whereas smaller ones are operated by local logistics service providers (Bergqvist, 2015).

Fig. 1. Railport Scandinavia: rail shuttles and destinations.
Source: Port of Gothenburg, 2018a.

quantification analysis of hinterland logistics during a case study of the Port of Gothenburg.

First, a general theoretical analysis of the effects of port conflicts is conducted. Second, primary effects of the conflict are described. Third, a quantification of the impact of this conflict on the dry ports through a longitudinal analysis is examined. Finally, an in-depth analysis and case study of the company, Jula, is presented to understand how the conflict and disruptions affected a large, import-dependent shipper and how they utilized a dry port solution as part of their mitigation strategy.

3.1. The nature of port labor conflicts

Nowadays, globalization facilitates the extension to new markets of supply chain operations, but, at the same time, this expansion can increase the complexity of, and the vulnerability to, supply chain disruptions (Stecke and Kumar, 2009). Consequently, in order to mitigate potential problems, companies often implement strategic initiatives (Tang, 2006; Stecke and Kumar, 2009; Micheli et al., 2014; Lam and Su, 2015), enhance information flow between actors across a supply chain (Wilson, 2007), as well as maintain stable relationships with all these participants (Loh and Thai, 2015).

Specifically, port infrastructure has become a critical factor in the movement of commodities (Lam and Su, 2015), while at the same time, any unexpected disruption in this principal supply chain node can negatively affect companies' achievements.

According to the literature, port disruptions can cause increased costs of logistics such as transportation costs because the use of alternative transport modes[10] (Hall, 2009; Gurning and Cahoon, 2011) hinders productivity (Lam and Su, 2015). Thus, the increase in costs due to this adverse situation depends mainly on the port's resilience and the decision to invest in alternative logistics plans (Loh and Thai, 2015).

[10] For a theoretical analysis of specific aspects of supply-chain costs, see Pettersson and Segerstedt (2013).

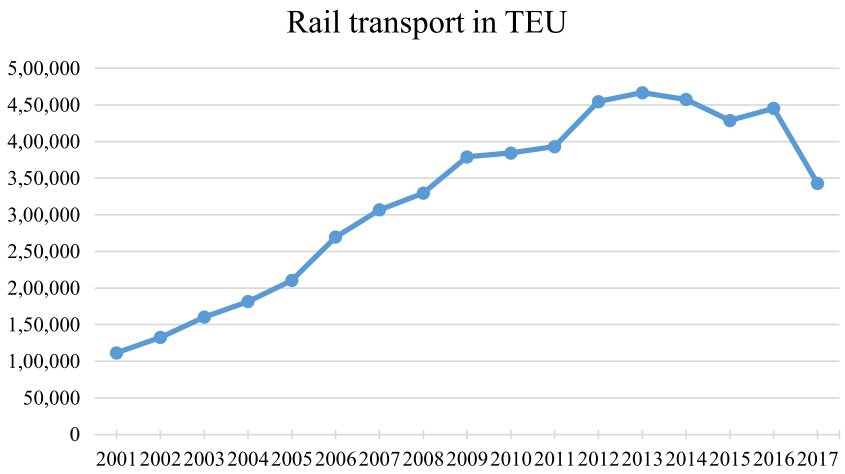

Fig. 2. Container volume development on rail in Port of Gothenburg.
Source: Port of Gothenburg, 2018b.

