SEVENTH FRAMEWORK PROGRAMME

THEME [7]

Theme Title: Transport (including Aeronautics)

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List of Abbreviations

AIS	Automatic Identification System
AMV	Verkehrsmanagement Audio Mobil (= audio mobile traffic management)
ARD	Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der Bundesrepublik Deutschland (=Consortium of public-law broadcasting institutions of the Federal Republic of Germany)
ASG	Anonymisiertes Sensordaten-Gateway (= anonymized sensor data gateway)
AWEKAS	"Automatisches WEtterKArten System" (= automatic weather map system)
CCTV	Closed-circuit television
CHD	Unified electronic toll system
CSW	Curve Speed Warning
DAB	Digital Audio Broadcasting
DVB	Digital Video Broadcasting
ECDIS	Electronic Chart Display and Information System
ENC	Electronic Navigational Charts
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
FCD	Floating Car Data
FIS	Fairway Information Service
GFS	Global Forecast System
Glonass	Global Navigation Satellite System
GNSS	Global Navigation Satellite System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HGV	Heavy Goods Vehicle
ICT	Information and Communication Technology
ILE	Information for Law Enforcement
IMO	International Maritime Organization
ISA	Intelligent Speed Adaptation
ITS	Intelligent Transportation System
KPI	Key Performance Indicators
LBS	Location Based Services
LDW	Lane Departure Warning
LRIT	Long Range Identification and Tracking
LSVA	Leistungsabhängige Schwerverkehrsabgabe (=Heavy Vehicle Fee)
M2M	Machine-to-machine
MODU	Mobile Offshore Drilling Units
RFID	Radio Frequency Identification
RIS	River Information Services
SBB	Swiss Federal Railways
SCM	Supply Chain Management
SMS	Short Message Service
SOLAS	International Convention for the Safety of Life at Sea
TMS	Traffic Message Channel
TPEG	Transport Protocol Experts Group
UMTS	Universal Mobile Telecommunications System
UN CEFACT	United Nations Centre for Trade Facilitation and Electronic Business
VHF	Very high frequency
VTMIS	Electronic Traffic Management
VTS	Vessel traffic service

Executive Summary

SuperGreen is a project that aims to promote the development of European freight logistics in an environmentally friendly manner. SuperGreen evaluates a series of corridors covering some representative regions and main transport routes throughout Europe. The project's web site is www.supergreenproject.eu.

This report concerns Work Package 4 and Task 4.3, "Potential for green supply chain management". Task 4.3 is based on the ICT cases and ICT applications examined in Task 4.2. The potential for improving the environmental performance of supply chains by means of ICT is evaluated in this Task 4.3 for each case and/or application.

First the indicators were defined for the evaluation of the potential for green supply chain management. The indicators are based on the SuperGreen KPIs, which have been identified in Task 2.2 and on the usability and availability of ICTs from a supply chain perspective.

The evaluation was carried out in two phases. First the usability and availability of the ICTs was evaluated based on three criteria: Availability of ICT solutions; Visibility and availability of information; and Transport chain suitability. The evaluation was done using a scale 1-3. Then the evaluation was done for the environmental and cost efficiency aspects. The seven criteria, which are based on the SuperGreen KPIs, were: *transport avoidance; loading factor incl. return cargoes; cost efficiency of transport chains; service quality: transport; service quality: interface; environmental sustainability; and infrastructure sufficiency*.

Several experts were interviewed in order to get an extensive view of the ICTs and a reliable evaluation of results. In total 54 different ICTs were evaluated. ICTs are divided into seven clusters. Based on the evaluation the following applications achieved the highest ranking in the overall analysis for each cluster:

- Expert charging systems – Unified Electronic toll system (CHD)
- Broadcasting, monitoring & communication systems – Broadband communication
- Centralised transportation management systems – Traffic flow optimization
- Decentralised transportation management systems – Intelligent Speed Adaption (ISA)
- Safety systems – Speed limiter
- E-Administrative Systems – Port Community systems
- Emission footprint calculator systems – Green Truck

The systems with the highest potential for each transport mode were then identified:

- Road: Navigation system for trucks
- Rail: Traffic flow optimisation (ERTMS)
- Inland Waterways: CHD
- Sea: Port Community Systems
- Intermodal: RFID

The results from Task 4.3 will be further considered among others in Task 4.4, "Benchmark Green Corridors with smart ICT".

1 Introduction

The purpose of "SuperGreen" is to promote the development of European freight logistics in an environmentally friendly manner. SuperGreen evaluates a series of corridors covering some representative regions and main transport routes throughout Europe.

This document describes the work completed in Task 4.3 of Work Package 4. The objective of Task 4.3 is to identify the potential of different ICTs for improving the environmental performance of supply chains. The Task is based on the cases examined in Task 4.2. A list of ICT solutions and applications, short term and long term, that will lead to an improved environmental performance is compiled.

Task 4.3 started on 15th of January 2011 as planned and is concluded with this report due 15th of January 2012. There have been four partners involved in this task. The partners involved were: Sito Ltd (task leader), National Technical University of Athens, NewRail - Newcastle University, and Dortmund University of Technology.

In Section 2 of this report the objectives of the SuperGreen project, Work Package 4 and Task 4.3 are described.

Section 3 describes the methodology applied for Task 4.3.

Section 4 presents the results from the ICT evaluation carried out during Task 4.3 together with the analysis of the greening potential of evaluated ICT technologies.

Section 5 presents a summary and evaluation of the findings of Task 4.3 giving recommendations and input for further work in the Work Package 4/ Task 4.4.

2 Objectives

2.1 Objectives of the SuperGreen project

The EU Commission's Freight Transport Logistics Action Plan[1] states that "Logistics policy needs to be pursued at all levels of governance" and introduces a series of policy initiatives and a number of short to medium-term actions to improve efficiency and sustainability of freight transport in Europe. One of these actions is to define "Green transport corridors for freight". In this framework, the SuperGreen project, an acronym for the "Supporting EU's Freight Transport Logistics Action Plan in Green Corridors Issues" project, was launched.

The general objective of the SuperGreen project is to support the development of sustainable transport networks by fulfilling requirements covering environmental, technical, economic, social and spatial planning aspects.

The SuperGreen project is a coordination action. It has sufficient "reach" in the wide area of freight logistics, and it actively contributes by giving input to on-going and new projects so that resources are used most beneficially. The SuperGreen project will:

- Give overall support and recommendations on Green Corridors to EU's Freight Transport Logistics Action Plan.
- Conduct a programme of networking activities between stakeholders (public and private) and on-going EU and other research and development projects to facilitate information exchange, research results dissemination, communication of best practices and technologies at a European, national, and regional scale, thus *adding value to on-going programmes*.
- Provide a schematic for overall benchmarking of Green Corridors based on selected KPIs, also including social and spatial planning aspects.
- Deliver a series of short and medium-term studies addressing topics that are of importance to the further development of Green Corridors.
- Deliver policy recommendations at a European level for the further development of Green Corridors.
- Provide the Commission with recommendations concerning new calls for R&D proposals to support development of Green Corridors.

2.2 Objectives of Work Package 4 and Task 4.3

The objective of Work Package 4 (WP4) is to define and exploit the role of Information and Communications Technology (ICT) flows towards the goal of greener transport. This will be complementary to the objective of and the work in WP3 and will ultimately identify "win-win" solutions and best practices based on implementation of methodologies that achieve a cost-effective utilisation of transport resources on the one hand, and a green supply chain management on the other. As much as this goal seems simple to state, to reach it is anything but trivial. To consider realistic and efficient solutions that will reduce

[1] Communication from the Commission: COM (2007) 607 final – "Freight Transport Logistics Action Plan"

supply chain emissions and at the same time will enhance international trade and will not unduly burden the intermodal transport industry is quite a challenge. WP 4 will develop taxonomy of these problems. Also, a map of relevant policy alternatives and measures will be developed, in an attempt to facilitate recommendations at the policy level (WP 6).

The relations between the WP 4 tasks and other tasks and WPs are as indicated in Figure 1

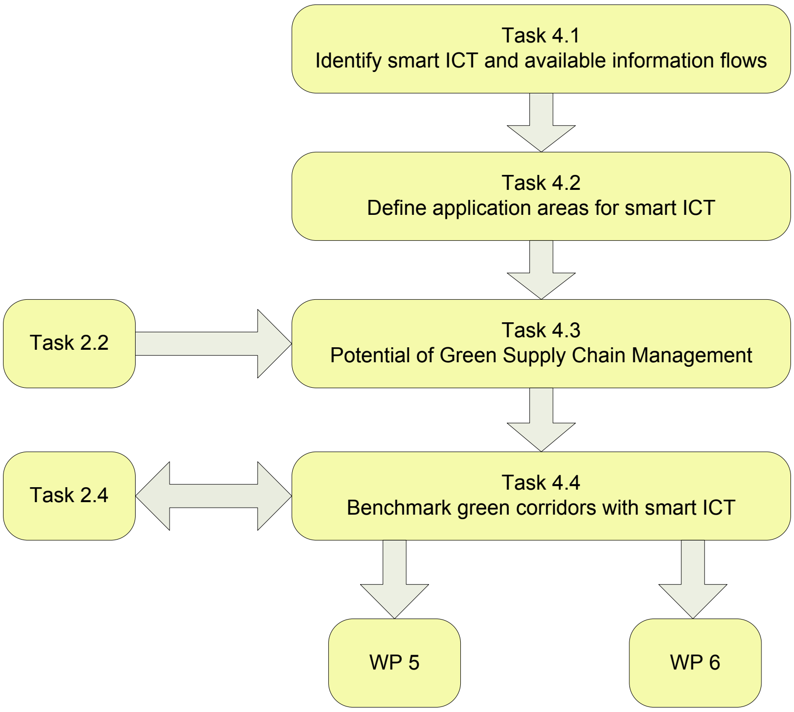

Figure 1 WP 4 "Smart exploitation of ICT-flows" and relations to other WPs and tasks

Task 4.3 is based on the ICTs examined in a previous Task, Task 4.2. The potential for improving the environmental performance of supply chains will be identified for each case and/or application. The list of ICT cases will include both strategic (long-term) and operational (short-term) means. The key performance indicators (KPIs) identified in Task 2.2 will be relevant in this regard.

3 Background and methodology overview

Supply chain management is management of material and information flow in a supply chain to provide the highest degree of customer satisfaction at the lowest possible cost. SCM requires commitment of supply chain partners to work closely to coordinate order generation, order taking, and order fulfillment, thus creating an 'extended enterprise' spreading far beyond the producer's location. The following figure presents the actors and interactions within supply chains.

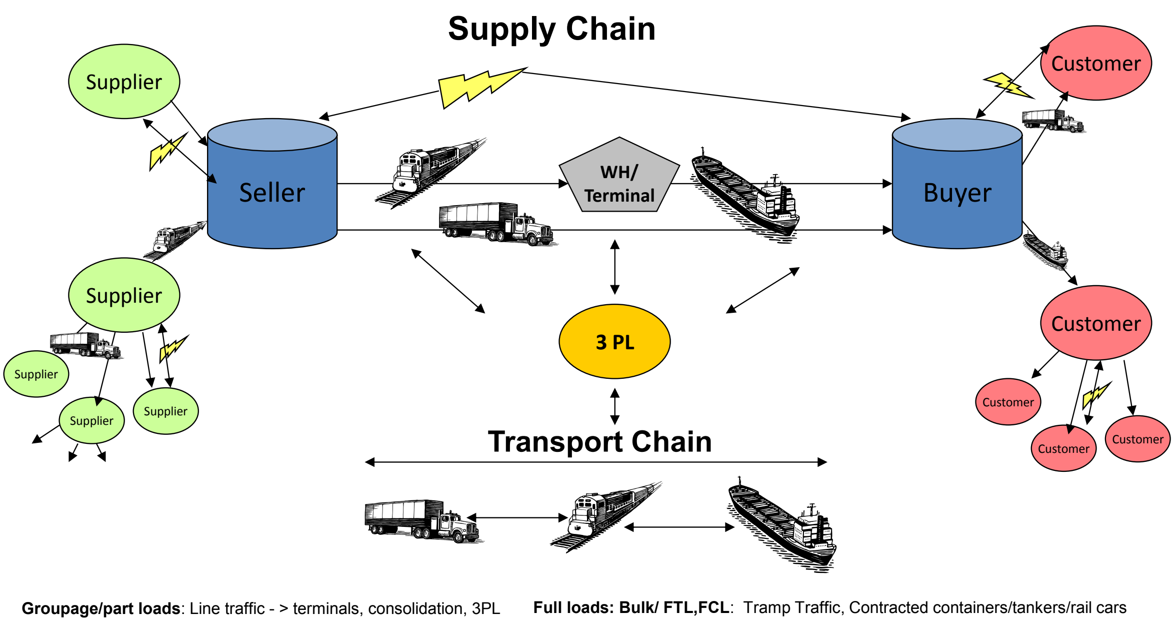

Figure 2 Supply Chain Management

This section gives a general overview of the methodology used in Task 4.3 for identification of the potential of ICTs for improving the environmental performance of a specific supply chain, with details being shown in subsequent sections.

The following picture describes the approach of this task that links different ICT solutions to the supply chain management procedures. Various factors affect the planning and use of ICT solutions in supply chains: company strategies, operational and business environment, operations models, transport modes, geographical locations, etc. The starting point for visibility of information and common development is the trust and cooperation between stakeholders in supply networks. The use of ICT can be an effective tool for avoiding unnecessary transports and reducing emissions by increasing the efficiency of supply chains. Development measures targeted to the supply chain design (starting from logistical product and package design) and management can in some cases be most effective in the sense of greening the transports (compared with solely technological solutions): decrease of unnecessary transports, increased loading factor, outsourcing and optimization of deliveries etc. Implementation of these measures primarily concern private parties, but public stakeholders can contribute with developing and implementing open and common applications and operation models for several supply chains. These kinds of common systems may have wider effects on greening of the transports.

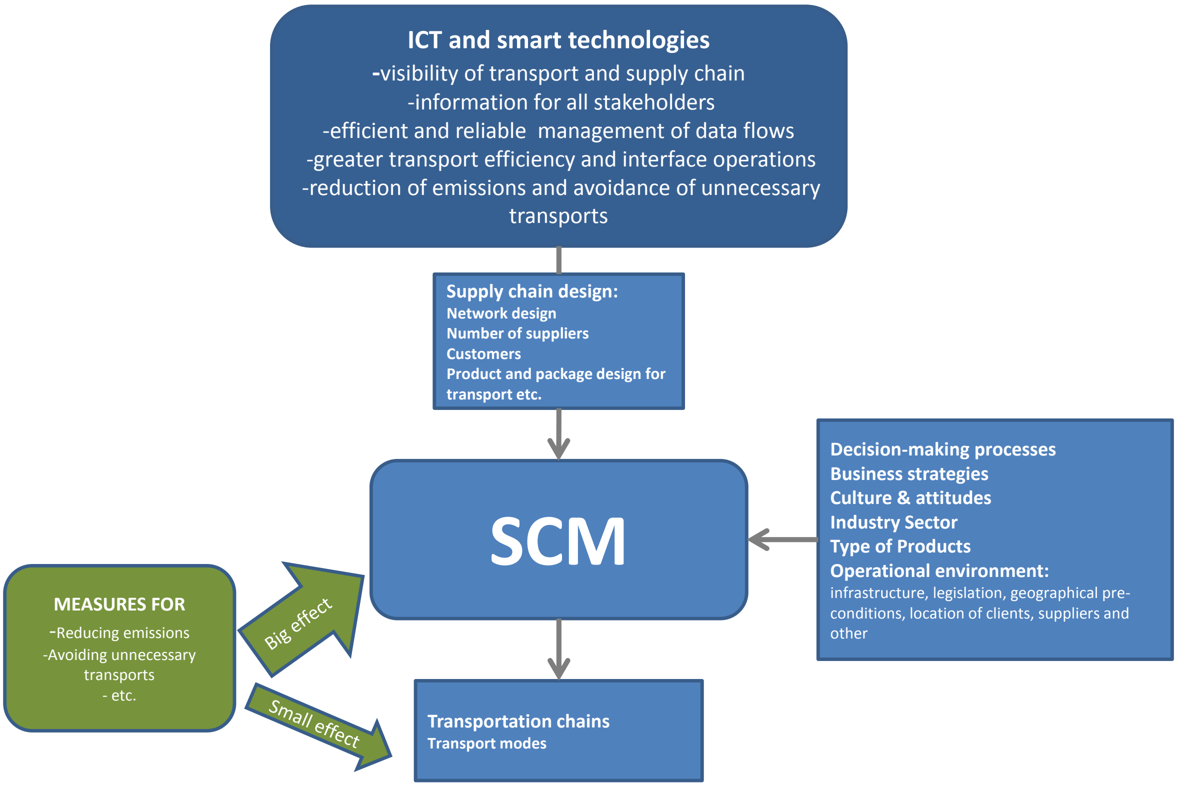

Figure 3 Approach of Task 4.3 – ICTs linked to Supply chain management procedures

Task 4.3 starts out with forming the indicators for the evaluation of the potential of different ICTs for green supply chain management. The indicators are based on the SuperGreen KPIs, which have been identified in Task 2.2 and on the usability and availability of ICTs from a supply chain perspective. Availability is evaluated from three different aspects: availability of ICT solutions; visibility and availability of information; and transport chain suitability.

