Stakeholder analysis in intermodal urban freight transport

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Abstract

This study aims to evaluate the feasibility of rail based intermodal transportation in urban regions. The feasibility is evaluated in a bi-sectional manner; first a quantitative assessment is carried out where costs and CO2 emission are estimated for a set of transport alternatives in the greater Stockholm region, Sweden. The most critical parameters are the train’s loading space utilization and the transhipment. Second, an analysis is made based on the principles of the ‘Delphi’ method i.e. experts involved in in-depth interviews, workshops and a survey; regarding stakeholders’ perspectives for utilizing such systems. The system must satisfy broader policy objectives of local authorities and commercial corporate interests in order to be adopted.

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Keywords: Intermodal transport; Transhipment Interface; Urban freight transport; Road-Rail

1. Introduction

For other modes to be competitive alternatives for road haulage in urban freight, they have to achieve this despite the fact that the logistical patterns of many industries are adapted to road transportation. Accessibility and flexibility are two areas where road is superior to other modes. On short and medium distances, speed and costs are also favorable for road haulage. Reis et al. (2013). Regarding rail based intermodal transportation; improvement of the cost-quality ratio is needed due to factors such as lack of reliability and punctuality, long lead times, low frequencies.

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1. Reducing transhipment cost
2. Reducing the cost for pre- and post-haulage on road
3. Reducing train transport cost
4. Increasing costs for road haulage

Conventional rail freight is commonly competitive on long distances and in line-haul relations between two nodes. However, an intermodal line train, as a transport system for freight differs from conventional rail freight systems, as it similar to a passenger train makes stops along the route for loading and unloading. Due to the frequent stops made at intermediate stations it enables a larger market area being covered by rail in a combined transport system. For intra- and inter-regional relations, the concept has the potential of reducing drayage by trucks to and from intermodal terminals, strategy number (2), and making rail freight competitive also over medium and short distances. Complex bundling concepts for freight e.g. hub-and-spoke or the line network, are considered to have longer average distances and times. However, this disadvantage could be compensated by the additional network links. Thus they can be competitive with unimodal road transport, at least for medium to long distances. Kreutzberger (2008).

Regarding strategy (4), there are factors in favor of non-road modes transport within urban areas aside from societal factors i.e. congestion on the road network and the high environmental impact of road haulage. There are also operational restrictions affecting road haulage in urban freight mainly regarding: vehicle size, loading/unloading procedures and operating hours. Limited vehicle sizes within urban areas implies that unimodal road transhipment is required when entering these areas or alternatively having a low capacity from the start. Other situations where land modes are competing on more equal terms are maritime flows connected to land transports, as the cost of transhipment inflicts both road and rail at ports. “Hinterland” and “Dryport” concepts connecting port terminals with inland terminals through the means of rail shuttles have proved to be successful.

The need of reducing greenhouse gas (GHG) emissions from transportation is evident and there is a demand for developing more sustainable transport systems. When sustainability is an objective of ‘combined transport’, the principle should be that the freight should be transported as far as possible with rail and then distributed by road as short distances as possible. EC (2001). However, intermodal rail transport suffers from a number of problems that restrict its competitiveness over short and medium distances. Several intermodal researchers have made contributions in finding the minimum distance that intermodal rail–road transport can compete with unimodal road services. The European results are found in the range 400-600 km. Klink and van den Berg, (1998); Nelldal et al. (2008). Intermodal transport must be able to serve more transport flows, also small flows and on relatively short distances, which can be achieved through implementing higher frequencies and serving more destinations. An intermodal line train making intermediate stops along its route could be a feasible solution for achieving this if it is operated efficiently.

Moreover, the need of reducing greenhouse gas (GHG) emissions from transportation is evident and there is a demand for developing more sustainable transport systems. When sustainability is an objective of ‘combined transport’, the principle should be that the freight should be transported as far as possible with rail and then distributed by road as short distances as possible. EC (2001). However, intermodal rail transport suffers from a number of problems that restrict its competitiveness over short and medium distances. Several intermodal researchers have made contributions in finding the minimum distance that intermodal rail–road transport can compete with unimodal road services. The European results are found in the range 400-600 km. Klink and van den Berg, (1998); Nelldal et al. (2008). Intermodal transport must be able to serve more transport flows, also small flows and on relatively short distances, which can be achieved through implementing higher frequencies and serving more destinations. An intermodal line train making intermediate stops along its route could be a feasible solution for achieving this if it is operated efficiently.

