The Development of International Freight Transport in Europe as a Result of Developments in International Trade and Logistics

Cees J. Ruijgrok
TNO Mobility and Logistics & TIAS Business School at Tilburg University, The Netherlands
Lori A. Tavasszy
TNO Mobility and Logistics & Radboud University Nijmegen, The Netherlands

ABSTRACT

The development of international trade is one of the main driving forces behind the international and transcontinental freight transport. Within Europe the European integration has given a significant impulse for the development of transborder freight transport. A third element, which is of significant influence on both the volume and the composition of international freight transport, concerns the (intercompany) logistics organization. Where which activity takes place, is being determined by the logistics requirements of the actors in the supply chain, most importantly its final customers.

This paper describes megatrends that are shaping international trade, logistics organization and (multi)modal transport in Europe. It focuses on impacts on the European context, both from the peculiarities arising from the European unification process and the European transport policies, but also taking into account the highly fragmented transport market that tries to cope with the increased level of congestion, the threat for increasing taxes and fuel prices as well as the ever increasing service requirements.

On the one hand transport systems will need to adjust better to a globalizing economy, with a higher variation in different types of networks than ever before. The splintering of flows that occurs due to the demands of customization and increased responsiveness will force firms to look outside their company borders for co-operation and, in the end, for scale. Thus, transport systems will need to be more flexible and obtain a more hybrid nature; to accommodate both slow and large scale flows as well as small scale, just-in-time shipments.

1. INTRODUCTION

The internationalization of freight flows is a megatrend, stimulated by a large number of underlying developments. The way in which individual trends manifest themselves varies according to the geographical scale at which companies and markets are operating. Complex global trading networks have evolved primarily to exploit labor cost differences and the availability of raw materials in particular countries. Their development has also been facilitated by major regulatory and technological trends. Trade liberalization, particularly within trading blocks such as the EU and NAFTA, has removed constraints on cross-border movement and has
reduced related ‘barrier costs’. Outsourced manufacturing, particularly to Asia, has significantly changed transportation patterns, and this trend is expected to continue as more companies seek to reduce production costs by moving operations and/or sourcing offshore. The transition to longer supply chains is expected to have a major impact on transportation markets of the future. While logistics costs have dropped dramatically in the last decades, flows have grown twice as hard internationally as within national borders. Together with the growing capability of firms to individualize their products and services, this has created new network architectures that can span the entire globe.

For the coming decades, we expect a continued growth of global freight flows. Some sources predict a doubling of present flows in half a century (WBCSD, 2004). Although this growth will be most visible in the emerging Asian economies (especially China and India), flows are expected to increase steadily in all regions of the world.

**Growth in freight travel by land modes 2000-2050**

![Graph showing growth in freight travel by land modes 2000-2050](source: WBCSD)

Within the EU, freight transport has doubled within a period of 30 years and forecasts are still equally strong (Kernohan, 2005). Apart from economic growth, this growth of freight travel is explained also by changes in intercontinental trade and a decrease of barriers within the European continent. In the past decades growth in cross-border flows, and in particular East-West, is twice as high as the growth in domestic transport and surpasses GDP growth by far (Figure 2). The decrease of trading impediments has been the most rapid between East and West Europe, leading to almost a doubling of trade in this period (see Figure 3).
Figure 2: growth of freight transport within the EU (source: European Commission)

Figure 3: Growth of trade with Western Europe 1999-2003 (source: WTO)
International trade goes hand in hand with technological and logistical innovations. Advances in telecommunications and information technology have given companies the means to manage the physical movement of product over long, often circuitous, routes. Many carriers have invested heavily in ‘track and trace’ systems to be able to establish the location of any consignment at any time, improving the visibility of the global supply chain to shippers and their customers (see e.g. HIDC, 1998). The consequences for the spatial patterns of settlements of production and logistics sites and the resulting freight movement are potentially huge. In Europe there are only two modes of transport that have benefited from the growth of the European economy in the past period; those are road transport and short sea shipping. Both modes have profited from the opening up of the European market, the liberalization of transport markets more than the other modes. Especially the rail mode was not able to profit although it was heavily supported by supporting measures from the various governments and the EU. See figure 4.

