ABSTRACT

This article focuses European intermodal road-rail transshipment terminals, although it includes some statements on ports and intermodal freight centres. Intermodal transport is initially depicted as a network of nodes and links. Terminals as transshipment nodes are then described and classified according to how trains use the links to connect the nodes and reference to some recently developed transshipment technologies are given. A brief analysis on how terminals, in a wide context, impede the development of intermodal transport in Europe is followed by some statements on whether the public sector should establish a terminal network and how this could affect the transport market. Finally, a vision on a future European intermodal system is presented. The general conclusion is that the public sector should be involved in the terminal planning process, mainly for city planning reasons, but stay away from day-to-day operations. Until the different transport modes carry their full social costs, intermodal, or even better modal-independent transport, has to be developed using public funds. It is then natural to focus on the terminals, either through direct investment support, or by subsidising the operations. The latter fashion will, however, probably violate EU legislation on competition. Ports are traditionally public assets and there are several examples of intermodal freight centres where local authorities have been the catalyst. Hence, the public interest is greater than in intermodal road-rail terminals.

KEY WORDS

Barriers, Intermodal Transport, Terminals, Transport Networks, Transshipment Technology.

1. INTRODUCTION

The answer to the question if the terminals are barriers for intermodal transport is obviously that it is an irrelevant one. A terminal, defined as the place for transshipment, could not logically be a barrier to intermodality since one transshipment between transport modes is a prerequisite for defining a transport arrangement as an intermodal one. Nevertheless, in a wider perspective the terminal function can be a factor impeding the development towards a truly intermodal transport system.

Transshipments between modes have always attracted attention in intermodal transport discussions since it is the activity distinguishing from single-mode transport. Terminal equipment is often used for symbolising intermodal transport, but it should be regarded as only one component in the complex transport system made up of a multiplicity of activities, actors and resources. Hence, the terminals

1 Department of Transportation and Logistics, Chalmers University of Technology, S-412 96 Göteborg, Sweden. Tel: +46-31-772 1339, Fax: +46-31-772 1337, E-mail: jwox@mot.chalmers.se.
should be analysed in its proper system surrounding, as argued by SONDERMANN (1997) when discussing the problems of implementing a transshipment technology replacing more than just the traditional gantry crane. Today there is a knowledge gap concerning the system implications of new technology in intermodal transport systems, however tried to be bridged by WOXENIUS and LUMSDEN (1996). It is the intention also in this article, to take a quite wide perspective on terminal matters and barriers.

After an initial presentation of a theoretical framework, some different terminal types are described. The focal question of terminals as barriers is then addressed with a brief analysis. After a discussion on which interests the public sector could take in terminal development, the article is finished with a vision on a future European intermodal transport system and some general conclusions. The article is focused on intermodal road-rail terminals but references are also given to ports and intermodal freight centres.

Chapters 2 and 3 are based upon relatively extensive and careful research, while the chapters 4 and 5 are limited to be more of a preliminary study based upon logical reasoning and a limited number of references. The vision in chapter 6 is reasonably well founded in research.

2. FRAMEWORK

In this section, the underlying transport system is described in terms of nodes and links and how transshipment nodes can be connected with rail links into intermodal transport networks.

Nodes and links

Transport systems are characterised by the successive movement of goods between supply and demand points, defined here as nodes. Activities such as consolidation, sorting, storing and transshipment between vehicles as well as between transport modes are performed at nodes. For each transport assignment, each node can be defined as a source, a sink or a transshipment node. The goods flow is always stemmed at nodes. Links representing transport and movement activities connect nodes making up a transport network.

By connecting all sources and sinks with a number of links through transshipment nodes, a physical transport network is defined (LUMSDEN, 1995). By restricting the view to the demand for a single transport service, an abstract network can be defined by connecting the sources and the sinks directly, i.e., short-circuiting the physical network. Nodes in physical networks are in daily terms referred to terminals. Figure 1 below shows a physical network and an example of corresponding abstract network.
In the coming classification of intermodal terminals, it is regarded as useful to start out from what role the terminal plays in the transport network. In figure 2, links and transshipment nodes connect the source A and the sink B in five different ways. A fixed example with ten nodes illustrates the different routes. The theory is based on the assumption that a sufficient infrastructure enables direct connection between all nodes in the system. It is then up to the operator to choose which routes to use.