The research project ‘Regional Combined Transport’, which has been funded by Swedish Transport Administration through the virtual research centre SiR-C (Swedish Intermodal Research Centre), has had the main objective of evaluating the feasibility of creating a regional rail based intermodal transport system in the greater Stockholm region. It is one of Europe’s financially strongest regions where a number of consumption intensive and also some production intensive cities are located in proximity to each other. Accomplishing the main objective of the project implies describing the current market for regional combined transport and try to identify existing needs of connections in the freight market as well as evaluating the operational efficiency of the proposed system, mainly regarding cost and CO2 emission. Three specific research questions directed the methodological design and the execution of the feasibility study:
1. Does a market exist for the system?
2. Can an operationally cost-effective system be implemented?
3. How can the system be designed in order to generate minimal environmental impact?

2. Research methodology

The feasibility study has been carried out in a bi-sectional manner; first a quantitative assessment was carried out where a set of transport chains were modelled and compared; and second through a more qualitative evaluation process, where stakeholders were gathered during two rounds of participatory research workshops, including a survey and in-depth expert interviews. One of the desired outcomes was to propose a demonstration project if the system was evaluated to be feasible in relation to the research questions. Due to this fact, an applied methodical approach was chosen - based on a concrete case study and participatory research at workshops with potential stakeholders. The alternative research methodology would mainly be based on market surveys and stated preference techniques, where a large number of stakeholders would have been required to get statistically significant results.

The shippers involved in the project as reference group members or workshop attendants are very dominant on the Swedish freight market, three of the largest wholesalers of daily consumables and grocery attended; together they constitute 87.5% of the Swedish market; as well as the incumbent postal office, which is currently one of two largest package delivery firms in the Swedish market. Hence, albeit the shippers involved were quiet few, the market coverage achieved was very high. The justification for this approach was based on the assumption that large base volumes are needed for initiating rail services as well as having to coordinate few large actors is easier than many small actors. However, a market survey could be a motivated continuation of this research in order to obtain a better picture of the market and its perspective on the feasibility of the system.

As a first step of evaluating the feasibility of the potential system, a quantitative assessment has been carried out - defined by the regional market boundaries and based on a case study for major actor within the Swedish consumer goods market. The assignment consisted of the wholesaler’s distribution of consumables to retail shops within the greater Stockholm region. The shipper’s data has been applied as input for a cost model: Intermodal Transport Cost Model (ITCM), Kordnejad (2014)

In the second phase of the feasibility study, an analysis has been conducted regarding stakeholders’ perspectives, barriers, demands and preferences for implementing and utilizing the proposed system. The analysis’ initial phase consists of describing and categorizing the main stakeholders and then based on the principles of the Delphi method a stakeholder analysis is carried out. In essence the main objective of the study is to evaluate if the system is currently feasible according the three research questions stated above and if not, in which scenario could it be considered feasible? Hence the study also involves scenario analysis to a certain extent.

Fig. 1 summarizes the methodological framework and the main findings for determining the feasibility of the evaluated socio-technical system. Section 2 outlines an overview of the system and existing similar systems around the world. Section 3 proposes a quantitative assessment of the feasibility study. Section 4 assesses the decision point of potential stakeholders in the studied region. Thus the quantitative assessment is an input for the stakeholder analysis in the disposition of this paper as they have been in practice i.e. an input for the two rounds of workshops with stakeholders and the stakeholder analysis. The two sections combined guide the results of the overall feasibility study.
3. Intermodal line train and regional rail freight

The first main prerequisite in order to make the intermodal line train efficient is a stable and balanced flow of goods with optimized loading space utilization along the route, affecting the train transport cost, strategy (3) in the introduction. As the objective is to consolidate small flows, imbalances along the route will constitute an obstacle for the line train to be competitive. Davidsson et al. (2007) cite several measures that can be undertaken in order to overcome these imbalances: adapt train capacity, adapt departure timing, use trucks parallel to rail lines, adapt train routes, assign terminals dynamically, apply price incentives, improve information sharing and apply decision support systems.

