Logistics trends and their impact on European combined transport - services, traffic and industrial organisation

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Abstract

In this paper an attempt is made to apply a joint logistics and transportation perspective on combined transport. Three conceptual models are used to explain the mutual complement of logistics and transportation, the increasing business process and transactional orientation of the industrial manufacturing system and the resulting fast increase in competence requirements.

An overview of current trends in logistics is provided, which together with the models is used to discuss impacts on the transportation sector and more precisely on European combined transport. The offered services, the structure of traffic and ongoing changes of industrial organisation are focussed.

This theoretical background is combined with evidence from a large number of references, which together support the development of a scenario of development trends for European combined transport.

The final conclusion is the combined transport industry needs a competence leap in the direction of an intermodal industry that is fully integrated across all four classic traffic modes and uses equally sophisticated information and communication tools for the logistics support of their operations as the large globally active manufacturing industries.

Kurzfassung


Dieser theoretische Hintergrund, erweitert durch eine Vielzahl von Quellenangaben, unterstützen zusammen das Szenario der Entwicklungstendenzen im europäischen Kombinierten Verkehr.

Die Schlussfolgerung ist, dass die intermodale Verkehrswirtschaft einen Kompetenzsprung in Richtung einer intermodalen Wirtschaft braucht, die sich über die vier klassischen Verkehrszweige erstreckt und die die gleichfalls anspruchsvollen Informations- und Kommunikationswerkzeuge zur logistischen Unterstützung in den zahlreichen global tätigen Fertigungswirtschaften anwendet.
1 Introduction

In addition to lowering environmental strains from road transport, European Combined Transport (ECT) has the potential to improve transport quality by relieving congested areas. The European Commission estimates that congestion in the EU costs 125 billion EURO:s annually and Van Schijndel and Dinwoodie (2000) claim that 10% of lorry operating time in the Netherlands is spent in congested conditions. Although ECT has enjoyed a slow but steady growth for half a century and accounted for 2.2% of all transport work in the EU in 1998 (European Commission, 2002), the political idea that it will be the magic tool to bring about a massive "transfer of goods from road to rail" has failed over and over again in spite of considerable subsidies.

The markets that have been penetrated successfully are mostly related to Alpine crossings and transport between the main seaports and their hinterlands (Eurostat, 2002 and Schöpfer, 1997). There are many reasons for this disappointing development; insufficient understanding of the competitive situation between road and rail, lack of commercial freedom of government-owned railways, fear of internal competition with existing wagon-load within railways, inadequate long term stable access to rail capacity at strategic times (see, e.g., Bukold, 1993 and 1996; Henstra and Woxenius, 1999 and Zapp, 1999). All of these are more or less related to the industrial organisation of ECT.

One purpose of the article is to develop a conceptual model suitable as a theoretical framework for explaining and analysing the interdependence of logistics and transportation. Another more analytical purpose of the article is to analyse how current logistics trends influence ECT in two dimensions: the transport service and traffic system dimension and the industrial organisation dimension.

After presenting the model some general logistics trends are identified and analysed. Then the effects of these trends on transportation are analysed using the structure lined out in the conceptual model. The results are used as a background for generating a scenario for the possible development of ECT transport service and traffic dimension. The industrial organisation analysis treats the impacts on the co-ordinating level of logistics service providers (LSP:s) and well as on those organisations offering the core rail service from one terminal to the other, and closes by identifying the needs for a competence leap.

The trends and their impacts are verified by data, illustrating examples and logical deduction. However, it is not intended to fully prove that the whole European logistics industry is changing in a certain direction, which would anyway be just a limited snap-shot combined with speculations concerning a rapidly changing and multi-faceted industry. It is of course tempting to analyse interactions between the different trends and their impact on the transport industry. Here this is done by caution since such interrelations are very complex and it is a delicate task to determine the action-response pattern between the supply and demand sides.

2 Logistics and transportation – conceptual models

Advancements in logistics over the last 15 years made it possible to radically change the organisation of manufacturing activities on the factory floor. Information and communication systems (ICS:s) have now reached a stage where similar advancements in information logistics allow the organisation of intellectual work, decision making and business transactions to be organised according to similar principles. Expressed in a very simple way it is no longer necessary for several human brains to be present at a single location to be able to jointly engage in such activities of a complex nature. This has made possible the creation of large value added or supply networks where a large number of manufacturing
companies contribute to the successive steps in the realisation of complex products. This development is illustrated in Figure 1.

The ICS in the centre of the picture serves several purposes. It has of course the traditional role of providing the continuous horizontal information exchange between all the actors at different locations who perform different roles in the value added network. Another traditional role is to maintain the relational data bases that keep the records of all transactions taking place in the business system. But in addition this system plays a new important role.

Natural and its applied sciences as well as industrial development have long relied on a trial and error mechanism, involving on one hand an inductive, creative element resulting in hypotheses, theories and ideas, and on the other hand a deductive, validating element, based on empirical observations. New knowledge is created by alternating between these elements in an iterative, cumulative procedure, which adds new knowledge at each step. The communication between these two elements is mainly based on the use of symbolic languages. Modelling has had an increasing but not decisive role, since it has normally been required to perform the ultimate validation in a real world environment.

Thanks to ICS, modelling has now reached a degree of sophistication, where it must be seen as a third leg in this iterative process. Thus the ICS in Figure 1 can be seen as an abstract or modelling level often referred to as a virtual world, inferring that it communicates with humans directly by means of their senses and not only by the use of symbolic language. Validation by the use of models is increasingly used as a substitute for observations in the real world. This trend is symbolised by the vertical information flow arrows in the upper part of the picture.