In the application to combined transport, the dots and circles represent transshipment terminals. Since an additional road haulage is needed, the discussed traffic solution only describes the rail based part of the total network. For more detailed reading on the different traffic patterns, see WOXENIUS et al. (1994).

3. DIFFERENT TERMINAL TYPES

In this section terminals are classified and described according to their role in intermodal transport networks referring to figure 2 above. Much of the rendering is taken from WOXENIUS et al. (1994).
**Terminals for direct connections**

In a direct connection design, there is no central terminal in the system. Instead, all handling of the unit loads is performed at terminals near the consignor and the consignee. This means that the goods volume passing any one terminal is limited, thus reducing the capacity requirements on the terminals. The capacity of the handling equipment is reduced when several tracks are used within the terminal. The transfer time requirements depend on how long the trains stay at the terminal. If trains stay at the terminal throughout the day, as is the custom in Europe today, this becomes a non-critical parameter. Nevertheless, due to the demand from hauliers, the terminal is mainly utilised in some early morning hours and some late afternoon hours, and quick transshipment is needed. Since two terminals are linked directly to each other, this design is ideally operated with fixed train sets.

**Traditional intermodal terminals**

Despite the large number of transshipment technologies developed over the last 30 years, the intermodal terminals look rather much the same throughout the world—a gantry crane overreaching some railway tracks and lorry driving lanes is complemented with large counter-balanced trucks. Large and complicated terminals are needed for handling many different types of unit loads and the costs must be distributed between a large number of transshipments. The trains remain at the terminal throughout the day and are operated as full trains between terminals in a direct connection style.

**Simple terminals for direct connections**

An alternative to the traditional transshipment technology is to equip the vehicles and unit loads for independent transshipment. The interesting feature of these systems is that the terminal requirements are virtually restricted to a track in the driving lane. Hence, the terminal investments and localisation becomes much less crucial and definite. Also simple sidings at the premises of the consignor and the consignee can be used as terminals.

An example of such a solution is a rail wagon designed for lifting swap bodies or cassettes. The restriction to direct connections is due to the fact that the wagons run underneath prepositioned swap bodies or cassettes and lift them in one operation. Brand names include Mercedes-Benz’ Kombi-Lifter, ABB Henschel’s WAS Wagon, AGEVE’s Supertrans, the Wieskötter System, Rautaruukki’s Wheelless System and Chalmers’ Titan cassette system. The two former brands are now entering service while the others are on the drawing board or have been abolished.

Also bimodal systems like Wabash’s Road Railer, Coda-E, A.T. Kearney’s Cars, Breda/Ferrosud’s Carro Bimodale, Fruehaufl/Talbot/Remafer’s Kombirail, Innothermodal’s 3R International system, Reggiane’s Protoe, Sambre et Meuse’s Rail Trailer, Technical University of Warsaw’s Tabor Bimodalny, Trailer Train Limited’s Trailer Train and Transfesa’s Transtrailer are practically limited to direct connections. The reason is that the system requires purpose-built trailers and bogies and that the bogies cannot easily be repositioned empty. Some of the above systems are today running in commercial services.

---

2 These and other mentioned new transshipment technologies are described in detail in an inventory report (WOXENIUS, 1997) written for the International Road Transport Union.
**Terminals for corridors**

In a system based on the corridor design, each train passes several stations during one day. Terminal transfer times must therefore be kept at a minimum, which must be considered when choosing the terminal handling equipment to be employed. On the other hand, only a limited amount of goods handled at each station, consequently limiting the capacity requirements. Since trains are unavailable at each terminal for longer periods of time, storage space for unit loads must be provided at the terminals, and detachability between road vehicle and rail wagon must consequently be high.

Demands for transshipment ability of all types of unit loads might lead to conflicts with the requirement of fast transfers, because for instance semi-trailers are unsuited for horizontal handling.

**Large-scale corridor terminals**

Germany with a huge demand for transportation along the industrial zones, e.g., along the Rhine, is the leading country when it comes to developing high-capacity corridor terminals. Immensely capital intensive concepts have been presented by Krupp (Fast Handling System), Noell (Fast Transshipment System) and, slightly cheaper, by Mannesmann Transmodal (Transterminal). Some of the new concepts are now being constructed in eastern Germany (O’MAHONY, 1996).