![Figure 4: Performance by goods transport in billion tonkm 1970-2001 (DG TREN, 2003)](image)

This paper explores the logistics dimension of these changes, and develops some thinking around the possible consequences for transport systems: what new requirements will these emerging logistics networks place on our intermodal transport systems? What do we need to build new scenarios for strategic decision making in the public sector that take these developments into account? The paper is organized as follows. In the next section we discuss the logistics trends that are the key to a globalizing economy. Section 3 treats the implications of these trends
on the spatial configurations of logistics networks. In section 4 we describe the requirements that these new network forms impose upon intermodal transport systems. Section 5 gives some scenarios for the European context using the most recent freight transport models that have been developed for the European Commission. We conclude our paper with a brief summary of the key findings in section 6.

2. HIGH QUALITY LOGISTICS NETWORKS ARE KEY TO A GLOBALIZING ECONOMY

The evolution of logistics networks during the last decades can be characterized by a strong rationalization of business processes. Companies have become more aware of the impact that their logistics organization can have on the costs of doing business and on the degree of satisfaction of their customers. Facilitated by the advent of information and communications technology and the lowering of trade barriers companies have sought to optimize their logistic processes by continuously restructuring distribution networks and logistics partnerships. Logistics costs have fallen worldwide with 20-40% in the last 15 years (ELA, 2004). Companies have found that one of the instruments to save resources and improve performance is to outsource logistics tasks to specialized service providers. Over a longer term, we can see that companies have been withdrawing to their core business by sourcing transport services (the so-called 3PL) and wider logistics services (4PL) from outside. At the same time, many external drivers have steered the development of logistics services. The series of production steps of goods is increasing, as the firms that produce goods tend to become more and more specialized, searching to reap economies of scale. The so-called ‘focused factories’ (producing only one specific, specialized item) are an extreme example of this. The increased technological possibilities to offer highly customized goods and to deliver these upon short notice to markets worldwide are much appreciated by the consumer, and firms now compete to outperform each other in the area of logistics performance, instead of competing on product prices or physical product quality alone.

Over the past years there has been a sustained trend towards the globalization of business. Ohmae (1985), for example points to the trend of several life-style preferences around the world, which creates ever-wider markets for products. Upstream in the market, there are also several important factors, which drive the process of globalization. Increasingly, it is too expensive to duplicate best manufacturing practice in each of an organization’s major market. Manufacturing facilities have therefore become more focused, both by product specialization and geographical location. Inevitably, as the process of globalization continues, the character of companies must change. The multinational and transnational or global corporations are not the same thing. The multinational corporation operates in a number of countries and adjusts its products and prices in each country - at relative high relative costs. The global corporation operates with resolute certainty - at relative low costs- as if the world (or major regions of it) were a single entity; it tries to sell the same products in the same way [Levitt, 1983].

Achieving economies of scale in business has been an important parallel development in line with the changes, in globalization and manufacturing. If
economies of scale exist that extend beyond the size of national markets, then there is a potential cost advantage to companies through centralized production [Lee, 1986]. In other words it will be worthwhile manufacturing in one location, to serve a number of markets, rather than to have national manufacturing units. This has been the strategy of companies such as Procter & Gamble, Kimberly-Clark and Unilever. A vital point about single sourcing of production is that it distances many final customers for production, as shown in figure 5.

Figure 5: Host-market production versus single source production (adapted from Dicken, 1986)

Figure 6: Single source production operating in a hub network
For the multinational company, operating a host-market production strategy, customers and production are in close proximity. As figure 6 shows, this is less true for global or transnational company practicing single-source production; it follows that there are major implications for logistics management in this transition from multinational to global operations; leading to a growing fragmentation of flows and increased transport distances.

