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Citation for the original published paper (version of record):
Khaslavskaya, A., Roso, V. (2019)
Outcome-Driven Supply Chain Perspective on Dry Ports
Sustainability, 11(5)
http://dx.doi.org/10.3390/su11051492

sustainability

MDPI

Article

Outcome-Driven Supply Chain Perspective on Dry Ports

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Received: 13 February 2019; Accepted: 6 March 2019; Published: 12 March 2019

Abstract: The hinterland leg of maritime containerized transport as a part of supply chain has been increasingly pressured by larger volumes, as well as by a need to fulfill sustainability requirements that are expressed by social opinion and formal regulations. There is a potential to relieve this pressure through integration of a dry port, as a seaport's inland interface, in the supply chain. Therefore, this paper aims to explain how a supply chain can benefit or enhance its outcomes of cost, responsiveness, security, environmental performance, resilience, and innovation, by the integration of a dry port. The data for this case study is collected through interviews and site visits from the privately owned Skaraborg dry port, Sweden; and the study is limited to the actors of the transport system involved in the development and operations of the dry port integrated setup. The results show that the six supply chain outcomes (cost, responsiveness, security, environmental performance, resilience, and innovation) are perceived by the actors as being desirable, and can be enhanced by the integration of a dry port in the supply chains. In particular, the enhancement of the supply chain outcomes can be achieved due to intermodality and reliability of rail transportation and customization of services associated with the dry port integrated setup, and by increasing the capacity of transportation system.

Keywords: dry port; outcome-driven supply chain; supply chain outcomes (SCO); sustainability; cost; responsiveness; security; environmental performance; resilience; innovation

1. Introduction

The biggest portion of cargo volumes worldwide is transported by maritime transport, and it accounts for 80% by volume and 70% by value [1]. According to Beresford et al. [2], a hinterland part of maritime cargo transportation constitutes over 60% of transport costs, and it has great potential for improvement. Among the sustainable solutions for hinterland transport improvement, the concept of a dry port has gained popularity within recent years as having the potential to reduce costs and to improve the environmental impact of hinterland transportation [3–5]. A dry port is the seaport's interface inland, offering a large range of services that are traditionally performed at the seaport with potential to generate benefits for the actors of the transport system [6]. However, in contrast to a seaport that is an integral link between the marine and land transport systems, a dry port is an optional transport node. A dry port as an element of hinterland transport is a part of many supply chains (SCs), and thus, it has an effect on SCs performance. The concept of a dry port has been studied by different research approaches, and from different perspectives, such as environmental, e.g., Roso [3] and Henttu and Hilmola [4], geographical e.g., Roso and Lumsden [7] and Roso et al. [8], economic, e.g., Lättilä et al. [9], hinterland access strategies e.g., Monios [10], directional development e.g., Bask et al. [11]. However, research on dry ports from the supply-chain perspective is scarce. According to Melnyk et al. [12], SCs need to be sophisticated, to fulfil changing demands and they need to be designed as outcome-driven in order to be competitive. Outcome-driven SCs in contrast to

traditional, cost-driven ones, focus on diverse outcomes that are important for target customers and other involved actors (ibid). The authors conclude that a focus on a "bland" of supply chain outcomes (SCOs) of cost, responsiveness, security, sustainability, resilience, and innovation can be one of the competitive strategies. The SC perspective has been previously applied to research on hinterland transport e.g., the effect of inland navigation on SC service performance [13] or SC perspective on modal shift [14]. Similarly, this paper combines two aspects that of (1) a dry port's potential to improve hinterland transportation, and (2) the outcome-driven nature of SC; and focuses on relationships between the two. Consequently, the purpose is to explain how a SC can benefit or enhance its outcomes of cost, responsiveness, security, and environmental performance, resilience, and innovation, by the integration of a dry port. This paper takes a SC perspective, and it investigates the perceptions of the actors of the system.

2. Frame of Reference

2.1. The Outcome-Driven Supply Chain

The purpose of a SC is to build customer value, and to generate competitive advantages in the overall SC, as well as to improve the long-term performance of the individual organizations included in it [15]. To generate value for the end customer, and to fulfil changing demands, SCs need to remain competitive, therefore sustainable SC management is gaining importance as the means of companies' performance evaluation [16]. Traditional SCs are price-driven, which is not always enough to retain competitiveness in the changing environment. In contrast to traditional SCs, outcome-driven SCs focus on multiple aspects important for target customers. SCOs in their variety have been covered from different perspectives such as e.g., modal shift, information technology, and rail and seaports perspective. For example, Chuanwen et al. [14] argue that one of the hindrances to shift goods from road to rail is that many stakeholders do not consider the overall SC impact (outcomes) of multimodal transportation. High-capacity transport modes are in general cheaper and greener, but not flexible or fast enough, resulting in logistics managers perceiving the straight modal shift leading to increases in inventory, and consequently having negative impacts on the SC [14]. Closely related to this issue is transportation as a part of SC, which has been analyzed by Woodburn [17], who observed that managers' perception of rail is impairing SC performance, and consequently creating a barrier to this mode increasing its market share. Furthermore, according to Bichou [18], seaports, as sites/nodes that bring together variety of actors in the SC, contribute to the SC and its outcomes by creation of competitive advantage and value-adding services. More specifics on SCO and its measurements can be found in the report by Singh and Teng [19], who specified two measures for SCOs: performance and transaction cost; and conclude that the application of information technology and inter-organizational trust influences those SCOs.

