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Intermodal Transport & Supply Chains

Moving the Global Economy

Prof. Dr. Wolfgang Stölzle; Dipl.Wirt.-Ing. Julia Bendul; Dipl.-Log Nicole Kudla

University of St. Gallen, Switzerland

OECD

INTERMODAL TRANSPORT AND SUPPLY CHAINS:
MOVING THE GLOBAL ECONOMY

Prof. Dr. Wolfgang STÖLZLE, Dipl. Wirt.-Ing. Julia BENDUL, Dipl.-Log. Nicole KUDLA
Chair of Logistics Management, University of St.Gallen, Switzerland

1. Introduction

In times of economic crisis and decreasing transport volumes efficient supply chain networks are on the agenda of global consignees and logistics service providers. Efficient supply chain networks imply both internationality and intermodality, but also imply actions within countries of different transport policies. Within this contribution, characteristics of efficient supply chains and reciprocal effects with transport policies and recent developments are shown by a case-study on an intermodal consumer goods supply chain. Against the background of global supply chain management trends, challenges and potentials for logistics optimization were identified and linked with current transport policy developments.

2. Trends and Challenges for Managing Global Supply Chains

Global trends affecting structure of international supply chains

Supply chain management and logistics are strongly influenced by the global economical, social and ecological trends. New challenges arise from the trend of the globalization itself: the stronger international division of labour, the demand for sustainability and corporate responsibility force companies and governments to create innovative solutions. Logistics and supply chain management are seen as enablers for the growing global economy. However, in this dynamically changing environment supply chain management has to enable not only the transport of goods from source to sink, but has to ensure security and safety of international transport chains and has to deal with challenges such as on-demand delivery, that effects changing structure of transport goods and an increasing cost pressure.

Furthermore, the Supply Chains themselves are dynamically changing. While in the first decade of the 21st century Supply Chains focus on reducing sourcing costs, *e.g.* by the concentration of suppliers and transport volumes, recently we are facing an evolution towards a major significance of costs for relationships with suppliers and service providers, towards the active identification of risks and the development of dyadic business relationships.

As a result, in a midterm view supply chain management is the expression of integrated business models. Nowadays, supply chain management actually stands for the integration and synchronization of companies and subsidiaries to adaptive and flexible networks already. To meet the price pressure and the consumers' demand for high quality, low prices and individualized products with short term changes, companies focus on their core competences: this means that on the one hand the degree of company-internal value-add is decreasing and value added is given to suppliers and service providers, both service providers and OEM are

tending to offer additional business such as maintenance or services to their individual customers.

However, the dynamically changing supply chain structures have to face the demand of the end consumer. There are new challenges companies have to face, such as the sustainability discussion and its subsequent policies as well as the general changes in the goods volume of freight transports.

First, the import and export flows are changing in Europe. According to the branch and the product type certain regions and transport modes are more or less stressed. Through the last two decades the imports from south-east china grew rapidly. Mass goods such as toys, clothing, but also high-tech and now cars and machines enter Europe mostly through the big ports Rotterdam, Antwerp and Hamburg. At the same time Germany is still the biggest export nation: goods with the value of 969 Billion Euro exported to all destinations.

To meet the growing volumes in sea freight transport larger vessels were constructed, what means that up to now vessels loading 15 000 TEU are discussed. Nevertheless, there is the question how to bring these goods into the hinterland? Especially the road infrastructure and the port infrastructures in the Benelux states is stressed. As a result lead times grow longer and delivery performance decreases.

On the one hand, especially for high-tech products, velocity, quality and delivery reliability are seen as the basis for corporate success. From a corporate point of view the traffic policies accountability for setting the conditions to meet the efficiency objectives and to create stable supply chains is important.

On the other hand society and governments claim for conflicting objectives: with the increasing traffic volume safety issues have to be discussed. Global agreements, like Kyoto-protocol promoting reduction of pollutant emission, call for more sustainability in forms of protection of environment and justice through the generations.

European traffic policy has to meet the demands of both the companies as well as the society. However, as the following case study will point out, the subject of reach of traffic policy is limited. Companies themselves have to assume responsibility to set the requisites for efficient production and logistics networks.

The case presented deals with a high-tech supply chain producing in China and with the main warehouse and market in central Europe. In order to increase the delivery reliability, to reduce the lead time and to meet cost and environmental objectives, an overall optimization process for the whole supply chain was initiated to fulfill the demanding system of objectives.