In total 17 different KPIs were identified in Task 2.2 and grouped into five different categories: efficiency, service quality, environmental sustainability, infrastructural sufficiency and social issues. Based on these KPIs a set of supply chain efficiency indicators is formed. In order to ensure relevant evaluation from supply chain perspective simplified set of KPIs were formed. Supply chain thinking covers many transport chains and all modes, therefore the KPIs have been evaluated at this more general level. Each supply chain efficiency indicator represents the mean value of original indicators. As an example the service quality represents the average qualitative estimation of transport time, reliability, ICT applications, frequency, cargo security, and cargo safety. Transport avoidance and loading factor indicators are related to both environmental sustainability and efficiency KPIs.

By looking at the values of both groups of indicators (availability and efficiency indicators) together the potential for green supply chain management can be identified. The background ideology and the formation of the indicators are described in the following figure (Figure 4).

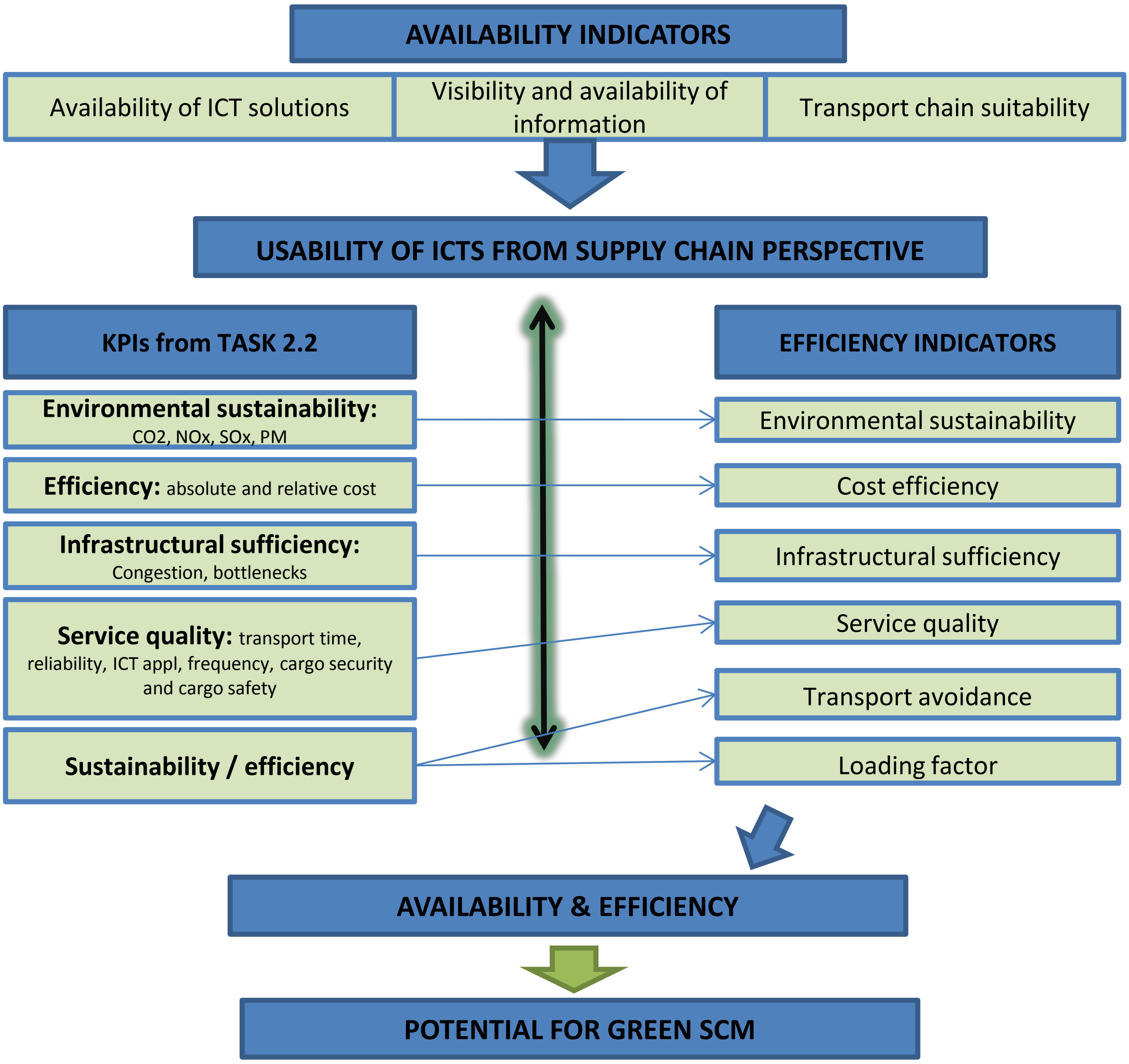

Figure 4 Supply chain indicators

Task 4.3 is based on the ICT cases examined in Task 4.2. The cases are listed in the table on the next page. In Task 4.2 the cases have been divided into seven clusters. The same clusters have been used in Task 4.3 as well.

Table 1Main clusters for smart ICT systems

ICTs	ICT cluster
Unified Electronic toll system (CHD) Congestion Charging Toll amount depending on the pollutant category of the truck (German highway truck toll system)	Expert charging systems
ERTMS Traffic flow optimization, Caesar (or systems of individual operators like kombiverkehr, ökombi, etc) VTS/VTMIS Electronic Traffic Management, River Information Service (RIS) Fairway Information Service (FIS) Information for Law- enforcement (ILE) Traffic control systems (TMC pro/TMC Plus, GPS/GSM) OPTIMAR International networking of national traffic control centres ICT: How to assign icebreakers to other vessels Traffic signaling optimization	Centralised transportation management systems
Platooning Intelligent Speed Adaption (ISA) Speed limits on the highway depending on CO2 emission values (VBA Umwelt Tirol)	Decentralised transportation management systems
Conducted communication systems Broadcasting systems (TMC, TMCpro, TPEG, DVB, DAB) Mobile radio systems (GSM,SMS,GPRS,UMTS) Car-to-X-Communication ENC/ECDIS Broadband communication (WiFi/WiMAX, digital VHF, etc), GNSS (GPS, Glonass, Galileo) Automatic Identification System (AIS) LRIT – Long Range Identification and Tracking, radar SafeSeaNet AGHEERA RFID SCHENKER SMARTBOX Route Guidance systems Personal navigation assistant (Navigationssysteme) Head-up display (HUD) Navigation system for trucks: Map & guide professional	Broadcasting, monitoring & communication systems
Road-weather-information systems (SWIS, AWEKAS, GFS Europa, Coupled general Circulation Models Eumesat Polar Systems (EPS)) Speed limiter Night Vision System Distance control systems Collision warning systems Braking assistant systems Lane Departure Warning (LDW) Lane keeping assistant Adaptive speed limit	Safety systems
Single Window solutions JUP Fretis ShortSeaXML Port Community Systems	E-Administrative Systems
Anonymised sensor data gateway etc	Emissions footprint calculator systems

For each ICT case examined under task 4.2 the potential for improved performance is evaluated, including an evaluation of the greening potential.

The methodology of Task 4.3 is described in the Figure 5. Seven application areas and 54 different applications were derived from Task 4.2. The evaluation is carried out in two phases. First the usability of the applications is evaluated. Then the different aspects of environmental performance and cost efficiency are evaluated.

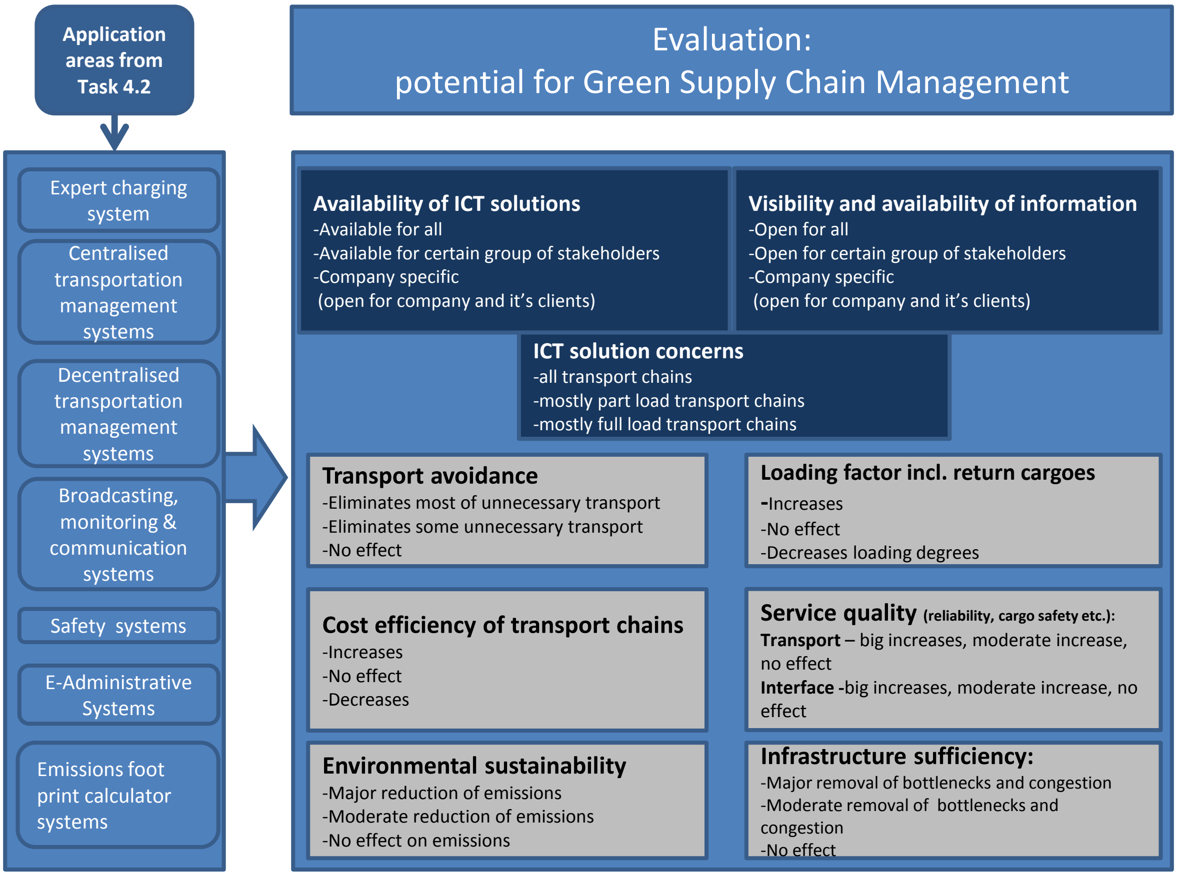

Figure 5 Methodology of Task 4.3

After the identification of supply chain indicators, the actual evaluation is carried out. The evaluation process is divided in the following five steps:

Step 1: Identification of the cases / applications and allocation of work based on transport modes for each partner. Each partner will have 12-14 ICT applications to evaluate.

Step 2: Description of ICT applications. Each partner works out a short description of each application assigned to them.

Step 3: Actual evaluation. The evaluation is done with help of external experts. The experts can be either interviewed or invited to a workshop where the evaluation is carried out. Evaluation is done by using an Excel-document designed for that purpose (see tables 2-8).

Step 4: Evaluation of results. Each partner writes down the evaluation results together with the analysis of each system.

Step 5: Common analysis and reporting. Results are then combined and common analysis of each cluster and final reporting is carried out by task leader.

4 Evaluations of different ICTs

The potential of ICT for green Supply Chain Management has been evaluated for 54 different ICT solutions or applications. The results of the evaluation are presented in seven different ICT clusters as defined by deliverable D4.2 and also given by Table 1:

1. Expert charging systems
2. Broadcasting, monitoring & communication systems
3. Centralised transportation management systems
4. Decentralised transportation management systems
5. Safety systems
6. E-Administrative Systems
7. Emissions footprint calculator systems

Each system is first given an overall description. Systems are then evaluated based on the availability and visibility of the system as well as on the basis of environmental performance and cost efficiency. The latter evaluation is based on the KPIs developed in WP 2. The evaluation has been carried out using a scale 1-3, with 3 as the best score. The results are hence indicative estimates of the experts on how different ICTs may affect environmental performance of supply chains.

It should be noted that data relevance and quality is dependent on expert / interviewee selection. The selection of interviewees in this Task may lead to some results.

For each system it is indicated in which of the SuperGreen corridor(s) the system has been pointed out. This is done based on the information gathered from D4.2. Short descriptions of each SuperGreen corridor can be found from Annex 1. At the end of each cluster a short overall analysis is given.

4.1 Expert charging systems

Congestion charging is a system of surcharging users of a transport network in periods of peak demand to reduce traffic congestion. Examples include some toll-like road pricing fees, and higher peak charges for utilities, public transport and slots in canals and airports. This variable pricing strategy regulates demand, making it possible to manage congestion without increasing supply. Market economics theory, which encompasses the congestion pricing concept, postulates that users will be forced to pay for the negative externalities they create, making them conscious of the costs they impose upon each other when consuming during the peak demand, and more aware of their impact on the environment. The application on urban roads is limited to a small number of cities, including London, Stockholm, Oslo, and Milan, as well as a few smaller towns. Four general types of systems are in use; a cordon area around a city centre, with charges for passing the cordon line; area wide congestion pricing, which charges for being inside an area; a city centre toll ring, with toll collection surrounding the city; and corridor or single facility congestion pricing, where access to a lane or facility is priced.

The availability of the ICT solution as well as the visibility and availability of information concerning congestion charging is evaluated to be "available/open for all" or "available/open for certain group of stakeholders" by the experts. The majority of the experts considered this ICT to be available respectively open for all. One reason for this rather clear statement might be that the public authority would be responsible for a congestion charging system. As a public system, most likely enforced by legislation, it should be available, visible and open to everybody. This ICT solution is unanimously evaluated to be covering all transport chains, meaning this ICT is applicable to all types of transport chains.

The experts` evaluation of the congestion charging ICT is that this system eliminates unnecessary transport. Half of the experts, however, are of the opinion that this system has no effect on the amount of goods transported. In terms of loading factors (incl. return cargoes) the experts on average think that this system will have no effect, one expert expecting even decreasing loading degrees. The cautious evaluation of the KPI „Loading factors“ concerning a Congestion Charging system can be supported by figures of the development of deadhead mileage in Germany. The implementation of a toll for trucks in 2005 had little to no effect on the loading degrees, as reduction of deadhead mileage was already a long term trend [BGL11]. On the cost efficiency of transport chains regarding this ICT half of the experts estimate that the cost efficiency will increase, whilst the others expect a decrease in cost efficiency. Regarding service quality the experts were asked to evaluate the transport and the interfaces. For "Service quality: Transport" the results vary. On average the experts evaluate that a congestion charging system will have no effect. However, this value comprises evaluations ranging from "increase" to "no effect" to "decrease". For "Service quality: Interface" the experts agree upon that this ICT will have no effect, one expert differs from this estimation, saying it will decrease the service quality concerning the interface(s). Significantly the experts do not estimate that a congestion charging system will have severe negative effects on the service quality although a reduction of (unnecessary) transport might likely result in tighter schedules or smaller time frames for pick-up and delivery in order to operate more economically. Regarding the KPIs "Environmental sustainability" and "Infrastructure sufficiency" the evaluation was unanimously expecting that emissions will be reduced and infrastructural insufficiencies will be removed. The reduction of emissions and the removal of infrastructural insufficiencies correspond with the positive estimation on the avoidance of unnecessary transport. The system has been pointed out in Brenner corridor.