According to Melnyk et al. [12], important SCOs for the actors are cost, security, sustainability, responsiveness, resilience, and innovation (defined in Table 1 as by Melnyk et al. [12] with adaptation to the current study) in various combinations of them. More specifically, an outcome-driven SC, apart from focusing on cost optimization, can at the same time focus on the enhancement of SCO of sustainability, resilience, innovativeness, responsiveness, and/or security. However, instead of being "overly focused" on one SCO, or trying to focus on all of them, a "blend" or a mix of SCOs, corresponding to the key customer preferences, should be found, in order to maintain a competitive SC [12].

Table 1. Framework based on the supply chain outcomes (SCO), proposed by Melnyk et al. [12].

SCO	Authors' Interpretation and Commentary
Cost	Cost reduction.
Responsiveness	Ability to quickly change according to the demand change.
Security	Safety of products/cargo along the supply chain.
Environmental performance	A positive contribution to the state of environment by e.g., reducing harmful emissions; in the original source, the same outcome is referred as "sustainability"; however, given the fact that sustainability is commonly associated with economic, social, and environmental performance, here, the outcome was specified as only focusing on environmental performance, also in accordance to the original source's definition.
Resilience	Ability to quickly and effectively recover from harmful influences of various natures, e.g., natural disaster, technological interruption, or economic recession.
Innovation	Obtaining innovative products and processes throughout SC partners.

2.2. The Dry Port as an Element of a Supply Chain

A dry port acts as the seaport interface inland: it is an intermodal inland terminal with a high-capacity connection to a seaport [20]. Dry ports are placed in strategic locations; i.e., on cross-roads or along the transport corridors, and/or in proximity (and/or with well-established access) to production or marketplaces. Consequently, the establishment of a dry port requires transport infrastructure to be in place. High-capacity connection between a seaport and a dry port is often performed by rail, or in some cases, by inland waterways (by barge), and requires river communication infrastructure [21]. Once the infrastructure and basic services are in place, the availability of value-added services increases a dry port's attractiveness; eventually, the range of the services available affects the dry port's development [6]. Services performed at dry ports vary and go beyond the standard services of rail transport to/from the seaport, transshipment, customs clearance, and storage [8,11]. Shifting the services from a seaport to a dry port has an effect on the SCs.

Veenstra et al. [22] emphasize the strong overall trend towards efficient, reliable, and sustainable SCs; and multiple actors involved in SCs can benefit from the integration of dry ports. This includes Outside-In dry ports, i.e., where the development of the dry ports is driven by the seaport side, such as port authorities, port operators, or ocean carriers, to secure seaports' hinterland [23,24]. In addition, dry port integration helps to eliminate congestion at the seaport gates, and to free up space at the seaport for core activities (e.g., [10,11]); in other words, it brings with it competitive advantages over other seaports [8,24]. In contrast to Outside-In, the Inside-Out model refers to initiation of a dry port from "landside" [23]. "Landside" can be represented by different actors of the transport system, including municipalities, shippers, transport operators, and/or forwarders. One of the main drivers of the Inside-Out model of dry ports' directional development is regional development, i.e., the creation of new businesses and working places in the region [7]. Shippers may prefer intermodal transportation solutions involving dry ports, to avoid congested roads, unpredictable delays, and to enhance reliability [22]. Nonetheless, the cost-benefit is a crucial and often primary element for transportation solutions with a dry port [9].

Multiple studies suggest that a dry port integrated solution brings cost benefits [3,7,9,25–27]. Henttu and Hilmola [4] conclude that the implementation of a dry ports network would cause a "reduction in both emissions and total transportation costs". The reduction is explained by a modal shift from roads to intermodal solutions (greater utilization of rail and inland waterways), which leads to decreased traffic, and congestions at the seaport gates and seaport cities [3]. These consequently lead to the reduction of harmful emissions: the emissions that are generated along the hinterland leg of transportation can be decreased by as much as 25 [3] to 32–45 percent [9]. Moreover, a decrease in road traffic leads to a reduction of road maintenance and probability of accidents, which also translates into

costs savings [3]. In this way, intermodal solution for the hinterland leg of seaborne cargo, encouraged by a dry port, bring multiple benefits to SCs. With reflection on the SCO framework used in the study (Table 1), literature findings on how the SCOs can be enhanced by the integration of a dry port in SCs are summarized in Table 2.

