A Project Financed under the Sixth Framework Programme

Workshop ETTAR

Transport and the Environment

Barriers to the take-up of more efficient transport and logistics planning and training and awareness raising methods

Background Paper

Prague

24-25 January 2008

1 Introduction

This introduction will describe the objectives of the ETTAR **(Environmental Technologies, Training and Awareness-Raising)** project and will explain the function and structure of this background paper.

1.1 The ETTAR Project

Transportation, one of the backbones of today's economy, is a service that significantly impacts the environment. The volume of transport, transport modes and technology used by transport vehicles determine the level of emissions into air (CO_2, SO_2, NO_x, noise, etc.) and consumption of resources (energy, raw materials, land). Since the 1950s, transport volumes (world wide and within the EU) have continually grown faster than GDP. Between 1990 and 2005, world trade volumes increased by 5.8% annually, while total economic output grew by 2.5% per year. Against this background, the need to employ advanced environmental technologies for passenger and freight transport in all transport modes (road, air, inland waterways and the maritime sector) is apparent.

At the same time, stakeholder consultations indicate that environmental technologies are not sufficiently used in this sector, partially due to a lack of knowledge and clear information. There is also a lack of capacity, as well as accurate and easily accessible information to provide a holistic picture of the potential benefits and costs of utilising "environmental" technologies, i.e. vehicle technology, fuel technology, logistics planning technologies. This prevents users (e.g. for freight transport: logistics companies) from making informed decisions on investing in these technologies. Business actors have pointed out that transparency should be improved with regard to the environmental technologies available and/or under development.

Additionally, there is the perception of insufficient co-operation between the different actors involved in the development and use of environmental technologies. There is a lack of co-operation between the research and business sectors, as they sometimes find it difficult to communicate their specific needs, but also within companies, as procurement and financial departments on the one hand and environmental departments on the other often have different perceptions of the benefits of environmental technologies.

Against this background of insufficient deployment of environmental technologies in the transport sector, the **ETTAR (Environmental Technologies, Training and Awareness-Raising)** project has been set up to identify and assess training needs, methods and activities for the wider use of environmental technologies in the transport sector, with a particular focus on **freight transport in the EU**.

ETTAR focuses on activities that could assist the transport sector in contributing to reductions not only of greenhouse gases but also of other emissions that have significant environmental consequences (for example fine particles, NO_x, SO_x, noise, etc.).

The project intends to raise awareness and build capacities to address the environmental impacts occurring along the supply chain so that businesses can become more aware of the impact linked to transport. Another major focus of the project is the identification and assessment of training needed to promote the practical adoption or up-take and application of environmental technologies in the transport sector.

The **first ETTAR-workshop in Gothenburg on 25-26 October 2007** focused on best available and environmentally sound **vehicle and fuel technology** for freight transport of all transport modes (road, rail, air and inland waterways). The **second workshop** (to be held in Prague on 24-25 January 2008), will focus on logistics optimisation, planning processes and training methods, while the **third workshop** (to be held in April 2008) will take a broader look at how technology can be used in the wider context of transport and planning in order to achieve environmental improvements. A final conference will discuss the findings of the project as a whole. The findings of the workshops and the project will also be documented in two policy briefs designed to raise awareness of the potential and uptake of environmental transport technology.

1.2 Function and Contents of this Background Paper

The **function** of this paper is to provide relevant background information to the participants of the second workshop and to outline key questions to be discussed at the event. The paper is meant to be used as a common starting point for further discussions and will further serve as a basis for the policy brief[1] to be developed after the workshop. This paper thus serves as a stimulus for debate and does not constitute a research or policy paper, nor does it formulate its own policy recommendations. Instead, it is intended to give an overview of the status quo of optimised logistics planning technologies and approaches. Most importantly, it identifies key issues of the workshop by revealing knowledge gaps that should be filled or narrowed by the contributions of speakers and the discussions of all participants at the workshop.

The paper is **structured** along the following lines:

- Chapter 2 will give insight into the current **political actions** at the EU level to foster the development and the adoption of optimised logistics technologies and intermodal logistics solutions;
- Chapter 3 will deal with basic management principles of freight transport relevant to determine the uptake of efficient logistics technologies;
- Chapter 4 will deal with the current developments of logistics technologies and the barriers as well as drivers to their uptake by freight industry;

[1] The policy brief focus on policy recommendations at the European level as well as the national level to develop a future common approach. The policy brief will be based on the discussions in the workshop.

- Chapter 5 deals with awareness raising and training as indispensable instruments to promote the uptake of efficient logistics technologies;
- Chapter 6 sums up the findings of this background paper to draw conclusions.

2 EU Policy context: Logistics Information Technology and Training

In this section the current European policy with regard to the promotion of innovative logistics information Technology and Training will be discussed.

2.1 Introduction

In recent years the logistics industry has had growth rates above the average of European economies; for example, intra- and extra-EU trade rose 55% in value between 1999 and 2007.[2] This growth has come about through European integration, liberalisation and the relatively low cost of freight transport, which has led to changes in production and trade patterns inside the EU and globally.

With ever increasing volumes in freight transport throughout Europe and the world, logistics needs to find solutions to the emerging consequences of this growth. In economic terms, these relate to the costs incurred through congestion, labour shortages and to the dependency on fossil fuels. Regarding the environmental and social dimensions, the challenge lies in reducing freight transport's negative impacts on natural and social habitats. Logistics service providers need to help develop solutions to these issues.

Road transport, with its ever-increasing share of the volume of freight transported, has lead to congestion, reduced reliability, environmental damage, and rising costs.[3]

Improvements in reducing environmental impacts can be achieved inter alia by:

- **Optimisation of the routes and capacity use through the use of intelligent technology and optimised supply chain organisation; and**
- **Promotion of inter-modal transport logistics.**

In the view of the European Commission, freight transport should be considered as a key component of an integrated logistics system in which the choices made will influence the efficiency and operating costs of a fully integrated, sustainable business. [4] As a result, the European Commission has published multiple communications outlining the policy steps to be taken.

The most important **communications** regarding freight transport as a whole are of recent date and include:

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[2] COM(2007) 607, Freight Transport Logistics Action Plan, p. 2.

[3] http://ec.europa.eu/transport/logistics/documentation/highlights/doc/2006_brochure_freight_en.pdf (15 November 2007).

[4] Ibidem, p. 2.

- **Freight Transport Logistics in Europe – the key to sustainable Mobility [COM(2006) 336];**
- **the EU's freight transport agenda: Boosting the efficiency, integration and sustainability of freight transport in Europe" [COM(2007) 606];**
- **Freight Transport Logistics Action Plan [COM(2007) 607].**

Recently published communications regarding the different transport modes include:

- **Towards a rail network giving priority to freight [COM(2007) 608];**
- **Communication on a European Ports Policy [COM(2007) 616].**

The European Commission acknowledged in its Communication "Freight Transport Logistics in Europe" that while the fast growth of freight transport has contributed to a rise of employment it has also caused congestion, accidents, noise, pollution, increased reliance on imported fossil fuels and energy loss.[5] Infrastructure resources are limited and any disruption in the supply chain has a negative impact on the EU economy.

To overcome such problems, Europe's transport system needs to be optimised by means of advanced logistics solutions including the employment of innovative technologies. Logistics can increase the efficiency of individual modes of transport and their combinations. As a result, fewer units of transport, such as vehicles, wagons and vessels, should carry more freight.[6] Relatively environmentally friendly transport modes, like rail and inland waterways need to be modernised and short sea shipping should be accelerated. Air freight should be more closely integrated in the system.[7]

Thus, freight policy is an important topic for the EU Commission's focus on concretising transport policy objectives but is to a large part in the development phase[8]. In the following section the different approaches proposed by the Communications mentioned above are described.

The following sections will describe the different approaches to improve the environmental performance of freight transport. The description will focus on the improvement of the environmental performance of the supply chain via improved logistics planning (including training) as well as the use of inter-modal solutions.

2.2 Approaches to optimise freight transport (all modes)

In the following passages general EU freight transport policy approaches will be discussed that concern all freight transport modes and are intended to improve the environmental balance of the transport.

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[5] COM(2006)336, p. 2.

[6] Ibid.

[7] Ibid.

[8] See the multitude of recent Communications.

2.2.1 Optimisation of transport routes/capacity use

Corridor-based approach

By exploiting economies of scale, suitable trans-national freight transport corridors offer unique technical and economic opportunities that make it attractive to optimally use the various transport modes. It is essential that the various transport modes as well as the corridors themselves are combined in a seamless door-to-door service, making use – where appropriate – of well-designed terminals. This is a precondition for freight to pass easily, reliably and cost-efficiently from one mode to another. The Communications on Ports Policy and on the Freight-oriented Rail Network, therefore, address the availability and the accessibility of trans-shipment platforms, while the Freight Logistics Action Plan focuses on quality and efficiency of the movement of goods, as well as on ensuring that freight-related information travels easily between modes. Thus, the appropriate employment of innovative technologies is relevant to make these corridors work properly. To render freight transport more sustainable, efforts must be undertaken to minimise energy consumption and the emission of noise, pollutants and greenhouse gases caused by the carriage of goods. The Logistics Action Plan introduces the notion of **green corridors**[9], i.e. freight transport corridors that are characterised by low impacts on human and natural environments. Rail and waterborne transport modes will be essential components of these green corridors.