The installation of a **unified electronic toll system (CHD)** is motivated by the excessive number of different toll systems in some sections or countries. Comprising different toll systems into a unified electronic toll system can bring benefits in terms of a decrease in local congestion around toll stations, a multitude of unnecessary frequent decreases of speed and resulting in fewer emissions. The system is evaluated to be available for certain groups of stakeholders by the experts. Regarding visibility and availability of information the experts` unanimous evaluation is that this ICT is open for all. This ICT is evaluated by most of the experts to be applicable to all transport chains. One expert is of the opinion that this ICT mostly covers full load transport chains.

The experts` evaluation of a unified electronic toll system is on average that this system will have no effect in terms of transport avoidance. One expert deviates from this, expecting a decrease of unnecessary transport. Also it is unanimously evaluated that it will have no effect on loading factors (incl. return cargoes). The cost efficiency of transport chains is also on average not affected by a unified electronic toll system. But the experts` evaluation includes all possible scenarios from an increase in cost efficiency to having no effect to a decrease in cost efficiency. The service quality in terms of *transport* can be increased according to the experts. The service quality in terms of *interface* is not evaluated similarly precise; with half of the experts expecting an increase in service quality while the other experts expecting this ICT will have no effect. The experts evaluate the KPI "Environmental Sustainability" identically. The only unanimous decision was made on the KPI "infrastructure sufficiency" expecting the unified electronic toll system will remove infrastructure insufficiencies. The high ratings of the KPIs "Service quality: transport" and "Infrastructure sufficiency" in contrast to the other KPIs might be attributed to the structure of this ICT. Because this system does not aim for a change in the existing toll systems, but for bundling these systems with electronic payment, waiting times at toll stations can be minimized, while other KPIs such as "Transport avoidance" or "Loading factors" remain unaffected. The system has been pointed out to be in use in Brenner and Strauss corridors.

Toll amount depending on the pollutant category - At the registration the correct pollutant category of the truck must be specified (A, B, C or D). Automatic control bridges identify the passing trucks and control the registered pollutant category. The toll is calculated depending on the toll route, as well as based on the pollution class of the vehicle, its weight and the number of axles on the vehicles.

The availability of the ICT solution concerning a system for charging a toll amount depending on the pollutant category is evaluated to be available for certain groups of stakeholders. Regarding visibility and availability of information the experts` opinions vary from "open for all" to "company specific". Half of the experts evaluate this ICT to be open for a certain group of stakeholders. However, according to a wide range of evaluations, the average of 2.0 points has to be rated appropriately. The coverage is evaluated similarly.

The experts` evaluation on the KPI "Transport avoidance" is split. Half of the experts estimate that this system will have no effect on unnecessary transport, while the others expect that it will eliminate unnecessary transport. The effects of the loading factors are rated worse than the effects on the previous KPI with an average of 1.6. The estimated low impacts on loading factors are also displayed in figures concerning the German toll system, which also includes the emission category of a vehicle in order to calculate the amount duly. After its establishment in 2005 the amount of eco-friendly vehicles did not increase significantly, but is still aligned to the obligatory Eurocode for emissions of trucks [BGL10]. In this respect it was argued that the regulations by the Eurocode are stricter than the impact of the German toll system. Moreover, the life cycles of trucks are quite short and purchasing new trucks results in purchasing updated technology according to the current Eurocode regulations [DOL07]. The experts evaluate this ICT to have no effect or even to decrease loading factors. On the effects of cost efficiency of transport chains the experts disagree. The experts evaluated this system to have no effect, neither increase nor decrease to the cost efficiency. The evaluation of the two service quality KPIs "Transport" and "Interface" is similarly diverging. On both KPIs the experts disagree with expecting every possible scenario. This ICT is clearly evaluated to affect environmental sustainability. In terms of infrastructure sufficiency the evaluation states on average that a system calculating the toll amount depending on the pollutant category will reduce insufficiencies.

A system for charging toll amount depending on pollutant category has been pointed out in Brenner and Edelweiss corridors. The following figure summarises all the expert charging systems and indicates in which corridor each of them has been pointed out in D4.2.

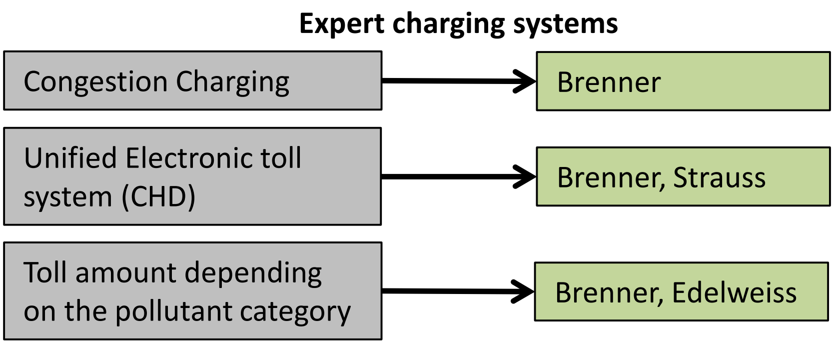

Figure 6 Expert charging systems pointed out in different corridors

Table 2 Expert charging systems - evaluation results

ICT Applications EVALUATION (1-3)	Availability of ICT solutions	Visibility and availability of information	Transport chain suitability
Congestion Charging	2,75	2,75	3,00
Unified Electronic toll system (CHD)	2,75	3,00	2,50
Toll amount depending on the pollutan	2,25	2,00	2,25
	3= Available for all	3 = Open for all	3 = All transport chains
	2 = Available for certain group of stakeholders	2 = Open for certain group of stakeholders	2 = Mostly part load transport chains
	1 = Company specific (open for company and it's clients)	1 = Company specific (open for company and it's clients)	1 = Mostly full load transport chains

ICT Applications EVALUATION (1-3)	Transport avoidance	Loading factor incl. return cargoes	Cost efficiency of transport chains	Service quality: Transport	Service quality: Interface	Environmental sustainability	Infrastructure sufficiency
Congestion Charging	2,50	1,60	2,00	1,75	1,75	3,00	3,00
Unified Electronic toll system (CHD)	2,25	2,00	2,25	2,75	2,50	2,50	3,00
Toll amount depending on the pollutan	2,50	1,60	2,00	1,75	2,25	3,00	2,50
	3 = Eliminates unnecessary transport	3 = Increases	3 = Increases	3 = Increases	3 = Increases	3 = Reduction of emissions	3 = Removal
	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect
	1 = Increases unnecessary transport	1 = Decreases loading degrees	1 = Decreases	1 = Decreases	1 = Decreases	1 = Increase of emissions	1 = Increase of operational bottlenecks and congestion

4.2 Broadcasting, monitoring & communication systems

Intelligent Transportation System (ITS) adds information and communications technology to transport infrastructure and vehicles in an effort to manage factors that typically are at odds with each other, such as vehicles, loads and routes to improve safety and reduce vehicle wear, transportation times, and fuel consumption. ITS (=Intelligent Transport Systems and Services) is identified as a tool to improve traffic safety with automatic enforcement and safety systems to ensure the capacity of network with electronic fee collection based on satellite positioning and to support the logistic processes with telematics. Intelligent transport systems vary in technologies applied, from basic management systems such as car navigation; traffic signal control systems; container management systems; variable message signs; automatic number plate recognition or speed cameras to monitor applications, and to more advanced applications that integrate live data and feedback from a number of other sources, such as parking guidance and information systems; weather information; and the like. Additionally, predictive techniques are being developed to allow advanced modeling and comparison with historical baseline data.

ITS is the major term covering all broadcasting, monitoring and communication systems, hence these systems are in use in all SuperGreen corridors.

Mobile radio systems (GSM, SMS, GPRS, UMTS) and **Broadband communication (Wi-Fi/WiMAX, digital VHF)** are communication systems that allow the use of different applications. These systems, which are available for all actors, usually in themselves do not improve environmental performance or efficiency of the transport / supply chains, but they enable and are crucial in the effective use of different applications which in turn have positive impact. These systems have been especially pointed out in Brenner, Two Seas, Silk Way and Edelweiss corridors.

Broadcasting systems (TMC, TMCpro, TPEG, DVB, DAB) There are analogue data channels like RDS TMC and TMCpro and digital signal transmission like TPEG, DVB and DAB. These systems are also used to broadcast traffic information. The broadcast radio can be used for the traffic control system in both a collective and individual way. Individual means the user only receives traffic information tailored to meet his actual situation by positioning technology, e.g. navigation systems with GPS. Otherwise all receivers within the transmission range obtain the transmitted information collectively.

TMCpro is based on TMC but, in contrast to its predecessor, it is fee-based. It is transmitted by RDS data channel as TMC. The service is available in Germany since April 2004 and is financed through the more expensive navigation systems which are compatible with TMCpro (about 50 € additional costs). Unlike its predecessor, TMCpro is only transmitted by private radio stations, not by the public ARD radio stations.

Another difference between TMCpro and TMC are the sources of traffic information. The service of TMCpro uses in addition to the described sources of TMC:

- about 4.000 radar sensors at German motorway bridges,
- about 5.500 induction loops,
- data from the road construction department,
- more than 10.000 vehicles, mounted with Floating Car Data-technology (FCD)

The radar sensors are solar-powered and they are installed mainly on motorway bridges at an average interval of 4 km. The radar sensors measure the speed of the vehicle and separate the cars from the trucks. If it registers a deviation from the standard values, it transmits the captured data via SMS through the GSM network to a computer centre. Induction loops are wires which are integrated into the carriageway, they react to metal and this allows the number, the type and the speed of vehicles to be determined. Floating car data is not determined by stationary detectors, they are transmitted from the driven vehicle. These signals can be transmitted to following vehicles via radar or short wave radio transmissions and made anonymous by GSM and transmitted cost free to traffic management centres. The position, determined by GPS, and the current speed of the vehicle fitted with FCD are captured, which predicts the development of the traffic situation. TMCpro can inform their users more precisely about the formation of dangerous situations and the associated road clearance by using these additional data collection devices.

The service is available on more than 90 per cent of the German motorways according to the provider, but it is encrypted when broadcasted. Only TMCpro-enabled navigation systems can receive it. An additional decoder is necessary to upgrade a system which is only compatible to TMC.

Since the end of 2008 the service of TMC PLUS is provided by ASFINAG Verkehrstelematik GmbH, the Austrian equivalent of TMCpro. It is also encrypted when broadcasted and accesses additional information sources, as in the German system. In Austria, too, additional detectors support the data capture and offer near-real-time information.

The use of broadcasting systems eliminates unnecessary transport and help in avoiding traffic jams as the information guide traffic to use the best possible routes. With the reduction of unnecessary transport emissions are also reduced. Service quality and cost efficiency of the transport chains are also improved with effective communication. These systems have been especially pointed out in Brenner, Two Seas and Edelweiss corridors.

GNSS (GPS, Glonass, Galileo) in general is a system of satellites that provides autonomous geo-spatial positioning with global coverage. It allows small electronic receivers to determine their location (longitude, latitude, and altitude) within a few metres using time signals transmitted along a line-of-sight by radio from satellites. A satellite navigation system with global coverage may be termed a global navigation satellite system or GNSS. Global Positioning System (GPS) is a space-based global navigation satellite system (GNSS) that provides location and time information anywhere on the globe, where there is an unobstructed line of sight to four or more GPS satellites. GLONASS (Global Navigation Satellite System) is a radio-based satellite navigation system operated for the Russian government by the Russian Space Forces. It is an alternative system to the United States' Global Positioning System (GPS), the Chinese Compass navigation system and the Galileo positioning system of the European Union.

GNSS system is available to all having the appropriate equipment. Visibility and coverage is all over the globe. GNSS improves navigation, transport economics and consumption at sea hence it is an eco-friendly ICT. On the other hand it can avert casualties like collisions helping to limit risk to safety and the environment. GNSS has a little or moderate effect on transport quality, loading factor and service. These systems have been pointed out in Silk Way corridor.

AIS (Automatic Identification System) is an automated tracking system for vessels and Vessel Traffic Services (VTS). AIS provides information such as identification, positioning, course and speed It is used for identifying and locating vessels by electronically exchanging data with other nearby ships and VTS stations. AIS displays incoming vessel information on a suitable device, collects vessel movement information and assembles it into an AIS compliant data sentence and Initiates and controls the flow of data sentences between participating units.

AIS is available to all having the appropriate equipment. Not all vessels are equipped with the AIS system. Visibility and coverage is limited to specific regions until the implementation of satellite AIS. The AIS sender and receiver are generally present on the big ship and the information is often available through dedicated internet sources (e.q. marine/traffic or Bloomberg). An AIS system has limited coverage based on radars specifications but this problem will be overcome with the implementation of satellite AIS.

AIS information supplements marine radar, which continues to be a vital method of collision avoidance for waterborne transport, hence it averts marine casualties and environmental pollution. AIS has little or no effect on transport avoidance, loading factor and Cost efficiency of transport chains. The system has been pointed out to in Mare Nostrum, Silk Way and Nureyev corridors.

The **Long Range Identification and Tracking (LRIT)** system is a designated International Maritime Organization (IMO) system designed to collect and disseminate vessel position information received from IMO member States ships that are subject to the International Convention for the Safety of Life at Sea (SOLAS). LRIT consists of the ship borne LRIT information transmitting equipment, the Communication Service Provider(s), the Application Service Provider(s), the LRIT Data Centre(s), including any related Vessel Monitoring System(s), the LRIT Data Distribution Plan and the International LRIT Data Exchange. Certain aspects of the performance of the LRIT system are reviewed or audited by an LRIT Co-ordinator acting on behalf of all Contracting Governments. LRIT regulation requires operators of ships regulated by SOLAS contracting governments and engaged on international voyages, including passenger ships, cargo ships of 300 gross tonne and above, and Mobile Offshore Drilling Units (MODUs), to provide compliant ship borne equipment for the transmission of LRIT information. Inmarsat C equipment already installed on the majority of vessels is frequently used for LRIT compliance. Dedicated terminals based on Inmarsat M2M and Iridium can also be used.

LRIT is available to all having the appropriate equipment and comply with the IMO regulation for the system. The coverage and visibility is wider than AIS. The system has the same functional characteristics as AIS. LRIT information can be used for Security, Safety and Environmental protection, and the system has the same characteristics as AIS. LRIT as AIS can increase travelling distances for safety rules, hence cost can be increased but by minimising risk the overall economic impact is rather positive. The system has been especially pointed out concerning Silk Way corridor.

SafeSeaNet is a vessel traffic monitoring and information system, established in order to enhance:

- Maritime safety
- Port and maritime security
- Marine environment protection

SafeSeaNet was established as a centralised European platform for maritime data exchange, linking together maritime authorities from across Europe.

SafeSeaNet is available in EU and all vessels having AIS system. Also National Competent Authority, Local Competent Authority and other EU bodies and Member State institutional users with an interest in maritime information may apply to become users of SafeSeaNet.

The SafeSeaNet has the same characteristics as AIS and LRIT. SafeSeaNet Features: traffic management, search-and-rescue, banned vessel tracking. SafeSeaNet provides early identification of high-risk vessels, earlier precautionary actions and risk mitigation, improved emergency response to incidents or pollution and increasing the efficiency of port logistics (e.g. providing more accurate estimated times of arrival, details of waste handling, etc.). SafeSeaNet has positive effect on environmental performance. The system has been pointed out in Silk Way corridor.

ECDIS system displays the information from electronic navigational charts (ENC) and integrates position information from the Global Positioning System (GPS) and other navigational sensors, such as radar and automatic identification systems (AIS). ECDIS is a computer-based navigation information system that complies with International Maritime Organization (IMO) regulations

ECDIS is available to all vessels having the appropriate equipment. ECDIS was developed in order to provide ships' navigators with a tool to manage their course, real time monitoring their position, avoid collisions and groundings and improve situational awareness. In that sense ECDIS has a positive impact on environmental criteria. The system has been pointed out concerning Silk Way corridor.