Figure 1. The manufacturing industrial system as seen from a supply chain management perspective.

Such modelling has one great advantage. It allows manipulations with the time dimension. Provided sufficient historical data has been previously recorded, going backwards in time gives an account of experience generated in the past, while going into the future gives forecasts.
In business the use of sophisticated models is quickly replacing the simple use of raw empirical data as a basis for decisions. Business is organised around transactions, which essentially are timeless changes of system state. The buzz term *business process* originated in the information industry. It indicates that business is no longer restricted to independent transactions, but increasingly involves studying the processes between large numbers of coupled transactions. This also widens the traditional meaning of the term transaction, which now seems to come close to the concept of change of state of a system. It also implies that business transactions increasingly rely on complex modelling at the abstract level as a complement to the combination of existing knowledge and raw data on the actual state of the real world.

Thus the new and increasingly important role of ICS is to provide a "virtual reality" type of model that compensates for the lacking possibilities of the actors to inspect more than a diminishing part of the technical system by means of their own senses. This model provides the transparency of the system needed to create sufficient trust among the actors in and cohesion of the complex industrial system. One example of is Volvo that managed to cut the development time for their successful city jeep from 44 to 27 months by carrying out all design work including the production planning and its supply network by exclusive reliance on computer modelling (Chew, 2003).

The ability to use a virtual reality model as a substitute for the real world is dependant of continuous updating in real time of the virtual reality model to assure that it sufficiently closely matches the state of the technical system. In Supply Chain Management (SCM), this is provided by the vertical information flows at the bottom of the picture. Track and trace functions, i.e. the ability to indicate the exact position of any moving object in the system at any given time is critically dependant on these vertical information flows and can be seen as a basic element in any virtual reality model.

Now it can be claimed that the development sketched above is only a vision and that industry is far away from accepting such an abstract operating paradigm. The real situation seems to be that there is a spectrum from a few of the large global manufacturing companies, where these ideas are already exploited, to the very large number of companies where such ideas have not been heard of. This is in line with current research, e.g., Patterson *et al.* (2003), that concludes that new ICS are more likely to be adopted by large companies than small but also by decentralised companies than hierarchies. It is then logical that the adaptation of ICS in the transportation sector is lead by the large forwarders and megacarriers and not the mode-specific transport operators like railways and hauliers. Other research (Golob and Regan, 2003) finds that road transport companies operating large fleets are more likely to adapt information technology but interestingly those engaged in road-rail intermodal transport are less likely to adopt technologies such as EDI.

Figure 1 reflects an SCM perspective focusing on logistics. It is often argued that transportation is part of logistics. As is shown in Figure 2 it is here argued that the logistics and transportation subsystems are complementary.
Figure 2. The complementary subsystems of logistics and transportation.

Very much the same as the application of the value added chain concept to several collaborating manufacturing companies has created the need for the professional role of SCM, one could expect that the application of the transport chain concept to several collaborating transport companies representing different modes would stimulate the formation of an analogue professional role of intermodal management. That this is rarely the case is an indication that the transportation sector lags behind in absorbing the development ideas described above.

An extension of virtual reality type of modelling beyond its current usage by the larger LSP:s would increase transparency in the transport industry and increase the potential for realisation of intermodal systems such as the ECT systems discussed as part of the scenario presented in chapter 4.

3 A changing logistics environment for combined transport

Over the years, shippers have been much more particular about their demand and the development seems to be towards even more advanced logistics services (see, e.g., Baumgarten, et al., 2002). The almost naïve exchange of stock levels for expensive Just-In-Time deliveries with small vehicles in the 1980ies and early 1990ies has certainly halted in line with lower interest rates and cost consciousness, but phenomena such as out-sourcing of logistics activities, delivery time windows, increased frequencies, global sourcing, merge in transit, demand for track and trace and ICS-support (see, e.g., Chopra, 2003) indicates that the transport companies have to offer much more than just place utility.

A part of the OECD-EU-project TRILOG-Europe regarded trends in SCM. The list of trends shown in Table 1 was generated using methods such as the Delphi survey, case research, analysis of statistics, workshops and desk research.

In the next section, the model in Figure 2 is used for structuring an analysis of how these logistics trends impact the transportation industry.
Table 1. Logistics trends lined out in the EU project TRIOLOG-Europe. (Source: Demkes (Ed.), 1999).

<table>
<thead>
<tr>
<th>Level of logistical decision making</th>
<th>Trend</th>
</tr>
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<tbody>
<tr>
<td>Restructuring of logistics systems</td>
<td>Spatial concentration of production and inventory&lt;br&gt;Development of break-bulk / transhipment systems&lt;br&gt;Creation of hub-satellite networks</td>
</tr>
<tr>
<td>Realignment of supply chains</td>
<td>Concentration of international trade on hub ports&lt;br&gt;Rationalisation of the supply base&lt;br&gt;Vertical disintegration of production&lt;br&gt;Wider geographical sourcing of supplies&lt;br&gt;Wider distribution of finished products&lt;br&gt;Postponement / local customisation&lt;br&gt;Increased direct delivery</td>
</tr>
<tr>
<td>Rescheduling of product flows</td>
<td>Time-compression principles applied in retail and manufacturing&lt;br&gt;Increase in retailers’ control over supply chain&lt;br&gt;Growth of ‘nominated day’ deliveries and timed delivery systems</td>
</tr>
<tr>
<td>Management of distribution</td>
<td>Changes in freight modal split&lt;br&gt;Reduction in international transport costs&lt;br&gt;Impact of legislation and regulation&lt;br&gt;Increased use of ICS&lt;br&gt;Developments in vehicle and handling technology</td>
</tr>
<tr>
<td>Changes in product design</td>
<td>Complexity, Packaging, Modularity&lt;br&gt;De-materialisation</td>
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3.1 Goods: larger flows but smaller consignments