As for the optimal capacity use of all existing **ports** in Europe, the Communication on Ports Policy suggests to explore alternative transport routes as a means to achieve a more intensive use of all existing ports – some of which are operating under capacity levels – and to have them nearer to users.[10] The construction of major new port facilities or the substantial expansion of existing ones should be primarily based on a sound economic assessment of the effect that the envisaged development will have on transport flows. The need for the expansion or the new construction of ports can arise for instance when a new sustainable modal shift away from the road transport mode towards inland water ways or maritime navigation (motorways of the seas) has been positively identified (see below 2.3.2). The Commission intends at this stage to leave this matter to regional and national authorities and to the market. However, it intends to evaluate ports hinterland connections status and needs and their impact on a balanced network of traffic flows on the occasion of the mid-term review of the trans-European transport network in 2010.

Information and Communications Technology (ICT)

Tracking and tracing of cargo in all modes is a prerequisite for efficient logistics and thus an important part of innovation in the logistics field. This is achieved and optimised via the use of Information and Communications Technology (ICT). The introduction of the satellite navigation system GALILEO will have a substantially positive impact on this development.

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[9] See COM(2007)607, p. 11.

[10] See COM(2007) 616, p. 4

The roll-out of systems such as RIS (River Information Services), ERTMS (European Rail Traffic Management System), TAF (Telematics Application for rail Freight) and VTMIS (Vessel Traffic Management and Information Systems) confirms the progress made in the respective transport modes. In road transport, however, the development of Intelligent Transport Systems (ITS) in helping to better manage infrastructure and transport operations is slow. A cohesive deployment strategy for ITS, incorporating the specific requirements of road haulage, such as for navigation systems, digital tachographs and tolling systems, could contribute significantly to material change in the logistics chain.[11] It furthermore calls for work to achieve integrated tracking and tracing and, in the longer term, also routing of freight across modes. The Commission is preparing a major initiative on ITS for 2008, which will establish a detailed roadmap for ITS development and deployment in Europe, thereby also addressing main technology applications relevant for freight logistics.[12] The Logistics Action Plan suggests that further efforts need to be undertaken for the development of Intelligent Transport Systems (ITS) in road transport in order to also achieve interoperability.

Smart technologies should, moreover, be introduced to avoid delays in the supply chain for security and other reasons. One such technology is radio frequency identification (RFID), which is a growing market but requires further research and work on radio spectrum management, interoperability and standardisation. Further elements in the equation are common messaging standards (e.g. EDI/EDIFACT) and new communications platforms (e.g. XML).

An optimal uptake of information and communications technology requires that companies have easy access to ICT solutions. Closed systems entail start-up costs both in terms of technology and software, which raises the threshold for SMEs to fully participate in the market.[13] In any case, **awareness raising and training** is of paramount importance to promote the factual uptake of ICT technology.

2.2.2 Logistics Training

A core issue in improving the performance of freight transport is the training of logisticians, which should help them to make effective decisions. In its Freight Transport Logistics Action Plan the Commission states: “In many areas of freight transport logistics there are shortages of skilled personnel. Therefore, the EU will examine measures in close co-operation with social partners to enhance the attractiveness of logistics professions and to encourage mobility of staff across borders. Within this context, Cohesion Policy instruments (the

[11] COM(2007) 607, p.4.

[12] COM(2007) 607, p. 4.

[13] COM(2006) 336, p. 6.

European Social and Regional Development Funds) could alleviate these shortages by targeting interventions towards training (actions and infrastructure)." [14]

Shippers, transport users and operators attach particular importance to the skills, knowledge and competencies of the personnel involved in transport and related logistics decisions. However, the supply of transport and logistics education and training provided by universities and other institutions varies greatly. The Commission is, thus, considering promoting the development of mutually recognisable certification, under a voluntary regime, for freight transport logisticians. Holders of the certificates would have an advantage when marketing their human resources.

2.2.3 Utilisation of infrastructure

The quality of infrastructure is a key to logistics in freight transport. The European Commission gives priority to optimising currently existing infrastructure over building new ones. Most importantly, infrastructure use can be optimised by deploying efficient and sustainable logistics solutions. This includes fleet management; rail and inland waterway infrastructure management; closer collaboration between business partners and infrastructure management; complete utilisation of loading capacity; and avoiding unnecessary empty runs or pooling resources across modes while respecting the European laws on competition. Still, existing or newly arising bottlenecks need to be identified and dealt with.[15]

The efficiency of trans-shipment facilities, including seaports and airports, is crucial for logistics performance. These facilities should employ modern technological solutions, such as advance informatics, and have quality infrastructure connections for co-modal solutions.

2.2.4 Benchmarking of logistics- and supply-chain quality

The Commission envisages introducing quality benchmarks for freight transport logistics and related services at European level. Establishing a set of European benchmarks would create uniformity in assessing logistics performance. In air transport such benchmarks are already widely used by shippers today. Companies could also develop these indicators further for their internal purposes. Based on experience to be collected during this exercise, such a quality label could be extended to logistics chains using other modes. Via a label dedicated to logistics chains or individual services, this work could also lead to a wider company label of quality encompassing the overall transport performance of a company.[16]

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[14] COM(2007) 607, p.5.

[15] COM(2006) 336, p. 7.

[16] See COM(2006) 336, p. 8.

2.3 Inter-modal transport logistics improving the interoperability of supply chains

Traditionally regulation of freight transport activities has been mode-specific. In order to foster transport modes that feature a low environmental impact as compared to other transport modes, the European Commission strives to encourage inter-modal solutions for freight transport, especially rail and ships.

Short sea shipping carries 41 % of all tonne-kilometres in Europe while road transport carries 45 %.[17]

In its recent revision of the White Paper on the European Transport Policy, the European Commission suggested a shift from the road to more environmentally friendly modes where appropriate, especially for long distances, in urban areas and on congested corridors.

2.3.1 General measures to promote inter-modal transport logistics

Inter-modal transport logistics requires improving the efficiency, interoperability and interconnectivity of rail, maritime, inland waterway transport, air, road transport and related hubs to achieve their full integration in a door-to-door service.[18]

The following tools and programmes facilitate inter-modal transport solutions.

Common technical standards

Common technical standards widely accepted by manufacturers and operators are the key to making inter-modal transport more efficient and a more attractive option for operators and users alike.

The European Commission aims to encourage the development of appropriate new standards, although in most cases it is fitting that industry takes the lead. One example is the Commission's proposal to industry to develop common standards for a European **Inter-modal Loading Unit (EILU)** that would be usable for all modes of transport and that optimises the average loading capacity between those modes. The proposal arises from the current multitude of different configurations of these units, which creates friction costs and delays handling operations between modes. European industry needs a better system of loading units for intra-European transport to reduce costs and improve competitiveness.

This proposal, which could help save an estimated 2% of aggregate average logistics costs, has yet to be considered by the Council and the Parliament.

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[17] http://ec.europa.eu/transport/logistics/documentation/highlights/doc/2006_brochure_freight_en.pdf (8 January 2008).

[18] See Communication , COM(2007) 606, The EU's freight transport agenda: Boosting the efficiency, integration and sustainability of freight transport in Europe, p. 7.

Marco Polo Programmes (I and II)

One central instrument to foster the shift between transport modes is the **Marco Polo** Programme[19,20]. This programme aims to relieve congestion of road infrastructures and improve the environmental performance of the whole transport system by shifting part of road freight to short sea shipping, rail and inland waterway.[21] Marco Polo aims to support commercially-oriented services in the freight transport market and to finance actions involving Member States and candidate countries alike. Marco Polo sets quantified and verifiable objectives for modal shift. More specifically, the aim is to maintain the traffic share between the various transport modes for the year 2010 at 1998 levels.[22]

On 15th July 2004 the Commission presented a proposal COM (2004) 478 to establish a second, significantly expanded "Marco Polo" programme from 2007 onwards. Relying on the proven mechanisms of the original programme, **Marco Polo II** includes new actions such as motorways of the sea and traffic avoidance measures. The programme, which has a budget of €400 million for 2007-2013, has been extended to countries bordering the EU. The Commission estimates that every €1 in grants to Marco Polo II will generate at least €6 in social and environmental benefits.[23]

Marco Polo II aims to reduce the expected yearly aggregate increase in international road freight traffic, measured in tonne-kilometres, by shifting to short sea shipping, rail and inland waterways or to a combination of modes of transport in which road journeys are as short as possible. It proposes to support actions to reduce congestion, improve the environmental performance of the transport system and enhance inter-modal transport, thereby contributing to a more efficient and sustainable transport system, which will provide EU added value without having a negative impact on economic, social or territorial cohesion.