**Small-scale corridor terminals**

More interesting to Scandinavian conditions are the small-scale corridor terminals suitable also for relatively small and dispersed flows. In Japan, fork-lift trucks are used at intermediate stops along terminals in JR Freight’s Multi-functional freight track system. Some horizontal transshipment technologies for corridor use have also been presented. Among the promising ones, the CarConTrain and the Kombiflex have Swedish origin, while the Mondiso Rail Terminal is Dutch.

**Terminals for hub-and-spoke designs**

The chief characteristic of the hub and spoke design is that all transports pass through a central terminal. Hence, this terminal has to accommodate an extensive flow of goods. It is therefore of paramount importance that the terminal has a large capacity as well as being able to offer short handling times. As is true for the corridor design, semi-trailers can only be used if transshipment times are kept short. Only rail-rail transshipment takes place at the hub terminal implying that it is actually not a true intermodal terminal. The satellite terminals are normally conventional ones with gantry cranes and fork-lift trucks.

France is the archetype of a hub-and-spoke system, not only when transportation is concerned. Hence, the French are leading the development with Technicatome’s gigantic Commutor system, but they are being challenged by German Noell with the Mega Hub Concept, by Austrian Pentaplan with the High Capacity Terminal and by Swiss Tuchschmid with the Compact Terminal. The latter development schemes aim at the emerging market for gateway terminals for transshipments between trains operating in different network modules.
**Terminals for fixed routes**

A fixed route design faces roughly the same requirements as a corridor one, but on a smaller scale. Short train to train transshipment times, or alternatively marshalling so that the last wagons in the train are to be decoupled at the gateway terminals, are therefore a crucial requirement. However, it is generally difficult to plan such routes that the last wagon is always the one to be decoupled. In order to make this design feasible, it is therefore necessary to restrict the types of unit load admitted or to employ a handling technique that can accommodate all types of unit loads. Serving as gateways between network modules can be a future task for the traditional intermodal terminals that today are very badly utilised during the mid-day hours.

In a current development project called Light-combi, Swedish State Railways (SJ) initially plans to employ fork-lift trucks travelling with the train and operated by the rail engine driver at terminals. Although the corridor network design is prioritised, also direct connections and loop trains will be mixed in a relatively dynamic fashion using traditional intermodal terminals as gateways. If Light-combi is to be realised, a network of 30-40 small-scale terminals will be linked to the traditional heavy combi network and international lines through gateway terminals (LARSSON, 1996, p. 3). The terminals will be connected by about ten rail corridor lines with an average length of 600 km, each connecting between five and ten small terminals (YOUNG, 1997/b, p. 111).

**Terminals for allocated routes**

In this design, the train sets operate routes, along which loading and unloading operations are performed on several occasions. The transshipment capacity required is limited since only a few unit loads are handled at each station. Due to the rigidity of train timetables, this is currently no option for intermodal transport. With future information systems, however, dynamic timetables are foreseen for freight trains.

**4. TERMINALS AS BARRIERS**

In this chapter, terminals as barriers is discussed briefly divided in intermodal road-rail terminals, ports and intermodal freight centres.

**Intermodal road-rail terminals**

A major barrier for intermodal transport growth is the large-scale terminals used today. Intermodal transport cannot compete for the really large flows over medium distances of 200 to 500 kms as long as the economies of scale limits the number of terminals severely. For shorter distances, all profitability calculations fall if the lorries have to drive too far – or even worse in the wrong direction – in order to reach an intermodal terminal. Small-scale terminals in relatively large numbers are required, but they have to be intelligently linked if the intermodal transport system should be an attractive alternative to single-mode road transport.

The terminal cost itself is another serious barrier. The business economic rationale for using intermodal road-rail transport is that the line haul costs are lower for rail than for road. This benefit can only
be used, however, after paying the price of terminal handling in terms of lift fees and also waste of time. Technologies and systems able to lower the terminal costs and delays will substantially contribute to the growth of intermodal transport.

**Ports**

Ports are in a slightly better situation than intermodal road-rail terminals when it comes to intermodal barriers. Shipping is today generally used when geography calls for it when rail is regarded as a substitution for road transport. Hence, there is no real alternative to using the ports. For some short sea shipping services along coasts and for feeder services, the barriers are somewhat similar to road-rail terminals. RoRo-ports generally implies low barriers since they only require small investments in a RoRo-ramp and enough space on the quay. Ports serving container feeder traffic, on the other hand, implies higher barriers due to the need for cranes for vertical handling of containers.