One identified trend is that the magnitude of freight flows increases while the average size of each consignment in long-distance transport decreases, meaning that the number of individual consignments increases significantly. The first part of the statement is supported by general statistics saying that the intra-European freight flows have more than doubled since 1970. The annual growth is about 3% with road and short sea shipping capturing the absolute majority of the increase (European Commission, 2002).

It is harder to show that the average consignment size decreases. Interviews with operators and numerous articles in business magazines support the statement, but these are rarely supported by statistics, often refer only to parts of the market and are of a rather general character such as by Demkes (Ed.), 1999, p. 132):

“A shift from material density towards information density ... has led and will continue to lead to major shifts in distribution patterns: the number of shipments will increase and at the same time their size decreases.”

The discussion is often confused by the fact that the size of consignments varies between the actors in a transport chain. In ECT, for instance, the forwarder might stuff a semi-trailer with hundreds of consignments while the semi-trailer as such is the consignment for the ECT operator. For the railway operator performing the haul between terminals, the wagon set constitutes the consignment. Sub-consignments, consignments and super-consignments can thus be defined in consolidation networks for describing the Russian Doll effect (Woxenius, 1997).

The LSP:s are prevented from fulfilling the new demand by just adding transport resources to the system by the economic and environmental restrictions set by customers and society. Hence, they must constantly find and implement new structural and operational patterns, of which most of them have in common that they add to the complexity of the systems.
3.2 Vehicles and vessels: larger units for the high-density routes

The trend of ever larger vehicles and vessels primarily concerns the biggest units for each mode, but there are strong tendencies that also the average size for each mode increases. However, due to the modal split towards road transport, the average size of all vehicles and vessels are rather decreasing.

Reasons for increasing vehicle sizes clearly involve economies of distance and scale. McCann (2001) argues that the unit cost of moving a shipment follows a concave curve with decreasing marginal costs with larger vehicles and vessels while there is no strict theoretical proof that marginal costs decrease by distance although this is the usual empirical result. For obvious operative and market reasons, any increase of vehicle size must be matched against departure frequency and transshipment productivity gains (Ballis and Golias, 2002).

Each period of time has a dominant traffic mode offering spatial or network coverage (Grübler, 1990) while other modes offer high capacity and low unit costs at densely trafficked routes over relatively long distances. Such improvements in the late product life cycle are often explained by the sailing ship effect, referring to the 50 years after the introduction of the steam ship, when sailing ships improved more than they did in the previous 300 years.

Accepting that road has the network carrying function of most societies today, larger vehicles and vessels mostly relate to rail, sea and air. On rail there is a trend towards longer and heavier trains for transportation of commodities in order to better utilise economies of scale. Here signalling systems, weight capacity of the tracks and length of meeting tracks limit the sizes. The fact that ECT with inferior load factor increases its importance at the expense of conventional wagon load transport, however, points in a direction of lower average payload of trains.

Container vessels have grown significantly in recent years after leaving the panamax era. Hapag-Lloyd’s Hamburg Express Class carry over 7500 TEU:s and their partner OOCL operate the OOCL Shenzhen at 8000 TEU:s. The future promises even larger vessels since shipping lines tend to invest in over-sized vessels to have low marginal costs for price wars and to meet future rather than current demand (Lumsden, 1998). To facilitate for larger vessels, ports’ fairways and handling equipment must be enlarged accordingly and port calls must not be prolonged significantly.

Also aeroplane sizes increase. Most significant are the 250-tonne freighter Antonov AN225 ‘Mriya’ that entered commercial service in 2002 (Antonov, 2002) and Airbus’ A388F carrying 150 tonnes that will enter service in 2008 (Airbus, 2003).

For road that is strictly limited by the parameters set by the infrastructure, the expansion mostly refers to the length of articulated lorries and semi-trailer combinations on long-distance routes. After a period of harmonisation within the EU implying increases in most countries, the vehicle length is now believed to stay at 18,75 m for several years, although 25,25 m is allowed in Sweden and Finland and might be allowed on the European core highway network like the interstate regulations in the USA. Height and width will probably be slightly adjusted upwards. Increases not resulting in more pallet places are less important. The maximum length of semi-trailers will most probably remain at 13,60 m.

3.3 Ways and terminals: more consolidation and more rigid systems

Pressured by decreasing transport prices, the LSP:s look for economies of scale and enhanced resource utilisation. The trend that the size of vehicles and vessels increases at the same time as the size of each individual consignment decreases implies that a larger number of consignments have to be consoli-
dated in each moving container, ship, train, lorry or aeroplane. It also necessitates further efforts to 
unitise the goods flow in order to transship quickly and cheaply between traffic modes.