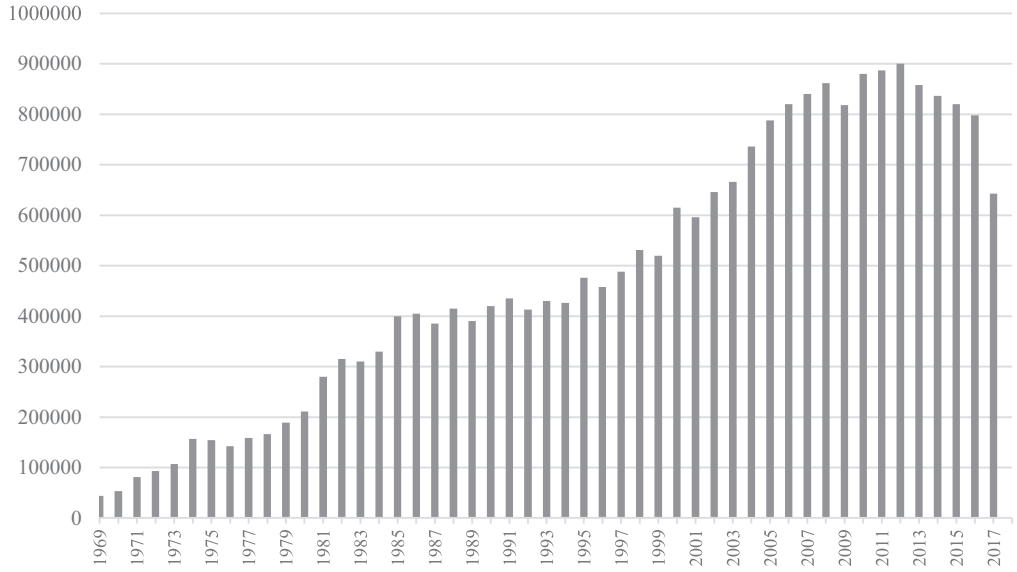

Fig. 3. Container volume (by TEU) development for Port of Gothenburg 1969–2018.
Source: Port of Gothenburg, 2018c.

Consequently, port labor conflicts negatively affect port service developing and port reliability (Notteboom, 2018). Thus, port disruptions can provoke uncertain operational performance of manufacturers (Wilson, 2007), instigate serious organizational risks to producers (Loh et al., 2017) as well as negative reputation with costumers (Porterfield et al., 2012).

3.2. The main causes and consequences of the port of Gothenburg conflict

The port of Gothenburg is the largest seaport in Sweden and high relevance for the Swedish economy. The port is manage by the municipality government and since 2012, APM Terminals has operated the container terminal through a concession agreement (Bergqvist and Cullinane, 2017; Gonzalez-Aregall, 2018). In general, the stevedoring service is based on two labor unions; however, according to the Swedish labor regulation, only one syndicate can sign the working conditions with the main company through a collective bargaining agreement (CBA)[11] and consequently, the regulation allows unions without CBA with their employers go on strike (Gonzalez-Aregall, 2018). In the particular case of the Port of Gothenburg, the minority syndicate has signed an official CBA with the terminal operator whereas the other labor union, with the majority representation, had decided to strike as it is not committed to any agreement (Gonzalez-Aregall, 2018).

As a result of the port conflict that occurred in Gothenburg in 2016–2017, the uncertainty generated by the dispute has been reflected in a reduction of port activity and has modified the port's customers' decisions, with many of them rerouting their cargo to other ports. Hence, several consequences have emerged.

Few studies have analyzed the logistical effects on industrial sectors of this specific seaport conflict. On the one hand, Kayello and Morsten (2018) studied the largest Swedish export sector, i.e., the forestry industry; the authors found that small-to-medium manufactures can adapt better to port disruption due to the lower complexity of their operations, whereas the distance of a company from the conflict node plays a relevant role in the severity of supply chain disruption. On the

[11] These agreements cover issues like wages, overtime payments, work (*footnote continued*) education, insurance and pension's rights (Gonzalez-Aregall, 2018).

other hand, the primary source of Swedish imports is the retail industry, e.g., the company, Jula, with more than 10.000TEU of imports annually. In this regard, Ha and Lindroth (2018) observed that this segment was especially vulnerable to port disruptions due to issues such as unpredictable demand and seasonal cycles. Thus, a short lead-time was essential in order to avoid increasing costs and customer discontent.