The second main prerequisite for intermodal line trains to be competitive towards unimodal road services in urban freight is time- and cost-efficient transhipment at the terminals, strategy (1) in the introduction. The physical intermodal interface consists of transhipment of unit loads, conventionally transhipped with gantry-cranes or reach-stackers. These types of intermodal terminals involve high volume operations, requiring high investment cost and utilization rate. Hence the concept of Cost Efficient Small Scale intermodals terminals, (CESS) terminals, is
presented in this study, consisting of the operational use of relatively novel transhipment technologies at terminal sites located at sidings. The following three transhipment technologies have been evaluated as they have been identified as suitable for the CESS-terminal concept; the Light Combi System, Megaswing and CCT, all illustrated in Fig. 2.

![Fig. 2. Evaluated transhipment technologies for CESS-terminals (a) The Light Combi System; (b) Megaswing and (c) CCT.](image)

The suitability of the evaluated transhipment technologies was based on the following characteristics; low energy consumption and being cost- and time efficient for small scale operations. They are required to enable transhipment at sidings under the catenary and handling of standardized unit loads. There are a number of other transhipment technologies on the international market of which most require some sort of modification on the unit loads, thus creating closed transport systems for a restricted set of shippers and “hot spots of resources”. Handling standardized unit loads with horizontal transhipment is on the other hand commonly associated with modifying the vehicles instead; thus reducing precious payload capacity which is not desirable from carrier perspective - in particular not for long transport distances. The Megaswing\(^{(2)}\) wagon is regarded as a candidate technology as it enables horizontal transhipment on sidings under the catenary without any additional transhipment equipment, thus avoiding the heavy investments associated with conventional terminals. The wagons are designed for semi-trailers of all types, including trailers without the attachment required for handling by the grapple arms of cranes and reachstackers. Hence the market for combined land transport can be broadened as more standardized unit loads can be transhipped. However, the rail investment cost increases as the wagons are more costly than conventional intermodal wagons and standardized heavy containers cannot be transhipped.

CarConTrain (CCT)\(^{(3)}\) is another horizontal transhipment technology that can be used at CESS terminals. The concept involves hydraulic poles on which unit loads are placed during the transhipment process. Hence, the transfer between modes does not have to be synchronized, offering a higher degree of operational flexibility. Nelldal et al. (2008). The system is currently at prototype stage but it is designed for handling all types of unit loads; albeit the system requires customization on truck and wagon chassis as well as a sliding transfer unit. CTT is not on the market yet, but a technologically similar system, ContainerMover\(^{(4)}\), is currently in operations in Switzerland.

3.1. International Context

There are only a few examples of current operations around the world that are similar to the notion of intermodal line trains and utilization of standardized unit loads at CESS terminals. Some of the existing intermodal and unimodal examples of regional rail freight services are described below.

3.1.1. Japan/Sweden

The ideas behind small scale handling of intermodal trains originates from Japan and JR Freight, which utilizes forklift trucks for transhipment of small 10-foot containers as illustrated by Fig. 3a. Albeit cheap and simple, this composes certain restrictions as well e.g. limited weight/size lifting capability and the requirement of forklift tunnels on the unit loads. During 1998-2001 a similar system, the ‘Light Combi system’ was implemented in Sweden as a pilot project, the ‘Dalkullan’, for transports between a wholesaler of daily consumables and retail shops. The system used 20-foot Swap-bodies with forklift tunnels. According to Bärthel and Woxenius (2004) the Dalkullan proved
that the Light Combi system worked well both technically and logistically. Technically, the locomotive drivers were positive towards their additional task of loading/unloading swap bodies using a forklift. Furthermore, the transfer of swap bodies under the overhead catenary using forklifts worked well. From a logistical perspective the system worked well; consisting of a schedule with intermediate stops for 15-30 minutes at unmanned terminals for overnight shipments over medium and long distance. The closure of the project was largely due to organizational and business related factors as the marketing was inadequate and insufficient volumes were generated.