In order to cope with the increased complexity, it is a postulate that the mega-carriers employ very 
strict systems in order to control their flows. This applies to the parameters of the consignments as 
well as the administrative systems. In the process “the fixing forwarder” is sacrificed and flexibility 
and tolerance in goods parameters yield for standardisation. The standardisation of transport systems 
contradicts with the shippers’ demand for more specific logistics demand. Forwarders’ trick is then to 
develop a service portfolio and interfaces so that services produced by a standardised transportation 
system are experienced as unique by the shippers.

4 Impact on ECT: transport services and traffic

The European Commission (2002) estimates that ECT almost doubled from 33 to 62 billion tonkms 
between 1990 and 1998, accounting for 2.2% of all transport work in the EU. Despite the growth, ECT 
does not fulfil the political expectations that it will deliver us from evils of road freight transport. Support-
ing words have been abundant and a truly wide range of political instruments have been used for 
promoting intermodal transport but they have never been able to create a truly levelled playing field 
with road transport. On the contrary, the perpetual promises that have not been realised have hurt in-
termodal transport severely. One example is when Danish politicians opened the Great Baelt connection 
for rail well ahead of road and indicated high lorry fees for using the connection. Rail than in-
vested in intermodal services that were immediately shut down after the parliament decided upon very 
low lorry fees. Nevertheless, political decisions like the new German road tax and the French subsidy 
to forwarders using combined transport are promising. With substantial border-crossing and transit 
traffic, the national policies also have a European dimension. Swedish Volvo, for instance has decided 
to transfer some 8 000 annual lorry loads from German suppliers to ECT when the Lkw Maut applies 
(Anderssson, 2003).

Trends towards shippers that grow in size and scope that source and market globally imply larger 
flows over longer transport distances. More consolidation implies shorter but denser transport flows 
between nodes. By use of unit loads, the potential of lower marginal costs of larger vehicles and ves-
sels can be utilised without restriction to the largest consignments. The trends do not all point in a 
direction of more intermodality, but the combined picture is favourable. The trend towards demand of 
more advanced transport services and modal split, due to environmental concern and saturation on the 
roads and in the air, will force ECT to offer a higher transport quality to meet the demand for new 
goods categories.

From a supply side perspective the main obstacles for growth of ECT are referred to infrastructure 
obstacles like lack of spatial coverage and terminals, infrastructure interoperability, some links and 
access to attractive slots. Hampering are also the lack of standardisation of load units, information 
systems and administrative procedures as well as the remaining lack of competition in the railway 
sector, despite EU efforts. From a demand side perspective, the non-compliance of intermodal trans-
port to service requirements is regarded as the main problem (Henstra and Woxenius, 1999).

Demand for environmentally friendly transportation will affect the demand positively, but ECT can 
not solely rely on the “environmental friendliness” (IFEU and SGKV, 2002). Once lorry engines can 
be made more energy efficient and discharge less emissions, their currently superior operational effi-
ciency might actually make them superior also from an environmental perspective. Moreover, on a 
local level, neighbours to intermodal terminals protest against the increased local traffic and related
disturbances (Slack, 1999). This implies that some present terminals have to operate during restricted hours and others have to be re-localised. New terminals will be built outside city centres or be designed for less noise emissions. Certain technologies, e.g.; Noell’s Mega Hub, Krupp’s Fast Handling System and Tuchschmid’s Compact Terminal, have been shown in versions with huge noise protecting hoods.

Overcoming the obstacles is a true challenge and it is here assumed that the ECT will follow four main development lines in order to compete successfully with single-mode road transport. Special emphasis is put to the competitiveness over medium distances of 150 – 500 kilometres that accounts for 46% of national transport work in the EU compared to the 22% above 500 kms (European Commission, 2002), that by few exceptions is the market ECT attacks today. All development lines do not aim for the medium distances, but it is still vital for the competitiveness of ECT that services with different characteristics can be co-ordinated (Trip and Bontekoning, 2002). Economies of scale are clearly present in railway transportation and the integration of different services can facilitate that economies can be utilised. In addition, Liu et al. (2003) prove that hybrids of traffic principles can save at least 10% of the travel distance in consolidation networks, an issue also addressed by Houtman (2002).

The scenario is focused on the network operation principles and the transshipment technologies, hence the terminal-to-terminal part of the intermodal chain. It is not aimed at lining out an ideal future situation, but rather at forming a realistic opinion of how the system must be changed in order to survive and capture market shares from single-mode road transport, also over distances as short as 200 kilometres.

In the long run and except the RoRo-niche, the services will be aimed at swap bodies, ISO-containers, pallet-wide containers and smaller freight containers. The recent standardisation initiatives of the European Commission (2003) will be of significant importance. However, in member states where road transport is currently dominated by semi-trailers, e.g. the UK, Spain, Belgium and France, intermodal services will encompass these for a rapid capture of market shares.

4.1 Long and heavy direct trains for large flows

Economic efficiency calls for direct shuttle trains wherever significant flows can be achieved (Rutten, 1998). 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 is; how large flows are needed for direct train services? The increased train capacity will probably not apply directly to ECT, trains will instead be more densely packed, but the frequency will gain significance. As passenger transport is transferred to dedicated high speed lines and freight transport gets higher priority (European Commission, 2001), the night-leaps must give way for a much more flexible train operating system. Expensive wagons and terminals must also be utilised more efficiently and new ICS will facilitate flexible timetables for freight trains. Consequently, daily departures will hardly be sufficient for direct train services in the future.