Table 2. Literature findings on supply chain outcomes related to the integration of a dry port.

SCO	Possibility for Enhancing the SCO (Literature Findings)
Cost	Dry ports can financially benefit different actors along the SC: dry ports increase seaport and hinterland transport chains throughput [25]; intermodal carriers increase profits along the hinterland part of the transportation chain (ibid); importers and exporters decrease transport costs and thus increase products' competitiveness [26]; further cost advantages can be achieved by networks of dry ports [9]; the utilization of dry ports lowers risks associated with hinterland transportation [26]; a dry port compared to a seaport usually provides lower container storage fees [7], and eliminates fees associated with road transportation (e.g., tolls fee) [27]; a dry port lowers the probability of road accidents (and its financial equivalent) [3].
Responsiveness	A dry port-integrated setup is "adaptive business network . . . which facilitates the supply chain" [28]; reliable and frequent transportation attracts and retains customers, and it positively affects customers' perception of a dry port performance [22]; a dry port can provide services in accordance with changing customers' needs [6]; a dry port can provide high-quality services and save time and money by avoiding congestion and enjoying benefits of intermodal transportation [24].
Security	A dry port assures safety and security of goods handled [28,29]; consolidation of goods in one location allows for better security i.e., a dry port might purchase expensive equipment (e.g., X-ray scanners for customs inspections) [30].
Environmental performance	CO_2 emissions can be decreased by 25% [3] up to 32–45% [9] by modal shift; the congestions at the seaport gates can be eliminated or reduced, removing emissions that are generated at that point [3]; A dry-port integrated setup is very likely to use road-based transport for the last mile, where the further reduction of emissions can be achieved by "cleaner and greener" fuels [5] and the utilization of long vehicles [31].
Resilience	A dry port in a transportation system sustains an SC, "given the constant change in the global transport system" [28]; the influence of a labor conflict in a seaport is less significant for companies using intermodal transportation solutions, rather than for those solely relying on truck transportation [31].
Innovation	Dry port as a combination of "on-dock rail, reliable inland connection and a functional inland facility" constitutes an innovation; "We cannot manage the growth and changing needs of customers, using old thinking and old processes" [32].

3. Method

This paper is based on the case study of the Skaraborg dry port located in Skara, Sweden, and the actors involved in the dry-port integrated setup. The study takes the SC perspective, and the framework is derived from the SCOs proposed by Melnyk et al. [12] (a detailed description is in the frame of reference). Considering the literature findings, the study seeks to explain how SCs benefit or enhance their outcomes, by the integration of a dry port. To study this matter, first-hand data were collected by interviewing representatives of the municipality of Falköping, the dry port owner, rail transport operator, seaport authority, seaport terminal operator, the customer (retail company using the dry port), potential customer (retail company located in the vicinity of the dry port), and the consultant closely engaged in the design and development of the dry port integrated setup (Table 3). The data were collected in June, July, and September 2018 during site visits, at a meeting during one conference, and by phone calls; face-to-face or semi-structured phone interviews of 20–60 min were conducted by two researchers. Each interview-guide was adapted for each exact interview; the interview guides were developed further during the meetings [33]. The interviewees received the interview guides in advance. During the interviews, the respondents were asked to describe their business relationships with the Skaraborg dry port, and their perception of how the SCOs can be enhanced by integration of

the dry port; the interviewees were asked both general questions on potential influence of a dry port on the SC, and more specific questions on the six proposed SCOs. Upon agreement, the interviews were recorded and transcribed; afterwards the summaries of transcripts were sent back for validation. In the end, the validated transcripts were coded and analyzed in a qualitative data analysis software, NVivo.

Table 3. Interviewees.

Actor	Interviewees' Positions
Municipality of Falköping	Manager, logistics and infrastructure at Municipality of Falköping
Jula AB, retail company, dry port's owner	Freight Manager
Rail transport operator	Key Account Manager
Seaport authority	Senior Manager Business Development
Seaport terminal operator	Business Development Manager and Commercial Manager Rail
Customer	Logistics Manager
Potential customer	SCC & Launch Manager
External consulting	Consultant

The qualitative data analysis software NVivo was used as a tool for thematic coding of the interview transcripts. Thematic coding implies the use of a priori defined categories that arise from the literature, and that correspond to the research purpose; in this case, the categories were cost, responsiveness, security, environmental performance, resilience, and innovation, in accordance with Melnyk et al. [12]. By this means, the data were categorized and reduced; and the conclusions were derived [33]. The findings are presented separately in each category (corresponding to the focal SCOs).