The above trends have introduced an important dilemma into logistics thinking - weighing logistics costs against logistics service quality. The supply chain management discipline embodies this strive to balance these two sides of the equation in order to raise profits, shareholder values and market shares. Especially when considering which changes in logistics networks are yet to come, this dilemma involves a tension between increasingly complex consumer demands and logistic costs. More specifically, on the one hand the firm is faced with a fragmentation of flows because of smaller, customized shipments in higher frequencies; on the other hand the need to maintain control over cost levels through benefits of scale in the logistic process is as high as ever. Typically, companies are now turning outside the boundaries of the firm and are seeking horizontal co-operation to bundle flows and save costs. Before we look at these co-operation issues, we first describe the spatial changes in logistics networks that accompany these globalized flows.

3. THE EVOLUTION OF LOGISTICS NETWORKS RESULTS IN NEW SPATIAL INTERACTIONS

Figure 7 shows how the 2 main ‘megatrends’ in terms of evolution of logistics networks, from a consumer perspective, named “customization” and “responsiveness” are melting together to form new structures, which satisfy the above demands.
We see an increase in product variety, up to the level of individualized products and services. Eventually, this will go hand in hand with and improvement of lead times to the extent that customized products have the same responsiveness as standardized products have now. Note that the two main axes for development, “service responsiveness” and “customization” can be operationalized using practical performance criteria like lead-time or reliability, respectively shipment size or frequency.

The question that needs to be answered is how these trends in logistics concepts are related to the global spatial economy. These relations are bidirectional, i.e. logistics structures depend on spatial economic structures and also influence them. We have two perspectives from which we observe these relationships:

1. The sectoral perspective: which logistics structures will evolve as a result of the above trends? We describe these changes in the remainder of this section.
2. The spatial perspective: what is the implication of long-term changes in logistical structures upon economic growth and economic development at various spatial levels (local, regional, continental and global)? (Figure 8)

![Figure 8: Interrelationships between logistics structures and spatial economic structures (adapted from Vermunt et al, 2000)](image)

The horizontal, i.e. sectoral dimension in the figure combines the 2 trends of responsiveness (translated into order lead time) and customization. The higher the degree of both responsiveness and customization, the higher the importance of individualized products and services, the nearer we are to the central axis of the figure. The spatial dimension is built up as concentric rings around the central area of consumption, the market. Figure 9 shows how different production and distribution concepts result in this spatial layout, from the global scale towards the local market.
These network structures vary according to the degree of customization and the degree of responsiveness required. Typical trends are the moves from European distribution, based on production to stock, towards production to order, where delivery takes place directly or through cross-docking. Also new concepts like rapid fulfillment depots (for low demand but urgent products) and flexible order production (allowing fast switching in batch size and end-product specifications) are being introduced to allow for better responsiveness. The changing of distribution concepts is accelerated by wide-reaching Internet based planning and management systems. These do not only include the new business-to-business and business-to-consumer applications, but business-internal applications as well. The Cisco spare part delivery network guarantees fulfillment of any order anywhere in the world within 2 hours; this is only possible through a seamless connection between external linkages and the internal logistics processes.

This is a mere illustration of the state-of-the-art transport requirements for products with a high degree of customization, short lead time and small shipments. In the next section we will describe in some more detail these requirements of increasingly global logistics networks upon the management of transport systems.

4. GLOBAL NETWORK MANAGEMENT: NEW DEMANDS UPON TRANSPORT SYSTEMS

The management of the intricate networks (in terms of planning and operations) described in the previous chapter, places high demands on the freight service industry. The expanding worldwide economy helped the Top 25 Global Logistics Service Providers (LSP’s) to strong growth. In turn, the large LSP’s are prosperous enough to invest in high-quality systems, processes and logistics networks that have allowed the world’s largest companies to implement efficient supply chains that stretch from Asia to North America and Europe. This synergy between the
major LSP's and their customers has been highly beneficial to both sides and is likely to continue. Continuation of this trend towards concentration is anticipated. “The big Third party Logistics Providers are expected to continue to get the big opportunities” (Foster et al., 2005).