Due to the new generation of huge post-panamax container vessels, more efficient hinterland transport services are needed. The concept of dry ports starts out from one large seaport connected with a number of smaller terminals where goods can be turned in as if directly to the port. These terminals are mostly located interior from the coast, thus the name dry port. Between the port and the smaller terminals, relatively large goods flows are being concentrated, giving room for several other traffic modes than trucks. It mainly refers to rail, but shipping on inland waterways is also included. The hypothesis is that a well-applied dry port concept can secure a hinterland for the port, increase the use of energy
efficient means of transportation, lower the amounts of road traffic in port cities, make port handling more efficient and facilitate more efficient logistics solutions for shippers in inland locations.

4.2 Corridor trains crossing Europe

In addition to the direct trains, fixed intermodal train sets will run along high-density corridors and make frequent but short stops at road-rail terminals and ports. These trains aim for a dual transport market; less dense flows over long distances and dense flows over short distances. By approaching the combination of these flows, the services can attract the amount of freight needed for high frequencies and for utilising economies of scale.

The stops at terminals need to be short in order not to prolong the total transit times severely. This requires the employment of fast transshipment technologies with high capacity, yet at a low cost per move. Time-consuming and costly shunting of single wagons must be avoided (Trip and Bontekoning, 2002). Instead, unit loads will be transshipped between trains at the main intersections between corridors. To begin with, this will be a way of utilising today’s conventional terminals better during daytime.

Along the corridors, fixed train sets will operate at a high frequency according to a tight and precise schedule. The schedule must be strictly held – trains cannot wait for arriving lorries – but through the high frequency, road transport companies will use the services in the way passengers use the underground railway; if one fail to catch a train there will soon be another one to catch. Other trains made up of self-propelled modules like the German CargoSprinter or the British TruckTrain will join some other modules along the corridor for a distance and then depart for other corridors or side-tracks. The speed of trains will facilitate mix with passenger trains on railway lines during the day.

Trains call at terminals approximately every 100 kilometres. Few hauliers will use rail for just one stop, but the high frequency and the possibility of using rail for two or more stops make this kind of service more competitive over shorter distances than today’s over-night services. A corridor connecting A and Z as well as the terminals in between is shown in Figure 3.

![Figure 3. Example of a corridor with intermediate terminals and some alternative transport arrangements.](attachment:figure3.png)

In the example, hauliers’ demand for service overlap, which can facilitate a satisfactory resource utilisation on the main part of the corridor. Shippers, hauliers or forwarders can book capacity in the train with short notice through up-to-date and transparent ICS. With such an efficient booking system and a dynamic train plan, terminal Y has not to be called.

Corridors are not restricted to north-south or east-west directions but will rather be introduced wherever there is a demand for it. When the demand increases, certain relations along the line will obviously be served also by direct trains as described above. Hence, the corridor trains serve a purpose of
building up volumes for more economical direct train services, and they back up direct train services, that cannot be maintained due to decrease in flows.

4.3 Regional solutions for the short, small and dispersed flows

As mentioned, the biggest challenge of ECT is to compete on the medium transport distances, typically between 200 and 500 kilometres, with relatively dispersed flows, a significant market today totally dominated by single-mode road transport (see, e.g., Rutten, 1995, Woxenius, 1998 and Trip and Bontekoning, 2002).

Beside the direct train shuttle services and the corridor trains, services tailor-made for specific local market conditions will emerge. The business idea is to take care of the secondary flows of unit loads and build up flows for new corridor and direct train services. Regarding the high barriers for implementing new operation principles and technologies, it is not realistic to expect one homogeneous and general European intermodal system in the coming years. Without strict adaptation to the prevailing conditions on local and regional markets, ECT can never compete with road transport unless the rules of the game concerning the market, the taxes and the legislation change significantly.

The large flows in Germany facilitate that most of the intermodal services will be arranged as direct connections, but the industrial concentration along the river Rhine and other inland waterways will imply complementing services along corridors. The focus is to integrate transportation on roads, on railway tracks and on inland waterways. Furthermore, Germany is heavily industrialised with facilities 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 will rather be determined by road 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. A hub-and-spoke network is then almost axiomatic, and the CNC’s custom of using such a network will spread to other operators. Combined transport in France is today merely a domestic phenomenon. Further emphasis on inter-operatibility will facilitate that a larger share of the French trade will pass the borders on steel wheels rather than on rubber wheels.

In the UK, true road-rail intermodal transport has only existed 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 transportation 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 low-built semi-trailer wagons and a relatively small extension of the current loading profile have partly solved the problem and initiatives for small-scale systems like Minimodal and TruckTrain are emerging.

Sweden with its small and dispersed flows has seen the emergence of several small-scale intermodal concepts. One example, Light-combi was tested in a pilot service along two different loops for the Swedish food wholesalers Dagab. It involved construction of a number of simple unmanned terminals with a short platform and ramp, allowing a train driver to unload a fork lift truck from a wagon, exchange swap bodies and drive the truck back onboard the train.

The pilot clearly showed that the concept worked technically and logistically well in the applied scale. Technically it was proven that rail engine drivers with positive effect on work content can transship swap bodies under the overhead contact line using simple conventional technology. Logistically, it was shown that the timetable with several intermediate stops at unmanned terminals worked for over-
night deliveries on medium as well as relatively long distances. The pilot was not expected to prove economic profitability, prototypes rarely do, but the operator Green Cargo was concerned about the scalability. Factors causing the termination of the development project included potential load factor, costs of terminal handling and road distribution, which cargo and customers to aim for and the development of the market price during the investment period. There are clear signs, however, that intra-organisational and business strategic shortcomings severely hampered the development process.