3. Case-Study: Optimizing an Asian-European Intermodal Consumer Goods Supply Chain

To demonstrate how global trends and the traffic policy – both in Europe and in Asia – significantly affect the design and performance of global supply chain networks, the following case of sourcing, transport and distribution of high-tech consumer goods is presented. By the presentation of this case, recorded early in 2008 – way before the effects of the financial crisis came to light – the critical processes that can either be affected by traffic policy or have to be impacted by companies themselves are identified.

The high-tech branch is a hardly embattled market with a strong cost and time pressure. However, due to the change from sellers' to buyers' markets, faster product life cycles and changing customer demands require flexibility. It turned out that in the presented case the delivery reliability is the primary goal: ambitious customers claim for highest quality and delivery performance in terms of delivery time and dates. At last, the company set itself a high demand for environmental sustainability. However, the supply chain costs were also taken into consideration: not only capital commitment costs, but further logistics costs (*e.g.* sea freight rates, handling, stock and hinterland transport costs, customs duty) and environmental costs (emissions per 40' container) were considered.

It is essential for the supply chain to guarantee punctuality and stability despite low stocks. Fixed dates of delivery are to be kept with the right goods in the right amounts at the right place.

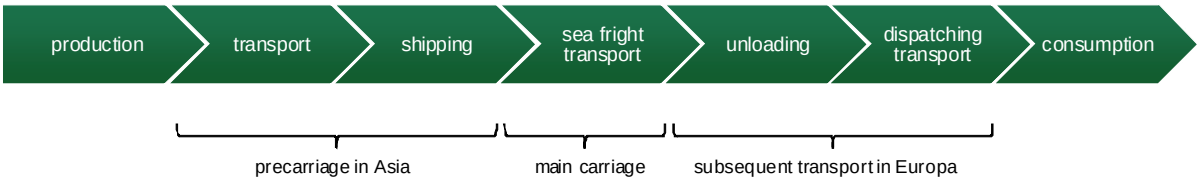
In the delivery chain the sea fright transport between Asia and Europe was considered as the supply chain's core element. Thus, it was to optimize the precarriage process in Asia as well as the subsequent transport in Europe.

3.1. Characterization and Problem Issues

Phase 1 – Asia: Precarriage from Facility to Port

The considered supply chain can be characterized by three phases: The precarriage phase encompasses the transport processes from the production facility in the Chinese hinterland to one of China`s big ports. The products can either be transported from the facility to Shanghai, Hong Kong, Yiantian and Shenzhen. In the precarriage phase the supply can be divided into three stages: (1) Transport from facility to port, (2) clearing and (3) the processes in the ports itself. According to the stages different influencing factors are important. To evaluate the transport – accomplished by a logistics service provider – reliability, loading and planning processes were identified to be important. However, the clearing – fulfilled by the customs authorities – depends not only on the completeness of documents, but also on the relationship to the clearing authority of custom brokers as well as the clearing inspection done by chance. Furthermore, the port processes are influenced by the performance of both the port operator and the shipping line.

Figure 1**. Overview on the consumer goods supply chain**



During the high season from July to November there are further challenges in the sub-phases. The lack of diesel causes long waiting times at the fuel stations. As a result there is a shortage of truck capacities. In the port the problem of overbooking or short-term re-scheduling can delay the transports. Due to the financial crisis in 2008 these capacity effects were absent during the process analysis. Nevertheless, the main problems are caused by the clearing process, especially caused by a lack of personnel and limited opening times. These problems cause delays up to 48 h and effect mean troubles for the set shipping times.

Overall, the analysis comes to the result that, although all ports are comparable in their performance, the most preferable port in China is Hong Kong, since the efficiency of the duty process is the highest. Problems resulting from the clearing do not significantly endanger the supply chain here.

The second step was to analyze the main carriage: For the analysis of shipping lines two shippers were taken into consideration. Both lines offer a reliable and regular timetables service between China and Europe and provide independent delivery, transport and interim storage. Short-term delays are due to the high experience and shipping line size unlikely. Thus, the shipping itself does not offer any optimization potential. The choice of the port in Europe will influence the selection of the shipping line.

Phase 2 and 3 – From Asia to Europe: But where to enter Europe?

