MEASURES TO MAKE INTERMODAL TRANSPORT SMARTER FROM A TRANSPORT CHAIN PERSPECTIVE

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ABSTRACT

Intermodal transport is appealing because a certain transport mode is used where its strengths are best utilised, e.g. truck transport to the customers door and train transport on the long haul. Why intermodal transport is used to a limited extent have been studied extensively. Measurable factors as transport times, vehicle utilization, and high initial costs are sometimes not in favour of intermodal transport compared to all-road transport. Further, more intangible factors as negative attitudes, high complexity and low flexibility is working against an expansion of intermodal transport. It is therefore of interest to know what can be done to overcome such limiting factors. The purpose of this paper is to identify weak areas in intermodal transport from a transport chain perspective and possible measures for intermodal transport to improve in these areas.

The identification of weak areas is based on knowledge in literature as well as from an ongoing research project. The areas are identified from a systems approach with focus on the operative perspective but reach up to the strategic level. Transport time, service frequency and punctuality were found to be weak areas. Several measures are identified. Application of some of these measures requires major investments while other requires reengineering of organisations and processes.

Keywords: Intermodal transport, weak areas, transport chains, improvement measures

INTRODUCTION

Intermodal transport is more complicated than direct road or rail transport and consists of more operations, while at the same time the goods are protected by a load unit all the way. Transport by rail, as part of an intermodal transport chain, generally has lower external costs. For the environment this is a smarter choice and often also from an economical perspective, even more so if external costs are internalised in the future. However, intermodal transport has had a slower development than road transport indicating that measures are required if the situation should change.

PURPOSE AND DELIMITATION

The purpose of this paper is to identify weak areas in intermodal transport from a transport chain perspective and possible measures for intermodal transport to improve in these areas.

SYSTEMS APPROACH TO INTERMODAL TRANSPORT

A transport chain is a sequence of activities, both administrative and physical movement of freight, with executing actors and utilised resources. Many factors shape these activities, actors and resources as depicted in Figure 1.

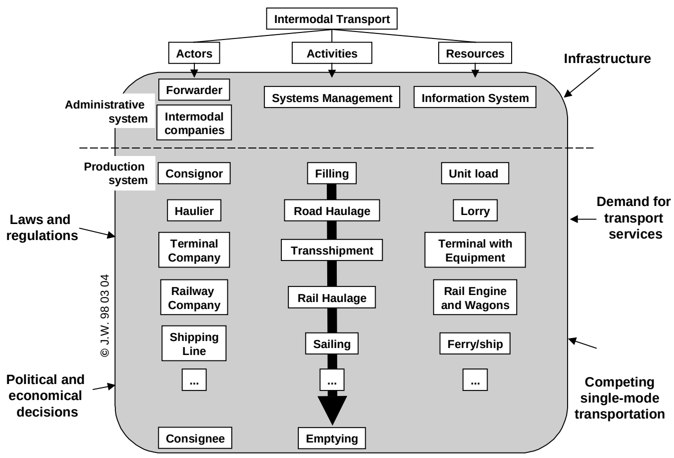

Figure 1 A reference model with the systems approach for intermodal transport. [1]

The administrative system in Figure 1 deals with a lot of issues in order to execute transport chains and transport networks. As Table 1 exemplifies, the administrative system can be viewed as working at different levels that deals with issues with different range of scope and degree of detail. At the strategic level the general development policies are outlined and operating strategies are shaped. Here the perspective is several years. At the tactical level the strategies are transformed into executable schedules with the aim to allocate resources efficiently with a time horizon of several months to a few years. At the operational level the schedules are given further detail and are executed, and exceptions handled, with a perspective up to a few months.

Table 1 Typical planning problems in a transportation system [2]

Decision level	Decision issues	
Strategic	Physical network design Resource acquisition	Location of main facilities Definition of broad services and tariff policies
Tactical	Service network design Traffic distribution	Terminal policies Empty balancing Crew and motive power scheduling
Operational	Scheduling of services, maintenance, crews etc	Routing and dispatching of vehicles and crews Resource utilisation

METHOD

This paper takes the system approach as a tool to identify the weak areas of intermodal transport chains. To identify possible weak areas a literature review has been done and results from an ongoing research project give example of real life weak areas. Improvement measures are sourced from literature, known examples and industry experiences.

Trying to find the weak areas of already existing intermodal transport chains implies that although the chains are used there are weak areas that could be improved and thus make the chains more competitive. Intermodal transport chains can thus be anticipated to have some weak and some strong areas.