4. Skaraborg Dry Port

The Port of Gothenburg is the largest container seaport in Scandinavia, handling 644,000 TEUs in 2017, and connecting to 26 inland destinations by rail shuttles that transport more than 60 percent of the total port container volumes [34]. One of those shuttles runs five times a week to Falköping, Skaraborg Logistics Centre, transporting containerized goods. The logistics center has six terminals, one of which is the Skaraborg dry port, designed for shuttle purposes and offering value-added services such as storage, forwarding, customs clearance, and road haulage. As early as in 2000, due to substantial volumes being transported to the seaport by road, the Falköping municipality had the idea of building an intermodal terminal in the area to move goods from road to rail. However, it was not until the end of 2006, when Stora Enso Oyj, a forest products company, showed interest in establishing a terminal in the area, that the actual construction of the terminal was initiated. The terminal was inaugurated in 2007, and after many ups and downs, it finally reached functionality, with Jula AB, a Swedish retail company in 2013, as a large customer bringing needed volumes. Their volumes of containers on the rail increased continuously, and eventually Jula AB acquired their own rail wagons for the service, and contracted Schenker AB as the rail operator. Gradually, other customers in the area started to use the dry port, and during the time in which the study was conducted, it handled about 21,000 TEUs for export, and 4000 TEUs for import. Jula AB bought the facility from the municipality in 2018. To fully utilize the potential of the dry port and rail transportation, the dry port owner, together with other actors involved in operations, started to attract customers who were interested in rail transportation between the Port of Gothenburg and the Skaraborg dry port.

5. Findings from the Interviews

A shift from a road-based hinterland transportation to a dry port-integrated setup causes changes in the hinterland part of SCs. In the dry port integrated setup, a cargo arriving to a seaport is transshipped to rail and delivered to the dry port facility inland, where it can be stored and undergo custom clearance or other suitable value-added services. From the dry port, the cargo is delivered, usually by road and sometimes by rail, to the customer's warehouses. The perceived SCOs of this setup were studied, and the interview findings regarding each SCO are presented.

5.1. Cost

SCO of cost is dependent on the configuration of the hinterland transportation, and it can vary, due to the different constituents of the cost: the SCO of cost can be enhanced, change insignificantly (remain the same or similar), or diminish.

There is potential to enhance the SCO of cost by the integration of a dry port. A dry port has a freight terminal where cargo from multiple owners can be consolidated. In this way, the cargo owners help each other to be more efficient by consolidating their cargo and sharing loading units or vehicles, depending on the volumes, and in that way lower transport costs. Furthermore, the proximity of a dry port to a customer's facilities allows for more accurate planning of deliveries, resulting in fewer trucks to the customer's warehouse area, leading to a decrease in the detention and production costs, and quicker turnarounds. Additionally, undesirable fees are eliminated: toll fees on roads and at the seaport entry and seaport fees for container storage (there is a grace period of three days, free of charge, in the Port of Gothenburg). Trains have the priority to be loaded and unloaded, and have predefined timeslots in the rail traffic schedule, and therefore they usually leave the seaport without delays.

An increase of the transportation system capacity can lead to an increase of productivity; there are multiple possibilities for increasing the capacity of a dry port in the system. In the case of the Skaraborg dry port, the capacity of its designated rail line can be increased by introducing extra trains on Sundays, as well as by running a second shuttle every day. Additionally, the length of the rail tracks can be extended from 630 m up to 750 m, so that longer trains can operate on the route. The same extension was already implemented in other Swedish dry ports, such as Eskilstuna and Katrineholm. The territory of the Skaraborg dry port has empty space that can be developed by the owner. Within recent years, the volumes transported through the Skaraborg dry port have increased: the import volume grew to about 21,000 TEUs per year, and export to about 4000 TEUs per year, and even further growth is expected in the future. Therefore, the dry port owner is expected to build and to rent out warehouses for other companies.

The SCO of cost can also remain the same or similar if a dry port is integrated: "Transportation price is pretty much the same as to have a truck from Gothenburg to the facility"; in such a case, other SCOs can be of interest for the customers "for the same price". However, if the conditions are not favorable (e.g., the locations of the dry port facilities and transportation connections are not convenient), the SCO of cost can be also diminished:

> "It [dry port integrated setup—authors' remark] has higher complexity if to compare to the current solution [road-based transportation—authors' remark] and also higher risks. (. . .) The distance is too short. Saving approximately 100 km on road and handling cargo 2–3 times more—it is not good enough".