The system in Japan called ‘E&S (Effective and Speedy)’ is still in operations today and ‘The Super liner container express service’ have established links with intermediate stops between Japan's major cities. The system has changed from loading and unloading at sidings to trains switch directly to a subsidiary main track, where they stop for unloading and loading at a platform, from where they will depart thus reducing terminal time and increasing the overall operation speed of the train. E&S is implemented at 26 freight stations in Japan. The main drivers enabling the operations of the new system were the compact terminal design, an upgrade in machinery and an upgrade in the information system dispatching the machine operator. Okumura (2004).

3.1.2. Switzerland

A horizontal transhipment technology that has been operationalized in recent years is Innovatrain’s ‘ContainerMover’ in Switzerland (Fig. 3b) - a technology that uses compressed air to lift the unit loads so they can be laterally and hydraulically displaced from a wagon to a truck and vice versa. The concept is similar to the CCT concept in the sense that it involves hydraulic poles on which unit loads are placed. Hence the transfer between modes does not have to be synchronized, offering a higher degree of operational flexibility. Albeit the technology can handle standard swap bodies and 20’ containers; chassis for trucks and wagons gain extra weight as they are customized with additional equipment, reducing precious payload. One of Switzerland’s largest wholesalers of daily consumables is currently using this technology and has created an intermodal transport system with several intermediate stations on short distances. Road distances in the country are relatively short, less than 500 km.

3.1.3. European Wagonload Traffic

Wagonload traffic (WL) is the oldest product and an essential part of the foundation of the railways’ freight traffic system. It is also the kind of railway service that is the most similar to intermodal services. It comprises the transportation of full wagons, single or groups, which are loaded and unloaded at industrial sidings or loading platforms. The wagons are shunted from the facilities of the consignor, marshalled into different train constellations along the route and then shunted to the facilities of the consignee. All European railways operate WL services. The international traffic is collected by domestic services and the international links in a European context may be relatively short e.g. between Belgium and France, or long e.g. between Italy and Scandinavia. EC (2001). A re-
occurring idea in rail freight markets experiencing inefficiencies and/or stiff competition is to scrap WL traffic in favor of intermodal traffic and unit trains. Some general drawbacks of WL traffic are related to relatively high costs for small freight flows and short distances due to e.g. high costs for feeder transportation to terminals and shunting processes at terminals. Thus the fixed costs are high compared to road haulage. Access to industrial sidings is a crucial factor if WL traffic is to be a serious alternative for shippers. In Sweden and in many other European countries a significant share of industrial sidings has been phased out or not maintained.

Another common problem in WL traffic in Europe is related to the amendment to the logistic patterns of the industry and commerce e.g. online shopping, which has resulted in reduced shipment sizes and increased shipping frequencies. Hence, in cases where WL traffic consists of occasional wagons in sparse relations, it experiences difficulties asserting itself cost-wise towards road haulage and are thus closed down. Alternatively, trainloads are established where the freight volume is sufficient and thus taking advantage of the economies of scale offered by rail services. Much in line with the ideas behind regional short line services in North America, which aims to create full trainloads for inter-regional long hauls.

3.1.4. North American Short Lines

In USA and Canada, a regional rail freight operator is called a short line carrier i.e. a “Class III” operator operating in intra-regional relations and feeding the systems of a major railway company, “Class I” carrier. From an organizational perspective, short line carriers are in cooperation with class 1 carriers and are responsible for the contact with local industry. Dablanc (2009). Neither of those aspects prevail to a significant extent in a European context. Albeit cooperation between rail operators do occur, it is rare in deregulated European markets; where the new rail operators enter the market as competitors to incumbent operators. Moreover, rail operators seldom operate strictly at a local level and thus are less in contact with the local industry compared to European road operators or North American short line carriers. Another important difference between the North American and the European railways is that they often own the infrastructure on which they operate, whereas in Europe, public tracks are in general accessible to all operators.