A recent barrier in the deep-sea ports is the new generation of Post-panamax container vessels. When Regina Maersk or any of her sisters calls a port with panamax cranes, only a part of the load can be transshipped, severely limiting the planning flexibility for loads and routes. Port of Gothenburg has recently manifested its ambitions in deep-sea shipping with the launch of an investment program for accommodating the new big vessels.

**Intermodal Freight Centres**

Despite far-reaching development plans and the theoretical attractiveness of intermodal freight centres, they have not proven to be too popular among the transport operators. One reason for their reluctance is that they fear restrictions in their flexibility once established at the freight centre. The establishment close to an intermodal terminal, implies a fear that the authorities will force them to use rail transport between the freight centres and perhaps also to co-ordinate their city distribution. The operators’ service offers will then be very similar, and thus they fear price wars. The general development in the logistics sector is rather the opposite – specialisation and deeper integration into the shippers’ operations. The limited operator interest is thus a serious barrier for the development of intermodal freight centres.

**5. TERMINALS – PUBLIC OR PRIVATE ASSETS?**

The question about who is to operate terminals is a decisive one in most transport systems. Forwarders have traditionally kept the consolidation of general cargo in-house while contracting out the physical movements between terminals. The national railways have placed the terminals and station buildings in the train operating part and not in the infrastructure part when splitting up, thus impeding the entrance of new railway companies. Ports, on the other hand, has generally been regarded as public assets although there are some privately operated ports and some big shipping lines operate own container terminals.

---

3 For further reading on intermodal freight centres, see HÖLTGEN (1995) and CARDEBRING and WARNECKE (1995). For Scandinavian conditions, see the latter reference.
Despite the strong position in infrastructure planning, the European Commission is not heavily involved in terminals. According to HÖLTGEN (1997/a):

“Terminals (like seaports) are an integral part of the Trans-European Network (TEN). The Community Guidelines for the development of TENs explicitly include the improvement of interconnection nodes as a priority measure. However, while the EU has established the main links of the European combined transport network, it has not yet provided guidelines regarding the location of the nodes of the network (neither has it so far determined criteria for the selection of port-related projects of common interests). Moreover, the functions of different types of transhipment centres (e.g. regional, national, European) have not been defined at the EU level.”

Consequently, the European Commission has concentrated its efforts to the links and not to the nodes. In a proposed amendment to the above mentioned decision (1692/96/EC), however, the European Commission has identified some 300 seaports as well as 233 intermodal terminals and 35 inland ports for inclusion in the TEN combined transport network (HÖLTGEN, 1997/b).

**Intermodal road-rail terminals**

Most intermodal road-rail terminals are still operated by the national railways, and thus a public asset by definition. In this article, however, the discussion starts out from whether terminals should be regarded as infrastructure (and thus a public concern) or an operational asset controlled by the transport operators. Public or private ownership of the transport operators is not relevant in such a discussion.

As described above, the European Commission has not clearly defined whether terminals are part of the TEN, mainly by referring it to the Member State level (HÖLTGEN, 1995, p. 315). At the national level, terminals are generally regarded as the operators’ assets. For instance, when SJ was split into Banverket for infrastructure and a “new” SJ for train operations, one of the basic criteria was that facilities and functions which were directly connected with product design and efficiency of traffic operators should not be included in the infrastructure (JENSEN, et al., 1992, p. 8). Freight terminals and station buildings where obviously of that category.

It must be stated that it is very risky to invest in terminals without controlling the operations on the links since the demand for transshipment is absolutely derived. Although Swedish road-rail terminals are operated by hauliers, forwarders and shippers, Rail Combi AB, the intermodal transport branch of SJ, is consequently the principal of all terminals. One of the terminals is operated by a company jointly owned by Rail Combi, the shipper IKEA and the municipality of Älmhult. Port terminals for sea-rail transshipment of semi-trailers and containers are dominated by public interests, and somewhat outside Rail Combi’s control. Rail Combi is, consequently, directing customers to its own road-rail terminals in Gothenburg and Stockholm although many customers would have preferred to go to closer port terminals.