5.2. Responsiveness

A SC with a dry port is mainly perceived as responsive to the customer needs. A dry port is likely to be closer to a customer than a seaport. In the case of Jula AB, their distribution center in Skara is located 120 km away from the Port of Gothenburg, whereas the dry port is only 28 km away: "the closer we are, the shorter lead time we have, [and] the faster we can react to the customers". A close location allows more accurate short-term planning: "to have a right container in a right time" and to plan each day how many people are needed to unload the container. Secondly, in the Port of Gothenburg, shuttles have priority over trucks to be loaded; they can also be operated during the night and evening shifts, and be rerouted in cases where the cargo arrives at another seaport. Further, in Sweden, road operators experience a shortage of drivers, due to labor issues; this kind of job is not considered attractive anymore, and it is hard to employ new truck drivers. This shortage of truck drivers has resulted in a competitive advantage of rail over road. Finally, rail transportation on the route proved to be reliable: in the five years of the Skaraborg dry port operations, only about 10 short delays occurred. However, potential interruptions of rail transportation (even though they

are unlikely to occur) can pose risks, with a high magnitude of loss on the overall flexibility (and thus responsiveness) of the dry-port integrated setup:

> "If there is any stop on the railroad we have no chance to do anything about our cargo that is stuck on the train. (. . .) That is the scariest of all. The risks are more or less the same for road and rail but I would say that for the train it is harder to find a good solution. Truck is more reliable if there is a break down. There are always possibilities to come with a new truck (. . .), but if something happens to the train then we are stuck, we cannot lift the container from the train to put it on something else. (. . .) There have been cases, rarely, but when it happens it costs a lot".

Not least important for the SCO of responsiveness is the dry port owner's way of doing business. Jula AB, as one of the main actors in the Skaraborg dry port development, prioritized responsiveness as one of the strategic goals:

> "They [Jula AB—authors' remark] were planning for a solution that was stable although demand might be fluctuating. They took a big risk and made sure that the system works, even though demand fluctuates. For example, for the first period of time when they started [shuttle operations—authors' remark] they did not allow for any external customers. Not that they did not want their revenue but they wanted to prove that the quality was there before letting customers in for their own sake, but also for the customers' sake and for [their] reputation. It has been proven stable".

5.3. Security

The transportation of goods in containers is associated with high level of security, and is one of the benefits of intermodal transportation; moving cargo in containers is "as safe as can be". Customs clearance as a service at the dry port requires a safe and secure environment for performing the same, and therefore it guarantees fenced and controlled territory. It is also perceived that there are fewer human errors occurring during rail transportation compared to road transportation, due to fewer interactions with other traffic participants. Overall, due to the relatively short distances discussed here, the issue of cargo security does not draw much attention:

> "I do not believe that there is any difference. It is fast delivery anyway. (. . .) We have never ever had any situation, it has never been on agenda".

5.4. Environmental Performance

The dry-port integrated setup is a great example when possibilities for enhancing the SCO of cost goes "hand in hand" with possibilities to improve environmental performance. There is a pressure on environmental aspects coming from society: "Younger generation is demanding this [environment consideration in doing business—authors' remark] more. Older generation is learning from children and grandchildren". Environmental issues are standing point of discussion on local, regional and state level; however, there are no concrete guidelines "on the table" that would stimulate actions towards more environmentally friendly transportation solutions. Nevertheless, the project of the Skaraborg dry port originated as an environmental idea. The idea was that "if we can do it with a train and a dry port for the same amount of money as we do it today, we will go for it." Even with shorter distances (such as 120 km, as in the case of Jula AB), having a big proportion of transport being rail brings the benefit of significant CO_2 reduction. Moreover, in the case of Sweden, the majority of rail is electrified; only a few routes still use diesel. Together with the idea of transporting through the dry port, Jula AB obtained permission to operate extra-long vehicles with a capacity of four TEUs, which can reduce the number of trucks on the roads, and thus, the associated emissions.

Jula AB claims that their business is "climate neutral." That means that 80 percent of emissions are eliminated by modal shift, 17 percent by changing trucks' fuel for more environmentally friendly

alternatives, and the rest is compensated by Jula's AB investments in a project on producing electricity from crop residuals. The project takes place in Rajahstan, India, where the utilization of crop residuals from local farms saves 75,000 tons of CO_2 emissions annually. Given all that, the shippers that choose to transport cargo via the Skaraborg dry port can significantly change their environmental reports: "When you are into logistics, more into road transport, you have a very big focus on environmental questions."