Conducted communication system is traffic control installations centrally controlled by signal cable or data line. These include optical signalling systems in cities and traffic guidance systems on motorways. Traffic guidance systems can inform, control and direct the traffic. They inform road users immediately about the traffic conditions of the road segment ahead and give instructions or recommendations (Variable traffic signs, Dynamic variable text displays, Variable direction signs, optical signalling devices). Road control systems use variable traffic signs to control the traffic on a long road section according to the traffic situation. They are installed in the form of an optical-fibre matrix or LED display unit on gantries or beside the road.

These signalling and guidance systems decrease delays and hence increase service quality of transport chains as well as cost efficiency. Infrastructure sufficiency will improve as congestion and other operational bottlenecks can be removed. There are also positive effects on environmental sustainability. The system has been pointed out in Brenner, Two Seas and Edelweiss corridors.

AMV Verkehrsmanagement Audio Mobil - Real-time car data (time, position, speed) from the on-board ASG (Anonymisiertes Sensordaten-Gateway) is transmitted to a computer (Clearingstelle) and formed into floating car data (FCD), it is made anonymous. By real-time data it is possible to control traffic by adaption of traffic lights and signs to the actual demand situation.

The system itself and the information in it are only available for certain groups of stakeholders. However the effects are visible for all road users. The system can have some positive effects to cost efficiency and service quality. Emissions might also slightly be decreased as well as bottlenecks and congestion. However the effects are seen to be quite moderate. The system has been pointed out especially in Edelweiss corridor.

Car-to-X-Communication, also known as Vehicle-to-X-Communication, is an ICT system which enables the exchange of information and data between vehicles (Car-to-Car Communication) or with the infrastructure (Car-to-Infrastructure Communication) with the intention to report to the driver critical and dangerous situations at an early stage. The vehicles collect data like steer angle, position, direction and speed. This information will be evaluated and transmitted via radio (W-LAN) to other road users or to the infrastructural facilities.

At this point the system is available to only certain groups of stakeholders. Most of the actual applications are still in development phase and are not widely available. The information in the system is visible for all and the systems can be used throughout the whole road transport chain. By distributing the information about the present status and different circumstances, the system contributes to avoid and mitigate disturbances. This leads to improved service quality and cost efficiency. The system has been pointed out in Brenner and Two Seas corridors.

Route guidance systems – This group includes personal navigation assistants as well as navigation systems for trucks. Route guidance systems and navigation assistants are available for all as well as the information in the systems. The systems can be used throughout the whole road transport chain.

The usage of special maps for trucks guide them on dedicated truck routes taking into account height and weight etc. The systems (e.g. Map&guide professional) offer optimized route planning with truck routing based on vehicle type and integrated truck and hazardous goods data for Europe; calculation of exact transport costs including vehicle costs, diesel consumption (depending on uphill and down incline), toll, special toll and LSVA; scheduling and vehicle assignment planning that accounts for driving times and rest periods; integrated CO_2 emission calculation and integrated freight exchange system.

Route guidance systems help in eliminating unnecessary transport. With these systems increased cost efficiency of transport chains is obtained. Route guidance systems also increase service quality and contribute to reducing the emissions. With less unnecessary transport infrastructure sufficiency improves. These systems have been pointed out in Brenner, Two Seas and Edelweiss corridors.

There are company specific ICT systems that provide **real time tracking** of containers, assets and shipments. Examples of this kind of systems are Schenker Smartbox and Agheera. Smartbox has GPS real time tracking that offers a dedicated solution for time-critical shipments. Sensor technology allows parameters such as temperature, humidity, door alarm and vibration to be measured and transmitted with position data provided by GPS. These telematics data are then stored in the customer information system (CIS) and customers are able to access it any time. Agheera offers real time tracking services for all transport modes on a global scale. It can be used with permanent tracking devices to track trucks, trailers and swap bodies or with no permanent tracking devices to track current pilots for single shipments, pallets or container boxes. The system offers worldwide tracking based on the GSM network including vehicle data. It allows tracking parameters such as temperature, humidity, shock or light. The integrity status is also monitored e.g. E-seals for containers.

As the systems are company specific the information is only visible to the company and its customers. The systems can be used in all kinds of transport chains. Service quality will be improved as the shipments can be traced from origin to destination. These systems have been pointed out in Mare Nostrum, Brenner, Finis Terrae, and Two Seas corridors.

RFID is a technology that uses radio waves to transfer data from an electronic tag, called RFID tag or label, attached to an object, through a reader for the purpose of identifying and tracking the object. RFID technology is available for all, however when in use the information is visible only for certain groups of stakeholders. RFID can be applied to all transport modes and to all transport and supply chains.

With RFID transport chains can be significantly improved, loading factors will be increased as well as cost efficiency. The use of RFID technology has also positive effect to the service quality of the transport chains. RFID has been pointed out in Mare Nostrum, Two Seas, Silk Way and Finis Terrae corridors.

Head-up display is transparent display that presents data without requiring the user to look away from his or her usual viewpoint. The technology is quite expensive and is applicable in addition to airplanes mainly only to trucks. The data presented is only visible to the user. This kind of technology helps the individual driver/user. It has no environmental effect and it does not improve the cost efficiency of transport or supply chains.

Head-up display has been pointed out in Two Seas corridor. The figure in the following page summarises the cluster by presenting in which of the SuperGreen corridor(s) each of the systems have been pointed out in D4.2.

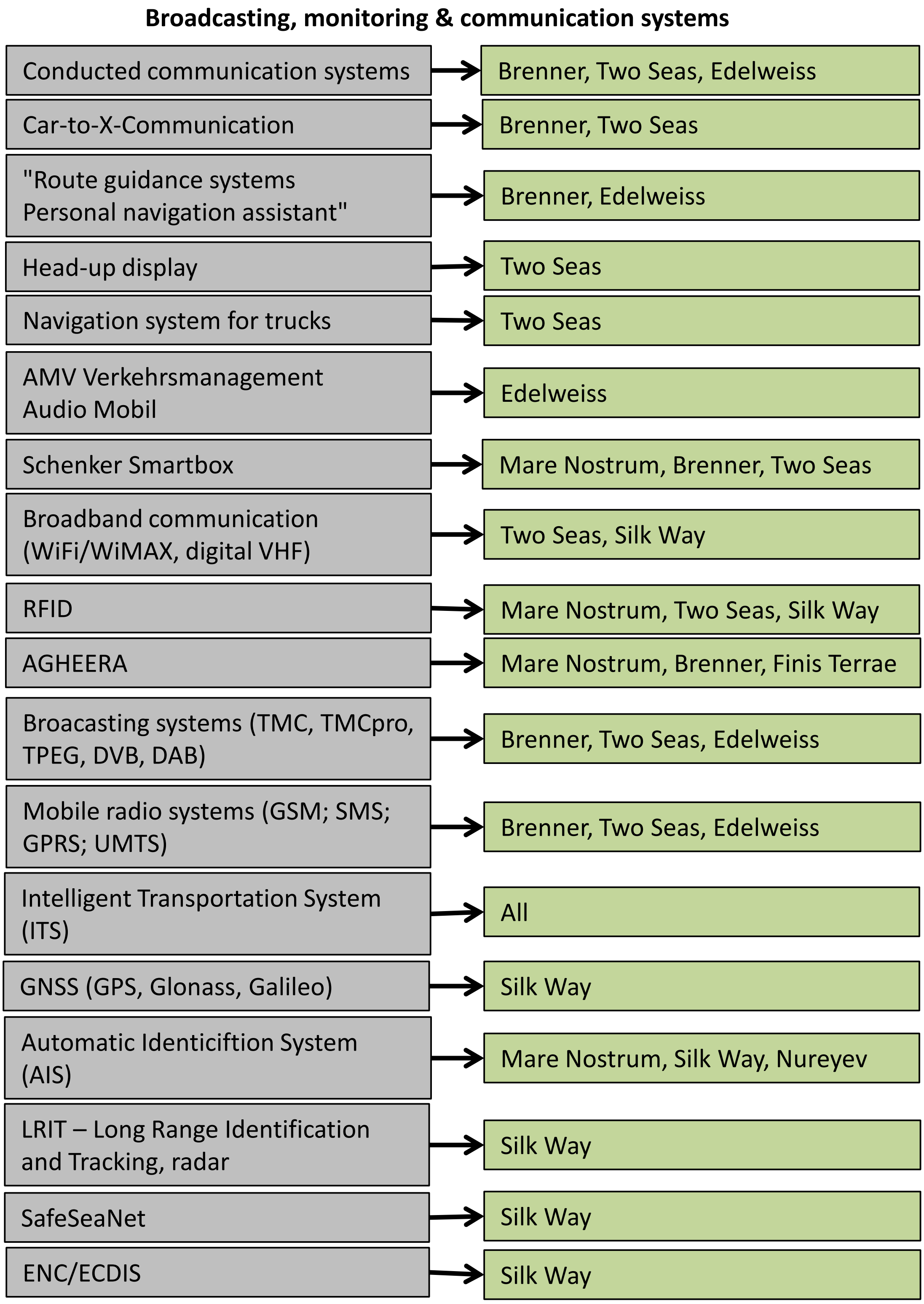

Figure 7 Broadcasting, monitoring & communication systems pointed out in different corridors

Table 3 Broadcasting, monitoring & communication systems – evaluation results

ICT Applications EVALUATION (1-3)	Availability of ICT solutions	Visibility and availability of information	Transport chain suitability
Conducted communication systems	2,00	3,00	3,00
Car-to-X-Communication	2,00	3,00	3,00
Route guidance systems Personal navigation assistant	3,00	3,00	3,00
Head-up display	2,00	1,00	Irrelevant
Navigation system for trucks	3,00	3,00	3,00
AMV Verkehrsmanagement Audio Mobil	2,00	2,00	3,00
Schenker Smartbox	1,00	1,00	3,00
Broadband communication (WiFi/WiMAX, digita	3,00	3,00	3,00
RFID	3,00	2,00	3,00
AGHEERA	1,00	1,00	3,00
Broacasting systems (TMC, TMCpro, TPEG, DVB,	3,00	3,00	3,00
Mobile radio systems (GSM; SMS; GPRS; UMTS)	3,00	2,00	3,00
Intelligent Transportation System (ITS)	3,00	3,00	3,00
GNSS (GPS, Glonass, Galileo)	3,00	2,75	3,00
Automatic Identiciftion System (AIS)	2,38	2,38	3,00
LRIT – Long Range Identification and Tracking,	2,20	2,50	3,00
SafeSeaNet	2,00	2,00	3,00
ENC/ECDIS	2,75	2,67	3,00
	3= Available for all	3 = Open for all	3 = All transport chains
	2 = Available for certain group of stakeholders	2 = Open for certain group of stakeholders	2 = Mostly part load transport chains
	1 = Company specific (open for company and it's clients)	1 = Company specific (open for company and it's clients)	1 = Mostly full load transport chains

ICT Applications EVALUATION (1-3)	Transport avoidance	Loading factor incl. return cargoes	Cost efficiency of transport chains	Service quality: Transport	Service quality: Interface	Environmental sustainability	Infrastructure sufficiency
Conducted communication systems	2,00	2,00	3,00	3,00	3,00	3,00	3,00
Car-to-X-Communication	2,00	2,00	3,00	3,00	3,00	2,00	3,00
Route guidance systems Personal navigation assistant	3,00	2,00	3,00	3,00	3,00	2,00	3,00
Head-up display	2,00	2,00	2,00	2,00	2,00	2,00	2,00
Navigation system for trucks	3,00	2,00	3,00	3,00	3,00	3,00	3,00
AMV Verkehrsmanagement Audio Mobil	2,00	2,00	3,00	3,00	3,00	3,00	3,00
Schenker Smartbox	2,00	2,00	2,00	3,00	3,00	2,00	2,00
Broadband communication (WiFi/WiMAX, digita	3,00	3,00	3,00	3,00	3,00	3,00	3,00
RFID	2,00	3,00	3,00	3,00	3,00	2,00	2,00
AGHEERA	2,00	2,00	3,00	3,00	3,00	3,00	2,00
Broacasting systems (TMC, TMCpro, TPEG, DVB,	3,00	2,00	3,00	3,00	3,00	3,00	3,00
Mobile radio systems (GSM; SMS; GPRS; UMTS)	3,00	3,00	3,00	3,00	3,00	3,00	3,00
Intelligent Transportation System (ITS)	3,00	3,00	3,00	3,00	3,00	3,00	3,00
GNSS (GPS, Glonass, Galileo)	2,38	2,00	2,25	2,50	2,25	2,50	2,08
Automatic Identiciftion System (AIS)	1,88	2,00	2,13	2,63	2,25	2,50	2,13
LRIT – Long Range Identification and Tracking, radar	1,75	2,00	2,00	2,50	2,25	2,50	2,00
SafeSeaNet	1,50	2,00	2,50	2,50	2,00	2,50	2,00
ENC/ECDIS	2,38	2,00	2,00	2,50	2,25	2,50	1,75
	3 = Eliminates unnecessary transport	3 = Increases	3 = Increases	3 = Increases	3 = Increases	3 = Reduction of emissions	3 = Removal
	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect
	1 = Increases unnecessary transport	1 = Decreases loading degrees	1 = Decreases	1 = Decreases	1 = Decreases	1 = Increase of emissions	1 = Increase of operational bottlenecks and congestion

4.3 Centralised transportation management systems

Caesar (or systems of individual operators) provides time schedules for combined transport lines of the main combined transport companies in Europe from terminal-to-terminal. The systems are available to certain groups of stakeholders.

These systems help eliminating unnecessary transport and with that they have positive impact throughout the transport chain. Cost efficiency and service quality will increase, emissions will be reduced and infrastructural sufficiency will be improved. These systems have been pointed out to in Brenner and Edelweiss corridors.

The European Rail Traffic Management System, **ERTMS**, is based on information technologies applied to rail signalling and automatic train speed control. It addresses more than 20 ageing and incompatible systems coexisting today with a modern and interoperable system using digital technologies (Vinck, 2006).

ERTMS is expected to be the only European-wide accepted signalling and control system to ensure that trains run safely and efficiently on the right tracks observing the appropriate speed limits, taking into account the available track geometry and keeping safe distances between running trains based on critical factors like braking characteristics and others.

The result of the interviews shows that ERTMS is available only for certain groups of stakeholders. The implementation were said to be unequally applied and very patchy.

On 20 July 2005, EC appointed six European coordinators for specific priority projects in the trans-European transport network (TEN-T) and entrusted one coordinator with coordinating the ERTMS deployment by 2012-2015. These corridors carry around 1/5 of Europe’s rail freight traffic (EC, 2008). The six corridors are:

- Corridor A: Rotterdam – Genoa
- Corridor B: Stockholm – Naples
- Corridor C: Antwerp – Basel/Lyon
- Corridor D: Valencia – Ljubljana
- Corridor E: Dresden – Budapest
- Corridor F: Duisburg – Terespol/Medyka

Initial implementation of ERTMS on the European rail network is expected to increase capacity by 5% by the year 2020 and 15% by 2030 (Boer et al., 2011). According to the latest studies, a slight increase in available capacity is in fact already achieved by means of ERTMS level 1 and level 2 without optimised block sections (only high-speed lines benefit of it). Application of level 2 with optimised block sections is expected to increase capacity up to 30-40% on conventional main lines and high speed lines. SBB (Swiss Federal Railways) infrastructure manager reported a 15% increase with ERTMS level 2 on optimised lines while NEWOPERA studies (Castagnetti, 2008) identified 16% capacity increase with ETCS level 2. Furthermore, in the case of lines with mixed traffic (passenger plus freight) a capacity increase of up to 25% was reported (Boer et al, 2011).

The interviews show that the visibility and availability of information is relatively open for all. Although at the detail level, there is limited information of what technical problems occur with the implementation. However, it was documented that ERTMS would only make economic sense if all the corridors (long distance ones) are equipped with such technology (Schabert, 2006) which then reinforces questions about its deployment and the benefits that flow from its application.