Recently, transport operators seem to have changed their minds concerning the operations of terminals. At the freight forwarder level, trials by Swedish ASG on involving hauliers in the consolidation operations have proven to be successful due to the hauliers’ increased understanding of flow optimisation. A new owner structure allows the ASG as a forwarder to implement such new solutions that previously always were blocked by the hauliers’ owner interests (Affärsvärlden, 1997, p. 67-68). At the
intermodal terminal level, trends in the USA point towards an increased role taken by independent terminal companies. The railroads sell or contract out the terminals to two large competitors, ITS and Parsec (CASS, 1997, p. 88), of which the latter is now expanding its terminal business into Europe (YOUNG, 1997/a, p. 67). Like its American counterparts, German State Railways, DB AG, wants to contract out more of its terminal business (ELLIOT, 1997, p. 13).

As analysed by HANSSON (1997), the different transport modes do not fully cover the costs they cause society in terms of pollution, noise, traffic accidents as well as excessive use of energy and land. Until that is a reality, and it is the major objective of EU’s transport commissioner Neil Kinnock, public money has to, and will, be spend on supporting the modal split towards the use of rail and sea to a larger extent than today. The question is how to spend the money.

A widespread, and mostly true, conception is that efficiency comes from competition. Nevertheless, taking the risk of being mistaken for a pre-glasnost communist, when it comes to infrastructure I think it is not such a good idea to use public means for creating redundant infrastructure. This is fundamentally true also for terminals. Until we have the perfect technology, economies of scale will be very prominent in the terminal business, and terminals created by the public sector will probably miss its target of favouring the rail mode. I think, however, that public terminals might be able to play a positive role in some major European cities, but for Scandinavian conditions, the terminal structure must be developed in accordance with the plans of the transport operators. The network operations principles feasible here implies that the terminals are much closer interlinked then for direct connections designs.

Subsidising intermodal transport per metric ton transported, as proposed by the Swedish Communications Committee, is neither a brilliant way of using public means. Intermodal transport should not be exhorted to compete for “tons”, which is easiest done by taking market shares from single-mode rail transport and coastal shipping. Instead intermodal transport should compete with road transport for the high-value cargo with demands for high transport quality. A much wiser way of subsidising intermodal transport should then be to cover parts of the transshipment costs. This could be done either through direct investment support to new terminals, or by subsidising the operations. The latter fashion will, however, probably violate EU legislation on competition, but that is the case also for the proposition of the Communications Committee.

**Ports**

Ports are traditionally a public asset. Its role in the transport chain has also been much less integrated with the transport operators than is the case for intermodal road-rail terminals and freight centres. Nevertheless, recently identified trends point towards an increased interest as the ports will probably span a larger part of the intermodal transport chain than they do today, e.g. by establishing distribution centres (HULTÉN, 1997, p. ES VI - 4).

**Intermodal Freight Centres**

Intermodal freight centres are regarded as mainly local matters, but there is a clear need for co-ordination at the regional, national and EU levels. Some years ago, a consultant tried to sell the idea (but basically his consultant services) to virtually any Swedish local authority. I agree upon that local
authorities should support the development, but only following objectives for better co-ordination and land use at the local level. Public infrastructure money can be much better spend than by local authorities in the competition for jobs with their neighbouring communities.

At a higher policy level, HÖLTGEN (1995, p. 314) argues that:

“... there would seem to be no reason to prioritise Europlatforms\(^4\) in the development and integration of the European combined transport network, which includes more than 500 terminals. Moreover, in view of the limited impact of logistics centres on combined transport, the proposition that EU funds should be allocated specifically for these facilities in the context of the TEN-programme has to be rejected.”

HÖLTGEN also mentions that at least three sites, Boulogne, Doncaster and Wakefield, have received financial help from the European Regional Development Fund, but he recommends further studies on the actual effects to the society. For a successful modal split, he recommends that the public policy should be focused onto the internalisation of the external costs.

The general conclusion from this part of the study is that the public sector should be involved in the terminal planning process, mainly for city planning reasons, but stay away from the day-to-day operations. Nevertheless, until the different transport modes carry their full social costs, intermodal, or even better modal-independent transport, has to be developed using public funds for achieving the well awaited modal split in favour of rail and sea transport. It is then natural to subsidise the terminal function, that is the barrier for intermodal growth.