Furthermore, in a situation of limited capacity, the terminal operator is forced to limit import containers in order to be able to dispatch export cargo inside the terminal (Ports of Sweden, 2018). Thus, imports on the APM Terminals may need to be rerouted before reaching their destinations in Sweden. Consequently, APM Terminals and Port of Gothenburg have lost market share to other ports.

Consequently, numerous containers have been shifted to alternative terminals such as roll on/roll off (ro-ro) terminals. However, sometimes, due to service features, these alternative terminals might not be suitable. In this regard, it seems that some cargo units changed the type of load unit and were being exported as trailers instead of containers (The Port of Gothenburg, 2018).

Finally, there is a high risk of the port losing business due to strategic risk management considerations. Several companies have initiated mitigation strategies such as switching their shipments to other seaports in Sweden or in Northern Europe or moving their cargo by truck or rail. As a result, this redirection of freight flow has affected the financial performance and distribution networks of manufacturers who have been forced into more expensive and more complex logistics agreements and contingency plans using land transportation. In the next section, we analyze how the Port of Gothenburg's hinterland logistics and the inland terminals have been affected.

3.3. The impact of this conflict on dry ports in Sweden

Considering the efficient hinterland logistics network at the Port of Gothenburg, several companies have used alternatives modes of transportation and other seaports to reach their final destinations and to guarantee an efficient supply chain.

The port conflict began in June 2016, and the main disruptive events occurred during 2016 and 2017.

As mentioned previously, numerous containers have been shifted to alternative seaports and terminals inside the port. Thus, according to the Port of Gothenburg (2018), in 2017 the total container traffic in the container terminal decreased by 19%, whereas the container volume rolled on ro-ro terminals increased by 15%. Furthermore, the main neighboring container ports increased container cargo movement during the period (Gonzalez-Aregall, 2018).

As a result, the share of rail for container transport to and from the Port of Gothenburg was higher during the conflict, and, therefore, it seems that dry ports provided a higher degree of resilience against the port disruptions compared to those segments not connected to the dry ports.

Based on a longitudinal analysis on considering the days of disruptions during the period, this study aims to connect the relation between port disturbance and its consequences on the supply chain through measuring the share of rail volume. Fig. 4 shows the share of rail volume when the main external disruptions, i.e., strikes and IT attack,[12] occurred from 2016 to 2017. Furthermore, the figure shows the number of days with disruptions (strikes and blockades) reported by port employers as well as the number of days with active combat measures through government mediations.

Transshipment in Fig. 4 refers to containers arriving outside the terminal area by rail but being transshipped to trucks for the final mile to the container terminal. From the volume development presented in Fig. 4, we can conclude that the rail shuttle and dry port system was fairly stable during the period of greatest disruption (July 2017), reaching an all-time high in terms of its share of handled containers. This result is in line with a report by Damvad Analytics (2018) that shows a reduction in the number of containers handled in the APM Terminal during the constant disruptions from November 2016 to June 2017. Consequently, after several mediation measures, in autumn 2017 the movement of containers at the terminal slowly started to recover. Thus, it seems that these disruptions resulted in a high risk of dissatisfaction from container terminals' customers.

[12] In June 2017, APM terminals around the world were affected by a cyber-attack on Maersk. Consequently, the Port of Gothenburg had to be operated manually with limited services (The Loadstar, 2017).

3.4. Case study: Dryport Skaraborg and Jula

The story of Dryport Skaraborg, located in the city of Falköping, begins around 2007 when the company, Stora Enso, a large integrated paper, packaging, and forest product company, announced their intention to build a 40,000–50,000m^2 terminal for round timber in Falköping. This decision enabled the construction of a marshalling yard in Falköping and opened up the possibility of other rail terminals (Bergqvist, 2008). Shortly thereafter, the Municipality of Falköping started developing a terminal for intermodal handling. During the first years, traffic volume was very low and increased slowly. However, since 2011, when the company, Jula, started an intermodal transport service, the development speeded up significantly. To understand the background and motives of Jula, we need to describe the nature of the business.