The present situation on the supply side of the market for logistic services, however, is still characterized by fragmentation, both in terms of market share and in terms of specialization. The top-25 LSPs in the world only have a limited market share, and usually generate most of their turnover in specific markets. These market specializations of LSPs may concern a specific product or mode of transport (e.g. ocean shipping, express delivery) or geographical coverage. On a global level the big LSP's are by definition intermodal companies. For intercontinental transport, intermodal transport, esp. container based intermodal transport, is the only way. On a European continental level, however, intermodal transport is of only limited importance for the big LSPs.

Only a few LSP's have integrated intermodal transport into their intra-European service offerings. Examples of LSP's that do make use of intermodal transport on a substantial scale include Stinnes (part of Deutsche Bahn) and P&O Nedlloyd /Maersk Sealand (operating the ERS rail shuttle). Most of the LSP's however are very much road-oriented.

As a result of the increasing sophistication that is required for logistics systems to fulfill the increasing demands from their users (or clients from these users), there is a growing need for flexible logistics structures that aim for cost and asset efficiency, responsiveness towards changing customer requirements and obtaining marketing advantage.

The first objective is forced even more by the last two, because only if logistic structures can be efficient, they offer feasible solutions in today's ever more competitive environment.

Consolidation and Collaboration (horizontal as well as vertical cooperation between chain partners) are the most logical ways to generate lower cost per unit of freight. Through consolidation of flows, larger vehicles can be used and the loading efficiency is optimized.

Through collaboration also the planning of logistic activities is synchronized with results is a much smoother, seamless flow of goods through the logistic system, which results in higher utilization but also creates the possibility of using cheaper and slower modes of transport and avoids the need of safety stock (Groothedde, 2005).

The high level of responsiveness that is required could possibly conflict with the above-mentioned need for slower and smoother flows of goods, but avoiding of this possible conflict is one of the biggest challenges in the design of logistic networks. The set up of hybrid networks (which create different possibilities for flows to reach their final destination), both for production, warehousing and transportation, creates the flexibility required. Part of the production with a demand pattern that can be predicted well in advance is produced on far away locations that use the low labor cost. The rest of the production is postponed to the last possible moment on locations close to the customer.

Valuable products with a very low demand frequency (C-goods) are stocked centrally and can be shipped quickly on long distances if the reduction in inventory costs outweighs the additional transport cost of small lot sizes using express
transport. The utilization of cheap and slow modes of transport in combination with faster means of transport can sometimes be much more advantageous than that of high speed expensive means of transport, especially for products with a low value density and with a high level of demand certainty. As such hybrid networks can combine the advantages of both network alternatives and thus create both a higher level of efficiency and flexibility.

The high level of responsiveness that is required could possibly conflict with the above-mentioned need for slower and smoother flows of goods, but avoiding of this possible conflict is one of the biggest challenges in the design of logistic networks. The set up of hybrid networks (which create different possibilities for flows to reach their final destination), both for production, warehousing and transportation, creates the flexibility required. Part of the production with a demand pattern that can be predicted well in advance is produced on far away locations that use the low labor cost. The rest of the production is postponed to the last possible moment on locations close to the customer.

There is a trend towards the increased usage of hybrid networks. Multimodal networks are a specific example of hybrid networks, especially if these modes are used in a parallel way and not only in a consecutive way. Hybridization occurs on all levels: production, inventory and transport.

Through an overall planning and control mechanism shortcuts are created that enable consolidation of freight flows and enable fast and reliable delivery at the same time.