The interviews show that ERTMS has positive impact for rail operation because of increased volume, enabling extra capacity, more reliability and therefore more product offer and environmentally sound for efficient operation. The only drawback reported at the interview was that ERTMS is still considered as too expensive and that the expected operational benefits still need to be proven. ERTMS has been pointed out to be in use in Brenner, Two Seas, Silk Way, Edelweiss and Finis Terrae corridors.

At a broader level **Traffic flow optimization** is part of the development of ERTMS that uses information derived from signalling system to optimise train operation. A recent technological study of a dedicated rail freight line reported that for software technology, it was identified that no European Rail company was able to calculate a train's expected time of arrival in real time (Dersin, 2008). As a result, trains delayed by more than 10 minutes will automatically loose their planned slot. A train pre-announcing system for disrupted international freight does not yet exist in Europe. Moreover, in emergencies most control centres have no intelligent tools for deciding trains priorities. A combined use of optimisation and rule-based methods are envisaged to overcome these problems of cross border rail circulation (Dersin, 2008).

Research into the management and response to disrupted train operations shows there are methods which could support the infrastructure managers how to best manage such situations and restore services at minimum cost and delay (see for example: Lindner and Zimmermann, 2005)

Despite the observation by Dersin (2008), one of the interviewee comments on the traffic flow optimisation; "this technology is actually recognised as an old system". This is especially true as the results of the interviews demonstrate that the level of availability and visibility in the market of this technology is perceived higher than the ERTMS.

With better optimisation of rail traffic flow, other features above are certainly addressed. The interviews show that this technology has higher evaluation point than ERTMS except on the service quality: interface. Traffic flow optimization has been pointed out to be in use in Brenner and Two Seas corridors.

The concept of **River Information Services (RIS)** aims at the harmonized implementation of information services in order to support traffic and transport management in inland navigation, including interfaces to other transport modes. The RIS concept is composed of advanced information services and functionalities which are supported by various technologies such as Internet, satellite positioning systems, electronic chart and display information systems, automatic identification systems etc. The provision of river information services leads to both operational (e.g. immediate navigational decisions) and strategic (e.g. resource planning) benefits for the users such as waterway authorities, skippers, terminal managers, the lock managers, transport service providers, shipping companies etc.

RIS facilitates the establishment of competitive inland waterway transport services and their integration into the entire transport chain since they comply with the information needs of modern supply chain management. They enable an enhanced use and monitoring of resources as well as prompt reactions to deviations from the original planning. RIS permits information interfaces with all supply chain members as well as with other transport modes. RIS enables further real-time monitoring of the inland navigation fleet and of changing fairway conditions en route. This allows improved fleet management including an optimized deployment of the vessels and personnel as well as better voyage planning.

The provision of estimated times of arrival and information such as stowage plans, vessel dimensions etc. will enable terminal and lock operators to optimise the use of the infrastructure and resources. For skippers this means a reduction of waiting times. RIS facilitates also the collection and provision of statistical and customs data in an automated and efficient way, which ultimately results in lower public expenditure.

Skippers are offered up-to-date and complete overviews of traffic situations by means of electronic charts, precise positioning data on approaching vessels, and electronic information about fairway and weather conditions. This allows them to take well-informed navigational decisions which will increase the safety level. Transparency is a main prerequisite for enhanced security (and efficiency) of transport operations. RIS supports the generation of comprehensive and transparent information processes and the smooth exchange of data (pre-announcement declarations, exchange of data on cargo/containers, customs data etc.).

RIS contributes to a better energy-efficiency by reducing fuel consumption as a consequence of better voyage planning and more reliable scheduling. It further provides the possibility to monitor the transport of dangerous goods. This allows fast response in the event of accidents and potential environmental calamities.

The availability of the ICT solution as well as the visibility and availability of information concerning river information services is evaluated to be available for a certain group of stakeholders by the majority of the experts. One expert is of the opinion that this ICT is available respectively open for all. River information services can include different systems depending on their individual design. The German RIS for instance provides basic information on inland waterways online and is open for all, but it is also possible that some of the collected data is only accessible for a specific group. In terms of availability of RIS the evaluation might be comprehensible insofar that the experts considered this ICT to be fully available only to inland sailors and therefore only available for a certain group of stakeholders. Apart from that RIS, as a system approved by the EU, should be available for all. Half of the experts consider this ICT to be applicable to mostly part load transport chains, the others evaluate the ICT to mostly cover full load transport chains or to cover all transport chains.

On average it is evaluated that RIS will neither help to avoid unnecessary transport nor that it will increase loading factors. Still on each of these KPIs one expert expects that the RIS will eliminate unnecessary transport and will increase loading factors. Regarding cost efficiency the experts evaluated on average that RIS will increase cost efficiency of transport chains. The experts unanimously estimated that the service quality, regarding transport as well as interfaces, will increase. Also the KPIs concerning environmental sustainability and infrastructure sufficiency are unanimously evaluated with 3.0 points. All experts expect an increase in service quality, a reduction of emissions and a removal of infrastructural insufficiencies.

Fairway Information Service (FIS) contains geographical, hydrological and administrative data that are used by skippers and fleet managers to plan, execute and monitor a journey. FIS provides dynamic information as well as static information about the use and status of the inland waterway infrastructure, and thereby supports tactical and strategic navigation decision-making. FIS contains data on the waterway infrastructure only – excluding data on vessel movements – and therefore consists of one-way information from shore to ship/office. Traditionally these services are provided through nautical paper charts and one or more of the following services in national formats and in the national language: Notices to Skippers, TV and radio broadcasts, internet, VHF nautical information radio, e-mail subscription services and fixed telephones situated on locks. RIS will provide standardised electronic charts and standardised Notices to Skippers in a machine readable format and in eleven languages.

The evaluation of the availability of the ICT solution as well as the visibility and availability of information concerning the FIS is exactly the same as the evaluation of the RIS. This accordance might arise from the fact that FIS is a part of RIS. Regarding the coverage it is possible to detect a deviance. Half of the experts consider this ICT to cover all transport chains whilst the others consider this ICT to mostly cover part load transport chains.

The experts agree that the Fairway Information Service (FIS) will neither affect the KPI "Transport Avoidance" nor the KPI "Loading Factor". In terms of cost efficiency of transport chains the experts see an improvement through this ICT. They also unanimously evaluated this KPI with 3.0 points ("increase of cost efficiency"). The evaluation of the effects on the service quality, transport as well as interfaces, is also distinct. Every expert believes in an improvement, stating that the FIS can increase the service quality. The experts` opinions on environmental sustainability differ. Two experts expect an increase, whilst the others expect that FIS will not have any effect. On infrastructure insufficiency, however, the evaluation is unanimous again. All experts are of the opinion that the system will remove infrastructural insufficiencies. The noticeable analogy to the evaluation of RIS is also probably due to the fact that FIS is part RIS. For both ICTs it seems like the experts consider them to be among the most substantial changes in the inland waterway transport sector for years.

Information for Law enforcement (ILE) ensures that people adhere to the laws of a jurisdiction. RIS supports law enforcement in inland navigation in the fields of cross-border management (e.g. the movement of people controlled by the immigration service, customs), compliance with the requirements for traffic safety, and compliance with the environmental requirements. It will also reduce waiting times at borders.

The availability of the ICT solution "Information for Law-Enforcement" is evaluated to be open to certain groups of stakeholders and in one case to be company specific. Concerning visibility and availability of information this ICT is primarily considered to be company specific. In terms of coverage it is considered to be mainly for part load transport chains.

The experts agree that the Information for Law- enforcement (ILE) system will neither affect the KPI "Transport Avoidance" nor the KPI "Loading Factor". Regarding cost efficiency of transport chains they also consider this system on average not to have an effect. One expert deviates with this expecting the ILE to increase cost efficiency of transport chains. The evaluation of the service quality of transport is identical. For the effects of this ICT concerning service quality at interfaces two experts expect an increase through ILE, the other evaluation differs saying there will be no effect. Looking at the KPI "Environmental Sustainability" the experts do not agree. Although an average of 2.3 might indicate that this ICT will have no effect, this result has to be reviewed critically with two experts expecting an increase in environmental sustainability and one expert expecting a decrease. The experts expect a removal of infrastructural insufficiencies. One expert evaluated differently and expects ILE to have no effect on infrastructural insufficiencies. ILE is also part of RIS. It is, however, not seen to be as effective as the previously described component FIS regarding the evaluated KPIs. The experts` recommendation therefore seems to be to focus on the RIS and FIS functionalities as described above and to consider them to be the RIS core functionalities.

RIS, FIS and ILE are systems designed for inland waterways and hence they are in use in inland waterway corridor Strauss.

An **international network of national traffic control centres** enhances communication between highway companies. The availability of the ICT solution concerning the international networking of national traffic control centres is unanimously evaluated to be open to certain groups of stakeholders. Visibility and availability of information for this ICT are evaluated only to be open for certain groups of stakeholders or even to be company specific. The evaluation of the coverage differs. The average of 2.0 “Mostly part load transport chains” arises from evaluations from “mostly part load”, “mostly full load” to “all” transport chains and therefore cannot be seen as a statement that this ICT is mainly for part load transport chains. One example of a regional network of traffic control centres is the “Verkehrsinformationsagentur Bayern (VIB)” in Bavaria. Their approach to the visibility and availability of the collected information helps to explain the moderate evaluation of the experts. While basic information is available for all users via internet, specific information (such as statistics concerning traveling time, occurrence of traffic jams and congestion or a management system for road works) is only supposed to be available for a certain group of stakeholders for instance authorities [VIB02].

The experts agree that an international network of national traffic control centres will neither affect the KPI “Transport Avoidance” nor the KPI “Loading Factor”. The evaluation of the effects on the cost efficiency of transport chains and the service quality (transport and interfaces) is identical. For all three KPIs one expert does not expect an increase in service quality respectively an increase in cost efficiency, but that an international network of national traffic control centres will have no effect. The same evaluation was made for the KPI “Environmental Sustainability”. The only unanimously positive evaluation was made on the KPI “Infrastructure Sufficiency”. All experts expect a removal of infrastructural insufficiencies. It is possible to infer from this evaluation that the experts do not expect a network of traffic control centres to have impacts on traffic or insufficiencies itself, but that it helps to identify trouble spots and to adapt traffic planning accordingly. This application was emphasized in Two Seas corridor.

Traffic signalling optimization projects are running in several different cities around the world. These programs are usually restricted to the urban area. These projects aim at maintaining signalized intersections at their optimal performance for different demand conditions. Projects like these are supposed to ensure maximum green light times for the heaviest traffic flows and to allow signal cycle time to adjust based on changing demands during peak times, such as rush hours.

The availability as well as the visibility of information of the ICT solution concerning traffic signalling optimization is unanimously evaluated to be open to all. Also this ICT system is unanimously evaluated to cover all transport chains. This unanimous evaluation on all three KPIs is not astonishing, since an optimized traffic signalling system is not only available and visible to all, can neither be avoided by any traffic.

On average the experts do not expect a traffic signalling optimization system to avoid unnecessary transport. Also they unanimously do not expect an increase in loading factors. The effects on the cost efficiency are evaluated to be better, with only one expert with a diverging opinion that this ICT will have no effect. The experts most likely assume that a traffic signalling ICT will be developed and implemented by the public authority resulting in no additional costs for the private sector with possible positive effects on efficiency. The evaluation of the two service quality KPIs (transport and interface) is identical: the experts expect an improvement, with one diverging evaluation. The evaluation of the environmental sustainability is rather good. The experts expect a reduction in emissions. The evaluation of the infrastructure sufficiency is even better. The experts unanimously expect a removal of infrastructural insufficiencies. The expected reduction of emissions and the removal of infrastructural insufficiencies can be backed up by figures of the 2003 established traffic signalling optimization programme in Seattle. Statistics from 2008 report a maximum of 27% reduction of overall corridor delay and a reduction of a maximum of 8% CO_2 emissions on “key arterials” during peak hours [SDO08]. These optimization systems have been pointed out to be in use in Brenner, Two Seas and Edelweiss corridors.

Location Based Services (LBS) are location specific services for mobile phones, which use communication and positioning technology. Prerequisites for a location-relevant service are a location positioning of the user, as exactly as possible, a powerful communications network, mobile end devices and service and data provider(s).

The position can be found by three different systems:

- GPS-locating:
  - A GPS chip, which is integrated into an end device, and which is located via satellite technology.
- GSM-locating:
  - A mobile phone, which is switched on, is located via the base station of radio cells by various systems.
- Locating only within local limited short distance radio systems:
  - WLAN-networks, infrared systems and other short distance applications also allow the position finding of an end device within the local radio network.

In the traffic area, LBS applications are mainly used in the field of fleet management and transport control at transport companies or taxi services. Systems which are based on short distance radio are also applied to control the use of toll roads and to transfer data to an accounting system. With the further development of mobile end devices, the improved display possibilities with improved locating precision, an increased application of LBS can be expected to traffic guidance technology. LBS applications allow a convergence of communication, locating and identification technologies.

The availability as well as the visibility of information of the ICT systems concerning traffic control (such as TMC pro/TMC Plus, GPS/GSM) is unanimously evaluated to be open to all. The distinct and positive evaluation on availability and visibility might arise from the positive example of the use of GSM and GPS, since these systems are already widely in use with several applications for traffic issues. Also this ICT system is unanimously evaluated to cover all transport chains.

Concerning the avoidance of unnecessary transport the view of the experts are more diverged. Half of the experts expect an elimination of unnecessary transport, while the others expect that traffic control systems will not have an effect. Concerning loading factors it is evaluated that these ICTs will have no effect with one expert stating that it will increase the loading factor. For cost efficiency of transport chains the evaluation is better for traffic control systems. The experts evaluate the effects on cost efficiency positively with most of the experts believing in an increase and one expert expecting no effect. Both service quality KPIs are also expected to improve. On the effects on the environmental sustainability the experts disagree. Half of the experts expect a reduction of emissions; the others do not expect traffic control systems to have an effect. On the KPI "Infrastructure sufficiency" the experts have a distinct opinion. All experts expect the removal of infrastructural insufficiencies. These systems have been pointed out least in Silk Way and Cloverleaf corridors.

IBNet (Icebreaker Net) is a computerised information and management system used by the Swedish and Finnish icebreaking services. IBNet contains a great deal of information that is highly useful to the icebreakers in their day-to-day assistance operations. IBNet contains registries of merchant vessels, the positions of all vessels, port information, current traffic restrictions, etc. IBNet gives the Icebreaking Management in Norrkoping/Sweden and Helsinki/Finland a complete and current picture of the conditions that facilitates allocation of icebreaking resources.

IBNet works over mobile connections and the data transfer is based on satellite systems. All vessels passing by Stockholm enrol in IBNet. The vessels have AIS equipment which imparts information to IBNet about vessel speed, direction, draught and power. IBNet utilizes satellite images, weather and ice forecasts for presenting and predicting the changes in the ice conditions.

IBNet is available to certain groups of stakeholders, namely to port operators, shipping companies and the icebreakers. It is used in Nureyev corridor. IBNet is evaluated to allow better utilization of icebreakers and increase productivity and quality of service. The overall system efficiency will be improved since vessels will face fewer queues. Overall transport service quality will be improved at the regions of implementation and logistics cost will also be decreased. In short, all of the top-tier KPIs are expected to be improved under this system.

Electronic Traffic Management - VTMIS is an important instrument/asset of traffic management with the main role of assisting the Port Control officers to follow up the voyages of vessels. A vessel traffic service (VTS) is a marine traffic monitoring system established by harbour or port authorities, similar to air traffic control for aircraft. VTS evolved as a response to the increased complexity of modern shipping, the diversity and potential danger resulting from their cargoes and the need to prevent congestion by maintaining a safe traffic flow. Typical VTS systems use radar, closed-circuit television (CCTV), VHF radiotelephony and automatic identification system to keep track of vessel movements and provide navigational safety in a limited geographical area.

The information service is provided by broadcasting information at fixed times and intervals or when deemed necessary by the VTS or at the request of a vessel, and may include for example reports on the position, identity and intentions of other traffic; waterway conditions; weather; hazards; or any other factors that may influence the vessel's transit.