Jula operates in the DIY segment. Their main markets are Sweden, Norway, and Poland. The company focuses on attractive pricing by means of large purchases directly from manufacturers all over the world, without intermediaries. As of 2018, the company had 98 department stores in three countries (Sweden 53, Norway 33, Poland 12) and about 3000 employees. In 2017 the company turnover was €0.65 billion with profits reaching €50 million. Jula is privately owned by entrepreneur Karl-Johan Blank. The company culture is focused on entrepreneurship and customer value. As for logistics, all flows are coordinated and consolidated at the 150,000 m^2 central warehouse and distribution center in Skara, Sweden. The majority of incoming goods to the central warehouse consist of imported containers, mainly from Asia. Schenker Air and Ocean in Sweden hold the key Jula account and coordinate incoming container flow.

3.4.1. Location description: Dryport Skaraborg

Jula and Schenker Air and Ocean had a close collaboration for more than a decade before the discussions regarding a joint intermodal transport service started in 2011. The Municipality of Falköping, Sweden, made the initial contact and presented the idea of an intermodal rail service to Jula. An initial study was made by Schenker Consulting that proved there was environmental and cost-saving potential as well as service quality improvement possibilities in using Falköping as a dry port. Container flow could be managed much more efficiently by using the terminal in Falköping as a buffer of full containers as well as an empty container depot, meaning that containers could be more easily distributed from the terminal in Falköping to exporting companies in the region. The study showed that the intermodal transport solution could be competitive with around 10,000 TEU (twenty-foot equivalent units) per year (Ye et al., 2014), which is a little less than what Jula transported during 2011.

In 2012, Jula's volume had grown to such a level that the company was comfortable starting up an intermodal service but wanted Schenker to act as the “control tower” for the solution. Jula and Schenker started a joint project to realize the service in January of 2013, and the first train between Skandiahamnen in Gothenburg and the port in Falköping (Dryport Skaraborg) departed on September 4, 2013. The train initially consisted of 11 wagons (half train) with a capacity of 44TEU and 5 departures per week. By October 2014, the train was extended to 17 wagons and 68 TEU, and as of 2015, the train was full length with