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 will be used in order to link different network modules. As mentioned above, direct trains will obviously go directly between terminals regardless of in which countries these are localised, but the secondary flows will be linked through gateway terminals at the rim of the network modules. This is current practice for transport over different rail gauges, like the borders between France and Spain as well as between Sweden and Finland, but that practice will spread. Current intermodal terminals will serve as gateways with the added benefit of serving as a connecting node, also to direct full trains and corridor trains. Hence, any regional network modules can be linked with direct trains rather than through the regional modules in-between.

Figure 4 shows an image of how national and regional intermodal transportation 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 dominated by single-mode road transport. The large flows over longer distances will for obvious reasons still go directly between origin and destination terminals or along large-flow corridors, thus short-circuiting the general network. Most gateway terminals will be able to handle network, corridor and direct trains.

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**Figure 4.** Examples of gateways between national/regional network modules in a future European intermodal transportation system.
4.4 Ro-Ro services for overcoming geographic and infrastructure hurdles

As a complement to the above services low-built rail wagons will take full lorry combinations and semi-trailers that are driven on-board over ramps. The technology is far from new – it was for long the standard intermodal technology in the USA – but the restricted loading profiles in Europe is one of the reasons for its limited use here. Bad utilisation of drivers and rolling stock as well as a low net to gross weight ratio are other reasons. Moreover, from a railway perspective this could be regarded as surrender to single-mode road transport since the rail mode is restricted to an infrastructure role. Nevertheless, several improvements of such rolling highway technologies are marketed and SNCF now invests in Modalor wagons.

The main field of application is, and will be, where geography calls for it, e.g. to get through mountains and across seas. Additionally, such rolling highway services will be used for overcoming highway sections hampered by congestion and for utilising the sleeping hours of drivers. All the above purposes imply a need for very high frequencies. Taking the obvious disadvantages into account, however, it will be restricted to the above purposes and by time be replaced with true intermodal concepts, not carrying rubber wheels and idle drivers around.

The corridor trains involve more complexity than the direct trains as several terminals are involved. If a very high frequency cannot be secured, perfect timing will be vitally important and implies a need for stricter management, especially for the train operations. The regional transport services are designed for low complexity, but when co-ordinated with other network modules and other types of ECT services, complexity rises dramatically. This is, however, only when seen as a whole transportation system. From the perspective of a single network module, co-ordination implies merely some extra administration and that the unit loads are delivered to a gateway terminal for further transport by rail rather than to a regular intermodal terminal for further transport by road. The complexity of RoRo services is kept at a low level by designing for maximum technological and commercial openness. Almost anything on wheels can be accommodated and the administration can be limited to selling tickets like any passenger service.

5 Impact on ECT: industrial organisation

Actors are only implicitly part of the model in figure 2 but are obviously vital for ECT’s existence and performance. There is a clear trend that logistics service providers (LSP:s) such as Maersk, Deutsche Post, DB Cargo, Lufthansa Cargo and Kühne & Nagel acquire, merge, start joint ventures or form alliances with other LSP:s to form true mega-carriers. They grow both in scale and scope, the latter in terms of geographical coverage, size of consignments as well as the traffic modes employed. This is necessary in order to meet the demands for a wide logistics service portfolio when their main customers, who likewise have grown in size and geographical scope, out-source their logistics activities or require “one-stop-shopping”.

It should be noted, though, that this applies to the relatively small number of already quite large transport companies. The absolute majority of transport companies are still small road hauliers, there are some 450 000 of them in the EU (European Commission, 2002), but these driver-operators are either active in the full-truck-load (FTL) segment or as tightly connected suppliers to the large forwarders in an FTL manner.

Beside the national railways, the largest transport companies have served the markets for the smallest and the largest consignments. Mail delivery demands networks with substantial geographical coverage
implying extensive economies of scale. The mail segment has also been a concentrated market due to
national monopolies. Transport of the largest consignments – crude oil – requires significant supply of
capital for investments in transport vessels and pipelines, which also deters small entrants.

Nevertheless, it is clearly so that transport markets requiring consolidation of parcels, general cargo
and part loads are served by ever-larger enterprises and alliances. The key to this development is that
the shippers demand that the forwarders follow them in their geographical expansion but but there is
also a strive to utilise the economies of scale that occur in consolidation networks (Zäpfel and Wasner,
2002).

In Europe, this development is expressed in a fight for being one of, say, ten mega-carriers operating
extensive networks selling their services directly to major shippers. Those who cannot make it to the
top are believed to be stuck in the often unpleasant position as supplier of different movement and
transshipment services to the mega-carriers or remain small serving niche markets. This has caused a
situation where companies are bought, earlier competitors merge or form joint ventures or alliances,
and others try to grow organically – all in a giant carousel-fashion.

It is not only the traditional forwarders that fight for being a mega-carrier. Also mode specific trans-
port companies widen their geographical coverage and service portfolios. No one seems to be content
to offer solely transportation anymore, all offer logistics solutions, acknowledging that it is the more
advanced services and the value added that are to account for the profits. The simultaneous vertical
and horizontal integration is also a fruit of anti-trust legislation – many of the transport companies are
now so dominant within their respective mode that expansion must be made outside the core business.
It is also difficult and expensive to capture the last market shares in the own market and rarely appre-
ciated by the customers.