2.3.2 Specific Measures on Short Sea Shipping

The European Union promotes Short Sea Shipping as a way to shift from road modals in order to reverse unsustainable trends in transport.

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[19] Legal basis: Regulation (EC) No 1382/2003 of the European Parliament and of the Council of 22 July 2003 on the granting of Community financial assistance to improve the environmental performance of the freight transport system (Marco Polo Programme).

[20] The financial framework for implementing the Marco Polo programme over the period 1 January 2003 to 31 December 2006 was 75 million €.

[21] http://europa.eu/scadplus/leg/en/lvb/l24159.htm (21 November 2007).

[22] The categories of actions eligible under the Marco Polo programme are described in detail in http://europa.eu/scadplus/leg/en/lvb/l24159.htm (21 November 2007). :

[23] http://ec.europa.eu/transport/marcopolo/index_en.htm (08 January 2008).

Short Sea Promotion Centres

Twenty **Short Sea Promotion Centres** currently operate in Europe. Led by business interests, they work for the benefit of Short Sea Shipping in line with EU policy. The centres aim at convincing cargo owners, forwarders and other industries of the advantages of short sea shipping. The German Short Sea Shipping Centre/Inland Water Way Promotion Centre, for example, dedicates itself to informing and advising industry, commerce and logistics companies with regard to an improved and more extensive use of short sea shipping (="coastal" shipping) and inland water way shipping. This centre develops inter-modal logistics concepts together with clients from the logistics industry, including short sea shipping or inland water way shipping.[24]

The Commission strongly supports the work of these Centres and their European Short Sea Network and expects this support to be matched at least at national level by the Member States and industries.[25] The Commission is investigating the potential to widen this scope to support the promotion and development of inter-modal land transport in a similar way.

The Commission has mentioned that one problem with short sea shipping is that transport users still do not perceive this mode as being fully integrated into the inter-modal supply chain. This problem could be overcome by managing and commercialising logistics chains involving door-to-door short-sea shipping as an integrated service.[26]

Creation of "motorways of the sea"

The **"motorways of the sea"** concept aims at introducing new inter-modal maritime-based logistics chains in Europe, which should bring about a structural change in the EU's transport organisation within the next few years. These chains will be more sustainable and should be commercially more efficient than road-only transport. Motorways of the sea will thus improve access to markets throughout Europe and bring relief to Europe's over-stretched road system. For this purpose, greater use will have to be made not only of European maritime transport resources, but also of the potential in rail and inland waterway to achieve Community added-value of motorways of the sea.[27]

Simplification of procedures for Short Sea Shipping

The different documentary procedures required in maritime transport have caused concern and are considered to hamper the development of the shipping mode to its full potential. To address these issues, the **Directive on reporting formalities for ships arriving in and/or**

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[24] http://www.shortseashipping.de/de/wir/wir.html (20 November 2007).

[25] http://ec.europa.eu/transport/logistics/documentation/highlights/doc/2006_brochure_freight_en.pdf (15 November 2007), p. 2.

[26] See ibidem, p. 2.

[27] http://ec.europa.eu/transport/intermodality/motorways_sea/index_en.htm (21 November 2007).

departing from ports of the Member States of the Community[28] has standardised some formalities for ships arriving in and departing from ports within the EU.

Shipping still remains, however, at a disadvantage compared to other means of transport. A vessel travelling between two EU ports is subject to more complex and time-consuming procedures than a truck would be, because a real internal market for maritime transport in Europe does not yet exist. The Commission will present a legislative proposal on the creation of a European Maritime Transport Space without Barriers in 2008. Moreover, the Commission has proposed the creation of a paperless environment for customs and trade, including a single window for the submission of data.[29]

Improving Performance of ports

New technological innovation related to port equipment such as automated stacking cranes, rail-mounted gantry cranes, automated container terminals, and twin and tandem lifting will play an important role in making Europe's ports more efficient. Co-operation between ports and especially between those close to each other is necessary, as it can lead, *inter alia,* to specialisation in cargo or ship types as well as organisation and pooling of hinterland transport facilities. [30]

2.3.3 Inland water way transport

Together with short sea shipping, inland waterway transport can contribute to the sustainability of the transport system.

European researchers have engaged in a range of pioneering projects that bring together the latest developments in Information and Communication Technologies (ICT) to support traffic and transport management in inland navigation, including interfaces to other modes of transport.

River Information Services

The central technology facilitating inland water transport is River Information Services (RIS). RIS are harmonised information services that support traffic and transport management in inland navigation, including interfaces to other transport modes. RIS streamline information exchange between public and private parties participating in inland waterborne transport. The information is shared on the basis of information and communication standards and is used in different applications and systems for enhanced traffic or transport processes.[31]

[28] DIRECTIVE 2002/6/EC of the European Parliament and the Council of 18 February 2002.

[29] See COM(2007)616, p. 7.

[30] See COM(2007)616, p. 8.

[31] http://www.euro-compris.org

The Directive on River Information Services[32] ensures the development and interoperability of such services and is intended to improve the efficiency, reliability and safety of inland waterway transport and support its integration into modern logistics chains.

NAIADES Action Programme

On 17 January 2006, the European Commission adopted a Communication on the promotion of inland waterway transport [COM(2006) 34]. The "NAIADES", short for Navigation and Inland Waterway Action and Development in Europe, Action Programme is intended for the period 2006–2013 and focuses on five strategic areas for a comprehensive Inland Waterway Transport (IWT) policy. [33]

2.3.4 Rail transport

"As road transport steadily becomes more efficient, rail transport has to become more competitive, especially as regards quality."[34] This is a basic assessment by the Commission of the status quo of today's rail freight system expressed in the Communication "Towards a rail network giving priority to freight". "For logistics customers, quality means in particular competitive journey times, reliability of goods transport and capacity adapted to needs."

EU legislation led to the complete opening of the rail freight market to competition on 1 January 2007, allowing the creation of a truly integrated European railway area. Initial results indicate that those Member States which have already opened their markets have seen rail transport increase significantly: the sector has become more competitive and railway undertakings have been encouraged to better adapt to the demands of industry and the forwarders.

New railway undertakings have emerged to create transport services in the new markets, in particular container transport, thus contributing to a modal shift towards rail transport. International interoperability remains a key issue for the further integration of rail markets as too much time and resources continue to be spent on overcoming the lack of technical and operational standardisation in the railway sector. In its Communication on Freight Transport Logistics in Europe the Commission referred to the lack of reliability and efficiency attributed to rail freight transport caused, inter alia, by insufficient technical and administrative interoperability and by the priority given to passenger trains on lines with mixed traffic. In its Communication "Towards a rail network giving priority to freight" the Commission deemed progress towards interoperability to be slow with problems at the borders remaining.

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[32] Directive 2005/44/EC of the European Parliament and of the Council of 7 September 2005 on harmonised river information services (RIS) on inland waterways in the Community [Official Journal L 255, 30.9.2005].

[33] For further information please see http://ec.europa.eu/transport/iw/prospect/index_de.htm (15 November 2008).

[34] Communication from the Commission to the Council and the European Parliament "Towards a rail network giving priority to freight", p. 3.

European Rail Network (Actions proposed by the EU Commission)

The European Commission aims to promote the creation of a strong European rail network which will offer a better quality of service in freight transport compared to today in terms of journey times, reliability, and capacity. The Communication "Towards a rail network giving priority to freight" made the first concrete suggestion of corridors which should compose a rail freight-oriented network. [35]

- The development of the **European Rail Traffic Management System** is a common control, command and signalling system designed to replace the existing national systems. So far, corridor structures have been created by Member States and infrastructure managers as part of the development of ERTMS along six major European routes that are important for freight.[36] The concept of trans-national corridor structures under the aegis of Member States and infrastructure managers will permit much more intense co-ordination than today's operational infrastructure management, including infrastructure charging, train movement and identification of investment requirements.

Action proposed: The Commission pledges to propose a legal definition of a freight-oriented corridor structure, in particular setting down the main rules applying to this type of corridor.[37] It will encourage Member States and infrastructure managers to create trans-national freight-oriented corridors. Each Member State will have to participate in at least one corridor structure by 2012. Furthermore, the Commission will propose a legislative measure on the publication of quality indicators.

- As regards the infrastructure capacity of a corridor, various study forecasts of rail traffic in Europe show that additional bottlenecks are likely to appear and become very problematical towards 2020, especially in certain central regions of the Union. It is, incidentally, possible to improve the competitiveness of freight by increasing the volume of freight each train is able to carry. This presupposes an improvement in the capacity of the infrastructure, particularly in terms of train length, gauge, axle load and maximum speed. In addition, the relation and, at times, prioritisation of rail freight transport to/over other types of rail transport needs to be subject to better regulation.

Action proposed: The Commission will ask the corridor structures to draw up a programme of investments aimed at eliminating bottlenecks as well as harmonising and improving infrastructure capacity, especially in terms of train length and gauge. It will examine the possible sources of finance for these investments within existing programmes. The Commission will propose tightening up the existing legislation relating to the priority of international freight in the event of disturbance of the network. It will ask the corridor structures and infrastructure managers concerned to harmonise the priority rules throughout the infrastructure under their charge.