5.5. Resilience

The dry-port integrated setup proved to be resilient during the labor conflict at the Port of Gothenburg. During the conflict, loading and unloading of the trains was prioritized over truck loading, due to the seaport's orientation on lifting out as many containers as possible, as fast as possible. Moreover, during that time, the trains were rerouted in cases when the cargo was delivered to other ports of Sweden. Operational work disturbance led to significant delays in truck deliveries, and played a crucial role in attracting hesitant potential clients to start using the dry-port integrated setup as a more resilient alternative:

> "They loaded the container to the rail in the seaport [potential client, that after the event started to use the setup continuously—authors' remark], took it to Falköping [Skaraborg dry port—authors' remark], picked it up there and drove it halfway back to their warehouse just to get the container. If it would be a normal way [by road—author's remark] they would need to wait seven, eight, nine, or 10 days to get it out there. They put it on the train and they had it the next day";

> "Strikes in the seaport... That is actually one of the situations that made us go for the train. We saw that the train was working really well and we had it with the trucks really really difficult (. . .) The train was running and those customers were good. (. . .) It was a push".

5.6. Innovation

The new owner of the Skaraborg dry port, a private entrepreneurship-driven company, has been an important driver in the development of the dry port setup. The setup was realized due to the strong interest and the joint effort of specialists representing different actors of the transport system. The current owner used to transport cargo by road, and they had been making many incremental improvements for their road-based transport solutions for the past 20 years. Then, they realized that they had nearly reached the peak in those improvements and, at the same time, they saw the potential in intermodal solutions: "We need to think 10 years ahead all the time; so dry port is one part of big solution". However, the development of the dry port implied big financial risks: "Everybody wants to be in the train when it is running, but no one wants to [take the] risk". The innovations were not easy to implement, and was risky, since it required running shuttles to attract the customers; however, to start the shuttle, the investments were needed, and these came from the customers using the shuttles. It was a "catch 22", but Jula AB decided to take the risk. Jula AB invested in wagons, assured volumes for the potential shuttles for the five following years, and eventually gained ownership over the dry port; all of it paid off.

When the new business was established and stabilized, it became possible to "sell" the dry-port integrated setup as an innovation:

> "I remember [the] first time I came and met Company X, they said: 'Yes, it is a good setup, but unfortunately we have another setup'. And then they had a discussion among themselves: 'You cannot say [it] like this now because you are always asking for innovations. Now we have one of the best innovations and then you just let it go'. I think that helped them a little bit. It took another half a year and then I think they were ready for the innovation".

However, customers do not necessarily perceive the solution as innovative; other SCOs prevail:

"Innovations are not in focus in our strategy, more like doing small changes to find good solutions. (. . .) We are just looking at what these guys have done and adopting it to our business and taking it step by step. It has been working for us".

5.7. Summary of the Interview Findings on the SCO

The summary of the interview findings on how the SCOs can be enhanced by integration of a dry port in SCs are presented in Table 4.

Table 4. Actors' perception on enhancing SCO by integration of a dry port.

SCO	Perceived Possibilities for Enhancing the SCO
Cost	Synergy effect (accumulation of cargo in one place and sharing cost for further distribution); Lowered production costs; Quicker turnaround; Optimization gained from intermodality; Lowered costs due to increased capacity (extra shuttles, longer rail tracks, and longer trains, expansion, and development of the dry port territory); Eliminated toll fees; Lowered risks of port fees from delayed pick-up of containers; Lowered detention costs; Introduction of new business models (e.g., renting out warehouses).
Responsiveness	Location in proximity to customers' facilities; More accurate short-term planning; Customized and frequent shuttle schedule; Reliability of rail transportation; Commitment of the actors involved in the dry port development, and operations to assure high quality service.
Security	Containerized transportation; Fenced and controlled territory of the dry port; Custom clearance as an assurance of a safe and secure environment; Fewer human errors during rail transportation.
Environmental performance	Shift from road to rail, leading to significant CO_2 reduction; Lower congestion on the roads and at the seaport gates, leading to significant CO_2 reduction; Substitution of fuels for last-mile delivery and the use of extra-long vehicles to reduce the amount of deliveries.
Resilience	Stability of operation during labor conflict in the seaport.
Innovation	Innovative business model; Greater potential for improvements; Possibility to sell the setup as an innovation.

Potential threats that could be caused by the integration of the dry port in SCs were also expressed during the interviews. For example, an increase in operation costs due to the increased complexity of the transportation chain, or due to the risk of overcharging services for the customers that are in the same business as the owner of the dry port. Furthermore, the SCO of responsiveness might be diminished, due to the inflexibility of rail in the case of interruptions that consequently might result in extra costs.

6. Analysis and Discussion

Overall, in case of its integration, the dry port is perceived, by the actors involved, as a potential to enhance all the focal SCOs. In order to enhance the SCOs, certain conditions have to be met, i.e., strategic location of the facilities, optimal distances between the seaport, dry port, and the customers' facilities, convenient and reliable transportation services, the acceptable level of complexity of the hinterland

transportation system. The perception also depends on the actors' strategies; i.e., that the SCOs should be of importance for the actors considering the integration of a dry port.