In order to find weak areas in intermodal transport chains it is important to know details regarding areas that are important for transport services. Important areas are listed below and weak areas are described in a few examples of transport chains. All transport chains have weak areas. Generally intermodal transport is compared with and benchmarked to direct truck transport. Therefore intermodal transport can be viewed as weaker in an area if its performance is lower than that of direct truck transport. In some cases intermodal transport is accepted as performing lower than direct truck transport due to stronger performance in other areas. In such cases the weak areas are anything that can break the transport chain, i.e. that the chain is not performing according to the transport plan. In order to determine what a weak area is, two criteria are thus used:

1. an aspect of the transport chain is weaker than a competitive transport mode
2. an aspect of the transport chain is weaker than the customers requirements

IDENTIFICATION OF WEAK AREAS IN INTERMODAL TRANSPORT CHAINS

Some factors important in the choice of transport services and transport mode have been identified in previous studies of transport mode choices; a compilation is presented in Table 2. Underperformance relative alternatives in any of these areas can consequently constitute a weak area.

Table 2 Typical mode choice factors compiled in [3]

Study	(McGinnis, 1990)	(Cullinane and Toy, 2000)		(Jeffs and Hills, 1990)
Factors	Freight rates Reliability Transit time Loss, damage, claims processing, and tracing Shipper market considerations Carrier considerations	Cost/price/rate Speed Transit time reliability Characteristics of the goods Service (unspecified) Frequency Distance	Flexibility Infrastructure availability Capability Inventory Loss/damage Sales per year Controllability/tracability Previous experience	Customer requirements Product characteristics Company structure/organisation Government Available transport facilities Decision maker

In previous research transport time, transport service timing, service frequency and punctuality were found to be significantly better for relations where a large forwarder used intermodal services regularly compared to relations where intermodal services were not used [4]. This suggests that time related factors are important for intermodal transport to be used.

FINDINGS FROM AN ONGOING RESEARCH PROJECT

In an ongoing research project several transport chains are mapped and described in order to identify weak areas of intermodal transport. Time, cost, service quality and administration of the transport chains are mapped. One special part of the project has measured vibrations and shocks during transport and the impact on the goods of these has been tested in a laboratory. Results from these parts are presented here, first vibration measurements and laboratory tests, and secondly brief summaries of three transport chains.

Vibration and shock measurements and laboratory tests

Generally goods can be damaged during transport by shocks in mainly vertical direction, by contact to other goods or the load unit's structural elements due to movement or by falling down from an upper layer. Movement is caused by shocks or by vibrations of the load surface. Vibrations and shocks are measured as accelerations.

Three different measurements of real transports were done:

1. Transhipment in intermodal terminals of containers, swap bodies and semi-trailers with different technologies
2. Internal transport in terminals with different means
3. Long distance transport by train and truck

Transhipment showed to have higher amplitudes while internal and long distance transport had larger impulses (amplitude x duration). Semi-trailers are subjected to lower impulses during transhipment compared with containers and swap bodies. Transhipment with crane is gentler than with reach stacker. Transport by train has typically double the amplitude and lower frequency than truck transport.

The laboratory tests showed that movement of the goods occurs if the goods are not secured with acceleration levels typical for train transport and transhipment while this did not occur for the levels corresponding to truck transport. The tested goods (glass, porcelain, paper sheets and gingerbread houses) were not damaged though, except the fragile gingerbread houses.

Mapping of one of Sandvik's transport chains

For Sandvik a transport chain between Sandviken in Sweden to Milan in Italy has been studied. The products in this transport chain are tubes, threads, bars and bands in stainless steel. In this relation both intermodal transport and truck transport is used. The reason is that the intermodal transport is too slow for deliveries sent in the beginning of the week to reach the customer by the end of the week. The transport cost for both alternatives is nearly the same. In Table 3 the transport schedule is presented. For the intermodal transport, Sandvik contracts one company for the haulage to the intermodal terminal in Gävle and one intermodal forwarder for the supply of semi-trailer and the transport from Gävle to Milan. The reason is that Sandvik has several other intermodal transport chains departing from Gävle, and thereby they achieve economy of scale and higher control on these short initial transports. Sandvik has extensive load securing instructions that their transport service providers must comply with, and thereby they have no problem with goods damages during transport.

Table 3 Transport schedule in the studied transport chain for Sandvik.