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[35] See p. 5.

[36] COM(2007) 608, p. 6.

[37] COM(2007 608, p. 7

- The allocation of train paths is at present decided by each infrastructure manager according to rules which differ from one Member State to another. The harmonisation of the rules for the allocation of train paths along each corridor could enable freight to realise benefits from efficient and reliable train paths. This may require, for example, joint planning of capacity distribution by all the corridor managers.

Action proposed: The Commission will propose additional legislation on the international allocation of train paths and on the priority accorded to international freight. It will propose enabling authorised applicants to request train paths throughout the freight-oriented network. It will encourage infrastructure managers to offer additional efficient international train paths and to intensify the work already started in the framework of RailNetEurope. It will specify the powers of the regulatory authorities in regard to international traffic and encourage the development of co-operation between them.

- Ancillary rail services and especially terminals and marshalling yards are essential links in the modern rail freight production chain. The development of terminal and marshalling yards has to be developed throughout the freight-oriented network. For this development it will be necessary to encourage investment in increasing terminal and marshalling yard capacities.

Action proposed: The Commission will encourage the corridor structures and infrastructure managers to set up an efficient and appropriate network of terminals and marshalling yards. It will examine the possible sources of finance for the development of this type of infrastructure within existing programmes. It will look into the possibility of additions to the existing legislation to improve the transparency and ease of access to ancillary rail services.

All of these actions proposed will be examined in the framework of structured deliberations in the form of a strategic group, which is intended to complete its work in the first half of 2008.

2.4 Sum-up

All these initiatives taken or envisaged by the European Commission show that improving the environmental performance of freight transport is a core policy field of European transport policy. The application of innovative technology as well as intelligent logistics planning and supply chain management stand out as promising instruments to achieve an environmental improvement. The promotion of intermodal transport solutions is another such strategy.

The adequate utilisation of these instruments requires a sound knowledge of logisticians. Therefore the question of awareness raising and training is paramount to the success of the strategies outlined in this chapter.

3 Management of freight transport processes

This chapter will look at the environmental challenges **supply chain planning, implementation and management** imposes on companies, especially SMEs as they usually don't have the same resources as larger companies to develop or use new technological solutions to improve efficiency and effectiveness. Furthermore, the chapter will outline the basic parameters, conditions and particularities of freight transport that have to be taken into account when planning the improvement of the environmental performance of freight transport.

Supply chains need to be planned carefully. The planning has to take into consideration not just the demands and needs of the main producer (focal company), but also the needs and demands as well as capabilities etc. of all other partners – raw material supplier, transport provider, warehouse owner, sales points, etc. In order for a supply chain to be successfully implemented, trust and information sharing is very important. Effective supply chain planning based on shared information and trust among partners is an essential element for successful supply chain implementation.[38]

Supply chain integration as a system of enhanced co-operation between the different parts of the supply chain is considered a strategic tool which attempts to minimise operating costs, thereby enhancing value by linking all participating players throughout the system. Supply chain integration means for one thing "to build strong partnerships through collaborative technologies". In a wider sense, it means that all parts of one supply chain exchange needed information, communicate clearly and regularly with each other, support each other in further developments, and thus work in an integrated and not separated way.

Therefore, a functioning network needs to be established in order to realise supply chain integration. What ETTAR especially looks at is not "just" the supply chain challenge as such but also the supply chain working towards less environmental impact of transports. Which factors need to be considered to achieve sustainable transport by the partners of a supply chain network?

3.1 Types of freight transport

Freight transport is a heterogeneous phenomenon and the tools and potential - including the suitable technologies - for decreasing CO_2 emissions differ significantly between the different kinds of services.

Examples of bases for division are:

- Owner of cargo: Transport of one's own goods (on one's own account) or for customers (for hire or reward)

[38] Kwon et al. 2005, p. 26.

- Geographical coverage: trans-ocean, intra-EU, national, regional or local distances
- Time for movement: express, normal or economy
- Size of consignments: full loads, part loads, general cargo or parcels
- Type of cargo: unitised cargo (boxes or pallets) or cargo requiring dedicated vehicles and vessels
- Traffic modes: single mode (sea, rail, road or air) or combinations of traffic modes

Most scientific literature as well as much of the public debate focuses on logistics service providers (LSPs) and long-distance transport of small consignments. Still, the majority of transport assignments deal with full loads, short distances and much is, despite a strong trend towards outsourcing of logistics activities, still transported by firms on their own account. Here, many white fields must be explored, preferably after an assessment of the CO_2-reduction potential.

Actions aiming at CO_2 reduction must take the perspective of making each segment of the supply chain more efficient but perhaps more importantly seek ways of transferring demand to more CO_2-lean segments. One example is to shift traffic mode, but one must bear in mind that each traffic mode has reserved markets with no realistic alternative[39]. A much larger potential is related to increasing consignment sizes, applying more moderate time demands and balancing flows. Special focus should also be laid on "the last mile problem"[40] of pick-up and distribution of small consignments.

3.2 Actor perspectives

Transportation is a field with significant economies of scale. Hence, one theoretical approach for dealing with operational deficiencies is to plan and control all freight movements centrally and execute them in a huge optimised system with full vehicles and vessels and sufficient balances. This is obviously a utopia given the firm belief that free markets can better handle resource utilisation than a set of restrictions, especially in the long run.

Instead, transportation is carried out by a multitude of actors, illustrated by the fact that the European Union has more than 500 000 goods transport companies of which 440 000 are road hauliers.

The perspective taken here is the one of the *supply chains* producing and marketing products rather than that of individual transport companies, sectors or traffic modes. Reasons for this include:

- The traditional perspective of (single/isolated) logistics service providers (LSPs), transport operators (TOs) and vehicle and energy providers (VEPs) is too narrow to achieve

[39] For the potential of modal shift, see, for instance, Godstransportdelegationen (2001), which states that if all domestic transport with Swedish lorries longer than 300 kms (about 15% of total traffic work) was transferred to rail and sea, the emissions from the road and transport sectors would decrease by around 3-4%.

[40] =the final link in the transport chain, the delivery to the customer.

breakthroughs for CO_2 emissions since much of the environmental impact is already defined by the structure and processes of the supply chains (e.g. site of production of products, central or regional/local stocking of products). Nevertheless, LSPs and TOs are integrated parts of supply chains while VEPs have a secondary role in most supply chains.

- Future competition in the consumer markets is believed to be between dynamically structured supply chains. Consumers' choice is then between products and their attributes rather than between companies. Conscious consumers should base buying decisions on total environmental performance of the product, including transport along the supply chains and to the point of purchase.
- It is the geographical locations and co-ordination of activities in the supply chains that define transport demand in quantitative as well as qualitative terms. Transport usually occurs between companies rather than within.

CO_2 emissions related to transport should be analysed together with those related to manufacturing. Some raw materials, for instance, are very energy-intensive to refine and might be best refined close to CO_2-lean energy sources (e.g. hydropower, solar power, etc.). This means that sometimes it is much more energy efficient to produce something far away even if this means long transport distances because of better energy efficiency in the production phase.

With an increased focus on supply chains rather than individual companies, this paper follows a **systems approach**. Such an approach is needed since traditional business economics focusing on the company as an organisational unit cannot explain all facets of supply chain behaviour.

Still, decisions on strategies, business logic and employment will be taken on a company level, meaning that the individual company's role as a part of different supply chains must not be neglected.

3.3 Transparent markets for transport services

Since external costs related to transport are to a large extent not included in the product price, transport customers and ultimately end-consumers should at least be informed about the included environmental impact to enable them to make a buying decision in line with their corporate or personal values. Transparency regarding emissions from individual transport assignments is thus needed for the business relation as well as for assessments of product emissions. Consumer demand for CO_2-lean products as a driver for sustainable supply chains should not be underestimated. Here, knowledge, calculation and publication tools and proper information are the tools for success.

Markets are created over time in interaction between the supply and demand sides and through influence of public debate and media. By offering **over-night transport** in most geographical markets, traditional road-based LSPs, such as Kühne & Nagel, Schenker and DHL, have set a standard that competing transport services as well as customers have adapted to. Yet, not all transport buyers need this kind of service for their goods. A different

and more flexible shipping mode would extend the options for efficient transport operations adapted to the situation implying at the same time a significant CO_2-reduction potential. Also, when demanding over-night transport, customers can influence the environmental performance dramatically by informing the LSP in advance or allowing the LSP to choose between different nights to transport the goods.

In order to make a correct buying decision, transport customers should also know or be informed about the consequences of their demand on the LSPs' operations, especially in terms of CO_2 and other emissions.

4 Logistics Technologies: Barriers to and Strategies for their uptake

This section will outline the basic barriers to and strategies for the uptake of innovative logistics technologies, especially those facilitating inter-modal transport solutions.