These trends mainly emerge from increasing customer requirements, translated into shipper demand. In general the supply of transport is lagging behind and especially the old fashioned unimodal modes of transport that only try to optimize flows as they occur from station to station (that is, the railways), are not able to cope with this increasing requirements. Increasing transport prices due to internalization of external costs and increasing labor and fuel costs will lead to a higher emphasis on reducing transport costs and will increase the need to use cheaper modes of transport, if possible. Also possibilities to substitute transport costs for inventory costs, through using slower modes and lower frequencies of transport, will become more attractive.

The main driving forces behind these trends are the necessity to reduce costs in order to stay competitive in globalizing markets and the improved possibilities to control logistic processes using information and communication technology.

Of course not everyone will welcome these innovations because they threaten existing market positions, and many of the more advanced ways of logistic organization not only rely on technology but also on trust. However the need to remove sub optimization in ever more competitive markets can only be realized if companies use the advantages of information that is available and make this information transparent to other partners in the supply chain. In many cases the existing level of information availability is insufficient to really optimize logistic processes. If however the need for optimization emerges because of cost increases or higher quality requirements, it is likely that these barriers will be overcome.

One specific consequence of the emerging occurrence of hybrid networks is the stabilization in time of the logistic processes. Better planning leads to less uncertainty and the possibility to use slower but more efficient means of transport.
The functioning of the network highly depends on the possibilities to synchronize the activities of each of the parties involved. Synchronization has to do with the timely and coordinated exchange of information between the parties enabling them to adjust their actions and avoid unnecessary buffers and disruptions of the flow. In order to achieve this one has to:

- improve transparency along the supply chain
- improve forecasting and planning procedures
- reduce uncertainty in demand and supply
- create flexibility and avoid panic decisions
- create parallel sourcing possibilities

Especially in the hybrid networks advocated in the previous section, the level of exchange of information regarding upcoming events and the realization of planned activities has to be much more intense than in a decentralized organization where everyone is self reliant. In such complicated networks there is a need for a ‘chain-manager’ that coordinates all related activities.

Such a chain manager has to have some authority in order to force parties to work according to the service levels they have agreed upon.

Valuable products with a very low demand frequency (C-goods) are stocked centrally and can be shipped quickly on long distances if the reduction in inventory costs outweighs the additional transport cost of small lot sizes using express transport. The utilization of cheap and slow modes of transport in combination with faster means of transport can sometimes be much more advantageous than that of high speed expensive means of transport, especially for products with a low value density and with a high level of demand certainty. As such hybrid networks can combine the advantages of both network alternatives and thus create both a higher level of efficiency and flexibility. Examples of these types of solutions can be found in the Eutralog report (TNO, 2004).

In recent years however information technology has opened up possibilities such as collaborative planning by creating transparency and connectivity in the supply chain. The use of such technologies showed that speed in itself is not the thing to aim for but delivering at the right time at the right place is. Also the synchronization of processes leads to reduction of unnecessary buffers in the supply chain. This trend will continue and besides cost reduction and higher customer service, it affects sustainable freight transport in two ways:

- Modal shift from expensive, fast and less sustainable transport modes to cheaper, slower, more sustainable transport modes in multi modal operations (i.e. more sea freight than airfreight);
- Higher utilization grade of vehicles through improved consolidation techniques using real time information on the status of the transport flows;

The smooth flow of goods (the ‘de-rushing’) will only be accomplished if the logistics chain can be controlled effectively having full visibility and if parties in the supply chain are willing to share information and cooperate (Andersson et al., 1999). Technologies such as smart tags, intelligent agents and wireless technology will push and enable this most definitely. Within a few years from now wireless technology (blue tooth type communication systems) will spread over the world,
even faster, maybe, than mobile communication systems have done in the recent past. This means that every new computer system will be able to communicate through web technology with any other system without any physical wires. Furthermore, products, packages and means of transport will be equipped with smart tags. Smart tags are programmable chips that can send and receive information by communicating with Radio Frequency Identification stations. These stations are able to transmit this information via the web. Smart tags are expected to be available at low cost (1-2 cents per tag), which makes them applicable to even the smallest units in which products are handled. These tags have great potential in creating supply chain visibility, even at product level. The combination of wireless technology and smart tags provides the possibility to improve the dynamic control of logistics systems through transparency and interconnectivity (Kärkkäinen et al, 2002). Added to this intelligent agents can be used to improve logistics control. Using intelligent agents will omit central control. Ultimately the development of 'intelligent packages' can be expected, that will become more similar to passengers in passenger transport: packages will decide themselves when to go, what mode and route to take in order to arrive at the point of destination not later than expected (Fox et al, 2000).