6. A VISION ON A FUTURE TERMINAL NETWORK IN EUROPE

In order to compete successfully with single-mode road transport, the European intermodal transport industry will probably follow two different development lines.

The first one is aimed for the large flows over relatively long distances which basically is the market niche – and it is really a niche with only a fraction of the total transport market (NEA, 1992) – intermodal transport has today. For obvious reasons, these flows are most economically carried out as direct full trains between end terminals employing proven transshipment technology.

The other development trend is far more interesting; how should the medium transport distances, 200 to 500 kms, be approached? The key to improved competitiveness in this market, which is a large one, is to firstly renew all of the train operation system, and also the transshipment technology since that is a prerequisite for implementing advanced train operation principles.

---

\(^4\) Note: Europlatforms organises intermodal freight transport centres in Spain (11), France (7), Britain (4), Denmark (4) and Germany (1). The number of organised centres refers to 1995.
Long and heavy direct trains for large flows

Economic efficiency calls for direct trains wherever significant volumes can be achieved. There is obviously no point to ply on terminals when the train is already full with unit loads bound for another terminal but the question that arises, however, is how large flows are needed for full train services.

Some railways, e.g. SJ (Transportjournalen, 1996, p. 6 and 1997, p. 27), want to operate significantly longer and heavier trains mirroring the experiences in America. The primary users would be the system trains with ore, steel, wooden products etc., but on a European scale, due to the new generation of container vessels becoming much larger, this issue will be especially important to rail feeder services with maritime containers as the introduction of the new ships will require more efficient land transport services. Nevertheless, this will require a difficult transitional period. Extending the European rail network for double stack trains is not realistic – although French State Railways (SNCF) wants a Rolling Highway corridor with very generous loading gauge (SINGER, 1995, p. 120) and the National Railways of the Netherlands calls for double-stacking on the Dutch Betuwe line (Containerisation International, 1995, p. 31) – passing tracks, signalling systems etc. must be changed before really long trains can be implemented which calls for gradual implementation and probably restrictions to certain lines or network modules. Weight can also become a problem as unit loads will be more densely packed on the trains.

Together with increased train capacity, the frequency will gain significance. As passenger transport is transferred to dedicated high speed lines and freight transport gets higher priority, the night leaps (Nachtsprung in German) must give way for a much more flexible train operating system. Expensive wagons and terminals must be utilised more efficiently and new information technology will also facilitate flexible timetables for freight trains. Furthermore, demand will change towards more advanced transport services. Modal split due to environmental concern and saturation on the roads and in the air will certainly force intermodal road-rail transport to offer a higher transport quality to meet the demand for these new goods categories. Consequently, daily departures might not be sufficient for full train services.

Regional solutions for the shorter or dispersed flows

The big challenge of European intermodal transport is to compete on the medium transport distances, typically between 200 and 500 kms, with relatively dispersed flows – a market that today is totally dominated by single-mode road transport.

Beside the full train services, there will emerge more general intermodal transport services that will be tailor-made to the actual preconditions on the served market. The purpose is to take care of the secondary flows of unit loads and build up flows for new full train services. It is not realistic to expect one homogenous and general European intermodal system in the coming years.

In Germany, the most significant European intermodal market, traffic can normally be arranged as direct connections, but the industry concentration along the river Rhine and other inland waterways

---

5 For further reading on national preconditions guiding transshipment technology development, see WOXENIUS, 1996.
makes a corridor layout feasible. Integrating road, rail and inland waterways is obviously a task for German transport system designers.

DB AG has ideas of directing unit loads, which are not sufficient to make up a full train, to hubs along corridors. This involves for example liner trains carrying unit loads, some of which are not intended for the final destination of the train transporting them, but for destinations of other trains. On its journey from origin to destination, such a train stops at one hub at least. All the unit loads which are not intended for the particular destination of the train are unloaded here and replaced with unit loads from other trains. Instead of marshalling wagons, it is now the unit loads which are moved from one train to the other. Furthermore, Germany is heavily populated with industry particularly concentrated to areas such as the Ruhr area. This means that space for intermodal terminals is limited and, due to road congestion, the size of pick-up areas is rather determined by haulage time than distance.