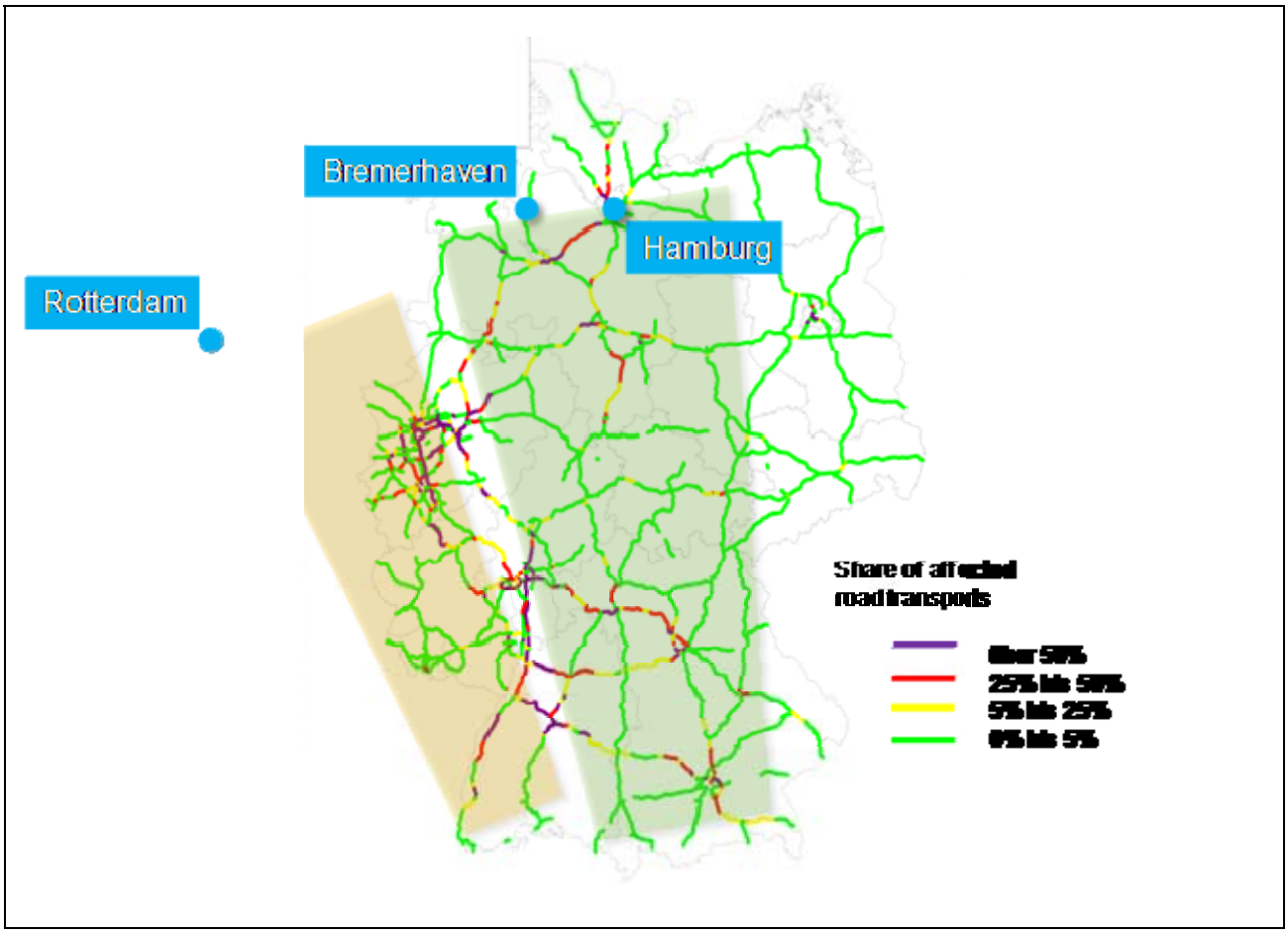
Since the shipping lines offer quite similar transport durations, quality and reliability in the next step of the supply chain analysis, the European ports, were examined. As presented in the previous section, hinterland infrastructure, the processes in the port as well as the clearing processes are the main criteria to evaluate the performance and suitability of one port for the entire chain.

The seaports with the highest container throughput in Europe are Rotterdam, Antwerp and Hamburg. Bremerhaven is a smaller port, but with significant potential. Due to their proximity to the goods' final destination in the southern part of Germany, the ports Rotterdam, Hamburg and Bremerhaven were taken into deeper consideration.

Hamburg and Rotterdam are the ports that are, due to their size, most frequented. However, the duration for transport to destination via the hinterland connection and the time for clearing and handling are of main importance.