4.1 Logistics Planning Technologies furthering CO_2-lean freight transport in supply chains

4.1.1 Introduction

Emission levels of air and road transport (and to some degree rail transport as well) have been improved considerably in the last 40 years and new legislation has been adopted to further reduce emission levels. The environmental challenge is therefore not the lack of improvement of laws and technologies, but the implementation of such improvements and the achievement of an even higher effectiveness and efficiency in mass transportation. Thus, transportation remains one of the core issues for ecological sustainability. The current increase of CO_2 emissions from transport activities must be stopped. Transport needs to be turned into a sustainable direction in order to maintain its role as society's lubricant. If not, substantial barriers in terms of prohibitions, restrictions and steeply rising costs of accessibility to transport could be introduced, with severe effects for society. Hence, the CO_2 and climate change issue is of strategic importance for society, manufacturing companies as well as companies within the transport sector.

There is an **enormous challenge** to efficiently design logistics systems; plan and control goods and passenger flows; utilise millions of vehicles and vessels; facilitate intermodal solutions; develop and implement new cleaner propulsion technologies as well as improve the competitiveness of the relatively clean traffic modes of rail and sea. As a consequence, there is a significant need to create and distribute knowledge and train individuals who can take on the challenge of operating future sustainable transport systems.

For climate change mitigation, there is a significant potential in technical improvement of vehicles, vessels and load units; i.e. to improve the quotient "CO_2 emissions/traffic work". Hauling freight instead of tare weight (i.e. the weight of an empty vehicle or container) has an impact on environmental performance. Also, more efficient engines and new energy carriers must be developed and implemented. When new technology is implemented in transport systems, it should aim at solving tasks at a node, at a link, along a certain transport chain or in a complete transport network. The wider the scope the more restrictions must be taken into account. Besides unit loads, vehicles and trans-shipment equipment, changes can also refer to the goods which can be formed or packed in order to fit into general transport systems.

4.1.2 Technologies optimising logistics planning

The following short outline concentrates on logistics planning technologies (mainly in the field of road hauliers). Technical details will not be given in this context.

Like in many other industries, information and communication technology (ICT) is regarded as a major facilitator for the improved planning and controlling of transport activities. This calls for reliable data capture, storage, processing and communication.

Recent hardware and software advancements have brought technologies to the market at a reasonable price. ICTs have been implemented for certain applications, but some technologies wait to be further exploited and technologies that are already implemented can be used in new ways.[41]

In order to optimise logistics flows, *inter alia* the following instruments can be applied:

- **Vehicle routing and scheduling optimisation**
- **Fleet telematics;**
- **Technologies facilitating intermodal solutions.**

These instruments will be shortly discussed in the following sections.

4.1.2.1 Optimised vehicle routing/scheduling:

The context of **vehicle routing and scheduling optimisation** is that of delivering goods located at a central depot to customers who have placed orders for such goods. The instrument is intended to strike up the most cost-efficient routes of trucks and the proper assignment of certain trucks to the suitable consignments in order to best use the available capacity.

Implicit is the goal of minimising the cost of distributing the goods and preventing trucks from running empty. The advantages are a minimisation or optimisation of overall route time, driver pay, vehicle maintenance and fuel use and costs. Given these advantages, the employment of vehicle routing and scheduling technology can be beneficial both from an economic and an environmental point of view, especially with regard to vehicle and fuel use.

Many technical approaches and formulas have been developed to foster vehicle routing optimisation. Specific vehicle routing software exists to generate cost efficient routes for trucks and vehicles. The different sorts of software available are in general adapted to different types of users and are able to take into consideration different factors related to the respective transport provider.

[41] Stefansson, G. Woxenius, J. (2007) The Concept of Smart Freight Transport Systems - the road haulier's perspective, proceedings of the 19th Annual Conference for Nordic Researchers in Logistics Conference (NOFOMA), Reykjavik, 7-8 June 2007.

4.1.2.2 Fleet Telematics.

The term telematics combines telecommunications and informatics.[42] Literally defined, telematics is the integration of wireless communications, vehicle monitoring systems, and location devices.[43] Telematics is a tool to manage freight flow and customer contacts and helps to increase punctuality, reliability, flexibility, and transparency of transportation services, and, at the same time, reduces empty mileage and low vehicle utilisation. This can result in a considerable reduction of CO_2 emission, fuel consumption and total costs.[44] [45]

Fleet telematics systems (FTS) allow the information exchange between a commercial vehicle fleet and their central authority, i.e. the dispatching office. A FTS typically consists of mobile vehicle systems (VS) and a stationary fleet communication system (FCS). The FCS may be a stand alone application maintained by the carrier or an internet service running by the supplier of the system. The FCS usually includes a data base in which all vehicle positions and messages are stored. Digital maps are often included which allow to visualise vehicle positions and traces.[46]

The communication between VS and FCS is realised by trunked radio, cellular communication, or satellite communication. Positioning of vehicles is usually realised by satellite positioning systems and/or dead reckoning using gyroscope and odometer. Usually, the VS is equipped with a simple input device that allows drivers to send predefined status messages. Drivers may add simple content, e.g. numeric values, but usually cannot enter arbitrary text. Besides of the messages sent by drivers, some VS can also automatically submit messages, e.g. the vehicle's position, data from sensors in the cargo body, or vehicle data from the CAN-bus (Controller Area Network).[47]

To sum it up, Telematics serve many purposes: They monitor idling time; help reduce bad driving behaviours; and eliminate unauthorised vehicle use. A vehicle's built-in system identifies a mechanical or electronic problem, and the telematics package can automatically transmit this information to the vehicle manufacturer, fleet manager, or service organization.

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[42] See Xu, Yonglu, Development of Transport Telematics in Europe, GeoInformatica 4:2, 2000, p. 179.

[43] http://www.worktruckonline.com/t_inside.cfm?action=article_pick&storyID=1093&gps=1 (16 January 2008).

[44] See Xu, Yonglus, Development of Transport Telematics in Europe, GeoInformatica 4:2, 2000see above, p. 180.

[45] see also presentation by MAN: http://download.sczm.t-systems.de/t-systems.de/de/StaticPage/24/87/66/248766_03_Praesentation-Marc-Avril-ps.pdf (20 January 2008).

[46] http://www.telematique.eu/transport_telematics/commercial_vehicles.en.html (20 January 2008).

[47] Ibidem.

GPS, AVL, MRM, WiFi, and RFID are just a few acronyms representing telematics systems and technologies.[48]

4.1.3 Technology facilitating intermodal solutions

Information and Communciation Technology (ICT) plays an important role to smoothen intermodal freight solutions, especially at intermodal facilities as nodes in a supply chain, including national borders.

Intermodal facilities are sites where freight is conveyed from one mode of freight transportation to another. Examples include water/port to rail or highway movements, and truck/rail interfaces. Intelligent Transport Systems can facilitate the safe, efficient, secure, and seamless movement of freight. Applications being deployed provide for tracking of freight and carrier assets such as containers and chassis, and improve the efficiency of freight terminal processes, drayage operations, and international border crossings.[49]

The next section will identify and describe the most common barriers to the uptake of these technologies.

4.2 Barriers to the uptake of technology

A *barrier* is here defined as a hindrance that is impossible to change or only can be changed at very high costs or in a very long time span.

It is important to thoroughly analyse the different kinds of barriers hampering the implementation of the pieces of new technology as well as strategies for removing them.

Examples of barriers are

- Technological barriers (e.g. standards/weights, domineering technologies) laws and regulations, .
- System-based barriers (lack of central decision power, problems of repositioning, “empty returns”, etc.
- Commercial barriers (competition, mistrust, etc.)

When analysing barriers, it should also be kept in mind that it is not always a common goal to keep the barriers at a low level. Sometimes barriers are created on purpose, mainly in order to achieve benefits in a restricted transport system, for competitive and strategic reasons. One example with a historical background is the wide gauge of Spanish tracks, which was at least partly designed to render it more difficult for French troops to invade Spain.

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[48] http://www.worktruckonline.com/t_inside.cfm?action=article_pick&storyID=1093&gps=1 (16 January 2008), for further information please see there.

[49] See for case studies: www.promit-project.net/UploadedFiles/Events/PROMIT_Bologna/Speech_4_Musso_DITS.ppt (16 January 2008).

4.2.1 Technological barriers

Standards and dominant technologies are beneficial for innovators of subsystems, but also create limitations for new and different technical solutions. Technological barriers also stem from the fact that the capacities of vehicles are different, which shows that technological change can impact modes with a small carrying capacity of each vehicle more significantly.

4.2.1.1 Standards, weights, dimensions and other regulations

Technical standards guide manufacturers and system designers. Standards for transportation equipment generally define the interfaces between system resources in terms of dimensions and fastening points but they also stipulate the required construction strength.

Most significant for development of inter-modal transport systems are standards stipulating the size of unit loads. These standards are narrowly linked to regulations for use of infrastructure. The purpose is that vehicles loaded with suitable unit load combinations shall benefit from the maximum vehicle weights and dimensions.

