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# DIRECT CALL OR FEEDER SERVICE TO PERIPHERAL REGIONS – THE IMPACT OF DRY-PORTS ON INTERCONTINENTAL DOOR TO DOOR TRANSPORT CHAINS

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## ABSTRACT

A common problem in the design of liner service systems for intercontinental container flows between regions is to determine which regions to service with direct calls by large vessels and which regions to service by feeder vessels from transhipment ports. The present rapid development of dry ports and dedicated hinterland transport systems can be expected to change some basic conditions in the competitive landscape, which may influence the value of direct calls compared with feeder services. The purpose of the paper is to predict and discuss some possible impacts that the development of dedicated hinterland transport systems and dry ports may have on the competitive strategies of ports and on the design of future intercontinental intermodal transport chains between a focal region and its intercontinental counterpart.

A conceptual and methodological framework is developed where special strategic costing models, and models for competitive analyses, are detailed and integrated into a transport systems framework. Significant, sustainable competitive advantage (SSCA) and market entry ability (MEA) are key concepts used in the competitive analyses of transport chains. The strategic costing models calculate the cost per container as a function of throughput volume between regions for the different door to door transport chains by means of dynamic cost curves, also termed "dynamic value functions".

The framework is used for analysing empirical data of the freight flows in both directions between Scandinavia and its intercontinental trade partners. The empirical evaluation of the SSCA of the transport chains is based on their performance in terms of costs, environmental impacts, and transit times.

The conclusions of the paper address the strategic implications for ports, vessel operators, train operators and terminals. The paper predicts that the new competitive landscape with risks of overlapping hinterlands with dry ports and dedicated transport systems, will force leading ports in peripheral regions to reconsider the fit between their strategies for direct calls, feeder services and hinterland transport systems.

KEYWORDS: Strategic Scenarios, Dry-ports, Intercontinental Transport Chains, Direct Call versus Feeder Services, Scandinavian Case Study, Significant Sustainable Competitive Advantage, Market Entry Ability.

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## 1 INTRODUCTION

A common problem in the design of liner service systems for intercontinental container flows between regions is to decide which parts of each region to service by direct calls by large deep sea vessels and which parts to service by feeder vessels or land-based transport from centrally located transhipment ports in the region. In a peripheral part of a region, the leading deep sea port, called the focal port in this paper, will try to attract direct calls from intercontinental container lines allowing direct transport of containers to/from transoceanic ports instead of being connected to them by feeder transport and transhipment through centrally located transhipment ports acting as hubs for the region. Implementing direct calls can be seen as a sub-strategy in an overall port strategy for market stabilization and growth since it, at the same time, makes the focal port less sensitive to competition from sea or land based feeder alternatives and offers freight customers improved service.

For some time now, major sea ports are developing railway based, dedicated hinterland intermodal transport systems for containers between inland terminals (sometimes called "dry ports") and seaport. Ports have several motives for these initiatives, such as limited space for expansion of container yards in their present locations, congestion of trucks in sensitive parts of port cities, the ambition to reduce environmental impacts from road transport, the opportunities for developing locally differentiated customer services, and the improving cost/service performance of road/rail intermodality. The development of dedicated hinterland transport systems for distribution and supply can be seen as another sub-strategy in the overall port strategy for market stabilization and growth.

The present rapid development of dedicated hinterland transport systems based on dry ports and similar concepts can be expected to change some basic conditions in the competitive landscape, and several actors involved in intercontinental door to door transport chains will have to modify their market strategies. In this paper we highlight the observed strategy used by the major Scandinavian port Gothenburg (focal port) for developing a dedicated hinterland transport system. The objective of our paper is to analyse if, and under what conditions, this strategy can be expected to be compatible with the port's strategies for attracting both direct calls by intercontinental container lines and calls by Intra-European feeder lines. We also intend to illustrate the competitive surfaces between land and sea based systems for feeder transport to intercontinental container lines.

Since other ports may apply the same kind of dual strategies, a case study of the port of Gothenburg can be expected to deliver some knowledge of general interest.