This change of nature of logistical systems will eventuate in a 'de-rushing' through enhanced anticipation. First of all, because activities and events do not anymore take place unexpectedly, but can be planned beforehand. Secondly, events do not take place at the last possible moment, which prevents taking all sorts of safety measures (e.g. stocks). Instead of this, logistics with 'enhanced anticipation' start at the earliest convenient moment in time. Express transport good flows can be transformed into steady pipelines of flows using slow modes of transport, thus creating immense possibilities for savings in transport cost, in energy, congestion and pollution.

As said, technology will facilitate this innovation, but a creative mindset of supply chain managers and the willingness to cooperate are important prerequisites. Besides the advantages of increased efficiency and effectiveness of logistic systems, they have also to cope with the transaction costs of complex and cumbersome forms of cooperation with other supply chain partners. This new mindset of collaboration in supply chains has been advocated for many years (Barratt, 2000) and in practice reality is often less positive then was foreseen earlier.

In figure 10 this trade-off between the advantages and disadvantages of increasing scale in advanced logistic networks is visualized. On the one hand the cost per unit (C/u) decreases with increasing volumes and scale of the operation, as is the general phenomenon in transport, but at the other side the transaction costs of these complex networks increase, which leads to an optimum where the total integral cost curve has its minimum (give the required service levels).

This natural limit to the size of collaborative communities and logistic networks (some cynicists even say: 'three is a crowd') does not mean that the principles of collaboration themselves are too idealistic. It does mean, however that the business models that can be used in these collaborative networks should be based on simple and clear cut measures of synergies that exist between the different components of the system and that in principle all parties involved in
such a collaborative system should clearly see their benefits: it should be a win-win situation for all (Groothedde, 2005).

Figure 10: Conflicts between economies and diseconomies of scale
Increasing scale and increasing complexity

An important enabling factor that makes the willingness to cooperate much larger is the growing interest in transport security. In circumstances where security becomes important the necessity to trust each other becomes more important and then some of the thresholds mentioned before can be overcome (see OECD, 2005). Other enabling factors include:

- the size of the economies of scale that can be obtained by working together
- the possibilities to improve the control of the logistic process, not only expressed in terms of integral cost reductions but also in improved service quality
- the competitive advantage that can be obtained through improved services
- guaranteed on time delivery at lower costs for the client
- the trust that the complications that may arise in working together can be overcome, as can be shown by running successful demonstration projects and offering low exit fees to disappointed participants

Note that in such a network the Logistic Service Provider (LSP or 3PL) plays a crucial role. This party has to make sure that the commercial contracts of the producers that have created a consortium to deliver their products in a synchronized way to their customers (the retailers) are performed according to the service level agreements they have agreed. This means that in order to work efficiently and effectively the LSP has to know what specific logistic agreements exist between all parties concerned, and has to know the orders and production plans timely in advance. Also he has to make sure that the utilization of the resources is optimized and that proactive action is taken if unplanned actions occur that obstruct the current plan. It is clear that such a hybrid network asks for
a good coordination and synchronization of the actions of each of the partners in the logistics network.