Technical standards are obviously stipulated in order to simplify the development of complex systems, but it also implies restrictions for the system's designer. The European intermodal system has not been hampered by too many standards but rather the opposite. Unit load standards have been established after discussions over so many years, indicating that some standards have been obsolete from their coming into force. Swap bodies (freight container built in a lighter material, often in the same size as a standard ISO container but not possible to stack), for example, have constituted a special problem since they lacked a standard for a long time. When the standard was finally approved, it included the lengths 7.15, 7.45 and 7.82 m. Three standards within 70 cm is regarded as almost a non-standard, and these containers still do not fit on all trucks

In order to plan and build compatible infrastructure, authorities must decide on the permissible **size of vehicles**. This applies both to the permissible cross section, normally referred to as the loading profile, and to the maximum weight that bridges, road embankments and tracks are designed to endure. Length is less important, but still restricted in road transport due to manoeuvrability in cities and to safe overtaking by other vehicles, and in rail transport due to the length of side tracks and platforms. The sizes of ships are mainly restricted in terms of draught during sailing and of length by quays in ports together with the outreach of quay cranes.

Permissible **dimensions** differ widely between transport modes but also between transport links of the same mode. One important example in inter-modal transport is the loading profiles of railways that differ widely even within larger territories, for example Europe. For obvious reasons, all resources in integrated transport chains must fall within the **maximum** dimensions allowed in each individual link. Consequently, national regulations must be harmonised for efficient international transport networks.

External effects are increasingly important in the design of transport systems. In addition to **existing regulations**, authorities have revealed plans for charging at least part of the external costs for each transport mode. Still, proper charging is a delicate task and petitions

about costs are frequently issued. In the future it is likely that higher taxes and even the prohibition of polluting, noisy and dangerous vehicles will occur (see statements in the European White Paper on Transports, European Masterplan on Transport and Logistics, but also road charging systems in Germany, Austria and Switzerland, laws on the transport of dangerous goods etc.). Although this might be seen as a catalyst for new cleaner and safer technology (e.g. increased use of intermodal transport), system designers must conform to existing and proposed future regulations. Even demand for the recycling of construction materials and working conditions for drivers are included in this problem area and influence the supply chain.

4.2.1.2 Prevailing technology

Even when firm standards are missing, technological development can be hampered by the presence of dominant technologies, so called de facto standards. This not only includes technical resources but also whole procedures and principal solutions. One example of de facto standards of transport procedures is the over-night traffic solution in European intermodal transport. Trains stand at terminals all day and travel between terminals over night. This has long been the prevailing way of running the rail system, but demand for more advanced logistics services, separate tracks for high speed passenger trains and new technologies for short stops at terminals has opened up the possibility for increased frequencies during daytime.

One reason for choosing another technology rather than the prevailing one is that new and better technology is available. When the Danish State Railway electrified their tracks they chose another current than the one used in neighbouring Sweden and Germany. This change was beneficial Danish domestic traffic, but problems are beginning to arise with the increasing amount of border-crossing traffic.

National pride and susceptibilities seem to be the cause of the many different signalling standards in Europe now obstructing trains running through Europe with one rail engine. It is a difficult task to harmonise national systems that contain 50 000 rail engines and over one million signalling points.

4.2.1.3 Different capacities of transport modes

In a technological context, the different capacities of transport modes imply that a change in one resource used in one link in the supply chain can force the replacement of many pieces of equipment in other links. For instance, a new type of train with integrated trans-shipment equipment working together with newly designed lorries implies that many such lorries have to be purchased at the same time. That is not necessarily a problem, since they represent a much lower price per unit, but there is a high probability that existing lorries were not all bought at the same time, thus representing different grades of depreciation. Replacing units not fully worn out is always costly even though a second hand market is usually available.

4.2.2 System-based barriers

Even the transport system itself contains barriers. It is especially difficult to introduce technology in systems lacking formal system's management in which unit loads and vehicles often must be repositioned before taking on a new transport assignment. For obvious reasons, the multimodal adaptation also implies higher barriers than if the technology is to be designed for a single transport mode.

4.2.2.1 Lack of formal system leadership

A large number of independent actors make up the intermodal industry in Europe. Hauliers, forwarders, terminal companies, railway companies and leasing companies co-operate in order to offer transport services to the shippers.

The Systems Approach developed by Churchman[50] assumes that there is a system's management guiding the resources of the system. In spite of their name, integrated transport chains generally have no such management with formal decision power. Instead, the activities are managed by contracts between the actors. It is rather seller-buyer connections along the chain than a situation where someone takes an overreaching responsibility.

Forwarders, as transport integrators, can be said to have a system's management role, but they possess no detailed power guiding the activities of other actors. Instead, on behalf of shippers, they demand a certain transport quality in terms of transit times, frequencies, degree of damage etc. from the transport operators.

The uptake of technological development is hampered by the fact that no single organisation can push for it along the transport chain and that problems arise when the benefits from the investments should be split along the chain. Often so called reverse salients (i.e. an improvement in one subsystem leads to deterioration in other subsystems) occur.

One example is that the Swedish intermodal operator CargoNet invested in new automatic gantry cranes. The new cranes demanded standardised placement of lift pockets and corner fittings in order to work automatically. Many hauliers with custom made trailers could not use intermodal transport anymore. An obvious improvement in one node made the network suffer, although in the long run it improved the efficiency of those hauliers operating standardised equipment.

4.2.2.2 Repositioning of system resources

Contrary to passenger flows, goods flows are almost always directed one way while vehicles and unit loads must be reallocated to the place where new consignments are waiting. Far from all goods flows are balanced, inducing a need for repositioning within the network. This is the key to the limited success of collapsible units, the empty positioning of many containers on one rail wagon implying empty positioning of wagons. The client may save freight charges in the short run and some savings on a system level are also possible, but

[50] Churchman, C. W. (1968) *The Systems Approach*, Dell Publishing Co., New York.

collapsible units have not proven to be economical. Consequently, the demand for repositioning is a barrier for implementing certain kinds of new technology.

4.2.3 Commercial barriers

Commercial barriers in the sense of competition between transport market actors are dealt with by Bukold[51], who divides them into structural, strategic and institutional barriers. However, also implementation of new technologies suffers from commercial barriers.

4.2.3.1 Modal competition

The most important commercial barrier is that the relationship between road transport companies and railway administrations historically has been characterised by confrontation and competition rather than co-operation. Technologically, this means that it is hard to implement new technical solutions implying co-operation since both parties fear losing customers to single mode transport by the other mode. Executives fear that integration might limit responsiveness to major changes in the competitive environment or are anxious that current suppliers or customers may become future competitors. If a company is regarded as a potential competitor by another party in the supply chain, the party afraid of this potential competitor will likely be much less interested in integrating this company into the supply chain, as this might mean sharing information about strategies, important figures and other relevant issues.

Smaller, resource-constraint companies fear that the larger channel “partners” might use supply chain management (SCM) opportunistically to extract value and squeeze margins.

4.2.3.2 Varying depreciation times for resources

Another barrier for new technologies in intermodal transport systems is that the resources, (e.g unit loads, vehicles, transhipment equipment and infrastructure) depreciate and technically wear out over different time spans. For efficiency and economic reasons, lorries are exchanged for new ones approximately every 12 years; semi-trailers and containers every 10 years; while transfer equipment, railway wagons and container ships are used for 20-40 years with intermediate refurbishment. General operation principles and infrastructure last for several decades, if not centuries. However, depreciation times are decreasing in the industry today, not because of technical wear and tear but because they become outmoded more quickly.

The next few years is a convenient opportunity to change the technology in the global intermodal systems since much of the equipment with longest depreciation time (i.e. transhipment equipment and rail wagons) has now served for some 40 years and large scale

[51] Bukold, S. (1993) Logistics by Combined Transport: Barriers to Market Entry and Strategies of Main Suppliers, *International Journal of Physical Distribution and Logistics Management*, Vol. 23, No. 4, pp. 24-34.

replacement of resources is foreseen[52]. Consequently, it is not believed that the post-panamax vessels are appearing now just by chance. Nevertheless, it will not be a total replacement over a short period of time, and it is absolutely crucial to the system's efficiency that the new technologies can work together with the old ones.

4.2.3.3 Financial aspects

Short-term thinking dominates current business, making longer-term agreements very difficult. Financial and operational agreements on inventory ownership, sharing investment costs and benefits, pooling resources, and sharing forward business plans are indispensable to the success in supply chain network practices.[53]

As should have become clear, there is a multitude of barriers to the coherent improvement of the environmental performance in a supply chain. The next section will, thus, deal with possible strategies to overcome or offset the importance of the barriers.

4.3 Strategies

The strategies presented are intended as guidance for approaching sets of problems rather than solving separate problems. Consequently, the strategies are rather theoretical than checklists for the system's designer.

4.3.1 To conform firmly to regulations, standards and prevailing technologies

The first and most obvious strategy is simply to comply with the restrictions set by the system's environment and not to seek to combat or change them. This is the safest one, but the price for a large potential market and geographical outreach is the restriction of the possibilities of radical improvements.