## 2 DEDICATED TRANSPORT SYSTEMS

The dedicated hinterland transport systems that ports have developed have some common characteristics, but they are not identical. A system consists of transport links between important geographical hinterland market segments and port. The minimum requirement in each link is that dedicated container shuttle trains operate according to a fixed schedule between terminal and port. Above the minimum requirement, several logistical and transactional services can be added to the terminal's offer to freight customers and make it function more like a logistics centre. Examples of such services are cargo handling; warehousing and open storage; port services documentation and clearance; shipping arrangements; booking of cargo shipping space and through bills of lading; customs brokerage documentation and clearance; insurance; and cargo consolidation. Regardless of the width of the terminal's service mix between the minimum requirement, as described above, and some possible upper level, we will use the term "dry port" in this paper for such terminals

## 3 OUR APPROACH

### 3.1 Two research questions

In order to analyze whether the direct call strategy and the hinterland terminal strategy can be expected to be compatible or not, we model two scenarios and raise the question whether the possible or realised occurrence of scenario 1 can be expected to lead to scenario 2. Scenario 1 can be seen as a model assumed to represent the present situation for some ports and an evolving one for others. In scenario 1, the focal port's direct call strategy is assumed to have been successful. Scenario 2 is conceptually an extension of scenario 1, in which the continental European transhipment port is assumed to have entered the hinterland market of the focal port by developing a dedicated hinterland transport system as a competitive response for regaining market shares lost due to the direct call strategy of the focal port, or for preventing future losses of market shares, or for more offensive strategic reasons. If market conditions can be expected under which scenario 1 could lead to scenario 2, then our conclusion will be that the direct call strategy and the hinterland terminal strategy must be considered to be strategically incompatible or at least highly risky. In the following, we structure the analysis around two core research questions:

- In model terms, will it be possible for the continental European transhipment port to design a competitive dedicated hinterland transport system in Scandinavia based on road/rail intermodality?
- Given a realistic conceptual model of an efficient competitive dedicated hinterland transport system of the European transhipment port, will it be possible for such a system to enter the market?

### 3.2 Conceptual framework

Our general approach and our analysis of the two core research questions is based on the conceptual framework for the design and evaluation of intermodal transport systems developed within the Logistics and Transport Research Group at Gothenburg University by Jensen (1987; 1990 and 2008). In order to be successful according to this framework, a proposed intermodal transport system must first of all possess a significant, sustainable competitive advantage (SSCA) and, given this, it must also have sufficient market entry ability (MEA).

SSCA refers to a unique combination of properties that allows the system to provide an output with a cost/service ratio that is preferred by customers over the closest competing alternatives.

"Significant" means that the difference is big enough and "sustainable" that it will last for a sufficient period of time. Otherwise, transport buyers will not change transport service provider. When evaluating the SSCA of a proposed system, cost efficiency, environmental efficiency, and transport quality are decisive performance dimensions. A sufficient criterion for SSCA to exist is that a proposed system shows a significant sustainable advantage in one of the performance dimensions and is at least as good in the other two, when compared with a reference system. The reference system will normally be the existing system, but it can be any hypothetical system.

MEA depends on two concept, integrability and communicability. A new transport system is said to be integrable if it is designed to avoid or reduce entry barriers and competitors' turf defence, factors that may make it difficult for a newcomer to get access to critical system components when entering the market. Infrastructure, transport and handling services, and customer contacts are examples of critical components. An intermodal transport system is considered communicable if it can be given a profile that facilitates for potential customers to compare its value to them with the value of the closest alternative. Creating this profile is not only a marketing issue. It is also related to intermodal system design. The sufficient criterion for SSCA mentioned above is also communicable, a characteristic that will not be true for all combinations of outcomes in the three performance dimensions.

### 3.3 Related research and empirical sources

Much research has addressed the issue of designing competitive liner networks. From a cost-efficiency perspective, Cullinane and Khanna (2000) analyse the economies of scale in operating large containerships for intercontinental operational scenarios. Ng and Kee (2008) penetrate optimal ship sizes of container feeder services in Southeast Asia. Regarding markets and marketing, Robinson (1998) describes the dynamics of the restructuring of the Asian hub/feeder nets. Panayides and Cullinane (2002) summarise and discuss theories of competitive advantage in liner shipping. Plomaritou (2008) develops an application of the marketing mix concept, and Notteboom (2006) points to the importance of the time factor in liner shipping services.