The French rail network is – as is much of the society as a whole – largely centred on Paris, which assumes the function of a national hub. In the different regions very different preconditions exist. Industrial regions coexist with purely rural regions as well as regions dependent on tourism. A hub-and-spoke network is almost axiomatic, and CNC (Compagnie Nouvelle de Cadres), SNCF’s subsidiary for container transport by rail, already operates such a network (NIERAT, 1995, p. 10).

The intermodal transport system of France is today merely a domestic phenomenon and almost all international traffic can be referred to as transit between Germany and the Iberian peninsula (ibidem, p. 1). Instead, French trade with Germany and the Benelux countries often contains one domestic intermodal service, but due to lack of technical and infrastructural standards the freight then passes the border on rubber wheels.

In the UK, true road-rail intermodal transport has been on a small scale although the Channel Tunnel is increasingly used for container and swap body trains. The reason for the modest market share of intermodal transport is that the road transport system is dominated by semi-trailers but the railway loading gauge does not allow these semi-trailers to be loaded on standard pocket wagons for semi-trailers. New initiatives now work for development of dedicated semi-trailer wagons and a relatively small extension of the current loading profile. The first wagon has been shown in full scale and, consequently, intermodal transport in the UK will hopefully increase in the coming years.

Also other European countries and regions will develop national/regional systems rather than wait until all national systems have matured for true integration. Instead, gateway terminals can be used in order to link different network modules. Full trains will obviously go directly between terminals regardless of in which countries these are localised, but the secondary flow will be linked through gateway terminals at the rim of the network modules. This is current practise for transport over different rail gauges, like the borders between France and Spain as well as between Sweden and Finland, but that practise will probably spread.

The figure below shows an example of how national and regional intermodal transport systems can work together through gateways all over Europe. The network modules are designed for taking on the challenge of medium distance transport with relatively dispersed flows that today are totally domi-

---

6 The thinking on gateway function of terminals is supported, i.e., by the European Commission (1997, p. 8): "Terminals and nodes will function as interfaces between high volume transport corridors and low volume regional and local networks".
nated by single-mode road transport. The large flows over longer distances will for obvious reasons still go directly between origin and destination terminals, thus short-circuiting the general network. Most terminals will probably be able to handle both network and direct trains. The figure should only be regarded as a pedagogic example – no further studies than a glance at today’s terminal network and at an atlas have been carried out.

Figure 3  A vision on a future European intermodal transport system. A basic intermodal network covers Europe with national and regional modules connected through efficient terminals called gateways instead of through marshalling yards. The basic network is used for dispersed flows - once the flows between cities are large enough, direct full trains replace the basic network.

As a complement, rolling highway services can backup along the main transport corridors. During heavy congestion, the highways can be relieved from some traffic while the hauliers might be helped to keep the contracted transport time. Alternatively, lorry drivers can use rolling highway services during their sleeping hours thus speeding up longer transport assignments.

7. CONCLUSIONS

Although it is logically wrong to classify terminals a barrier for intermodal transport, they impede the development in some ways. For intermodal road-rail transport it is mainly the transshipment costs and the few and large terminals that cause the problems. Ports cannot easily be bypassed by lorries, and are thus not that much of a barrier. Intermodal freight centres can be catalysts for intermodal transport, but as the road based companies fear to be forced to use rail between centres, they are somewhat reluctant to move to the centres.
The general conclusion concerning public interests is that the authorities should be involved in the terminal planning process, mainly for city planning reasons, but stay away from day-to-day operations. Until the different transport modes carry their full social costs, intermodal, or even better modal-independent transport, has to be developed using public funds. It is then natural to focus on the terminals, either through direct investment support, or by subsidising the operations. The latter fashion will, however, probably violate EU legislation on competition. Ports are traditionally public assets and there are several examples of intermodal freight centres where local authorities have been the catalyst. Hence, the public interest is greater than in intermodal road-rail terminals.

REFERENCES


Transportjournalen (1997) Tyngre tåg och mera last (Heavier trains and more load), No. 2, pp. 27-29. In Swedish.


BIOGRAPHICAL NOTE

Johan Woxenius holds an M. Sc. in Industrial Engineering and Management and a Licentiate of Engineering (an intermediate degree between an M. Sc. and a Ph.D.) from Chalmers University of Technology. For six years he has carried out intermodal transport research with funding from the Swedish State Railways. He is the author or co-author of seven major reports and about twenty articles for conferences, journals and books, all in the field of intermodal transport.