Based on the interview findings it is evident that the SCOs of the cost and the environmental performance are generally important to the actors, and they are often perceived as a "duo". The SCO of cost can be enhanced, due to the changed cost structure, quicker turnaround, and improved business operations (capacity increase and benefits from intermodal transportation). As concluded by Talley and Ng [25], seaports and dry ports have the potential to grow their throughput; and with increased productivity comes increased profit. In the case of the Skaraborg dry port, following the growing demand, the capacity can be increased by beginning more frequent shuttle transportation, by extending rail tracks at the dry port up to 750 meters and by expanding and developing the area of the dry port. In addition, an intermodal transportation solution assures a faster turnaround time, and allows a reduction in associated costs [7]. The costs of container storage fees at the seaport and tolls fees, as noted by Roso and Lumsden [7], are also eliminated. On the other hand, the threats of overcomplicating the system, and a potential conflict of interest with a dry port's owner poses a risk to diminish the SCO of cost. Ng and Tongzon [35]; however, found that the privately-owned dry ports have higher efficiency than those publicly owned. In addition, the costs of transportation via dry ports were kept stable and relatively low [26]. Similarly, in the case of Skaraborg dry port, cargo transport costs remained stable and competitive. Furthermore, interview findings suggest that private ownership allows the owner to make better business decisions on the utilization and development of the dry port, generating revenue and consequently developing the region by attracting new businesses.

As for the second part of the "duo", the environmental performance, intermodal transportation, solution through the dry port implies the use of less emitting transport modes (rail) on a significant part of the route. Enhancement of the SCO of environmental performance, is achieved by replacing trucks with rail shuttles that in Sweden can substitute about 40 trucks [3]. Literature findings suggest that CO_2 emissions can be reduced by as much as 25–45 percent along the hinterland leg of transportation, just by modal shift [3,9]. By shifting cargo flows from road to rail, the case of Skaraborg dry port showed 80 percent reduction in CO_2, which is higher emissions reduction than those presented in the literature so far. One reason for significantly lower environmental effect due to shift from road to rail in Sweden is electrified rail. Further reduction can be achieved by substituting truck fuels (used for the last mile) for "cleaner and greener" alternatives [5], and by operating longer trucks in order to minimize the number of trips. These solutions are already implemented in the case of Skaraborg, and positively perceived among the actors of the transport system. The case of the Skaraborg dry port is claimed to be "climate neutral", due to the investments in a project in India on producing electricity from crop residuals.

With an integrated dry port, the SCO of responsiveness enhances, due to SC's improved ability to adapt to the changing customers' needs [28]. First of all, the quality of access to a dry port and the quality of the road and rail interface determine the dry port performance; therefore, it is necessary to have scheduled and reliable transport to and from the seaport [30]. However, the threat of rail transportation interruption, potentially leading to the inability to lift out the cargo from the train, is perceived as a risk with a high magnitude of loss. So far, the frequent schedule of shuttles between the Port of Gothenburg and the Skaraborg dry port with very few delays reported over the past few years has allowed customers to plan their business accurately, and to rely on train deliveries. In addition to being reliable and frequent, the shuttles can be customized to further enhance the SCO of responsiveness, as suggested by Jeevan et al. [28]. Extra shuttles can be arranged during the evening or night shifts and on weekends; the shuttles can also be rerouted to other Swedish seaports if the containers are delivered there. However, there are various obstacles that prevent customers from choosing rail [17] as the main mode of transport: lack of flexibility in time and space is the major reason [14], followed by resistance to change, and a preference to continue with "business-as-usual" [17,27]. Secondly, the integration of a dry port means that cargo can be relocated closer to the shippers' facilities, allowing to buffer there. For further customer convenience, a dry

port can provide the same services that are available at a seaport: not only storage, but also custom clearance, transshipment, and other value-added services [11]. Using these services at the dry port results in shorter queues at the seaport gates, due to the arrival of a lower number of trucks, saving time and avoiding delays.

The literature on the influence of a dry port on the SCO of resilience is scarce. Evidence from Lindroth et al. [31] suggests that companies transporting goods through a dry port are less affected by interruptions of seaport operations caused by labor conflicts. The studied case is similar: the seaport has prioritized loading and unloading of container trains at the time of the labor conflict in order to push large amounts of cargo inland, which enhanced the SCO of resilience.