4. Quantitative assessment

As a way of evaluating the proposed transport system, freight volumes from a major actor within the Swedish consumer goods market have been attained. The assignment consists of the wholesaler’s distribution of consumables to retail shops within the region of Stockholm. The quantitative assessment and the model ITCM are fully presented in Kordnejad (2014). ITCM consists of two main phases: generating an initial plan that matches the constraints of the demand and to process the demand and supply in the three integrated cost modules; terminal handling, rail and road transport. Thus the first step is to examine the constraints of the demand. As seen in Fig. (4a) the shipper has three distribution centers (DCs), each handling a separate goods class; common (i.e. non-tempered), refrigerated and frozen goods. The set of terminals that are considered are actual conventional intermodal terminals in the region and potential sites for CESS-terminals. The required cycle time of train is another main parameter influencing the scheduling. A 466 km long rail route consisting of a loop around the region is evaluated in the case study. The route was considered the optimal route within a set of evaluated routes. The rail route connects the set of conventional intermodal terminals and sites for CESS-terminals in the region, Fig. (4 b). The intermodal alternative is estimated in a ‘maximized’ scenario i.e. all available terminal locations along the route are selected, and the cost performance of the intermodal alternative is presented as a function of train loading space utilization.
Results for the baseline scenario i.e. for the current market structure and existing technologies, regarding transport costs using various transport chain constellations and transhipment technologies, are illustrated by Fig. 5. A break-even point is found between the estimated costs of road haulage and using CESS terminals with Megaswing if the loading space utilization of the reference train is 92%. The reference train is 396 meters and consists of a locomotive and fourteen wagons.

Regarding the alternative future scenario, there are coherent plans, paradigms and visions that are commonly similar at global, European, national and regional level, albeit with varying focal areas. At a global level there are two visions that can be identified; lower emissions from the transport sector by large and reduced congestion on the road network in urban areas. Regarding European transport policy, in EU’s White Paper from 2011, energy efficient transports and movement of goods are the areas that are emphasized. It is stated that a shift to rail and sea transports is critical in order to achieve these objectives and the best way of achieving this mode shift is by increasing the competitiveness of intermodal transport. EC (2011). As for Swedish national transport policy, efficient transport systems, regional development and environmental as well as health aspects of transports are the most emphasized areas. Concerning the plans and visions of the studied region, a regional development plan for the Stockholm region has been created, (RUFS2010), where the focal areas are transport connectivity, capacity and regional environment.

A set of factors and trends have been identified that could affect the results of the feasibility study in the future scenario in 2030. The trends are summarized in Fig. (1) and those considered as quantifiable have been included in the cost and emission estimations for the alternative future scenario. Fig. (4) illustrates the estimation of the total transport cost in the alternative future scenario. A factor that would affect the results positively for the intermodal alternative is the introduction of improved transhipment technologies e.g. if the CCT technology is fully developed or if a similar system such as ContainerMover would be introduced in the Swedish market. The CCT is estimated to have the lowest cost per transhipment. Note that the Semi-Trailer (ST) commonly has a capacity of 33 EURO-
pallets and the Swap body (SB) 18 EU-pallets; hence using STs require fewer number of transhipments. However using SBs enables trucks with higher capacity, 2 SBs and 36 EURO-pallets, whereas using ST’s enables a truck capacity of 1 ST and 33 EU-pallets and hence a higher cost for road haulage. Thus the total transport cost is higher when using CCT compared to Megaswing as the lower cost for road haulage and transhipment cost/loading unit do not compensate for the higher number of transhipments that is required.

If the train length would increase to 501 meters i.e. four additional Megaswing wagons, the intermodal cost is equal to the cost for unimodal road haulage at 79% train loading space utilization. If the train length is increased, the total transport cost decreases as long as the loading space utilization is maintained. The train length is however subject to infrastructural constraints e.g. the length of sidings and crossing stations on the rail network.

Another quantifiable trend is the increase of fossil fuel prices. If diesel prices would increase so would the feasibility of the intermodal option. As illustrated by Fig. (6), if the diesel prices would increase with 25%, which is estimated to take place by 2020[7], the total cost for the reference train is equal to the cost for unimodal road haulage at 74% train loading space utilization when using CESS-terminals with Megaswing wagons and 99% when using CESS terminals with CCT. For the intermodal chain where the train length is increased and using CESS terminals with Megaswing wagons, the break-even point decreases to 63% loading space utilization.