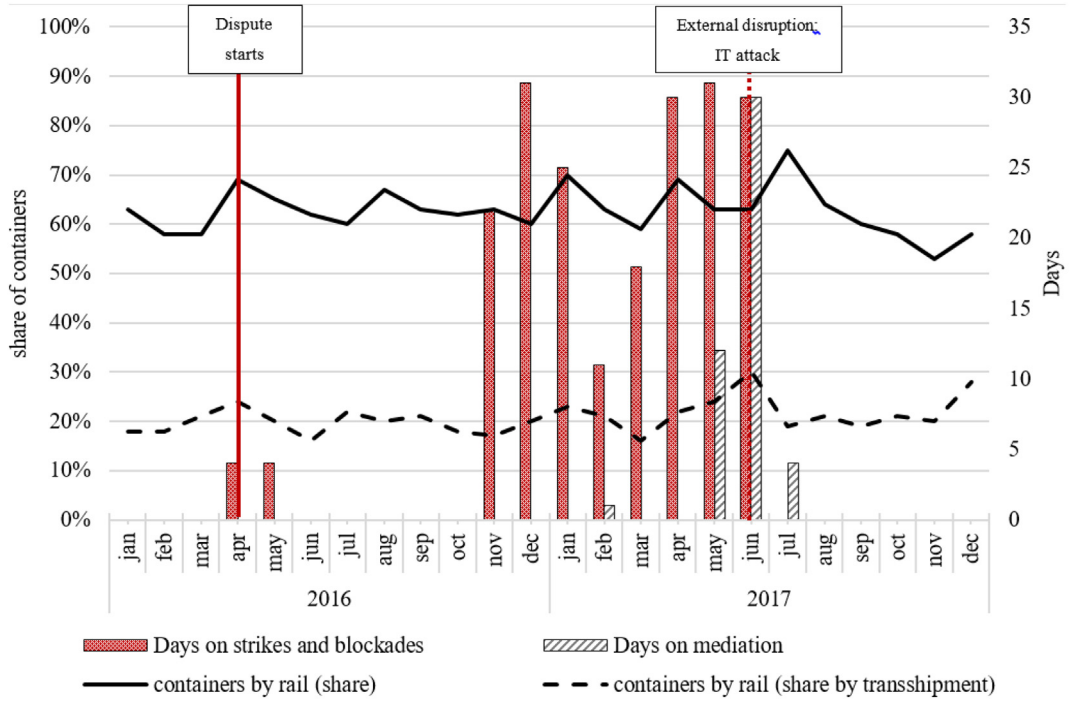

Fig. 4. Evolution of the share of rail for container transport.
Source: Own elaboration based on Port of Gothenburg, 2018b and Ports of Sweden, 2018.

84TEU in each direction.

3.4.2. Setup

When starting up the intermodal service, there was a need to develop the terminal infrastructure in Falköping. This, in combination with coordinating all other stakeholders, generated a huge challenge in developing and signing contracts in a synchronized manner.

Fig. 5 illustrates the structure of agreements needed to start this intermodal service. The complexity and coordination required a large amount of trust and commitment. Trust was generated through months of contacts, discussions, and relationship building before the actual signing of contracts.

Central to the setup is the open-book agreement between Jula and Schenker. This agreement defines how investments, risk, and returns are distributed. Both Jula and Schenker have recognized the importance of long-term and transparent contracts and agreements in order to ensure that all actors involved focus on cost-efficiency and service quality. The long-term contracts facilitate risk by enabling long-term investments for all actors instead of short-term leasing arrangements. The agreement between Jula and the Municipality of Falköping defines the conditions for the investment and extension of the intermodal terminal in terms of surface and track development. Jula's role can best be described as the large shipper that provides volume and financial guarantees to the setup and Schenker's as the control tower of the service. The terminal operator was initially determined by means of public tendering by the Municipality of Falköping and was rewarded a

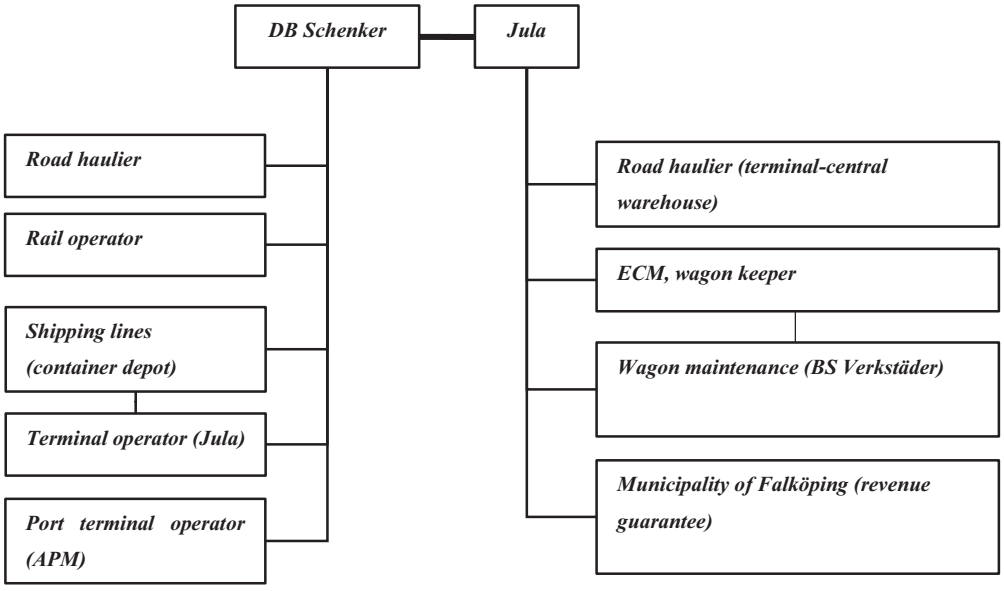

Fig. 5. The structure of agreements (Monios and Bergqvist, 2015).

five-year contract (Bergqvist and Monios, 2014). As of 2018, Jula has increased its control of the dry port by acquiring the terminal from the Municipality of Falköping for 2.5 MEUR. Furthermore, Jula took over as terminal operator in November 2018 with the strategy of developing more intermodal services and traffic.