4.3.2 To change the barriers or to obtain exemptions

According to the definition of barriers used here, barriers can only be changed through great difficulties or at a high cost. Perhaps the most expensive barrier to change is infrastructure. Even though barriers can be changed over time at a lower cost, the long depreciation times of infrastructure make it hard to overcome infrastructural hindrances.

The regulative barriers guiding the use of infrastructure are often more restrictive than the physical restrictions. If large benefits, especially for society, can be realised, exemptions can be applied for and allowed by authorities. One example of such an exemption is the lifting of the night drive ban in some countries for the local road haulage around intermodal transport

[52] According to SJ, Sweden, the lifetime of a rail wagon is around 20-30 years, but are used for a longer time.

[53] Kampstra et al. 2006, p. 313

terminals. The principle of “give and take” rules apply, meaning that it is suitable to disturb locally if the long haul is undertaken with less disturbance overall.

Exemptions can also refer to restricted parts of a network. By defining roads in different classes, longer vehicle combinations can be permitted on especially suitable links. In the USA special legislation allows longer vehicle combinations on the interstate highways, thus requiring break-points adjacent to the highway before entering local roads. Similar legislation is discussed in Europe where roads might be divided into three classes suitable for lorries with different unit load combinations. On a core network of continental motorways the 25.25 m vehicles used in Sweden and Finland might be allowed.

4.3.3 To create closed systems

It is obvious that the barriers become less dramatic if the scope of the intermodal transport system is restricted. The limitation could regard

- the range of resource variants (e.g. to limit an intermodal service to one strictly defined unit load),
- the range of customers (e.g. to keep the control of the transport chain under one management and direct it to one shipper), or
- the geographical area served by the service (e.g. to serve only one link in a network).

The principle is that by limiting the transport system a more specialised technical solution could be implemented, but one should bear in mind that scale economies and flexibility are lost.

4.3.4 To change technology over time during the system’s investment cycle

New transport systems take time to establish themselves. However, if the technology implementation is led with long-term planning and persistence, it can be strategically managed. Hence, resources can be planned and developed and then implemented when the system and its environment have matured to include the new resource.

One such example is the implementation of the maritime container by Sea-Land under Malcom McLean’s management. With their first generation of container-ships - modified World War II tankers introduced in 1956 - only a restricted number of ports were called and conventional cranes made the container handling an arduous task. The second generation - introduced in 1957 - employed onboard cranes, adding to cost and limiting stacking volume on deck, but facilitating calls at all ports with equipment for moving the containers on the quay. First when many ports had invested in gantry cranes in the late 1960’s the time was ready to introduce container ships as we know them today.

4.3.5 To design one resource to make another superfluous

Instead of optimising combinations of two resources, a single resource can be designed to accommodate the functions of the two resources. The strategies are similar but different to the extent that the resources always go together giving more flexibility but adding costs.

Examples are side-loaders (i.e. vehicles equipped with a hydraulic lift that can trans-ship containers to ground and to rail wagons) and RoRo ships with internal loading ramps making it possible to call at any port with sufficient open space on the quay. Also rail wagons can be built with internal transhipment equipment.

4.3.6 To implement an interface between system resources

Instead of changing technology over night, it is possible to change one resource while letting another remain unchanged for a while. This can be solved by introducing an interface between the resources. Interfaces can also be used permanently when pieces of technology representing different systems must fit together for certain transport assignments. The most common interface is the semi-trailer chassis that is used as an interface between an ISO-container and a semi-trailer tractor. Instead of sending expensive, bulky and heavy semi-trailers by rail, the unit loads are handled as containers on rail but with the use of chassis they are handled as semi-trailers on road. Interfaces can also be used in order to accommodate non-standardised equipment in the standard system.

4.4 Conclusions

Implementing new pieces of technology into existing transport system is a difficult task. As a result, the following provides advice that can be given to transport system operators or designers with technological renewal on the agenda[54]:

- Investigate and analyse barriers carefully before developing and implementing new technology;
- Emphasise the networks effects;
- Decide upon the scope of the new technology;
- Choose an appropriate strategy and apply it;
- Go through the investment analysis algorithm many times and fix variables along the path;
- Learn from earlier success and failure stories.

It should be kept in mind that the whole field of renewing intermodal transport systems is a very delicate and complex matter. One single technology cannot solve all problems globally and certainly not within a short period of time.

[54] J. Woxenius and K. Lumsden (1996) *Implementing new technology in intermodal transport systems – threshold identification and bridging strategies* Chalmers, Paper presented at the conference Techno Ocean ´96, Kobe, Japan.

5 Training and awareness raising

While it is a known fact that the technologies for environmental improvement of freight transport exist, many logistics providers shy away from using them either for economic reasons or due to a lack of interest, knowledge about their advantages and skills.

This surely is not a barrier in the sense defined in this paper, because the lack of information, know-how and even interest can definitely be overcome; here, training and awareness-raising can help managers understand that investing in new technologies and an improvement of the environmental performance can pay off economically. The European Commission acknowledges in its Freight Transport Logistics Action Plan the importance of training for logisticians[55] (see 2.2.2), which involves also the knowledge of how to apply best available technologies in the freight transport sector. The personnel of the logistics sector are therefore the pre-eminent target group for training and awareness raising. Training regarding new technological approaches can be provided to the logistics firms either by external consultants or can be achieved through internal schoolings by experts appertaining to the respective transport firm.

Yet, also the industry buying transport is a target group. Training and awareness raising can have much influence on what kind of supply chain they want to get involved in.

In addition to this, at least awareness raising about environment-related logistics issues and targeted to the public would step up customers' sensibility about what their buying decisions imply. In an indirect way this sensibility might sooner influence industry's decisions on what kind of transport they choose.

A primary objective of the workshop will be to identify best practice examples of how such training and awareness raising should be organised.

In the following sections some examples of existing awareness, information exchange and training activities are given.

5.1 Overview of Research Activities and their Results: Transport Research Knowledge Centre

The Transport Research Knowledge Centre (TRKC) is a web-based information portal. The project aims to illustrate how research programmes and projects help to develop innovative, efficient and cost-competitive technologies and applications. It also shows how these support the European transport policy for sustainable mobility. In short, TRKC is an internet portal providing information on transport research carried out at European, international and national level enabling the interested users to extract the information that they need.

[55] COM(2007) 607, p. 5.

5.2 Project-based awareness raising and training activities

There are many projects dealing with awareness raising and training in the field of transport at the European and national level. These projects are financed for a certain duration.

Many such projects are financed under the EU **Intelligent Energy Europe Programme**. This programme funds projects dealing with an "intelligent" use of energy in different areas including transport.[56]

5.2.1 INTERACTION Programme

The interaction (International Transport and Energy Reduction Action) programme aims to enhance logistics and freight transport performance by shippers to reduce energy consumption, CO_2-emissions and transport costs. The project is part of the IEE(Intelligent Energy Europe) programme of the European Commission and builds on a successful Dutch project (Sectoral Approach, 2005) in which 50 companies linked to six industry associations realised a 5-10% transport costs reduction.

INTERACTION is intended to provide tailored solutions to the participating industry associations and companies. Examples of feasible measures are: clean vehicles, collaboration (e.g. consolidating freight), improvements in internal logistics organisation, modal shift, standardization of loading units, transport avoidance, eco-driving, etc. In collaboration with clients, INTERACTION identifies and helps to implement measures which improve the logistics and freight transport performance. When possible and/or relevant, cross-border supply chain issues are also addressed.

Benefits to the companies include cost-reduction and/or profit maximisation. Benefits for society will be energy and CO_2 reduction.

5.2.2 COMPETENCE Programme

A core project designed to develop training in the transport field is the 30-month **COMPETENCE** programme.

The overall aim of COMPETENCE is to strengthen the knowledge of management agencies in the transport field so that these agencies will:

- support the implementation of relevant policies and activities of the Intelligent Energy Europe Programme;
- promote the up-take of best practice and other measures aimed at increased energy efficiency and use of alternative fuels in transport;
- support local actors to collaborate in relevant programmes and project participation; and
- network at trans-national and national levels.

[56] An overview about other transport-related projects in the framework of the Intelligent Energy-Europe Programme can be found at http://www.ec.europa.eu/energy/intelligent/projects/eetransport_en.htm .

5.2.3 TRAINER Programme

TRAINER stands for TRAining programmes to INcrease Energy-efficiency by Railways[57]. The programme focuses on energy saving on European railways. The programme is implemented by a European consortium of rail companies and partners from the railway sector.

The main competition for rail companies comes from other means of transport, such as road transport. European rail companies can help one another to meet this competition. By cooperating they can learn from each other's initiatives. The TRAINER programme supports this exchange of knowledge and experience with its 'Energy-efficiency Network' by organising meetings and disseminating information on its website.

5.2.4 BESTUFS II project

BESTUFS II is a follow-up initiative of the EU-funded BESTUFS project and aims to maintain and expand an open European network between urban freight transport experts, user groups/associations, ongoing projects, the relevant European Commission Directorates and representatives of national, regional and local transport administrations and transport operators in order to identify, describe and disseminate best practices, success criteria and bottlenecks with respect to City Logistics Solutions (CLS).[58]

BESTUFS II will strengthen and extend the promotion and dissemination of CLS in Europe and beyond, e.g. by establishing new links with other networks, groups and other international Experts that interface with urban freight transport issues.