The role of ports has been addressed by several authors. Port and terminal selection by deep-sea container operators is the focus of Wiegmans et al (2008). Sanchez et. al. (2003) measure port efficiency as a determinant of maritime transport costs in international trade. From a northern European perspective, Ng (2006) assesses the attractiveness of ports in the North European transhipment market and, in a case study, Baird (2002) finds that transhipment can offer operating and capital cost advantages compared with multiport direct services.

The issue of dry ports and hinterland transportation have been address by many. Some argue that the challenge of liner shipping have moved from the sea, first to the ports and then to the hinterland (cf. Notteboom, 2002 and Guthed, 2005).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 in connection to principal ports is also comprehensive. Examples with their main geographical context are: 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 – south-west Europe), Gouvernal and Daydou (2005 – north-west Europe), van Klink and van den Berg (1998 - Rotterdam with hinterland), Bundesamt für Güterverkehr (2005 – Germany), (Bergqvist 2007 and Bergqvist et al. 2010–

Sweden/Scandinavia) and Roso (2006 – Sweden/Scandinavia). However, few researchers have dealt with the issue of dry ports, hinterland transport and the dynamics of direct call and feeder system setups in a comprehensive and coherent framework with respect to cost and environmental performance.

For identification and estimations of cost related data, a number of scientific sources have been used. Besides above mentioned sources related to sea operations, Flodén (2007) and Bergqvist (2007) have been key references related to intermodal transport. The research conducted by Bark et al. (2008) and Woxenius (2003) on road-rail intermodality and terminals have further contributed to cost estimations in the context of Scandinavian conditions. Enarsson (1998) have been the platform for road transport cost data. The environmental estimations and data input are based on Flodén (2007) and Banverket (2005).

## 4 TWO SCENARIOS

Scenario 1, modelled in Figure 1, is assumed to represent a successful implementation of the direct call strategy. It contains three container flows with volumes A1, B1, and C1 passing the focal Scandinavian port G. D can be regarded as an average dry port representing a set of 24 dry ports in Scandinavia. A1 represents the sum of flows in both directions between G and intercontinental ports by direct calling container vessels, the flow B1 is carried in the link between G and the transhipment port R by smaller feeder vessels, and shipped between R and other European or intercontinental destinations after handling in and out. The third flow, (C1), is moved by ship between G and other European ports. It may consist of both containers that are transhipped to/from intercontinental ports and intra-European flows. All flows with notations A1, B1 etc. are sums of flows in both directions of a link and flows are assumed balanced. At present, the approximate yearly flows of the focal port Gothenburg are A1=150000, B1= 75000, and C1= 575000 giving a total flow TF= 800000 TEUs. Flow TF is moved by train between D and G.