Rotterdam and Bremerhaven here score by the short period for running-in due to direct location at the North Sea. This means a five-hour-advantage in comparison with Hamburg. Furthermore, Rotterdam is the only port that offers an adequate connection to Europe's inland water transportation system. Nevertheless, due to the high-tech goods inland navigation is not relevant for the further discussion. But, Bremerhaven and Hamburg offer several advantages: Especially Bremerhaven stands out, due to its good train and road connections. Additionally, Bremerhaven is a free trade port. Like in Hamburg, the Bremerhaven port is strongly agglomerated which means that there are no further internal transports necessary. Good stock capacities are given. With approximately 48h, the time of dispatch is quite low compared to 72h in Rotterdam. The Rotterdam hinterland connection has to face at least two main problems: on the one hand there is only one multi-user terminal for handling, on the other hand there is a significant risk of traffic jams. The long-term road building processes in Rotterdam mean unpredictability and unreliability of truck departures. Nevertheless, the usage of trucks is necessary due to inadequate train connection. Therefore, the forced modal split in the Dutch hinterland depots leads to further uncertainty within the planning process. Another problem arises in Rotterdam from the fact that the goods need to be cleared for free transport in Germany. In contrast to German ports, there is an additional expense (approximately 50 € per 40' container) linked to the necessary clearing processes. Furthermore, redirection of containers to different destinations is not feasible during these processes.

Figure 2. **Schematical catchment area of the analyzed ports for road transport**



Lead time and Cost Comparisons

More than 80 shipping connections have been evaluated to compare and wage the presented advantages and disadvantages of shipping schedules as well as ports. The German ports score in both the economical and the lead-time comparison. In contrast to Rottterdam, up to four days can be saved from Shanghai to Bremerhaven, and up to two days from Shanghai to Hamburg. Also, transport from all other Chinese ports would have shorter lead times to destinations Bremerhaven and Hamburg than to Rotterdam. As a consequence the stability and delivery reliability increase due to the well-scaled infrastructure in Northern Germany.

For the economical comparison plan quantities are used. Furthermore, the costs are calculated by the hinterland distance, the sea freight costs, storage and handling costs as well as transport and environmental costs. It comes out that there are additional costs into millions. The main factor for this is the hinterland transportation and the enhanced environmental costs caused by the increases usage of road transports.

3.2. Key Learnings

Global changes and globalization challenges claim for fast and flexible, high quality and reliable processes. But, more and more companies tend to integrate sea freight and rail transports and slow down their supply chains.

In general, the type and state of goods is the central point for choosing the transport mode. Here, among others, volume, mass and price are relevant factors. However, in Europe the capacities in the hinterland transportation infrastructure and the quality of port processes are the relevant criteria when globally reorganizing a supply chain. Although, in the presented case, the company especially wanted to create an overall integrated approach, only few factors determined the reorganization process. The performance of infrastructure turns out to be the core factor influencing the system of objectives.

The presented case shows that there are several points where European transport policy may influence the design of intermodal transport chains. Here, the starting points are the quality of hinterland infrastructure, security aspects, the port infrastructure as well as the clearing processes in both European and Asian ports. Thus, in the following section the impact of policies on intermodal transport will be pointed out and the direct connection to the success of European companies and European and Global Economy will be stated.

4. Transport Policy for Efficient and Sustainable Supply Chain Management

4.1. General Role of Transport Policy in Economy and Society

On one hand society and economic markets demand for and benefit from freight transports. On the other hand transport processes cause external effects. Hence, transport enables distributed production systems and realizes competitive advantages, but distances between facilities, sources and customers lead to transports and thus environmental pollution by emissions and noise, landscape disruption by infrastructure and damages by the traffic itself. In this context, transport policies need to create conductive conditions for all market participants and reduce negative effects of transport. These interests are obviously conflicting. The main tasks are: The extension and maintenance of infrastructure to meet the demands of public and freight transports as a basis for a wealthy economy and society, considering all social benefits and costs, funding by public as well as private investment. Furthermore, transport policy aims at the improvement of efficiency and quality in transport markets. This is accomplished for instance by encouraging fair competition and applies to regulation as well as to enforcement. Additionally, policies are supposed to foster the standardization of today's wide spectrum of technological and organizational solutions at all levels of the supply chain. Furthermore, international objectives, as for instance the Kyoto Protocol to reduce environmental impacts caused by traffic (*e.g.* health risks, damaging vegetation, crops, CO_2 emissions), need to be implemented within national transport policies. In this context actions and measures to regulate and support transport avoidance, modal shifts and efficient logistics concepts, as well as the application of new technologies play a major role. Finally, security aspects in terms of the social costs caused by accidents, dangerous goods and vulnerability of transport systems are considered.