European best practice and innovation shall be seen to a certain extend also from a worldwide context. Successful CLS innovations elsewhere in the world shall become also known in this European network to check if European cities can profit from international approaches and vice versa.

5.3 Institutional Training and Awareness Raising Activities

Many automotive and logistics associations carry out basic schooling activities to raise the environmental awareness of drivers of cars and lorries ("eco-driving").[59] Some EU Member States have quite advanced legislation concerning environmental driving instructions for

[57] http://www.iee-trainer.eu/ (6 January 2008).

[58] http://www.bestufs.net/index.html (10 January 2008).

[59] see for example www.dekra-online.de/co2/fahrertraining.html (5 January 2008) or http://www.vcd.org/fileadmin/user_upload/redakteure/themen/flottenmanagement/VCD-Empfehlungen_Emissionsminderung_im_Fuhrpark.pdf (5 January 2008).

applicants for drivers' licences. Other private firms specialise in educating drivers of logistics firms in eco-driving and petrol consumption measures.[60]

Specific environmental training tools exist also for Air Traffic Management Staff, such as the e-tools Environmental Awareness [ENV-AWARENESS] and Environment in Air Traffic Management [ENV-ENV], which guide personnel how to raise the environmental quality of their actions.[61]

The following initiatives offer more inclusive services to logistics firms:

5.3.1 Example I: Guidance Book Urban Cargo Transport Verkehrsclub Deutschland

The German Association of Transport (Verkehrsklub Deutschland) has issued a comprehensive guidebook for the environmental optimisation of urban cargo transport.[62] The guide gives concrete best practice examples referring to suitable vehicle design (tyres, exhaust filters), fuel use and fuel consumption control. To optimise routes, achieve higher effectiveness and save costs, the guide recommends and describes the use of telematics and on-board systems.

The Guide also refers to initiatives which have met rather limited success in Germany, as the concept of groupage in city freight transport. In this concept, transport buyers share a certain transport for their goods in order to best use the transport capacity.[63]

5.3.2 Example II: www.Freight.Best.Practice.org.uk

Freight Best Practice[64] is an internet-based tool. It is funded by the UK Department for Transport (DfT) and managed by Faber Maunsell Ltd; its aim is to promote operational efficiency within freight operations in England. Freight Best Practice offers free essential information for the freight industry covering topics such as saving fuel, developing skills, equipment and systems, operational efficiency and performance management.

A series of publications has been made available, for example to help monitor the internal operational performance against Key Performance Indicators (KPIs) and to benchmark operation against the very best of the competition. The Guide to Performance Management for efficient road freight operations[65] incorporates a CO_2 Calculator which helps fleet operators improve their operational efficiency through using KPIs and recording

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[60] http://www.ecocargo.de/website/leistungen.htm (5. January 2008).

[61] http://www.eurocontrol.int/ians/gallery/content/public/docs/pdf/catalogue2008.pdf (6 January 2008).

[62] http://www.vcd.org/fileadmin/user_upload/redakteure/themen/gueterverkehr/VCD-Leitfaden_Gueterverkehr.pdf (5 January 2008).

[63] http://www.vcd.org/fileadmin/user_upload/redakteure/themen/gueterverkehr/VCD-Leitfaden_Gueterverkehr.pdf, p. 11.

[64] http://www.freightbestpractice.org.uk/ (5. January 2008).

[65] www.freightbestpractice.org.uk/download.aspx?pid=172&action=save (10 January 2008).

performance. Furthermore, a guide has been published that shows how to establish the potential performance of fuel saving devices in fleets.

5.4 Existing networks spreading information

In the following sections, examples of industrial or environmental NGO networks in different geographical regions are given, which deal to a certain extent with transport and logistics:

5.4.1 World Business Council for Sustainable Development[66]:

Sustainable Mobility:

The Sustainable Mobility Project (SMP)[67] was a project that analysed how global mobility patterns might evolve in the period to 2030 and beyond, what strategies exist to influence this evolution in ways that might make transport more sustainable, and what is required to enable these strategies to succeed. The project concentrated on mobility issues related to road transportation.

Sustainable Value Chain:

The overall objective of the WBCSD-UNEP/SETAC Initiative on the Sustainable Value Chain is to promote, assist and support life-cycle thinking and life-cycle approaches – including life-cycle management – among WBCSD member companies and their suppliers, customers and value chain partners for the sustainable innovation and global trade of more sustainable products.[68]

5.4.2 Eye for Transport

Founded in 1998, eyefortransport[69] is a global conference organiser dedicated solely to the transport, logistics and supply chain arena. The conferences are focused to reflect the most important issues, current developments and latest trends in the industry, including the environmental quality of freight transport.[70] In addition, eyefortransport is a major provider of Logistics and Transportation information and services.

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[66] The Members comprise BP, Daimler, Ford, General Motors, Honda, Michelin, Nissan, Norsk Hydro, Renault, Shell, Toyota, Volkswagen.

[67] http://www.wbcsd.org/plugins/DocSearch/details.asp?type=DocDet&ObjectId=MTg0 (8 January 2008)

[68] http://www.wbcsd.org/templates/TemplateWBCSD5/layout.asp?type=p&MenuId=MTUyMQ&doOpen=1&ClickMenu=LeftMenu (8 January 2008).

[69] http://www.eyefortransport.com/about.shtml (10 January 2008).

[70] E.g. the Conference “Green Transportation & Logistics World Summit” next February.

5.4.3 T&E European Federation for Transport and Environment

Founded in 1989, T&E is Europe's principal environmental organisation campaigning on sustainable transport. T&E’s primary focus is on European policy, but its work in Brussels is supported by 49 NGO member organisations working in 21 countries to promote an environmentally sound approach to transport.

6 Summary and Conclusions

6.1 Summary

Freight transport is an area with major potential for environmental improvements. Consequently, the European Commission has developed policies directed at a more efficient and environmentally friendly freight transport and aims to improve the environmental impact of freight transport via legislation and specific programmes.

These instruments are concerned with the **optimisation of the routes and capacity use through the use of intelligent technology for all transport modes as well as intermodal transport solutions.** Such an optimisation can be ensured via the promotion of trans-national, well infra-structured **corridors**, the employment of information and communications technology (ICT) is another major and ever more important way to improve and rationalise transport, even though the investment in expensive ICT systems can overburden some SME. Finally, the development of labels certifying a high environmental quality of freight transport is another effective instrument to promote environmental improvements in the freight transport sector.

Aside from the instruments that encompass all transport modes, the European Commission also promotes **inter-modal transport logistics**, thereby improving the interoperability of supply chains and accentuating the role of shipping and railway. These instruments include well-financed technical programmes, such as Marco Polo or NAIADES, and the development of common technical standards (e.g. inter-modal loading unit or the levelling of administrative procedures in shipping). Furthermore, concrete political measures are also foreseen to promote and enhance transport by short sea/inland water way shipping and railway.

While the European Commission and a number of Member States have realised the importance of promoting environmentally friendly freight transport, there are still a number of important barriers which impede the unequivocal uptake of these technologies. These barriers concern:

Technical Barriers:

- Problems of compatibility of standards and norms
- Domineering Technologies throughout a supply chain

Legal Barriers

- Different legal requirements in different countries
- Restrictions of transport (e.g. ban of night traffic and deliveries)

System oriented Barriers:

- Lack of formal and single leadership/championship over the whole system, i.e. all the supply chain
- Repositioning problems

Commercial barriers:

- Lack of co-operation between transport providers and different transport modes;
- Different depreciation periods for resources according to the different transport modes

The strategies aimed at improving freight transport can be developed either by accepting restrictions and developing approaches in sync with the restrictions or by trying to overcome these barriers, e.g. via exemptions or the creation of closed systems (supply chains foregoing the barriers). In any case, the strategies should consist of careful and long-term planning of technology implementation and can at times concentrate on the optimisation of one specific link in the supply chain, for example by creating interfaces between different resources and transport modes to keep compatibility with different systems.

Training is required to inform all companies of the newest technological developments and to raise awareness of best practice cases in the use of these technologies, especially for SME. Industrial networks, transport institutes, specialised web portals and specific EU-funded projects exist that gather and spread knowledge concerning the new technical and practical developments in the transport sector. The workshop will discuss whether the current training and awareness raising activities are satisfying and can be extended or whether they need to be optimised.

6.2 Key Questions

The key questions of the workshop will be:

- To what extent is progressive logistics planning technology used and known to the transport providers?
- Which barriers hindering the uptake of these technologies can be addressed by the European Commission via political actions?
- What are the training and awareness raising needs?
- Best practice examples of training and awareness raising? How can existing information and training tools be optimised?
- How can a working group beyond the ETTAR project be established to support training and awareness raising actions in the freight transport field?