![Fig. 6. Total transport cost for evaluated transport chains in the alternative future scenario.](image)

The results of CO₂ emission for both scenarios are illustrated by Fig. 7. The emission from electrification is assumed to stem from electricity produced in Sweden. If hypothetical medium-sized conventional intermodal terminals were used at each CESS-terminal site, the annual CO₂ emission is estimated to 1198 tonne (33.9 % reduction compared to unimodal road). For CESS terminal Light Combi, the CO₂ emission is estimated to 800 tonne (55.9% reduction) and for CESS terminal Megaswing to 776 tonne (57.2% reduction). In the alternative future scenario CCT is added, generating the lowest amount of CO₂ emission, 613 tonne (66.2% reduction).

![Fig. 7. CO₂ emission in tonne for the evaluated transport chains.](image)
4.1. Findings

From the results of the quantitative assessment of the baseline scenario, it can be concluded that a rail based intermodal transport system is on the threshold of feasibility in the studied region if CESS terminals are used. However the cost performance of the transport chain including conventional intermodal terminal is far from that of road haulage. The loading space utilization of the train and the transhipment cost are the most critical parameters. Regarding loading space utilization, it is necessary to consolidate other freight flows in the train in order to achieve high and balanced loading space utilization along the route. If those factors are optimized then intermodal road-rail transports can compete with road haulage cost-wise and outmatch it regarding the environmental impact.

5. Stakeholder analysis

As stated in the research methodology section, in the second phase of the feasibility study a stakeholder analysis is conducted. The analysis regards stakeholders’ perspectives, barriers, demands and preference for implementing and utilizing such systems. A stakeholder analysis is conducted for a proposed business model for the system, the ‘local cooperation model’. The analysis is based on the principles of the Delphi method i.e. experts involved in interviews, two workshop rounds and a survey. The Delphi method is a method for gathering data and analysing opinions gathered from experts within their specific field. The technique is designed as a group communication process which aims to achieve a convergence of opinion on a specific issue (Hsu and Sandford, 2007).

5.1. The Decision Making Process and the Local Cooperation Model

In order to conduct an analysis of the decision making process and organization of regional intermodal transport systems, it is essential to have a holistic view on the system; the actors involved and their perspectives. As illustrated by Fig. (8), intermodal transport systems constitute of the stakeholders in the private sector; shippers, carriers, forwarders and operators as well as the regulatory framework set by stakeholders in to the public sector; authorities and urban and regional planners. The actors could however in principle be active in both sectors. Due to an increasing share of global value chains the focus of their perspectives commonly varies as the private sector’s sphere of interest is increasingly on national and global issues whereas the emphasis of the public sector is commonly more on the regional and local level. Albeit both are commonly engaged at all levels to a certain extent e.g. regional planners are bound by international and national commitments such as climate and emission targets and private terminal operators are affected by the demand of local industries.

Fig. 8. Private and public stakeholders in intermodal transport systems are engaged at four levels of interaction.

The study of Dinwoodie (2009), investigating the potential of urban rail freight distribution in UK, concluded that urban authorities will only adopt sustainable urban freight distribution strategies if they “satisfy broader policy objectives as well as commercial corporate interests.” This conclusion is very well in line with the results derived from this analysis i.e. for the system to be considered feasible there has to be a corporate commercial interest and
local authorities’ incitements are genuinely guided by sustainability policies. Only then could the conceptual idea of this study be considered feasible. The key point for this decision making process is ‘corporate commercial interest’, which for a specific technology or mode is based on the ability to offer cost leadership for their value networks or to offer market differentiation. Cost leadership depends on a wide range of factors e.g.; “the scale of operations, linkages, resources utilization, coordination, integration, level of standardization, regulatory framework as well as time related and locational factors” (Ibid).