The local rail operator, Tågfrakt AB, is responsible for rail haulage. However, Jula controls the time slots at the Port of Gothenburg and is the owner of the wagons, which makes switching the rail operator easier in case this is needed.

In order to achieve high levels of flexibility and robustness in the system, the ability to use the dry port as a container depot is crucial. Consequently, a number of agreements have been signed between Jula as terminal operator and major shipping lines. This enables full and empty containers to stay in Falköping and not be repositioned to the depots at the Port of Gothenburg.

Overall, the structure of the contract and agreements is complex but enables all actors to focus on cost-competitiveness by means of transparency and long-term commitments.

3.4.3. Effects of the port disturbances

As control tower, Schenker is responsible for booking, accounting, monitoring, and marketing of the service. Jula and Schenker continuously discuss ways of increasing the goods volume on the rail service by attracting more local shippers to the service. So far, the efforts have been successful; the rail service is now running at full capacity, and there are plans to increase the number of departures from five to six per week. Customers include companies like Parker Hannifin, Swedish Match, A Lot of Decoration, MIO, and Gyllensvaan (supplier of “Billy” bookshelves to IKEA). Schenker has continuously tried to coordinate shippers and their choice of shipping lines in order to enable best fit between import and export containers.

To improve flexibility for many shippers, the customs clearance process has been developed in such a way that containers/goods do not need to be cleared until they leave the dry port in Falköping.

In sum, the benefits from the rail service and the associated dry port solution can be characterized as Table 1:

The last benefit refers to the project Jula applied for and was awarded, giving them a five-year exemption on current road vehicle restrictions, which enables the road haulage of 2*40f containers simultaneously, improving the cost-efficiency of the pre- and post-haulage to and from the dry port. This has improved the cost-efficiency of the intermodal transport solution for Jula since about 70% of their containers are 40 ft. and about 30% are 20 ft. (Bergqvist and Behrends, 2011).

Neither Jula nor Schenker entered the intermodal transport solution on the assumption that it would bring resilience to the supply chain in case of disturbances, however, they were aware of the benefit of flexibility it could bring. During the port disturbances at the Port of Gothenburg during 2016–2017, however, it became clear how important the rail service and dry port were as tools for mitigating supply chain disturbances. From previous studies of the effect of the Port of Gothenburg-related disturbances (e.g., Ha and Lindroth, 2018; Kayello and Morsten, 2018), we know that many shippers had logistics-related cost increases up to 70% during this period. Cost increases were generated by effects such as rerouting of containers to ports farther away, shortage of trucks, overtime at warehouses as goods could arrive very suddenly and unpredictably, halted production, missed seasonal sales and campaigns, etc. These effects were minimal for the shippers that used the rail service and the dry port in Falköping. Jula had logistics cost increases of about 15% during this period (compared to 70% for many other shippers), and this was accounted for by increased rail-operating costs for those circumstances when their trains were rerouted to other ports. During the port conflict, 80% of Jula's containers were still delivered to the Port of Gothenburg, and the rest were rerouted to other ports, including the Port of Stockholm, Malmö, Halmstad, and Aarhus in Denmark. With the ability to reschedule the train operations, most of the containers were still delivered on rail to Falköping.

Table 1
List of benefits from rail service.