5. TRENDS IN INTERNATIONAL FREIGHT TRANSPORT IN THE NEAR AND FURTHER FUTURE

Several models exist to forecast the development of freight flows on a global scale. The most recent European model is called TRANSTOOLS (see http://www.inro-tno.nl/transtools/Deliverables.htm), in which the expertise of several models and modelers is combined. For the Netherlands both NEA and TNO participate in this project. For DG TREN recently this model suite was used to make forecasts of the European freight flows up till 2020, also using different scenarios for European Transport Policy (TML 2005). In this model many of the trends that were described above in this paper are being reflected through endogenous variables or through exogenous parameters and assumptions. A number of outcomes for these scenarios are presented below.

**Figure 11:** Development in Export volumes for the EU 25 countries (source NDL, 2006)

Figure 11 shows the total trade (all commodities) in millions of tonnes for a number of years. The main conclusion that comes out of this picture is, that although the growth rate of trade with Asia is growing tremendously, the majority of international flows to and from European countries remain within the European
EU25 are main trading partners with a volume of 4 bln tonnes in 2000. The share of Asia (China/India) in EU trade is increasing in both imports and export, but remains small. The share of Asia in EU exports increases from 0.8 in 2000 to 3.6% in 2020. These results are in line with a recent study of CPB (2006).

**Figure 12.** The development of containerized transport as forecasted by Transtools (Source: TNO, Transtools intermediate results based of the European base scenario that is used for the Mid term review of the White paper (Assess study) and reported in NDL, 2006)

In figure 12 the total imports and exports for NSTR Group 9 are shown. As we do not have a container indication yet, we use NSTR9 (finished products) as a proxy for international containerized transport. This picture shows that the share of Asia in EU imports increases from 1.4% in 2000 to 5.9% in 2020. So the important growth of Asian imports has to be looked upon in the perspective of the total imports from European countries that still are dominated by imports from nearby countries. Also here the dominancy of intra EU trade can be observed. There is an import further growth of imports from Asia to be expected (from 40 to 223 Mio tonnes), but the share in the total amount of import and export still remain relatively small (it grows from 4% to 19%). The share of NSTR9 in total imports from Asia is already high 33% (in 2000) and remains high 35% (in 2020). The share of exports of NSTR9 to Asia decreases from 21% to 19% in 2020.
In figure 13 the composition of the total external flows of the EU countries is presented by origin and destination. Also this picture illustrates the dominance of the intra European flows.

6. CONCLUSIONS

The main conclusions that come from this paper can be summarized as follows:

International transport is emerging at high speed and its growth is likely to continue due to the progressing outsourcing of activities and the division of labor on the one side and the still relative limited costs of transport and the ever-growing efficiency of logistic supply chains on the other.

Although growth of worldwide international transport is immense (double digit growth figures can be found everywhere), the international transport on shorter distances is still dominant and also growing due to trade liberalization and economic growth.

The logistics structures that can cope with the high level of customer service requirements ask for agility and responsiveness. These requirements can be met by a high level of transparency in supply chains, which are facilitated by advanced IT systems and through improved collaboration of supply chain partners.

Hybrid networks that can combine slow and efficient transport flows with fast and expensive flows are often the basis of efficient and effective logistics operations.
7. REFERENCES


Dicken, P., 1986, Global shift: industrial change in a turbulent world, Addison-Wesley


European Commission, 2004, DG TREN, EU Energy and Transport in Figures, Brussels

Foster, T. and R. Armstrong (2005), Top 25 Third-Party Logistics Providers: Bigger and Broader


NDL 2006, Wereldstromen, wereld kansen, Hoe Nederland grip krijgt op globalisering van produkten, produktie en logistiek, (World flows, world opportunities, How the Netherlands gets control over the globalizing of product, production and logistics), Zoetermeer


TNO, 2004, Bogers, E and D. Henstra, State of the art of Intermodal Freight Transport, Eutralog deliverable 4.1., Delft
TNO, 2006, Kees Verweij, De logistieke Kracht van Nederland (the logistics strength of the Netherlands), report for NDL, Zoetermeer
Vermunt, J., F. Binnekade, 2000, European logistics, Holland International Distribution Council, The Hague,
World Business Council for Sustainable Development (2004), Mobility 2030, Geneva