In an efficient intermodal transport system the actors and activities have to organized and coordinated in a business model i.e. a model for how a company conducts its’ business. It can be defined as the set of activities that a company performs in order to create a profit, how and when it performs them. Osterwalder (2004). Note that the concept entails how a company makes a profit and not just how it generates revenues. Flodén (2009) adopts the same framework as Osterwalder (2004) and categorizes four typical business models for intermodal transport systems; subcontractor, complete transport, own-account and local cooperation model – arguing that prevailing intermodal services represent one of the models or a mixture between them. The main characteristics of each of the models are described by Fig. (9).

![Fig. 9. Categorization of four typical business models for intermodal transport systems (Flodén, J., 2009)](image)

The model that represents the conceptual idea of the study is ‘the local cooperation model’, where the intermodal transport is organized by several local actors along a transport route, commonly in cooperation with local authorities. Local cooperation model will often occur in areas where there is no previous intermodal road-rail service. On the demand side, the constellation of shippers consists of several private actors that are interested in a shift to intermodal transport, but where no single actor has sufficient volumes to operate the intermodal service on their own. On the supply side, the actors include forwarders, operators and infrastructure owners. This model is considered challenging in the sense that it is difficult to agree on an appropriate division of responsibilities and revenues among the partners and that there is no clear channel leader. This enables flexibility but also increases the risk of conflicts and power struggles. The organization can vary in form; it could be anything from a jointly owned company to an agreement where one partner acts at the formal coordinator. Maintaining this partnership of core partners is important for the business model to be successful. Within the scope of this study, two rounds of workshops have been arranged in order to create a platform for consensus finding and the establishment of partnerships among the stakeholders as well as to explore the possibilities for the continuation of the project with the desired outcome of a pilot project. The workshops participants are presented in table 1.
Table 1. Workshop participants

<table>
<thead>
<tr>
<th>Workshop Round 1</th>
<th>Workshop Round 2</th>
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<tr>
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<td>Road haulier</td>
<td>Rail operator</td>
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During the workshops a survey study was conducted investigating the experts’ opinions about the system, regarding both market related and technological aspects. Other objectives were to investigate the stakeholder’s requirements and preferences regarding routes, frequencies, times, terminal sites, and business model. Some of the most relevant and summarizing questions and entries from the survey are presented below. The results are discussed in the following chapter.

**Question 1.** Business model. Choose the actor that best represents your organization in the table below as well as the activities that your organization may be able to contribute with in the proposed transport system. Feel free to add other activities or actors to the table.

![Fig. 10. Actors and activities in the local cooperation model.](image)

**Question 2.** SWOT analysis. What strengths, weaknesses, opportunities and threats do you associate with the implementation of the proposed transport system? (Recurring entries are stated in Fig. 11)

![Fig. 11. Results of the SWOT analysis](image)
**Question 3.** Do you think it is realistic to implement the proposed transport system?

<table>
<thead>
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<th>Alternative</th>
<th>Entries</th>
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<tr>
<td>Yes - provided that road haulage becomes more expensive</td>
<td>4</td>
</tr>
<tr>
<td>Yes - provided that intermodal transports becomes more efficient</td>
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<tr>
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<td>0</td>
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<tr>
<td>Do not know</td>
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5.2. **Findings**

Same experts were invited for the two workshop rounds and the response rates were almost equal, however the constellation of experts was not the same. Fig. (10) represents the actors that the respondents identified themselves as and the activities they thought they could to contribute with.

On the demand side, during round 1, only one shipper attended and two other invited shippers left last minute cancellations. Albeit being the second largest wholesalers in Swedish grocery market – a mismatch between supply and demand emerged. During the second round all three shippers attended; including the largest wholesaler in the Swedish grocery market as well as the incumbent postal service provider. The two shippers of grocery were positive towards cooperation within the transportation segment. However, the competitive relationship within their core business was an obstacle for cooperation from the perspectives of their organizations. During the workshops it was also revealed that the time requirements of the postal service provider’s package delivery segment and those of the shippers within the grocery industry differed to the extent that it did not enable a joint rail service. However, a business relation was established between one of the shippers and a terminal owner – who initiated a discussion for a pilot project in one of the sections of the suggested route.