Cost-efficiency
Traffic safety (less heavy transport on the road)
Environmental performance (about 80% less CO_2 emission vs. road transport)
No waiting time at the Port of Gothenburg
No port demurrage and no road toll fee
Imported container stock now closer to shippers' warehouses, which creates more even cargo flow
Long-term agreements
More efficient road haulage through the exemption for long carriage (32 m = 2 × 40 ft)

The main reason that the cost impact was so low for the shippers was the fact that rail operations and handling at the Port of Gothenburg was prioritized by the operator during the conflict. One possible explanation for this is that it is less labor intense and that disturbances in rail operations can be transferred to the rail network and thus create more disturbances, something that the Port of Gothenburg wants to avoid since it would make planning for operations even more difficult going forward. In fact, there were situations in which shippers in Gothenburg had difficulty getting their containers out of the port due to congestion of trucks and huge waiting times, so they used the rail service to Falköping and then transported the containers back to Gothenburg using road transport. Furthermore, the stock of full and empty containers at the dry port acted as a great buffer against the minor disturbances affecting the rail services.

Given the case of Dryport Skaraborg and the port conflict and disturbances at the Port of Gothenburg during the period 2016–2017, it is evident that the concept of intermodal transport and dry port setup as a mitigation strategy for dealing with contingences in the supply chain is quite powerful. The dry port option provides the ability to be more responsive, flexible, and robust at the same time, a combination that is normally difficult to achieve in supply chain management. Besides flexibility, this option also enables companies to use locations that might be favorable in terms of labor costs, availability of land, level of de-regulation, etc.

4. Conclusions

Freight traffic has become a fundamental factor in a country's economic growth. Thus, an efficient supply chain allows goods to be moved from seaports to land facilities through a hinterland transportation system.

Sweden has been developing an efficient, integrated hinterland transport system that focuses on effective road and rail connections to the Port of Gothenburg. However, this exclusive infrastructure strategy became vulnerable due to a port labor disruption stemming from a conflict with one of the stevedores' unions.

This paper analyze the effects on hinterland logistics of the port labor conflict that occurred in Gothenburg in 2016–2017 and to evaluate dry ports as a potential solution for this kind of disruption. Through research on hinterland logistics in Sweden and the case of the dry port in Falköping and the shipper Jula, it is evident that intermodal transport together with a dry port setup can act as a powerful mitigation strategy for supply-chain disturbances. From a shipper perspective, several researchers higlights supply chain vulnerability in regard to dsruptions and streategic inititaties to address these, such as enchanges information exchange and stable realtionships with partners in the supply chain (Tang, 2006; Stecke and Kumar, 2009; Micheli et al., 2014; Lam and Su, 2015; Wilson, 2007; Loh and Thai, 2015). The results of this research propose to extend the list of strategic initiatives to include the concept of dry ports and hinterland integration as a powerful mitigation strategy for supply-chain disturbances

Although the analysis focused on a Swedish case study, we can infer

from the results that the paper can be valuable in guiding stakeholders' decisions and strategies to better manage supply chain disturbances generated at the port, as in the case of labor conflict related disruptions.

From the perspective of the seaport, the results from this case study suggest that inland terminals and dry ports increased their traffic share during the conflict, which was a response to uncertainly at the Port of Gothenburg. The repeated disturbances throughout this sustained period led to an uncertain situation with a high risk of the port losing business due to a redirection of freight flow to other ports or land transportation. Consequently, this situation created a risk to the seaport's ability to compete as well as an adverse social and economic situation. The mitigation of supply chain disturbances by means of integrating the seaport more with its hinterland further supports the argument that it can be seen as a strategic step in extending the life cycle of the seaport (cf. Monios and Bergqvist, 2016; Notteboom and Rodrigue, 2009; Leitner and Harrison, 2001).

In conclusion, the results support the argument that port authorities must design an effective and efficient hinterland transport system not only for cost efficiency, sustainability, and service quality, but also as a risk-mitigation strategy. Hinterland logistics is a crucial element of the supply chain as well as a potential alternative for managing negative situations.

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