VTMIS is available to all maritime stakeholders (port operators, vessel operators, authorities etc.) in a sense that all parties have a crucial role in VTMIS functionality. VTMIS is not yet available to all regions, but it is common around major ports or close to high flow areas and strains. To be more specific all stakeholders participate in VTMIS functionality, but only the corresponding harbour masters have access to the output.

VTMIS aims to provide regional real-time traffic image outside radar coverage with the use of long range transponders and information contents of which can serve such functions as vessel traffic management, port resources management and cargo flow management. VTMIS improves safety standards, hence strengthens the KPIs related to safety. VTMIS provides economic benefits to the ship owners, either directly by improving vessels management, or by minimising casualties, cargo losses and insurance fees. Since VTMIS promotes safety, then the ICT-system can also provide resource management information to ports, such as towing/line handling and berth/terminal planning or cargo flow management, such as intermodal connections, fleet management and JIT information for shippers. VTMIS is an ICT with a safety aspect. By minimising the risk of collision, contact and grounding, it produces an indirect benefit for environment. The usual direction of VTMIS is among others, speed reduction and this is a direct eco friendly practice. VTMIS has little effect on transport avoidance, loading factor and service quality. VTMIS has been pointed out to be in use in Mare Nostrum and Finis Terrae corridors.

Optimar system provides models for fleet size and mix decisions and network design decisions that require evaluation of ship routing strategies.

- Tramp ship routing and scheduling
- Tramp ship routing and scheduling with flexible cargo sizes
- Integrated inventory management and ship scheduling

Information related to availability, visibility and coverage of Optimar is not available and hence the evaluation cannot be carried out. Optimar provides significant improvements in vessel fleet utilization reducing transportation and logistics costs, reducing environmental impact and improving customer service through developing optimization models and efficient solution methods for challenges within maritime transportation and logistics. In doing so, it can improve the efficiency, reliability and environmental KPIs. Optimar has a positive effect on every KPI considered.

Optimar has been pointed out to be in use in Mare Nostrum and Finis Terrae corridors. The figure in the following page summarises all the centralised transportation management systems and indicates in which corridor each of them has been pointed out in D4.2.

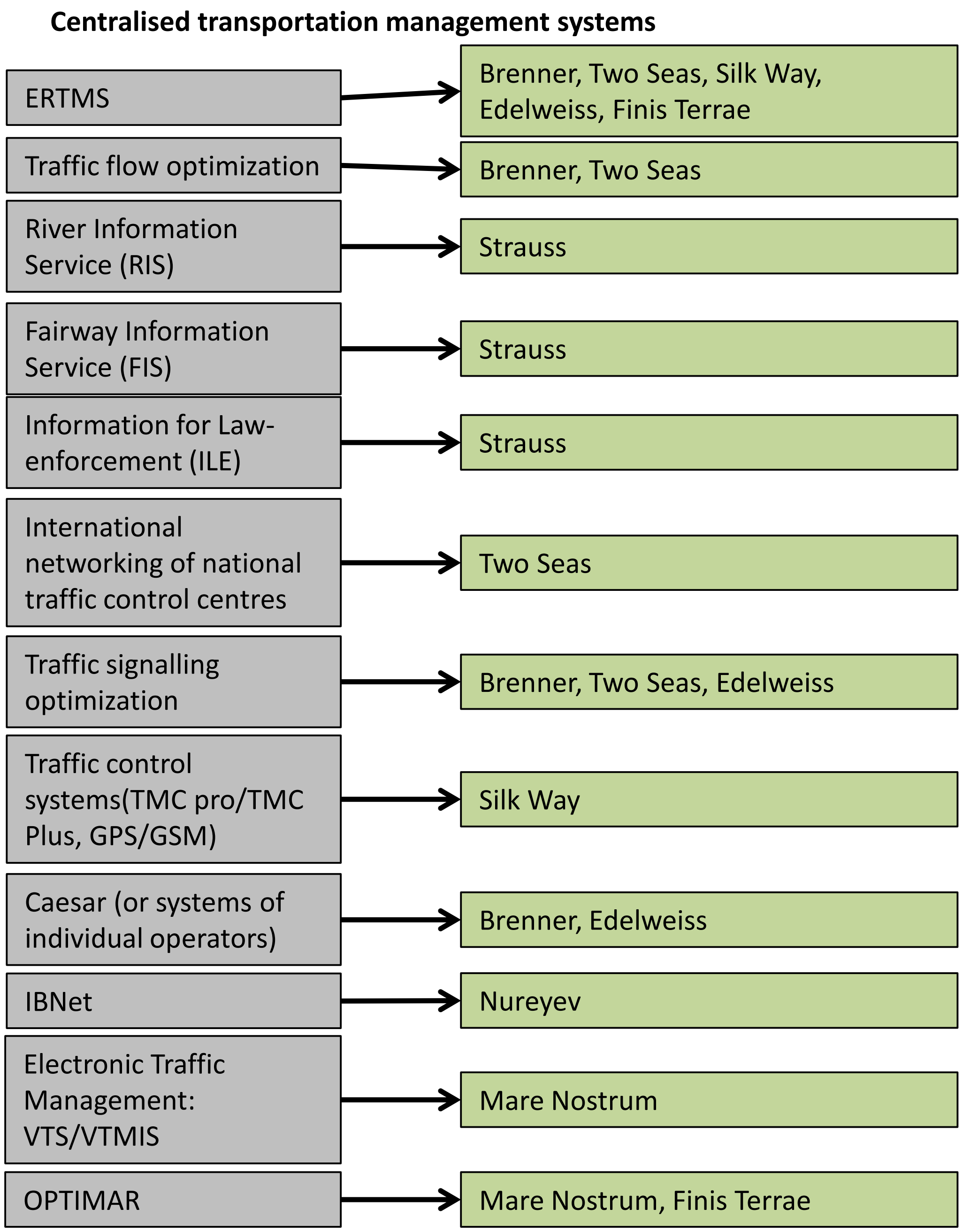

Figure 8 Centralised transportation management systems pointed out in different corridors

Table 4 Centralised transportation management systems - evaluation results

ICT Applications EVALUATION (1-3)	Availability of ICT solutions	Visibility and availability of information	Transport chain suitability
ERTMS	2,00	2,75	3,00
Traffic flow optimization	2,67	3,00	3,00
River Information Service (RIS)	2,25	2,25	2,00
Fairway Information Service (FIS)	2,25	2,25	2,50
Information for Law- enforcement (ILE)	1,60	1,33	2,33
International networking of national traffic	2,00	1,60	2,00
Traffic signalling optimization	3,00	3,00	3,00
Traffic control systems (TMC pro/TMC Plus, GPS/GSM)	3,00	3,00	3,00
Caesar (or systems of individual operators)	2,00	2,00	3,00
IBNet	2,00	2,00	3,00
Electronic Traffic Management: VTS/VTMIS	2,17	2,00	3,00
OPTIMAR	1,50	1,50	2,50
	3= Available for all	3 = Open for all	3 = All transport chains
	2 = Available for certain group of stakeholders	2 = Open for certain group of stakeholders	2 = Mostly part load transport chains
	1 = Company specific (open for company and it's clients)	1 = Company specific (open for company and it's clients)	1 = Mostly full load transport chains

ICT Applications EVALUATION (1-3)	Transport avoidance	Loading factor incl. return cargoes	Cost efficiency of transport chains	Service quality: Transport	Service quality: Interface	Environmental sustainability	Infrastructure sufficiency
ERTMS	2,25	2,50	3,00	3,00	3,00	3,00	3,00
Traffic flow optimization	2,67	2,67	3,00	3,00	2,67	3,00	3,00
River Information Service (RIS)	2,25	2,30	2,75	3,00	3,00	3,00	3,00
Fairway Information Service (FIS)	2,00	2,00	3,00	3,00	3,00	2,50	3,00
Information for Law- enforcement (ILE)	2,00	2,00	2,30	2,30	2,60	2,30	2,60
International networking of national traffic	2,00	2,00	2,60	2,60	2,60	2,60	3,00
Traffic signalling optimization	2,30	2,00	2,60	2,60	2,60	2,30	3,00
Traffic control systems (TMC pro/TMC Plus, GPS/GSM)	2,50	2,30	2,75	2,75	3,00	2,50	3,00
Caesar (or systems of individual operators)	3,00	3,00	3,00	3,00	3,00	3,00	3,00
IBNet	2,00	2,00	3,00	3,00	2,00	3,00	3,00
Electronic Traffic Management: VTS/VTMIS	1,67	2,00	2,83	2,67	2,25	3,00	2,50
OPTIMAR	3,00	3,00	3,00	2,50	2,00	3,00	2,50
	3 = Eliminates unnecessary transport	3 = Increases	3 = Increases	3 = Increases	3 = Increases	3 = Reduction of emissions	3 = Removal
	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect
	1 = Increases unnecessary transport	1 = Decreases loading degrees	1 = Decreases	1 = Decreases	1 = Decreases	1 = Increase of emissions	1 = Increase of operational bottlenecks and congestion

4.4 Decentralised transportation management systems

Platooning describes a technology of grouping vehicles into platoons in order to increase the capacity of roads. Platoons decrease the distances between cars using electronic, and possibly mechanical, coupling. This capability would allow many cars to accelerate or brake simultaneously. Instead of waiting after a traffic light changes to green for drivers ahead to react, a synchronized platoon would move as one, allowing up to a fivefold increase in traffic throughput if spacing is diminished that much. This system also allows for a closer headway between vehicles by eliminating reacting distance needed for human reaction. This idea is conferrable to trucks.

The evaluation of the availability of the ICT solution and the visibility of information concerning a platooning system are the same. In both cases the evaluation ranges from "company specific", "available/open for a certain group of stakeholders" and "available/open for all". The experts' opinion on the coverage is more distinct. One expert considered this ICT not to cover all transport chains, but mainly part load transport chains.

In terms of avoiding unnecessary transport the experts evaluate platooning not as a possible option. Also in order to obtain higher loading factors the experts do not consider this ICT as an adequate option. The experts furthermore on average do not think that this ICT helps to establish more cost efficient transport chains. One expert is of the opinion that this is possible. Regarding service quality this system can help to facilitate transport; for the processes at interfaces the experts do not agree. Half of the experts expect an increase of service quality regarding interfaces, while the others expect platooning not to have any effect. For the KPIs "Environmental sustainability" and "Infrastructure sufficiency" the evaluation is similar. For both half of the experts expect a reduction of emissions respectively a removal of infrastructural insufficiencies, the others do not expect platooning to have any effect. The moderate evaluation of the environmental performance of the platooning technology does not necessarily reflect a small potential of this technology. It might also be due to the possibility that the experts do not believe in a long-term comprehensively realisation or that they see other technologies in the same field to be more effective (i.e. the EuroCombi).

As platooning is still in development phase with few tests carried out in highway conditions, it is not in use in any of the corridors yet.

CO_2 emission sensors and **dynamic electronic traffic signs** are used to reduce the displayed speed limit automatically, if the CO_2 boundary value is exceeded. In Europe, a flexible speed limit depending on CO_2 emission values was established for the first time in Tirol, Austria in 2007. In 30-minute intervals sensors record the traffic volume and the CO_2 emission. With this data the share of the traffic in the total CO_2 load can be calculated. In the case that this share exceeds the statutory threshold, defined by the emission air protection law (IG-L), the highway speed limit gets reduced from 130 km/h to 100 km/h. Every10 minutes after half an hour, the speed limit can be changed, but has to remain for at least one hour. The current valid speed limit is displayed on the variable message signs on the highway.

The availability as well as the visibility of information of the ICT systems concerning speed limits depending on CO_2 values is unanimously evaluated to be open to all. Also this ICT system is unanimously evaluated to cover all transport chains. This is also an example of the experts' good evaluation of availability, visibility and coverage of a system that is most likely to be installed by the public authority.

The experts agree that speed limits depending on CO_2 values will neither affect the KPI "Transport Avoidance" nor the KPI "Loading Factor". The evaluation concerning cost efficiency of transport chains is on average that this system will have no effect. However the experts do not agree on the impact on this KPI; their evaluations range from a decrease in cost efficiency, to having no effect, to an increase in cost efficiency. The KPI "service quality: transport" was evaluated to have no effect. One expert expects a decrease in service quality concerning transport. For the second service quality KPI "Service quality: interface" the experts disagree. Some experts estimate that speed limits depending on CO_2 values will increase the service quality at interfaces while others expect a decrease. The evaluation of environmental sustainability, however, was unanimously positive. All experts are of the opinion that the system can help to reduce emissions. They also see that the effects on "Infrastructure sufficiency" are positive. This kind of systems have been pointed out to be in use in Brenner and Edelweiss corridors.

Intelligent Speed Adaptation (ISA), also known as Intelligent Speed Assistance, is any system that constantly monitors vehicle speed and the local speed limit on a road and implements an action when the vehicle is detected to be exceeding the speed limit. This can be done through an advisory system, where the driver is warned, or through an intervention system where the driving systems of the vehicle are controlled automatically to reduce the vehicle's speed.

Intelligent speed adaptation uses information about the road on which the vehicle travels to make decisions about what the correct speed should be. This information can be obtained through use of a digital maps incorporating roadway coordinates as well as data on the speed zoning for that roadway at that location, through general speed zoning information for a defined geographical area (e.g. an urban area which has a single defined speed limit), or through feature recognition technology that detects and interprets speed limit signage. ISA systems are designed to detect and alert a driver when a vehicle has entered a new speed zone, when variable speed zones are in force, and when temporary speed zones are imposed. Many ISA systems will also provide information about locations where hazards may occur or where enforcement actions are indicated. The purpose of ISA is to assist the driver in keeping to the lawful speed limit at all times, particularly as they pass through different speed 'zones'. This is particularly useful when drivers are in unfamiliar areas or when they pass through areas where variable speed limits are used.

The availability of the ICT solution as well as the visibility and availability of information of intelligent speed adaption is mostly evaluated to be "available for all" respectively "open for all". One expert is of the opinion that this system's availability and visibility of information is restricted ("company specific"). In terms of coverage this ICT system is unanimously evaluated to be covering all transport chains.

The experts agree that ISA will neither affect the KPI "Transport avoidance" nor the KPI "Loading factor". The evaluation of an improvement in cost efficiency of transport chains is similar. One expert assesses that ISA can help to increase the cost efficiency of transport chains. When evaluating the service quality the experts' opinions differ. For both service quality KPIs (transport and interface) half of the experts expect an increase in service quality, the others expect ISA not to have any effect on service quality. Also the evaluation on the environmental sustainability and on the infrastructural sufficiency is identical. For each KPI one expert does not expect a reduction of emissions and a removal of infrastructural insufficiencies, but considers that ISA will not have any effect.

ISA has been pointed out to be in use in Brenner, Two Seas and Edelweiss corridors. The following figure summarises all the decentralised transportation management systems and indicates in which corridor each of them has been pointed out in D4.2.