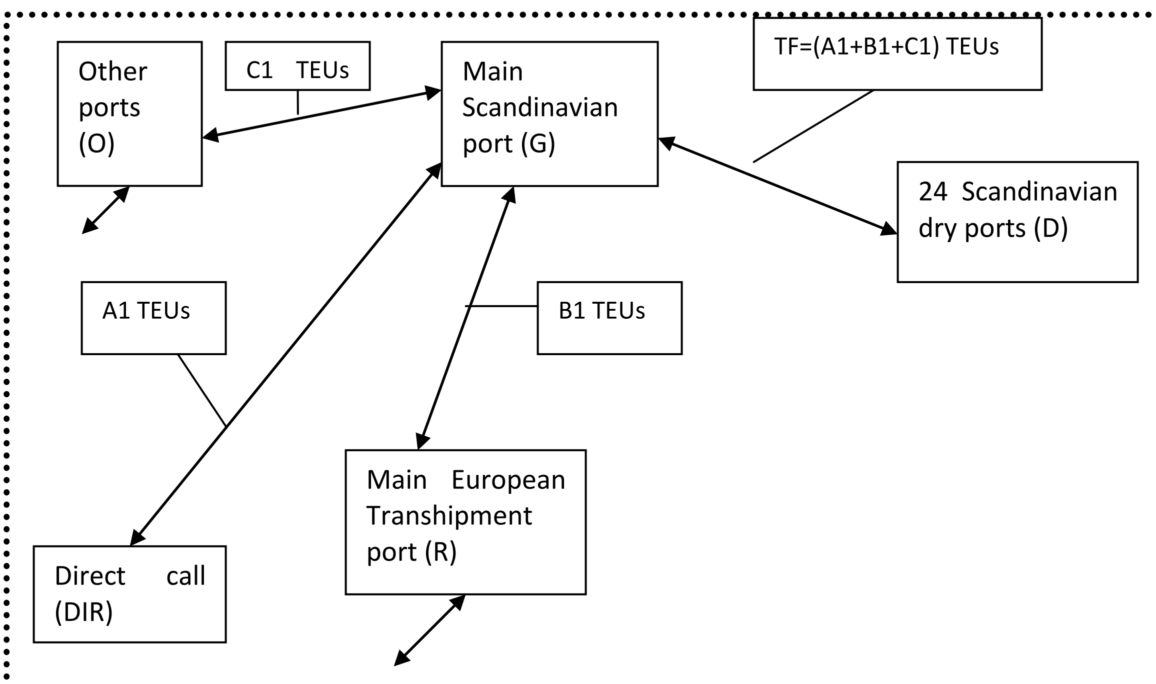

**Figure 1. Container flows (Arrows) in different links under scenario 1 (System model S1). Total flow TF= 800000 TEUs. Flows are assumed balanced in all links (half of the shown quantities in each direction).**

Scenario 2 represented by the system model in Figure 2 assumes a situation where the main European port R has developed and implemented a competitive strategy in an attempt to win all or part of volume A1 and C1 in scenario 1 due to defensive or offensive reasons. The concrete response consists of the establishment of dedicated transport links from dry ports to the transhipment port R. The only difference between scenarios 1 and 2 in terms of transport links is the addition of link D–R in scenario 2 and a possible shift of freight volumes between links. The total container volume TF to and from D are assumed to be the same in both scenarios, but in scenario 2 the flow will be shared between link D-R with X TEUs and link D-G with (TF-X) TEUs. This means that the flows passing G and R will change accordingly.

Other designs of the link D-R in scenario 2 were considered such as links consisting of smaller Scandinavian ports in combination with road or rail connections and small feeder vessels from ports to R. However, they were found less realisable for the main European transhipment port due to problems of efficiency, effectiveness, and organisation. They were not analysed further since analysis of the most likely solution was sufficient to answer the research questions.