Political responsibilities in Intermodal Transport

Since transport processes enable globalized and distributed production systems by intermodality and internationality, the development of transport policy and implementation takes place at all political levels – local, regional, national and EU. Sharing responsibilities subsidiary is the working principle: the highest political level acts as soon as the stated objectives cannot be reached by the lower levels. In intermodal transport, with cross-border operations, international transactions of the EU policies are mostly relevant. Here the main tasks are to promote the coordination of national policies and to coordinate actions in other fields, like target setting for emissions and standardization.

National transport policies are the key players regarding infrastructure development. This applies to rail, road and waterway infrastructure as well as to interconnection-points like ports, terminal, logistics parks, maintenance and traffic management. Furthermore, the degree of promotion of, for instance, intermodality and innovations in transport is dependent on national governmental decisions. Hence, especially combined transports deal with challenges like time-consuming customs processes at borders and delays, due to their dependency on other transports.

Modal Shift Policies & Intermodal Transport Promotion

Efficient intermodal supply chains are characterized by the right mix of transport modes with respect to distances and transport durations. In this context, transport policies aim at sustainable and equitably utilized infrastructure networks in order to avoid capacity bottlenecks.

Contemplating that transportation accounts for around 18% of greenhouse gas emissions in Germany, of which around 41% can be attributed to goods traffic (cf. McKinsey & Company, Inc. 2007), modal shift policies and promotion as measures to reduce emissions and external effects are the centre of attention. Over the next few years, the biggest levels of growth are expected to be seen in particular with air and road as modes of transport, which produce the highest levels of emissions. Therefore the shift to modes of transport such as rail and waterways, which are more resource-saving and more cost-efficient, are the clear focus of measures subsided by both the EU and at a federal level (cf. Bundesamt für Güterverkehr (2008)).

Consignments sent by air freight, for instance, generally include high-priced goods of sensitive value which need to be transported over fairly long distances, with short transit times that have to be met with a high degree of reliability and for which express shipment is therefore deliberately requested by customers. This is countered by continuously rising kerosene prices which represent an additional burden on air freight when it comes to competing on cost. In addition, air travel in general and air freight in particular are in the crossfire of the discussion about CO2, which may lead to stronger regulations and duties within emission trade in the context of modal shift policies. For instance, the question is consistently being asked as to whether it is conceivable to shift consignments currently shipped by air freight to other modes of transport, such as road, rail or waterways. For international consignments, apart from shifting to ocean-going vessels or rail movements from Asia to Europe, this can largely be ruled out. For continental traffic and thus hinterland traffic, the transport carrier neutrality of consignments was investigated – with the result that for 67% of consignments one particular transport carrier is not predetermined for transportation (cf. Wittenbrink 2008).

These results show the scope of action for transport policies, which can be exemplified by actions being taken to shift volumes from road to rail transport. In this context four different kinds of actions can be distinguished: regulatory policies, such as controls of road transports regarding driving and rest times and motorized vehicle prohibitions; taxes and duties, as for instance toll costs with respect to EU-pollutant categories and internalization of external costs; infrastructure and technology, which require investments on maintenance and improvement and finally international harmonization and standardization.

4.2. Impact of Political Instruments on Efficient Intermodal Transport

Political instruments and measures give the framework for the transport market, but also govern and control market developments. Reasons for regulatory policies are either from an economic or a managerial point of view. Economic reasons are a high market share of

governmental enterprises, specific shift policies to reduce external effects or balance capacity usage. In this context political instruments such as regulations, traffic specific taxes and duties, infrastructure development, as well as international harmonization and standardization may lead to positive effects through modal shifts, but may induce negative effects in terms of market deformations by competitive advantages for certain transport modes. Whereas managerial aspects encompass, for instance, imbalanced transport volumes, high fix costs shares, low price elasticity of consumers or heterogeneous market participants.

4.2.1. Regulatory Policy

Regulation policy contains measures to control and accomplish competition neutrality within transport markets. Therefore, regulations need to be considered transport mode specific. In road transport this encompasses, for instance, control measures regarding driving and rest times, such as the digital tachograph and an enforcement of road controls as stated in the EU directive 2006/51 EC. Furthermore, these contain speed limitations, but also driving prohibitions within time frames or in specific sectors, such as urban areas or environmental zones as stated in the particulate directive 1999/30 EC.