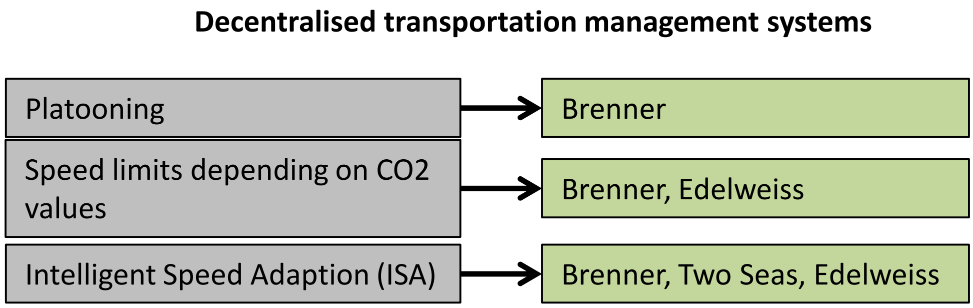

Figure 9 Decentralised transportation management systems pointed out in different corridors

Table 5 Decentralised transportation management systems - evaluation results

ICT Applications EVALUATION (1-3)	Availability of ICT solutions	Visibility and availability of information	Transport chain suitability
Platooning	2,25	2,25	2,50
Speed limits depending on CO2 values	3,00	3,00	3,00
Intelligent Speed Adaption (ISA)	2,50	2,50	3,00
	3= Available for all	3 = Open for all	3 = All transport chains
	2 = Available for certain group of stakeholders	2 = Open for certain group of stakeholders	2 = Mostly part load transport chains
	1 = Company specific (open for company and it's clients)	1 = Company specific (open for company and it's clients)	1 = Mostly full load transport chains

ICT Applications EVALUATION (1-3)	Transport avoidance	Loading factor incl. return cargoes	Cost efficiency of transport chains	Service quality: Transport	Service quality: Interface	Environmental sustainability	Infrastructure sufficiency
Platooning	1,75	2,00	2,25	2,75	2,50	2,50	2,50
Speed limits depending on CO2 values	2,00	2,00	2,00	1,75	2,00	3,00	2,75
Intelligent Speed Adaption (ISA)	2,00	2,00	2,25	2,50	2,50	2,75	2,75
	3 = Eliminates unnecessary transport	3 = Increases	3 = Increases	3 = Increases	3 = Increases	3 = Reduction of emissions	3 = Removal
	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect
	1 = Increases unnecessary transport	1 = Decreases loading degrees	1 = Decreases	1 = Decreases	1 = Decreases	1 = Increase of emissions	1 = Increase of operational bottlenecks and congestion

4.5 Safety systems

Road weather information systems (SWIS, AWEKAS, GFS Europa, EPS) **-** The interviews show that there is no common understanding concerning the issue of road weather information systems. One interviewee saw this as part of the information that you can easily get from your smart phone, while the other saw this as an extra additional ICT gadget to be installed to the existing road hauliers.

If we see this as additional ICT gadget to be installed on existing trucks, one interviewee commented that 85% of road haulage companies in Europe are small and medium sized enterprises, and the fact is that the smaller the company is, the less likely they use ICT in their operation due to its investment.

The overall rating for availability is good. The majority of stakeholders are supposed to have satisfactory knowledge about this ICT technology.

This system has a high rating on transport avoidance and service quality since it can tell road freight operation to stop at bad weather situations, but it is also noted that this technology would not propose any deviating route out of congestions. From the environmental aspect point of view, this ICT technology certainly reduces unnecessary travel. However it has nothing to do with volume capacity; it is a reactive tool, but not a planning tool. Road weather information systems have been pointed out in Brenner and Edelweiss corridors.

In February 1992 Council Directive 62/6/EEC was issued which required 12 tons and above freight vehicles to be outfitted with **Road Speed Limiters**. This was followed by Council Directive 92/24/EEC which set out, in the annex, the technical specifications for such limiters (source: adapted from http://www.transportsfriend.org/road/rsl.html).

In November 2002 the European Parliament and Council issued Directive 2002/85/EC which amended the original Directive 92/6/EEC to extend the range of vehicles to which the Directive applies. The Road Vehicles (Construction & Use) Regulations 1986 have now been amended (SI 2102/2004) to incorporate these new requirements which came into effect as of the 1st January 2005.

From 1 January 2007 additional vehicles now fall into scope under the speed limiter legislation introduced in January 2005. The changes affect all goods vehicles over 3.5 tonnes maximum gross weight and all passengers. The relevant date for fitting speed limiters varies depending on the gross design weight of the vehicle, engine type (such as Euro III), international or national usage and the date of first registration.

Specifically affected from January 2007 are goods vehicles between 3.5 and 7.5 tonnes which were first registered between 1 October 2001 and 31 December 2004, have Euro III engines approved to Directive 88/77/EEC. In addition, goods vehicles first registered between 1 October 2001 and 31 December 2004 with a maximum gross weight between 7.5 and 12 tonnes, will have to have their existing speed limitation devices recalibrated from 60mph to 56mph (96.5km/h to 90km/h).

The above note was also acknowledged by the interviewees that concluded that speed limiter is not a new ICT technology and the installation of such technology in every road freighter is endorsed by the law. There are fines and penalties for road freight if such technology is not used. It was said that this technology is a safety trade off more than anything else.

Speed limiters are considered as a device for gaining safety, but have also a cost savings and environmental impact potential. It is well accepted that with certain speed of operation, road haulage would operate more efficiently with less emission. However, this benefit would only be obtained with real time support to the driver concerning driver's behaviour and operation of the road freighter.

The interview result shows that **Night Vision System** is conceptually known, especially with the introduction of such technology to a number of new passenger cars being manufactured (Wikipedia). However, it is a bit confusing whether this is part of ICT technology or not. However, the application at road freight is questionable as the majority of respondents indicated that 'haven't heard of it'.

One interviewee from a large road haulage trade association confirmed that this technology is not used on trucks. However, there is another technology that is more known to the industry called 'contour marking' that helps drivers to control blind spots. This technology – the contour marking' – is expected to be endorsed by the law for installation on every truck by 2013. The overall rating of the night vision system visibility and availability is relatively low compared to other technologies in question. No environmental gain is expected from this technology as reported from the interviews.

D4.1 confirmed that **Distance control systems** is part of a package of other technologies including 'collision warning systems', 'braking assistant systems', 'lane departure warning', 'lane keeping assistant' and 'curve speed warning' that has relevance to Safety Systems and or 'Green' Trucks.

Distance control systems were conceptually well accepted among the interviewees as positive measures towards safety. But again, for freight practitioners, this technology was acknowledged but unsure if anybody used it.

The rating from the interview shows that this technology is still subject to research before available in the market. One interviewee reported that adapted cruise control has been tested by the Volvo car manufacturer using platooning systems as also documented at D4.1. There is no evidence as yet that this system will improve environmental performance according to the interviewees. However fuel efficiency is envisaged from its operation.

Related to 'distance control systems', '**collision warning systems'** is depending on construction. These systems support the driver by giving warnings, initiating automatical emergency braking and ensuring maximum braking power in the event of an acute risk of a collision (Zacharioudakis et al, 2011).

The interview result shows that 'collision warning systems' has relatively high rate among other systems in the safety systems' package. One interviewee mentioned that legislation is on-going towards making this technology compulsory. However, there are still debates within the industry and practitioners about the advantages and disadvantages of installing this technology at certain groups of vehicles or on all trucks. The question is if this technology should be embedded at every truck rather than being installed separately and optionally by operators at an extra cost.

One interviewee reported that Volvo has been testing this application of ICT for a long time while in the US a lobbying group has asked to put this system into law like the speed limiter.

There is no evidence that this system will increase environmental performance. In D4.1 was noted that the system potentially reduces cost due to reduced probability for delay caused by accidents. Also the fuel efficiency is envisaged from steady movement of the vehicle.

Braking assistant systems also links to the previous two systems and the technology is well accepted among the interviewees. This may be due to its popularity in several passenger cars on the market today. The availability, visibility and coverage were evaluated by the interviewees to be similar to the previous two systems described above. Efficient fuel consumption by road freight using this system is expected.

D4.1 reported that **Lane Departure Warning** (LDW) is a mechanism designed to warn a driver when the vehicle begins to move out of its lane (unless a turn signal is on in that direction). The objective is for safety reasons and therefore reducing costs of freight operations due to accident.

Interview result demonstrated that the concept was well accepted, but the issue reported by one of the interviewee was that the industry does not want to make this system obligatory for road haulage. The respondents were generally aware of the safety gain associated benefit. As this is a safety related device, there is no expectation that environmental issue can be addressed accordingly. The interview result confirmed that.

Lane keeping assistant is highly related to LDW as described above. The interviewees tended to take it as part of the LDW package and the all rating of factors measured are relatively equal with LDW rates.

Speed limiter, night vision systems, distance control systems, collision warning systems, braking assistant systems, lane departure warning and lane keeping assistant have all been pointed out in Two Seas corridor.

Curve Speed Warning (CSW) has been developed to help drivers identify potentially dangerous situations if a bend on the road was taken too fast and warned the driver in advance allowing him/her to react properly (Zacharioudakis et al, 2011).

The interview result shows that this technology is conceptually accepted, but the technology is not fully developed. It also reported that the technology is unsure of its use in the EU at least in trucks. This system was also considered to be related to other systems like systems taking into account maximum allowed axle loads on bridges and also monitoring the spread of the load of road freight. As noted by one of the respondents, CSW may contribute to environmental issues through efficient use of fuel.

CSW has been pointed out in Brenner corridor. The figure in the following page summarises all the safety systems and indicates in which corridor each of them has been pointed out in D4.2.

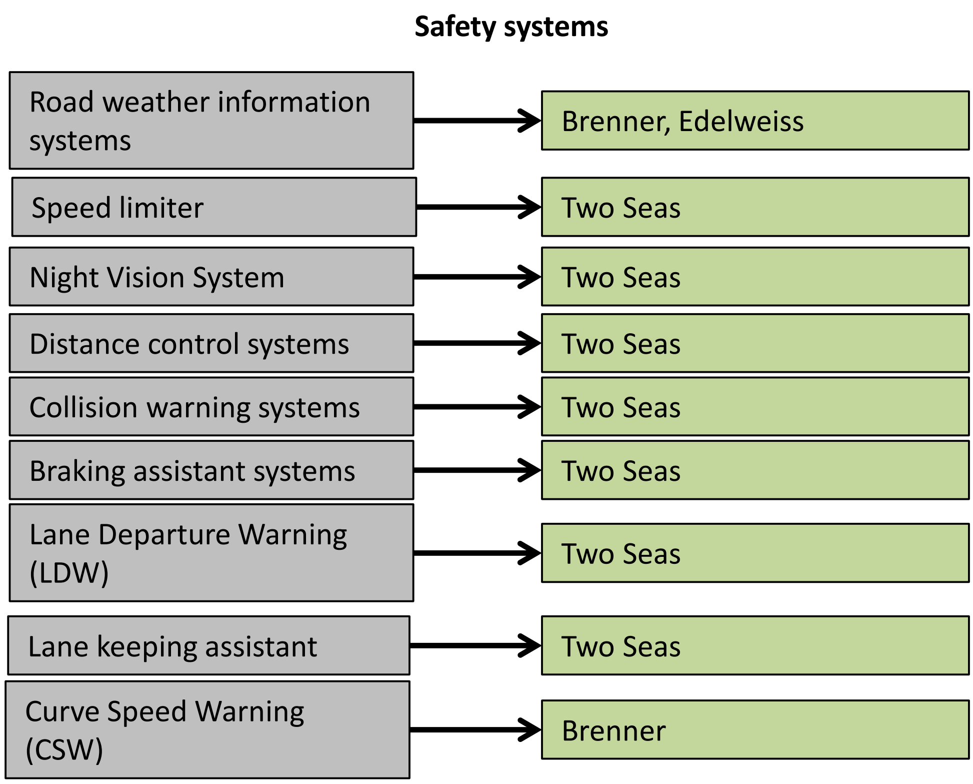

Figure 10 Safety systems pointed out in different corridors

Table 6 Safety systems - evaluation results

ICT Applications EVALUATION (1-3)	Availability of ICT solutions	Visibility and availability of information	Transport chain suitability
Road weather information systems (SWIS, AWEKAS, GFS Europa, EPS)	2,25	2,25	2,50
Speed limiter	2,63	2,75	2,50
Night Vision System	1,38	1,38	1,75
Distance control systems	1,63	1,75	1,75
Collision warning systems	1,88	2,63	1,75
Braking assistant systems	3,00	1,88	2,50
Lane Departure Warning (LDW)	1,75	1,38	2,50
Lane keeping assistant	1,75	1,63	2,50
Curve Speed Warning (CSW)	1,25	1,00	2,50
	3= Available for all	3 = Open for all	3 = All transport chains
	2 = Available for certain group of stakeholders	2 = Open for certain group of stakeholders	2 = Mostly part load transport chains
	1 = Company specific (open for company and it's clients)	1 = Company specific (open for company and it's clients)	1 = Mostly full load transport chains

ICT Applications EVALUATION (1-3)	Transport avoidance	Loading factor incl. return cargoes	Cost efficiency of transport chains	Service quality: Transport	Service quality: Interface	Environmental sustainability	Infrastructure sufficiency
Road weather information systems (SWIS, AWEKAS, GFS Europa, EPS)	2,75	2,00	2,00	2,67	2,50	2,50	2,33
Speed limiter	2,00	2,00	2,33	2,00	2,00	2,75	2,00
Night Vision System	2,00	2,00	2,50	2,00	2,25	2,00	2,00
Distance control systems	2,00	2,00	2,00	2,00	2,00	2,25	2,00
Collision warning systems	2,00	2,00	2,00	2,00	2,00	2,25	2,00
Braking assistant systems	2,00	2,00	2,00	2,00	2,00	2,38	2,00
Lane Departure Warning (LDW)	2,00	2,00	2,00	2,00	2,00	2,25	2,33
Lane keeping assistant	2,00	2,00	2,00	2,00	2,00	2,25	2,00
Curve Speed Warning (CSW)	2,00	2,00	2,00	2,00	2,00	2,50	2,00
	3 = Eliminates unnecessary transport	3 = Increases	3 = Increases	3 = Increases	3 = Increases	3 = Reduction of emissions	3 = Removal
	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect
	1 = Increases unnecessary transport	1 = Decreases loading degrees	1 = Decreases	1 = Decreases	1 = Decreases	1 = Increase of emissions	1 = Increase of operational bottlenecks and congestion

4.6 E-Administrative Systems

Single Window solutions are special port community commercial applications enabling international (cross-border) traders to submit regulatory documents at a single location and/or single entity. Such documents are typically customs declarations, applications for import/export permits, and other supporting documents such as certificates of origin and trading invoices. These systems allow traders to lodge information with a single body to fulfil all imports or exports related regulatory requirements. Various models of single window have been proposed, the single authority, single system and the automated system.

Various systems (fretis, JUP, J2R) operate at different ports on the globe. Single window ICTs are commercial applications for ports. The single window environment simplifies information flow between trade and authorities and has multiple benefits for all parties involved in cross border trade allowing more effective and efficient deployment of resources, cutting cost through reducing delays, faster clearance and release. Single Window systems have been pointed out Mare Nostrum and Silk Way corridors.

Port Community Systems are commercial applications with common characteristics like JUP, Fretis, J2R etc. In broad terms, these systems have the following features:

- Ships and cargoes electronic clearance,
- single window in the port and
- procedures simplification and easiness

Port community systems are commercial applications implemented in various major ports of the globe. There is a variety of such systems available on the market. The implementation of port community systems allows more effective and efficient deployment of resources, cutting cost through reducing delays, faster clearance and release. It can bring better risk management, improved levels of security and increased revenues levels with better deployment of human and financial resources.

JUP implementing statistics data (Time of the In Manoeuvre, Time of the Occupation of the Quay, Time of the Operation, Out Time, Time of the Staying on Port, N. of Containers/Hour (Average), management metrics and invoicing information. JUP also interacts with the customs systems centralizing on a technological platform for all the information, documents and processes concerning the different players working at the ports, allowing the economic agents to present the information through a single channel, thus obtaining the needed clearances.

JUP is not yet available to all users since it has been developed and implemented only at Port of Sines and therefore concerns only Mare Nostrum corridor. JUP helps in minimising obstacles in transport processes and improves port operations. Dead time and congestion at ports is minimised. The result is better and more efficient and eco friendly operations. These are the common positive effects of the port community ICT implementation.

Fretis is a commercial Port Community ICT that provides the user with a complete and comprehensive tool for the management of freight transport operations in a fully intermodal environment. It has the following modules:

- Central Information Management Platform. A relational database management structure, coupled with appropriately developed interfaces, constitutes the backbone of the overall system and facilitates the dynamic integration of all applications.