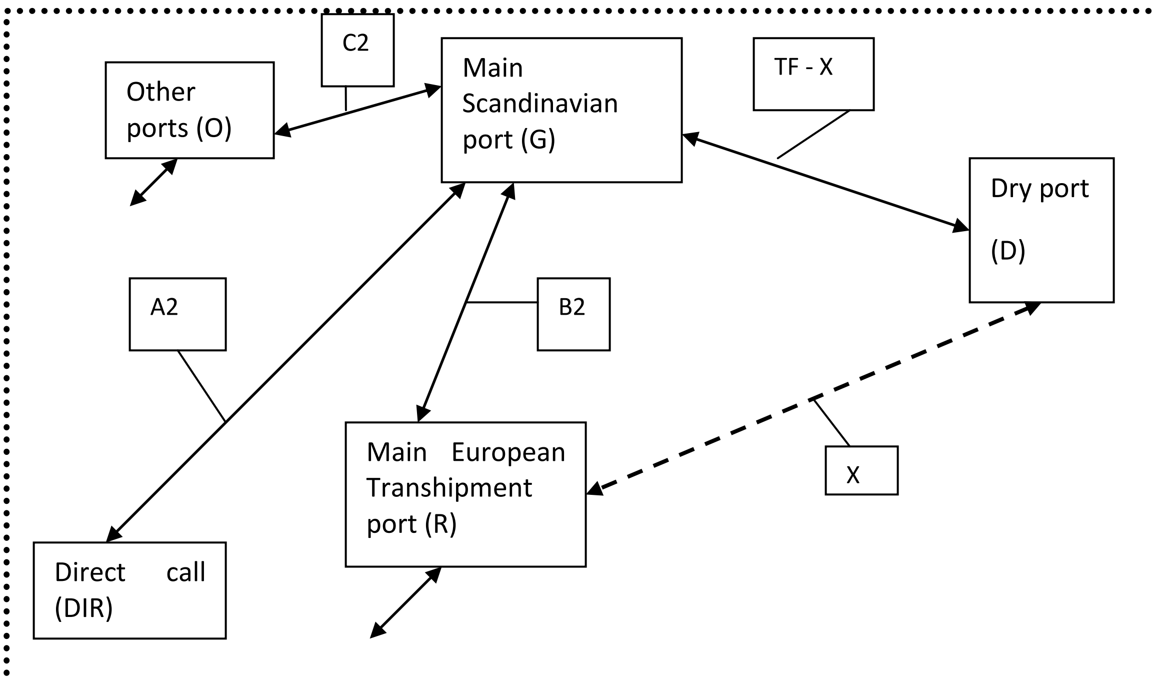


**Figure 2. Container flows in scenario 2 (System model S2).**

## 5 CALCULATION OF PERFORMANCE DIFFERENCES BETWEEN FLOW X IN SCENARIO 1 AND 2

According to our framework, a potential dedicated hinterland transport system of the European transhipment port R must have SSCA as well as MEA in order to be realizable. In this section we make some strategic calculations of performance differences in terms of unit costs, environmental impact and transport quality that will occur if the door to door container flow X is transferred from link D-G to link D-R. This is one step in our attempt to throw light on the question whether it is possible for a main European transhipment port (R) to design a dedicated hinterland transport system that it will have a SSCA.

### 5.1 Strategic cost calculations

Following principles and motivations for strategic cost calculation outlined in Jensen and Bergqvist (2010), we calculated differential costs per container from door to door for container flows that are affected when scenario 1 represented by system model S1 is assumed to be transformed into scenario 2 represented by system model S2 . For hinterland transport cost in S1, calculations are made on 24 individual dry ports and the Scandinavian dry port system including terminal handling costs. Due to the difficulty to determine from which dry ports volume X is moved the cost of hinterland transport in S2 is based on three homogenous groups of dry ports based on the distance to the transhipment port R. This has been done for a set of alternatives where each alternative specifies a certain change of container flows when the container volume X is moved from link D-G to link D-R. We thus calculate the differential cost (pos. or neg.) per container flow moved to D-R. The cost calculations are based on the following assumptions and methods:

- We compare two systems, S1 and S2, each under stationary conditions, in order to calculate the difference between them regarding resource consumption measured in cost terms.
- In the transport links G-O and G-R as well as in the terminals G and R we assume that resources have alternative use and can be moved in to or out from the system at market prices.
- In the link with direct call, a proportionate reduction of volume will only lead to a less than proportionate reduction of total costs since scale advantages will be lost or capacity unused. It is assumed that some adaptation to demand is possible by changing frequency of call or type of vessel. When calculating costs that consider the possible adaptation to demand, we have used "dynamic value functions" determined in Jensen and Bergqvist (2010). These are dynamic cost curves where costs are expressed as functions of ship types and roundtrip frequencies. However, we assume that at volumes below a certain break-even point between the dynamic cost curve and the cost curve of feeder shipping, feeder shipping will be used between G and R together with transhipment at R as a substitute for direct shipping.
- The railway shuttle between a dry port and the focal Scandinavian port will normally run a fixed number of trains per week according to a fixed schedule in a yearly train plan. The number of trains per week will be determined from the average demand per week. We adopt the following notations:
  - Expected demand per year (TEUs) per dry port = Y
  - Average train utilization factor = U*100%
  - Number of trains per week = T
  - Maximum number of TEUs per train = H
  - Number of production weeks per year = W

With these parameters the scheduled number of trains per week in the yearly train plan is determined as T = integer part of (Y/W)/(U*H)