	Intermodal transport		Truck transport	
Contracted transport operator	Haulage company and Intermodal forwarder		Forwarder	
Distance / highest average speed	2464 km / 33 km/h		2207 km / 38 km/h	
Punctuality	92-93 %		97-98 %	
Loading day	Loading time	Transport time [h]	Loading time	Transport time [h]
Monday	09	75	21	59
Tuesday	06	78	18	62
Wednesday	10	122		
Wednesday	18	114		
Thursday	12	96		
Friday	12	96		

A weak area is the transport time for intermodal transport that has lead to the usage of truck transport as a complement for Sandvik. The punctuality is somewhat lower for intermodal transport, but this is not regarded as a problem by Sandvik.

Mapping of two of ICA's transport chains

For the grocery store chain ICA, two transport chains have been studied. Both are transports of beverages from respective brewery to an ICA warehouse that is done by intermodal transport of 13.6m swap bodies. One of the chains is from Stockholm to Kungälv and the other is from Falkenberg to Stockholm. Details over the transports are given in Table 4; the transport time is door-to-door, the booking deadline is expressed as difference between booking and departure time and departures depict maximum per day. Green Cargo is the transport service provider in both these chains and provides the full door-to-door transport and produces the service with own resources as load units, trains and trucks. The operational administration is simple for the customer by the application of a fixed schedule that is running without manual work. Punctuality is 95% according to Green Cargo (ICA says the punctuality is satisfactory) and both ICA and Green Cargo state that there are no problem with goods damages.

Table 4 Transport schedules in the studied transport chains for ICA.

Relation	Falkenberg – Stockholm			Stockholm – Kungälv		
Road distance	490 km			475 km		
Intermodal distance	565 km			480 km		
Loading day	Transport time [h]	Booking deadline [h]	No of departures	Transport time	Booking deadline	No of departures
Monday	22-25	46-50	5	27-29	62-65	4
Tuesday	22-25	22-26	5	27-29	62-65	4
Wednesday	22-25	22-26	5	27-29	38-41	4
Thursday	22-25	22-26	5	27-29	38-41	4
Friday	70-73	22-26	5	27-29	38-41	4
Weekend delivery by truck	39-41	29-31	3	9	88	3

As ICA requests delivery on Sundays and Green Cargo cannot provide an intermodal service for Sunday delivery, this has been pointed out as a weak area by ICA. Green Cargo has solved the problem by doing the Sunday deliveries by truck. Worth noting is that ICA has not used any of the departures for weekend delivery during 6 months. The cost for the truck deliveries is approximately 50 % higher than the intermodal services, thus a strong area for the intermodal transport. One area that is weak for intermodal transport, at least in the Stockholm – Kungälv relation, is the transport time as intermodal transport has an average speed of 18 km/h and road transport 53 km/h.

Mapping of one transport chain of Schenker's consolidated cargo

Schenker is one of the largest forwarders in Sweden and employs hauliers for the transports. A haulier, GP Last, has been studied on the Malmö – Stockholm relation. They transport full loads, part loads (>1 ton) and consolidated cargo (<1 ton) on this relation. In 2005 they had 12 trucks with trailers in each direction every day, of these were approximately 2.5 trucks filled with consolidated cargo. In Table 5 distances, and departure, arrival and transport times are given. The figures are door-to-door. The haulier used only direct truck transports. The cost for intermodal transport for the haulier has been estimated to be approximately 30% lower than direct truck transport.

Table 5 Transport details in the studied relation for Schenker.

Relation	Malmö – Stockholm			Stockholm – Malmö		
Road distance	634 km			634 km		
Intermodal distance	642 km			642 km		
	Departure	Arrival	Transport time	Departure	Arrival	Transport time
Consolidated cargo 1	19:00	04:00	9	19:30	04:30	9
Consolidated cargo 2	21:00	06:00	9	22:00	07:00	9
Intermodal 1	16:10	05:30	13:20	19:30	05:30	10:00
Intermodal 2	18:40	05:30	10:50			
Intermodal 3	20:45	06:45	10:00			

The haulier has stated that the intermodal transport time is too long, arrival too late in the morning and the departure frequency too low for them to use intermodal transport for the consolidated cargo. From the rest of their transports, they point to that intermodal transport will limit the load capability of the load units and that the intermodal service provider does not provide surveillance of tempered load units. That limits their willingness to use intermodal transport for part and full loads as well and thus limits their interest in investing in intermodal load units.

EXAMPLES OF MEASURES TO IMPROVE WEAK AREAS

CUSTOMER DEMAND AND MARKETING

Adjusting the logistics/transport chain to accommodate available intermodal transport services

Transport times for intermodal transport services are generally longer than for direct truck transport. One measure to deal with this area is to influence the decision maker to lower their demand on the transport time, i.e. that the customers change their requirements on the transport task to accommodate the intermodal transport service. Examples of this principle were found in the studied transport chains of ICA and Sandvik. Both companies have accepted a somewhat longer transport time for the intermodal transport compared to what can be achieved by direct truck transport.