One such example is Maersk that has incorporated the shipping lines Sealand, Safmarine and Norfolk
Line but still take active part in alliances/conferences. Substantial growth in the core business con-
tainer shipping is no more an option and the company already owns the industries supplying equip-
ment such as ships and containers. Maersk-Sealand now goes ashore developing a multitude of logis-
tics services marketed to shippers.

The rail mode has traditionally been dominated by very large companies, Indian Railways, for in-
stance, is regarded the largest employer in the world with a staff exceeding 1,5 million in 2002
(Kumar, 2002), however also for producing passenger transportation. After a long period of very sig-
nificant lay-offs, the European freight railways now merge in order to form larger units. The most
obvious one is Railion with Dutch NS, German DB Cargo and Danish DSB Cargo as partners. DB
Cargo is clearly dominating with 92% of the shares. DB has also formed joint ventures with non-rail
based transport companies for developing logistics services and bought back the forwarder Schenker.
This situation is also present in the USA where a decade of mergers has resulted in only four remain-
ing Class 1 railroads.

There is also a trend that the markets earlier defined by the size of consignment are loosing signifi-
cance. One clear example is that the express delivery companies such as TNT, UPS and FedEx leave
their well defined market of transporting parcels not needing mechanical handling equipment, nor-
mally below 35 kg. Under the category integrator they now compete more head-to-head with the air-
lines for somewhat larger consignments, but also with road-based forwarders and third party logistics
providers. For instance, TNT’s offer now ranges from warehousing, transportation and distribution to
total supply chain solutions.
Also the post offices expand. Especially Deutsche Post in Germany has realized a first-class shopping spree for companies including DHL, Van Gend & Loos (The Netherlands) and the forwarders Danzas (Switzerland), which in turn has bought ASG (Sweden) and Nedlloyd Logistikbereich (The Netherlands) and has now merged them with the own parcel network under the DHL umbrella.

5.1 The suppliers of ECT services

The combination of traffic modes implies that many actors are involved. The European intermodal rail transport market is traditionally divided between companies based upon rail and road transport respectively. Considering regulated monopolies and the historic scope of concessions, the borderlines between market segments have been drawn according to types of unit load and geographical markets (Bukold, 1996). Due to transport policy deregulation in the EU, this practise is now diminishing (Aastrup, 2002).

The classic role of the railway companies has been to sell rail haulage between intermodal transhipment terminals. They also operate terminals and supply rail wagons. In addition, the railway companies have owner interests in virtually all of the other actor categories needed for producing intermodal transport services.

When the maritime or ISO container was introduced in the 1960's, the national railway companies founded container transport companies in order to offer complementing land transport. Intercontainer-Interfrigo, ICF, was founded for international transport and companies like Transfracht in Germany and CNC in France were founded for domestic transport. ICF and the national container companies have their base in the transport of maritime containers to and from seaports, but they also offer transport of containers, swap bodies and to some extent also semi-trailers between European inland terminals.

Forwarders and hauliers formed their own national intermodal transport companies such as Kombiverkehr in Germany, Novatrans in France and HUPAC in Switzerland. The original purpose of these organisations was to organise the transport services that the road-based transport companies had concessions for. Now in the post-regulation days, they still arrange combined transport services but due to the fact that most hauliers are small companies, their role as a strong counterpart to the railways in negotiations is significant. This goal is, however, rarely stated since the national railways usually hold a minority share of the companies. In the case of German Kombiverkehr, DB now owns 50% of the company. The companies co-ordinate their international operations through the organisation UIRR.

Many, not least the European Commission, entertain hopes that new entrants will emerge on the scene and start to offer ECT services. However, high initial investments, large economies of scale, lack of worked up market shares and the industry’s currently low profitability keep new entrants away. Also the lack of long-term transport policies discourages private investments. One exception has been that American companies unsuccessfully have tried to practise their domestic intermodal experiences in Europe. There are also some genuinely new actors such as IKEA Rail, NeCoSS and Hafen und Güterverkehr Köln. The general trend, though, is that the already active European actors find new markets or extend their service offers. The present actors have also formed alliances, such as Polzug, Metrans, Hansa Hungarian Container Express, TARES and European Rail Shuttle, in order to get access to critical resources or worked up shipper contacts (Woxenius and Bärthel, 2002).

In general, the new intermodal operators are found in the northern part of Europe and in particular in the large market for hinterland transport of maritime containers relating to the ports of Hamburg, Bremerhaven, Rotterdam and Antwerp. The ports themselves have also manifested their interest in the
hinterland transport by rail. In the case of Germany, for instance, HHLA has bought 50% of Transfracht from DB. These initiatives all aim for picking the cherries of intermodal transport and not primarily capture market shares from road transport but from existing intermodal services.

Supplying unit loads, rail wagons and engines are activities involving both rail operators and leasing companies. So far most of the rolling stock has been owned by the railway operators, but there is a clear tendency towards avoiding large investments through leasing engines and wagons. A clearer actor role concerning rail traction is also distinguishable with many small rail companies, often with a short-line origin. Availability of traction and leasing services are vital for lowering the entry barriers for new entrants since capital for intermodal equipment is found to be a major barrier to an increase of intermodal transport (Golias and Yannis, 1998).

In all, it is obvious that changes due to deregulation take place in the ECT industry. Some cherry-pickers have entered, some of them have left, while others maintain and develop their place in the market. Above all, however, the large players change strategies, enter new markets or form alliances which give much faster and more dramatic changes as well as a more scattered picture than in the monopoly days.