On the supply side, there was a positive attitude towards the project and suggestions were made for taking actions in order to facilitate the implementation of the potential system. One example was when an urban planner suggested overviewing regulations within the city limit and in vicinity of terminal sites. Another example was an infrastructure owner from a surrounding municipality who offered a terminal site for a demonstration project. Furthermore, a set of possible routes and mode alternatives were evaluated and stakeholders’ underlying assumptions about the transport system were explored. Consensus was found for a suitable conceptual business model, ‘the local cooperation model’.

Fig. (11) is the most summarizing question from the survey. Here opinions are stated regarding internal strengths and weaknesses of the system as well external opportunities and threats. Internal refers to characteristics of the system and external to those of the surrounding e.g. shippers, competitors and society. What is perceived as the as the strongest internal strength of the system is the low energy consumption. Other equally strong factors were; reduced congestion on roads, development of the railway sector and reduced operational costs. The weakest internal characteristic is thought to be the lack of track capacity. This is mainly a problem in Stockholm during rush hours. There are also concerns regarding the complexity of the transshipment technology. External opportunities generated by the system are; streamlining local transportation, increasing fossil fuel prices and environmental attention. The external threats associated to the system are related to the competition from road haulage; that the market is perceived as not sufficiently regulated and cabotage road haulage i.e. the haulage of goods in one EU member state by a vehicle registered in a different member state, generating price pressure on the freight market. The survey was conducted during round 1. Afterwards the statements for the SWOT analysis was compiled by the research group and disseminated to the respondents, thus enabling them to react and give feedback to the compilation during round 2.

Entries to question (3) reveal the overall assessment of the experts regarding the feasibility of the proposed system. Only four out of 15 experts believed that the system is implementable under current conditions. Equal share of the participants believe that it is so - provided there is an increase in prices from road hauliers. Five of the participants stated that the system technically needs to become more efficient. None of the participants stated that the implementation of the system was unrealistic.
6. Conclusion

From the findings of the quantitative assessment of the feasibility study it is concluded that a rail based intermodal transport system is on the threshold of feasibility in the studied region if CESS terminals are used. However, the cost performance of the transport chain with conventional intermodal terminal is far from that of road haulage. The loading space utilization of the train and the transhipment cost are the most critical parameters for cost leadership. The transhipment concerns the technical feasibility of the system, mainly concerning research question 2, and the loading space utilization is related to the market, research question 1. If these factors are optimized an intermodal system can compete with unimodal road cost-wise and outmatch it regarding the environmental impact.

From the findings of the qualitative assessment of the feasibility study, the stakeholder analysis, it can be concluded that a rail based intermodal transport system faces a number of challenges albeit also offering a number of opportunities. The challenges are mainly related to organizational and physical coordination. The need of organizational coordination is evident in the proposed ‘local cooperation’ business model as there is a lack of formal channel leader; consisting of several equal shippers and the supply side is commonly fragmented. Physical coordination is also a concern, as transhipment is a matter of reliability and trust and not only costs and environmental impact. Novel technologies must prove themselves reliable. The main opportunities with the system are associated with lower level of impact on the environment and a better utilization of existing infrastructure in the region.

As stated in Stakeholder analysis if there exists a corporate commercial interest of implementing regional intermodal services and CESS terminals and local authorities’ incitements for structuring the regulatory framework are based on sustainability policies; only then could the conceptual idea of this study be considered feasible. The key point for this decision making process is the intensity of the corporate commercial interest and local authorities prioritization of sustainability policies. The former is for a specific technology or mode based on the ability to offer cost leadership for their value networks or to offer market differentiation. This study has showed that in the studied region rail based intermodal services could offer cost leadership in certain relations if resource allocation and utilization are optimized. However, albeit interest for regional intermodal transport is shown by individual public officials as for instance expressed in our workshops; the political will from local authorities in the region must be more consolidated and concretized for the system to become adopted from a societal perspective. Regions were cost-leadership and a strong will from local authorities prevail, have created a foundation for implementing regional rail based intermodal services e.g. the operational examples from Japan and Switzerland presented in this paper.

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