- The container flow in and out demanded at a dry port will vary from week to week depending on a lot of factors. The container flow per week is assumed to be a random variable (z) following the normal probability distribution with mean M and standard deviation S. If demand a certain week exceeds train capacity, the overflow will be moved on road by lorry between dry port and sea port. The number of containers moved on road per week is equal to (z – T*H) for z > T*H, and equal to 0 for z<= T*H. The expected number of containers in need of road transport per week in a given dry port link can be shown (for a derivation, see Jensen, 1990, pp. 401 – 403) to be equal to S*[p(k) – k*(1 – F(k))]. In this expression, p(z) is the density function of the standard normal probability distribution, F(z) its distribution function, and k = (T*H – M)/S, a standardized normal variate. Given estimates of the coefficient of variation of dry port container flow, CV, we calculate S=CV*M.
- We assume, as in practice, that road transport is used in case of insufficient train capacity as a method for reducing costs. This method allows running trains with high load factor and accepting a minor additional cost of road transport in infrequent cases of overflow leading to lack of train capacity. The cost of the extra road transport is set equal to the average cost per TEU of road transport between dry port and sea port multiplied by the expected number of containers carried by lorry.

The results of our calculations are shown in Table 1 below.

## 5.2 Differences in environmental impact and transport quality

Similar to the strategic cost calculations we calculate the environmental performance of $CO_2$ per container from door to door for container flows that are affected when scenario 1 represented by system model S1 is assumed to be transformed into scenario 2 represented by system model S2 . This has been for the same set of alternatives as described in sections 5.1. In comparison to the assumptions and methods described in sections 5.1, the following additional assumptions and methods apply:

- We assume an electric power supply of the locomotives. Since the rail service is of such great scale we assume that there is the possibility for the electric locomotives to directly connect to the rail handling terminals without any need for diesel powered marshalling locomotives.
- The source of electricity is based on Sweden’s electrical power mix since the principal part of the transport route is located in Sweden.
- To simplify calculations environmental performance is based on three categories of LoLo ships, >8000dwt, 2000-8000dwt and <2000 dwt.

The environmental performance is measured in $CO_2$. Besides differences in carbon dioxide, there are other well known and significant environmental improvements when shifting goods from sea to rail for other emissions, e.g. NOx and $SO_2$. These emissions, however, are outside the scope of this research.

## 6 CONCLUSIONS ABOUT THE SSCA OF DEDICATED TRANSPORT SYSTEM

### 6.1 Criteria

In a strategic analysis of the Scandinavian hinterland market, we assume that a potential entrant will first estimate whether a new dedicated hinterland transport system between Scandinavian dry ports and the entrant's port will be able to offer a competitive advantage for the container flows. The estimate will be based on differential outcomes in three dimensions: cost efficiency, environmental efficiency and output quality. If the new system is found significantly superior in one dimension and at least as good in the remaining two, it fulfils the sufficiency criterion for SSCA.

From Table 1 it can be seen that CO2 emissions and transit times representing environmental impact and transport quality are only marginally better for flows shifted to the dedicated hinterland transport chain D-R instead of following chain D-G. This implies that if the cost advantage is perceived to be significantly higher for chain D-R, the D-R chain will by definition have a SSCA over the existing chain for the same flow. This is perceived as a favourable condition for market entry into the Scandinavian dry port market by the European transhipment port R. It deserves mentioning that the environmental advantage of S2 is slightly underestimated since only CO2, and not NOx and $SO_2$ , is considered and shipping has higher emissions in these dimensions than freight trains.

### 6.2 Cost advantage

Following the principles outlined in section 5.1 above, we have calculated the increase in cost per TEU for different combinations of flows (A1, A2, ...) assumed to be shifted from the focal port G (flow D-G-) to the potential dedicated hinterland transport system of the transhipment port R (flow D-R-). The results are shown in Table 1. In terms of our notations, this is expressed as shifts of flows A1, A2, … etc. occurring when scenario 1 (S1) is transformed to scenario 2 (S2). In this hypothetical shift of container flows, the volume given for each alternative in the column for direct flows, "From G-DIR", is assumed to be the entire direct flow, whereas the volumes in columns "From G-R" and "From G-O" may be only parts of larger flows. The results are shown in Table 1, where impacts on performance are expressed as reduction per TEU of costs, emissions and transit times. In Table 1, a negative reduction of costs per TEU represents a cost increase by the absolute value of the negative reduction.