The dry port concept is an innovation in the sense that its crucial elements, such as on-dock rail, reliable inland connection, and a functional inland facility previously seen as separate entities are perceived as the elements that comprise the concept [32]. Indeed, the Skaraborg dry port setup came into being after a long process of identification, investments, negotiations, and constructions, and afterwards, once the innovations were implemented and the operations stabilized, customers with an orientation on innovative development became attracted to the possibilities that are offered by novel solutions (e.g., Company X, mentioned above). However, innovation as the SCO as such, is perceived differently among the actors of the transport system, with a stronger emphasis on its importance, from the actors who are involved in the development and operations of the dry-port integrated setup, rather than customers and potential customers. It is still referred to as "a step forward" by latter ones, but more "down-to-earth" SCOs of the solution, such as cost, resilience, and responsiveness prevail over the urge to be innovative.

Interestingly, the SCO of security was not brought up as "being in the agenda". The elements assuring security such as the fenced territory of the dry port, guarding services, and secure transportation in containers were mentioned. Generally, though, the statement "it has never been on agenda" applies to the majority of the respondents. The security of the cargo that is transported in containers is relatively high. Consolidation of goods at a dry port allows for increased security for the cargo [28,29]. This is assured by security fences, guards, and video surveillance systems. Also, as noted by Roso [30], the consolidation of goods in one location allows for the purchase of expensive equipment such as X-ray scanners for customs inspections. Furthermore, the longer leg of the transport is completed by rail, which is considered to be more safe and secure than road [20,31]; same was noted by the actors of the transport system.

A summary of the findings on how SCOs can be enhanced by the integration of a dry port in SC is presented in Table 5; the table also contains remarks regarding threats that can cause the diminishing of the SCOs.

Table 5. Impact on SCO by the integration of a dry port.

SCO	Means to Enhance the SCO by Integration of a Dry Port from the Literature Findings	Reflection Based on Interview Findings
Cost	Increased capacity of the hinterland transportation system; Benefits from networking among dry ports; Lowered risks associated with the hinterland leg of transportation due to intermodal setup; Elimination and decrease of storage and road transportation fees.	Literature findings are confirmed; Risks of financial losses due to private ownership of a dry port and overcomplicated hinterland transportation setup are expressed.
Responsiveness	Flexible and adaptive setup; Reliable and frequent transportation arrangement; Less delays; Customization of service.	Literature findings are confirmed; In addition, more accuracy in short-term planning is expected; risks with a high magnitude of financial loss in the case of transportation interruption are expected.
Security	Safety and security assured by dry port-assured security due to consolidation of the cargo.	Literature findings are confirmed; Fewer human errors are expected in the dry-port integrated setup.
Environmental performance	CO_2 reduction due to modal shift, eliminates congestions and alternative fuels for trucks;	Literature findings are confirmed.
Resilience	Resilient setup towards potential labor conflicts in a seaport.	Literature findings are confirmed.
Innovation	Constitution of new thinking in the environment of changing needs.	Literature findings are confirmed.

7. Conclusions

The integration of a dry port in SC generates a change in the system: instead of transporting goods by road between an inland terminal and a seaport, the transportation is performed by a high capacity transport mode like rail; and a variety of customer-oriented services are offered at the dry port. The change in the business model requires effort from multiple actors such as, in the studied case, the representative of the municipality of Falköping, dry port owner, rail transport operators, seaport authority, seaport terminal operator, customer, potential customers, and consultants, who have joined forces to develop the dry-port integrated setup. The results show that all six SCOs, cost, responsiveness, security, environmental performance, resilience, and innovation, are perceived by the actors as desirable, and can be enhanced by integration of a dry port in SCs. In particular, the enhancement of the SCOs can be achieved due to intermodality, the reliability of rail transportation, and the customization of services that are associated with the dry-port integrated setup, and by an increase in the capacity of the transport system. Based on the outcome of this case study, companies that are dealing with similar transport-related issues can consider the strategy of dry port integration in the SC, to reach different combinations of SCOs.

However, the dry-port integrated setup has proven to be cost-effective under certain conditions, such as effective management, sufficient goods volumes and the capacity of the transportation system, competitive pricing, and reliable and quality customer service. A lower environmental impact in general is considered to be one of the main benefits of the dry port concept. The dry-port integrated setup is perceived to be a solution that significantly reduces CO_2 emissions by modal shift, particularly in Sweden, where most of the rail is electrified. Additionally, the last mile of transportation is performed by extra-long vehicles using alternative lower-pollution fuels, altogether contributing to lower emissions and reduced congestion on the roads.

The case of the Skaraborg dry port also indicates that SCOs are perceived differently by the actors of the transport system, and their relative importance in hinterland transportation should be researched further. The study demonstrates the dry port effect on SCOs with the specific case of the Skaraborg dry port; a more comprehensive view on the studied subject could be obtained via multiple case studies of other dry ports in Sweden, to obtain a Swedish perspective on SCO.

Author Contributions: Conceptualization; Data collection; Formal analysis; Writing—original draft, review & editing, A.K. and V.R.; Methodology, A.K.

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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