For rail transportation, the organization of railway companies and their regulation towards fair conduction of inter- and intramodal competitive conditions is discussed. Moreover, the realization of interoperability of railway technology and safety systems, namely the ETCS as the European standard for railway safety systems, European driving licenses for locomotives and the implementation of environmental standards for traction vehicles and wagons plays a major role.

Similar regulations are also given for air transports with respect to night flight prohibitions and operation times of air hubs and airports. Basis for further regulations are the standards of the International Civil Aviation Organization (ICAO) regarding to human resources, interoperability and specification on feasible plane sizes. Furthermore, standards of the European Aviation Safety Agency (EASA) are considered.

On one hand regulatory policy variously influences logistics processes und thus, supply chain performance. On the other hand regulatory policy sets the boundaries for integrated international transports and therefore quality of freight transport modes. As a conclusion, political regulations influence the service level of logistics processes, but also costs and pricing, which both effect the transport mode decision of consignees and logistics service providers, especially when it comes to hinterland transports.

4.2.2. Traffic Specific Taxes and Duties

Traffic specific taxes and duties effect the costs and therefore the competition constraints of companies. Therefore, tax harmonization within the European Union is of strategic relevance. Traffic specific duties on the other hand aim at an internalization of resource usage, finance assurance as well as management of transport demands.

In this context the height of tolls and its EU emission classification, as well as the internalization of external costs due to the change within EU-road tax directive need to be contemplated and discussed.

For rail transports traffic specific taxes and duties refer to railroad prices and financing of siding tracks. In this context transport policy also deals with the harmonization of track prices and usage dependent costs for freight and passenger transports.

In air transport for instance "route charging" is practiced since a couple of years, which means that air traffic control companies are working on a cost covering basis. Furthermore, the Single European Sky Project aims at a harmonization of air traffic control in all member states.

4.2.3. Infrastructure and Technology Policy

The government is financing road, rail and waterway infrastructure by public means and from toll returns. These services build the basis of infrastructure policy and result in an infrastructure network connecting consignees and logistics service providers. All further infrastructure capacities as siding tracks, handling areas and connection on company areas need to be provided by the users.

Nevertheless, the avoidance of capacity bottlenecks requires an active influence of transport demands by a combination of measures regarding infrastructure development and maintenance, but also application of feasible automotive engineering as well as transport management and optimization through the use of telematics systems.

Infrastructure development and maintenance implies the building of roads and railways considering priorities with respect to capacity bottlenecks as well as increase of reinvestments to maintain these. Furthermore, this encompasses the optimization and coordination of construction sites.

In addition, technology policy support for instance the feasibility of automotive engineering in context of vehicle heights, weights and lengths, which are often interconnected with infrastructure capacities. Moreover, telematics systems give opportunities to control transport flows by the provision of traffic information and suitable actions for network users. In this context, the support and realization of Galileo and interconnected applications within the European transport market play a major role in technology policy.

4.2.4. International Harmonization and Standards

Supply chain and logistics networks and thus, source-sink and transit traffic as well as the responsible operators are characterized by its internationality. Hence, international harmonization and standards are a main political goal and consider especially tax conditions, infrastructure usage duties, working conditions, standards in telecommunication or even permission regulations.

The named segments overlap with various fields of transport policy. In practice international policies are only given in air and sea transport, whereas all other directives and implementation guidelines are substituted by EU policies. As a result from the described case-study international harmonization and standards do especially lack simplification of administrative and customs efforts.

5. Conclusion: Corporate Initiatives and Transport Policy – Moving the Global Economy

The key learnings from the case-study on the presented intermodal consumer goods supply chain as well as the status and needed developments in transport policy showed that efficient intermodal transports demand for collaboration of both sides.

Whereas corporations initiate logistics optimizations with respect to transport avoidance, modal shift and efficiency improvement by intelligent consolidation strategies to utilize their network structure sustainably and sufficiently, transport policy plays a superior role when it comes to infrastructure planning and maintenance. But also regulation policy, taxes and duties as well as international standards and technology promotion are of significant relevance, since they influence company decisions and the development and operation of global supply chains. Considering global trends such as security and risk management, but also sustainability in supply chains, the influence of transport policy especially on intermodal long-distance transports will increase and operators will have to cope with rising requirements regarding for example transparency and reduction of greenhouse gas emissions. On the other hand transport policy opens up and supports the implementation and usage of telematics systems, which have a significant impact on the offered service level and the efficiency of supply chain networks. Moving global economy and realize efficient supply chain networks depends therefore on both sides: corporate initiatives and transport policy.

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