### 5.2 Demands for a competence leap

National container companies offer door-to-door services and, together with shipping agencies and forwarders, they control the very important contacts with the shippers. The ICF and the UIRR companies take a wholesaler role, although ICF occasionally sell directly to large shippers. In international transport, the forwarders decide whether rail should be part of the transport chain but the hauliers take a stronger role in domestic transport since they are then often contracted for a long distance haul and can in turn outsource to an intermodal operator.

Shippers rarely specify traffic mode. When they do, however, they are generally rather critical. Some of the critics of ECT, mostly by those shippers actually not using it, can be explained by old experiences and problems that no longer apply. Sometimes it is like “we tested computers in the 1970’s but it was such a mess with clean rooms and technicians in white coats that we abolished computers”. Nevertheless, a lot of the criticism is relevant and has to be dealt with by the ECT operators.

![Figure 5. Competence growth in the intermodal sector.](image-url)
The existence of a competence and confidence gap between the large shippers with global activities on one hand and the ECT industry on the other hand was advocated by representatives of the European Freight and Logistics Leaders Club at the first meeting of the advisory board of the European Reference Centre for Intermodal Freight Transport, EURIFT. Their opinion was that ECT must advance upwards in the competence pyramid shown in Figure 5.

If this judgment of the position of the ECT is correct, this may largely explain why the ECT often has difficulties in winning sufficient trust among shippers to be given responsibility especially for high-value goods, where in addition requests for providing third party logistics tasks such as warehousing and order handling are becoming increasingly common. The ECT often does not even provide system-wide track and trace functions. Experience, for instance by J. B. Hunt in the USA, shows that well functioning track and trace systems can dramatically increase both trust from customers and create the data base needed to dramatically increased reliability and productivity within the system. The creation of system-wide track and trace was a major element in J. B. Hunt’s pioneering decision to start using intermodal transport and switch to rail for all long distance trunk hauls. Advancing upwards in the competence pyramid can only be achieved by intense use of ICS. A long term vision is an ECTS, where a modularised virtual reality model complex extends across all four traditional traffic modes and allows them to be perceived by the shipper as a single interconnected traffic system. In this way ICS could contribute to restructuring the transport system to an extent as dramatic as when introducing an entirely new traffic mode. Co-operation in voluntary consortia can also facilitate organizational learning on how to focus customers, results and performance as is suggested by Gifford and Stalebrink (2002).

Research at the International Institute for Applied Systems Research in Austria (see, e.g., Grübler, 1990) has shown that historically the introduction of new traffic modes have followed growth curves with more than 50 years between 10 and 90% of saturation levels. This indicates that if what is generally referred to as intermodal transport in Europe will change from just a combination of two traffic modes using standardised load units (here denoted European Combined Transport, ECT) to a fully integrated system that exhibits the characteristics of a single mode (European Intermodal Transportation, EIT), this will be a comparatively slow process which will last for many decades. This vision of a fully integrated transport and traffic system is her suggested to be called the fifth mode.

6 Conclusions

6.1 For the ECT traffic system

The first development line relates to the large flows over relatively long distances. For obvious reasons, these services are most economically produced with direct trains between end terminals and they will employ well proven large-scale transshipment technology.

The second and third development lines are far more interesting; how should the substantial market for transport over medium distances – 200 to 500 kilometres – be approached? The second development line aims for the part of this market that involves densely populated areas generating large flows concentrated along arteries. This market will be approached by introducing services where trains make frequent but short stops at road-rail transshipment terminals along corridors. The large flows and the high frequencies imply that the services can compete for short-distance transport, but as a bonus also for transporting unit loads over longer distances on connections with too small flows for direct trains.
The third development line regards small and dispersed flows over medium distances. The key to improved competitiveness in this part of the market is to firstly renew all of the train operations system. However, also the employed transshipment technology must be renewed since that is a prerequisite for implementing advanced train operation principles.

The fourth development line is rolling highway services where complete lorry combinations are driven onto low-built rail wagons. The purpose of using this expensive solution with an unsatisfactory net to tare weight ratio, is to overcome hurdles related to the geography or the infrastructure, or use the drivers’ sleeping hours productively. The concept does not quite fulfil the classic definition of an intermodal service, but it is still included here as it is generally discussed together with the downright intermodal concepts.

6.2 For the ECT industrial organisation

The ECT industry has until now shown much less violent dynamic behaviour than the trucking sector, where the rush for a strong position as a megacarrier is evident. Progress in ICT development promises very large economies of scale and scope for anyone who succeeds to control all resources needed to offer spatial and network coverage in every corner of Europe. This is clearly much more difficult to achieve for intermodal transport, which must rely on highway transport for spatial coverage than for an actor who mainly performs modal highway transportation.

As logistics competence increases in the ECT industry and sinking prices for ICT technologies allow mapping complex intermodal systems in a virtual reality fashion, while simultaneously the awareness of the critical issue of sustainability spreads through society, more fundamental change will likely take place also in the ECT industry. The limited traffic capacity in all modal infrastructures will force the integration of all traffic modes in order to allow further increase of total transport capacity. But the rate of change will be slow and it will probably take several decades to complete the process of transforming the ECT industry into an EIT industry, with a level of integration that makes it relevant to be perceived as working with single transportation mode – the fifth mode.

References