A very interesting observation that can be made in Table 1 is the fundamental importance of direct calls to the focal Scandinavian port and its system of dry ports. This importance is represented by the series A1, A2, A5, A8, A11 and A14, where there is a cost reduction per TEU for flows in the competing link D-R- according to the series 5, 7, -7, -12, -26, -33. This means that for growing volumes, there is a growing cost advantage for direct calls compared with the flow via the European transhipment port using rail. Direct calls can be seen as a protective weapon in port competition. If the direct flow is above a certain volume, it is unlikely that a competing port will try to enter the market with a dedicated hinterland transport system in Scandinavia since the cost advantage of flows passing the main Scandinavian port may be perceived as too difficult to match.

The cost advantage of strategies aiming at winning market shares in the flow from the Scandinavian port to other ports (the flow G-O) is shown in alternatives A21, A22 and A23, which indicate cost reductions from 7 to 29 EUR per TEU depending on volume. A shift of this flow to the chain D-R- would mean a loss of business for the Scandinavian port G and a gain for the transhipment port R.

Alternatives A24 and A25 show a cost advantage of 7 and 5 EUR respectively for a shift of flows from the chain D-G-R to a railway shuttle between the European transhipment port R and Scandinavian dry ports. However, this shift is deemed less likely to be perceived as attractive by R, since R already owns this market for transhipment between transoceanic trunk lines and feeder lines to the Scandinavian port. Besides that, port R would start competing with its own customers, the feeder vessel operators. Only in situations where the feeder operators and the transoceanic operators are identical, do we consider this to be an option in a market strategy for the port.

There are several alternatives among A1 – A25 in Table 1 that can regarded as having a significant cost advantage. The competitive advantage of one chain over the other can also be regarded as sustainable since it depends on differences in transport distances, use of different and stable modes and different and stable transport and handling technologies.

**Table 1. Impact of competition for container flows in the hinterland dry port market on cost, emission and transit time per TEU for alternative combinations of flows in scenario 2.**

| Alternative | Shift of container flow (TEU/year) to link D-R from other links when S1 is transformed into S2 | | | Impact of transformation from S1 to S2 on shifted container flow's door-to-door competitive advantage | | |
|---|---|---|---|---|---|---|
| | From G-DIR | From G-R | From G-O | Reduction of costs[2] (EUR/TEU) | Reduction of emissions kg (CO2/TEU) | Reduction of transit time (Days) |
| A1 | 37 500 | 0 | 0 | 5 | 14 | 0 - 1 |
| A2 | 75 000 | 0 | 0 | 7 | 12 | 1 - 2 |
| A3 | 75 000 | 0 | 143 750 | 24 | 14 | 2 - 3 |
| A4 | 75 000 | 0 | 287 500 | 31 | 14 | 2 - 3 |
| A5 | 112 500 | 0 | 0 | -7 | 12 | 2 - 3 |
| A6 | 112 500 | 0 | 143 750 | 13 | 14 | 2 - 3 |
| A7 | 112 500 | 0 | 287 500 | 31 | 14 | 2 - 3 |
| A8 | 150 000 | 0 | 0 | -12 | 12 | 2 - 3 |
| A9 | 150 000 | 0 | 143 750 | 9 | 14 | 2 - 3 |
| A10 | 150 000 | 0 | 287 500 | 18 | 13 | 3 - 4 |
| A11 | 187 500 | 0 | 0 | -26 | 12 | 3 - 4 |
| A12 | 187 500 | 0 | 143 750 | -2 | 13 | 2 - 3 |
| A13 | 187 500 | 0 | 287 500 | 11 | 14 | 3 - 4 |
| A14 | 225 000 | 0 | 0 | -33 | 11 | 2 - 3 |
| A15 | 225 000 | 0 | 143 750 | -5 | 13 | 2 - 3 |
| A16 | 225 000 | 0 | 287 500 | 5 | 13 | 3 - 4 |
| A18 | 150 000 | 37 500 | 0 | -1 | 13 | 2 - 3 |
| A17 | 150 000 | 75 000 | 0 | 3 | 14 | 2 - 3 |
| A19 | 150 000 | 37 500 | 287 500 | 21 | 13 | 3 - 4 |
| A20 | 150 000 | 75 000 | 575 000 | 32 | 12 | 3 - 4 |
| A23 | 0 | 0 | 71 875 | 7 | 17 | 1 - 2 |
| A22 | 0 | 0 | 143 750 | 23 | 16 | 2 - 3 |
| A21 | 0 | 0 | 287 500 | 29 | 15 | 2 - 3 |
| A25 | 0 | 37 500 | 0 | 5 | 19 | 0 - 1 |
| A24 | 0 | 75 000 | 0 | 7 | 17 | 2 - 3 |