However, this cannot be expected to be applied in general. ICA transports beverages in the studied transport chains, a relatively low cost commodity. Sandvik on the other hand, has a long transport distance which entails a higher acceptance to the transport times that intermodal transport offer.

Customer focus

A natural alternative of the principle above is to inverse it, i.e. let the customer requirements form the prerequisites for the intermodal transport service and train production. Shorter transport times are then required and this measure will be dealt with below. However, from a customer point of view the average speed of the trains are often rather low while the maximum speed is higher than for trucks, which indicates that the rail transport service providers has improvement potential.

Another area in need of attention is to increase customer confidence in intermodal transport as a viable and reliable alternative. This is especially important in order to convince potential customers to start using intermodal transport. The confidence would increase with higher punctuality, offer of relevant value-added services and showing responsibility for the transport service through quality incentives in the agreements with customers.

An example of an ongoing work for increased punctuality is a cooperation program between the Swedish rail administration and some passenger train operators [5]. The rail administration has committed to invest in some meeting stations, improve the signalling, ensure faster acute infrastructure repairs, change critical components in the infrastructure and improved information to passengers. The train operators has committed to invest in new rolling stock, improve maintenance for higher reliability of the rolling stock, educate locomotive drivers, educate cabin crew in departure routines and close doors 15 – 30 seconds prior to departure.

In discussions with transport buyers value-added services as electrical supply to load units during transport as well as real-time positioning and status has been mentioned as interesting. Solutions for these services exist but the economy of them must be viable for the intermodal transport service provider.

PRODUCTION

Shorter transport time

Contrary to truck transport, rail transport can have higher speeds than usually utilised. Increased speeds on the long-haul rail transport can be achieved through several measures. In Sweden, Posten AB uses fast trains for mail transports between their main hubs. The table below exemplifies the effect on the 600 km relation between Malmö and Stockholm. In this case, the transport time is about 2 hours and 20 minutes (>30%) shorter by increased speed from 100 km/h to 160 km/h. Higher speeds requires new rolling stock and appropriate load units which makes this measure a strategic issue affecting the owner of the load unit.

Table 6 Transport details for conventional intermodal train and mail train.

Train type	From	To	Departure	Arrival	Transport time	Train no	Distance	Average speed
Intermodal train	MGB	ÄSG	21:41	05:07	07:26	42246	607	82
Intermodal train	ÄSG	MGB	21:11	04:34	07:23	42419	607	82
Mail train	MGB	TM	20:27	01:44	05:17	9802	615	116
Mail train	TM	MGB	22:10	03:18	05:08	9825	615	120

The intermodal trains exemplified above are rather fast already while other intermodal trains have a much lower average speed. What the cause is for low average speed must be determined in each case, but train formation, time on meeting tracks and scarce resources as locomotives and train drivers could be reasons for low average speed. Appropriate measures would then be prioritised train slots for the whole journey, efficient train formation, and efficient locomotive and train driver schedules.

Further, if the terminal handling time would be lowered, the total transport time could be shortened. Time efficient arrival and departure procedures and adjusted terminal planning for prioritised load units would lower the terminal time at a tactical and operational level, respectively. A strategic measure is to introduce more time-efficient transhipment technology or more transhipment resources.

Increased transport frequency

High transport frequency is more comfortable for the customer as they can have more flexibility in their planning, increase resource utilisation and the customer's customer can receive a higher service level. One strategy used by forwarders in scarcely populated area to increase transport frequency is cooperation with competitors, i.e. different forwarders utilize the same vehicle. All the benefits above are achieved but the autonomy is lost. The implication of applying the strategy to intermodal transport could be investigated further.

Increased volumes are a more common basis for higher frequency. With lower cost the demand would increase according to general economical theory.

Lower transport cost

Cost for intermodal transport is often lower than for the corresponding transport service with truck transport. Lowering the costs would nevertheless improve the competitiveness of intermodal transport as the competition in the industry is fierce. More efficient utilisation of rolling stock is one measure and alternative transhipment technology another. Solutions have been suggested using fork-lift trucks or horizontal transhipment, both limiting the type of load units that can be used. CarConTrain [6], FastRCargo [7] and RoRoRail by K-industrier [8] are some examples.

Avoid damages to goods and load units

Damages to goods and load units are rare but occur. In order to avoid damages and avoid investments in or changes to utilised technology, education of involved personnel in proper cargo securing and unit transhipment is certainly a cost efficient measure.

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