Table 1 also shows that alternatives with low and medium sized volumes for the direct flow G-DIR plus addition of some volumes from the G-O flow may be perceived by an entrant to have a cost advantage.

[2] A negative reduction of costs represents an increase of costs by the absolute value of the negative reduction.

## 7 MEA

Table 1 shows that there are several alternative shifts of flows that appears to be able to equip a competing dedicated hinterland transport system with a SSCA. However, in order to actually enter the market it must possess market entry ability, MEA, as well. This means, according to our framework, that it must be integrable in the hinterland transport system consisting of dry ports and rail shuttles and communicable to key decision makers.

In order for a promising transport system to be integrable, it must have access to critical system components. The two most critical physical resources in this case are intermodal road-rail terminals (including handling) and trains. The Swedish railway network is an open market for freight train operators and there are several operators that compete in the market. So access to train services will not be a barrier to market entry.

Access to the necessary terminal services is more complicated to analyze. The rail shuttle system of the main Scandinavian port, Gothenburg, has 24 terminals/dry ports. These are located strategically in locations that can be regarded as demand centres. There are several restrictions for terminal location besides demand factors such as rail and road access, legislation and others. The consequence of these restrictions and demand factors is that the terminal function of an entering competitor from an efficiency point of view will have to choose the same locations as the existing 24 terminals/dry ports, at least so to a very high extent. Duopoly in each location with two physical terminals will not be economically feasible. It will also be questionable from a community planning perspective. Therefore, integrability implies sharing terminal functions with the existing terminal users except in the rare cases where there is a market for a new investment. The only existing user in the majority of cases is the focal port, Gothenburg. Unless port of Gothenburg (G) can use its market power, a dedicated hinterland transport system developed by the European transhipment port R appears to be integrable. At present the market power of G is rather weak since it does not control the terminals of the dry ports by ownership or long term contracts that give the port a prioritized position.

A dedicated transport system of the transhipment port R will not have any communicability problems. For the subset of alternative shifts of volumes where it has a SSCA, the system will also be communicable since it has a significant cost advantage and also marginal advantages in environmental impact and transport quality. There are no other aspects indicating that communicability should not be present since we are considering services that are well known by all actors involved.

## 8 CONCLUSIONS AND DISCUSSIONS

Given the present policy of only having weak control over competitors' access to the terminals in its dedicated hinterland transport system, the port of Gothenburg, is exposed to certain strategic risks. One risk is that the opportunity of winning a substantial market share from transoceanic flows between the port of Gothenburg and other transhipment ports than R (the G-O flows) may lead to market entry in the hinterland of the Scandinavian port. This risk also exists for low volumes of direct flows particularly in combination with the former.

There are two counter strategies against this scenario. One is to increase the flow shipped by direct calling intercontinental container lines. This also has the indirect effect of reducing size of the flow carried via other transhipment ports, which is vulnerable to competition as explained above.

The other counter strategy is to take control of the access to the terminals in the system of dry ports. The main Scandinavian port can do this either by ownership, the safest strategy, or by signing long term exclusive contracts with the terminal owners. This counter strategy should be extended to all key terminals in the system.

It seems as if port management is neglecting an important factor in the developing new competitive landscape, the need for turf protection. This will become a key issue when intermodal road-rail transport chains become more efficient and effective and terminals develop administrative and transactional aspects of the dry port concept. Can ownership of ports by local Governments explain the absence so far of strategic response?

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