- Document Submission. The electronic Document Submission is a robust document control mechanism eliminating much of the bureaucracy and paperwork. With a friendly, multi-functional interface and unlimited interoperability capabilities, it is an ideal point of contact between the port and its clients.
- Customer Service. The Customer Service module offers an interactive web-based/M2M application, providing accurate and real time information to the port customers through the Internet.
- Entry/Exit Control. The automatic control of the container movements from the landside is carried out through the Integrated Entry/Exit Control module for containers, vehicles and drivers entering through the land gates of the Container Terminal.
- Loading/ Unloading Control. The Loading/ Unloading Control module handles the control and electronic storage of data relating to the loading and unloading of either ships or trains. It comprises a set of client server applications, which check loading/ unloading rights and track all relevant activities.
- Yard Planning. The Yard Planning module offers effective yard utilization and minimizes the lead time associated with the stacking activities.
- Yard Inventory. It comprises a GIS based central management application and a batch application for handheld terminals. Yard Inventory functionality provides the flexibility to determine which areas to survey, frequency and resources application.
- GIS. The GIS provides the user with a graphical environment capable of managing the stacking area and coordinating all activities required for supporting the terminal's operation.
- Resource management. The Resource Management module performs the automated organizing, delegating and monitoring of all container transfer activities within the terminal.
- Administration. Crucial administrative operations such as issuing transfer/ cargo permits, maintaining logistics warehousing records, electronic storing of customs documents and several more, are carried out through a user-friendly environment.
- Invoicing. Invoicing Application is fully integrated with the IFT and allows for timely and automatic calculation of the clients' financial obligations to the terminal.

As all port community systems, Fretis is a commercial product available only at certain ports. The port of Thessaloniki is such a port implementing Fretis. Thessaloniki is node in Brenner and Two Seas corridors. Fretis, as all port community systems, provides the ability to increase port operations efficiency. This has multiple benefits in terms of cost and environment sustainability. The implementation of Fretis can decrease waiting hours, congestion at ports, emissions and increase productivity and assets utilization.

Shortsea XML is a message standard for exchange of data between parties in a short sea transport chain. The Shortsea XML project has been financed by the European Commission through its "Marco Polo Common Learning" funding scheme. Shortsea XML is used:

- For description of short sea schedules and contact details. For long term repetitive Master Schedules, ship Voyage Schedules and Delay updates from the Carrier
- For booking of port-to-port and door-to-door shipment of consignments and transport equipment (containers and trailers). Used for Booking, Confirmation, Updating and Confirmation
- For cargo documentation for loading, unloading, trans-shipment, pre/on-carriage and government reporting

- For tracking and tracing of consignments and equipment. Can also be used for damage reporting.

Shortsea XML is based on UN CEFACT and build on UN Core Components. It is an open standard and is freely available to all parties. A range of European maritime associations, shippers, lines, agents, ports and IT suppliers are supporting the standard.

The core objective of Shortsea XML is to introduce a common messaging standard which has the potential of reducing overall costs by 10-20% (reduction in administrative errors, improved customer service, saving of man hours, better vessel utilisation) thereby increasing the competitiveness of short sea shipping when compared to road. By achieving this cost reduction Shortsea XML support the shift of cargo from road to sea.

Shortsea XML has been pointed out in Mare Nostrum, Brenner Silk Way and Finis Terrae corridors. The following figure summarises all the e-administrative systems and indicates in which corridor each of them has been pointed out in D4.2.

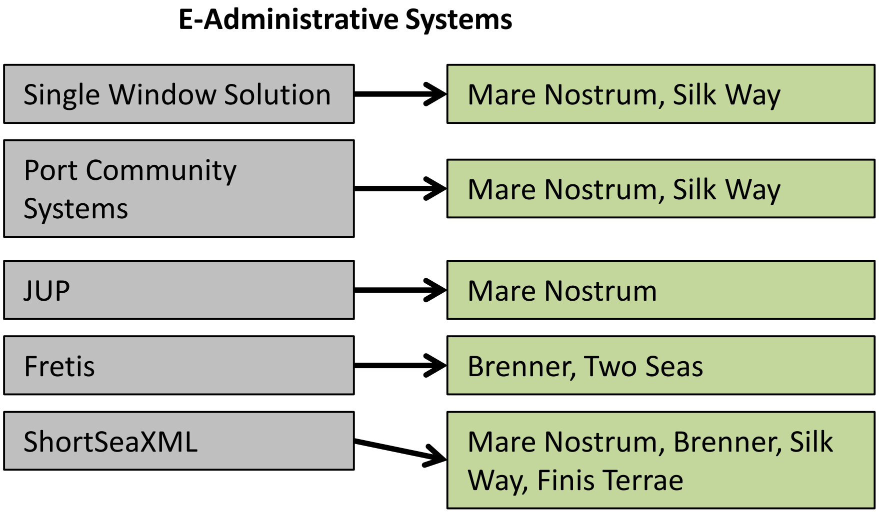

Figure 11 E-Administrative systems pointed out in different corridors

Table 7 E-Administrative Systems - evaluation results

ICT Applications EVALUATION (1-3)	Availability of ICT solutions	Visibility and availability of information	Transport chain suitability
Single Window Solution	1,00	1,00	2,50
Port Community Systems	1,00	1,00	2,50
JUP	1,00	1,00	2,00
Fretis	1,00	1,00	2,50
ShortSeaXML	1,00	1,00	2,50
	3= Available for all	3 = Open for all	3 = All transport chains
	2 = Available for certain group of stakeholders	2 = Open for certain group of stakeholders	2 = Mostly part load transport chains
	1 = Company specific (open for company and it's clients)	1 = Company specific (open for company and it's clients)	1 = Mostly full load transport chains

ICT Applications EVALUATION (1-3)	Transport avoidance	Loading factor incl. return cargoes	Cost efficiency of transport chains	Service quality: Transport	Service quality: Interface	Environmental sustainability	Infrastructure sufficiency
Single Window Solution	2,33	2,00	3,00	3,00	2,25	3,00	3,00
Port Community Systems	2,33	2,00	3,00	3,00	2,25	3,00	3,00
JUP	2,00	2,00	3,00	3,00	2,00	3,00	3,00
Fretis	2,00	2,00	3,00	3,00	2,25	3,00	3,00
ShortSeaXML	2,00	2,33	3,00	2,83	2,13	3,00	3,00
	3 = Eliminates unnecessary transport	3 = Increases	3 = Increases	3 = Increases	3 = Increases	3 = Reduction of emissions	3 = Removal
	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect
	1 = Increases unnecessary transport	1 = Decreases loading degrees	1 = Decreases	1 = Decreases	1 = Decreases	1 = Increase of emissions	1 = Increase of operational bottlenecks and congestion

4.7 Emissions footprint calculator systems

The response from the interviewees related to **sensors (shock, thermo, noise)** was insufficient. Only one interview gave feed back on the technology in question. The technology can be implemented internally and externally. The internal implementation can be seen as geographically bounded (limited application to certain geography) and the external can be seen as the environmental impact including emissions, noise monitoring and vibration issues.

For internal sensors, the interviewee indicated that the technology, including the logged information, would be available and open to everybody. This is because an operator should know as much as possible related to the environmental issues before entering a business.

External sensors are of greatest interest to certain groups of stakeholders. Noise monitoring of rail has been quite high on the rail research agenda, but recently vibration is getting more attention and turn out to be the main issue.

Internal sensors are contributing to cost efficiency and service quality, but have less effect on environmental aspects. External sensors affect emissions only. Sensors have been pointed out to be in use in Two Seas and Silk Way corridors.

Similar to the above ICT application, the respondents got confused with the term "**Anonymised sensor data gateway"**. However, after being told that this is related to real time information services, the issue that came out was about the 'data protection act'.

One interviewee responded that real time monitoring of truck operation is good for specific freight operations including dangerous goods, live animals and remote enforcement (remote control traffic operations). However at the wider operation this technology is heavily debated. The application of such technology on trucks should be on voluntary basis since the implementation touches sensitive areas of privacy, causing a need for an agreement concerning protection of data. A number of cities have carried out pilot testings without reporting any obvious advantages. A potential reduction of cost of operations and improved environmental performance through more efficient use of fuel is envisaged. These systems have been pointed out to be in use in all corridors.

In D4.1, **Green Truck** was described as a truck that have various technological features envisaged to reducing the environmental impact attached to it. Such technologies include adaptive cruise control, platooning, eco-driver assistance, automatic engine start-up/shut-down and tyre pressure indicator (Zacharioudakis et al, 2011).

However, the respondents associated Green Truck much more with alternative fuels substituting from non-renewable to the renewable ones including electricity. For freight operations on medium to long distances, there is no option substituting to electric powered vehicles as they still have a challenge with battery capacity. DG MOVE has reportedly commissioned a number of studies looking at the issue specifically including the Green Car initiatives.

In general the information on green truck is well known and available to the public audience, but issues such as affordability, investment guarantee, oil vs. other energy resources, impact on operational, LPG and LNG vs. diesel, loading impact and so forth have brought the green truck debate to a new level. Because its global benefits the industry has no negative and biased view on the implementation.

In terms of transport avoidance and loading factors, there is no clear indication concerning possible effects as this is very early technology. It is assumed that the cost of operation initially will increase, but in the long run efficiency will probably improve. Green truck is supposed to contribute to increased service quality and reduced emissions.

Cullinane and Edwards (2010) observed that in terms of atmospheric emissions, freight transport largely depends on the type of fuel used. Whilst various alternative fuels now exist, the main fuel used by goods vehicle continues to be diesel, with relatively small amounts of freight moved in petrol-engined vans (ibid). For the SuperGreen project, with long distance corridors, petrol fueled vehicles are of relatively less importance than diesel vehicles. Diesel engines emit much higher levels of particulate matter and nitrogen oxides than an equivalent petrol-powered engine (Holmen and Niemeier, 2003).

At the state of the art of measuring the environmental impact of freight transport, there is no single, agreed method of doing so. However an important distinction can be made between top-down and bottom up approaches to the estimation of energy use and emissions as introduced by McKinnon and Piecyk (2009). The former approach measures total fuel consumption by transport (diesel fuel purchase data) and uses standard conversion factors. The later approach, which deems to be more accurate, involves surveying a large sample of HGV operators and enquiring about the distances their vehicles travel and quantities of fuel consumed.

Green trucks have been pointed out to be in use in Brenner and Edelweiss corridors. The following figure summarises all the emission footprint calculator systems and indicates in which corridor each of them has been pointed out in D4.2.

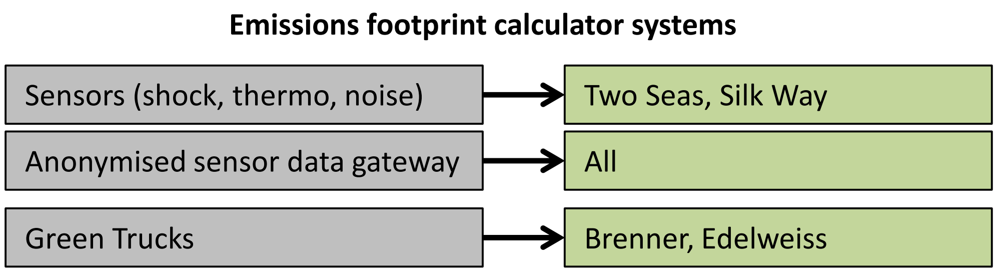

Figure 12 Emission footprint calculator systems pointed out in different corridors

Table 8 Emissions footprint calculator systems - evaluation results

ICT Applications EVALUATION (1-3)	Availability of ICT solutions	Visibility and availability of information	Transport chain suitability
Sensors (shock, thermo, noise)	2,50	2,50	3,00
Anonymised sensor data gateway	1,50	2,00	1,00
Green Trucks	2,25	3,00	3,00
	3= Available for all	3 = Open for all	3 = All transport chains
	2 = Available for certain group of stakeholders	2 = Open for certain group of stakeholders	2 = Mostly part load transport chains
	1 = Company specific (open for company and it's clients)	1 = Company specific (open for company and it's clients)	1 = Mostly full load transport chains

ICT Applications EVALUATION (1-3)	Transport avoidance	Loading factor incl. return cargoes	Cost efficiency of transport chains	Service quality: Transport	Service quality: Interface	Environmental sustainability	Infrastructure sufficiency
Sensors (shock, thermo, noise)	2,00	2,00	2,50	2,50	2,50	2,50	1,50
Anonymised sensor data gateway	2,00	2,00	2,50	2,00	1,00	2,50	2,00
Green Trucks	2,00	2,00	1,25	2,50	2,50	3,00	2,00
	3 = Eliminates unnecessary transport	3 = Increases	3 = Increases	3 = Increases	3 = Increases	3 = Reduction of emissions	3 = Removal
	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect	2 = No effect
	1 = Increases unnecessary transport	1 = Decreases loading degrees	1 = Decreases	1 = Decreases	1 = Decreases	1 = Increase of emissions	1 = Increase of operational bottlenecks and congestion

5 Summary and conclusions

5.1 Expert charging systems

All the expert charging systems were similarly evaluated concerning availability, visibility and coverage. The environmental performance is therefore the determining factor for picking the best system for greening transportation. The unified electronic toll system (CHD) got the best score. This result might be astonishing at first glance, because CHD does not change systems in operation, but will rather comprise them and give support to the operations. Next to its direct benefits in terms of infrastructure and environment, the advantages of this approach are the possibilities after implementation. With a unified electronic toll system it might be possible to include functionalities from other expert charging systems such as congestion charging. To speed up the implementation the public authorities may need to consider dedicated and goal-oriented incentives and policies.

5.2 Broadcasting, monitoring and communication systems

ITS (Intelligent Transport Systems and Services) is a major term covering all the systems in the cluster. There has been a lot of discussion related to the ICTs related to broadcasting, monitoring and communication systems. Some stakeholders argue that broadcasting, monitoring and communication systems cannot, by themselves, be relevant for green corridors. It is considered that especially mobile radio systems (GSM, SMS, etc.) and broadcasting systems (TMCpro, TPEG, etc.) give support to the real planning systems contributing to greening the corridors. Some others look at information provided by such systems as critical in shaping operator's decisions such as speed, route selection, and real-time fleet management. Since these decisions can have a critical impact on corridor KPIs, the role of these ICT technologies can thus be critical.

Based on the evaluations carried out, the best broadcasting, monitoring & communication systems are the broadband systems and analogue and dialogue broadcasting systems. The best applications are the ones conducting traffic. They have the biggest effects on transport chains as they are available and visible to all and have impact on all aspects on the transport chains as well as on corridors.

5.3 Centralised transportation management systems

Most of the ICTs in the section of centralised transportation management systems came out well in the experts` evaluations. In the overall analysis traffic flow optimisation (part of the development of ERTMS) and traffic control systems like TMC pro/TMC Plus and GPS/GSM got the best scores concerning availability, visibility and coverage. Technology of traffic control systems is already in use and has proven to be suitable for everyday use. To make them more useful for sustainable traffic it is recommended to push their further development and implementation so that more traffic can benefit from their potential

If only environmental and cost efficiency aspects are taken in consideration four systems are mostly qualified to green the corridors: ERTMS, Caesar, the River Information Service RIS and the Fairway Information Service FIS. These systems are all ranked high in the overall analysis concerning their environmental performance. On the one hand this result related to RIS and FIS confirms the connection of both systems (FIS is a subsystem of RIS). On the other hand it gives valuable information on what issues RIS should focus, because the information for law-enforcement system (ILE), which is also part of the RIS, is ranked worse. Decentralized transportation management systems

5.4 Decentralized transportation management systems

All three ICT systems in the section of decentralized transportation management systems are ranked quite low compared to other ICTs in the overall analysis of the KPIs concerning the environmental performance. The "Intelligent Speed Adaption" (ISA) system is evaluated to have the best effects on average concerning the environmental performance. Since all systems are ranked equally, this alone does not qualify the ISA to be best suited to greening the corridors. The fact that firstly no expert expected ISA to have any negative effects on any KPI concerning environmental performance and secondly the experts` evaluations on ISA show the highest congruency is the basis for choosing ISA as the best one. Based on pure mathematical average, the speed limit depending on CO_2 values is considered the best application.

5.5 Safety Systems

As in the decentralised transportation management system cluster, the applications in the Safety Systems cluster ranked fairly low compared to the overall results. It was seen that the applications in general have no or only minor effect on greening the supply chains. Speed limiter and road weather information systems were seen as the best ICTs. They are expected to improve fuel efficiency and therefore reduce pollution.

5.6 E-Administrative Systems

The JUP, single Window, Fretis and J2R system are commercial Port Community ICTs that belong to the e-administrative cluster. The differences between these systems are small compared to their similarities hence, in general and in terms of basic functionalities, these can be assessed as indistinguishable systems having similar scope, performing similar operations and having similar features: Ships and cargoes electronic clearance, single window in the port and procedures simplification and easiness. In other words; to centralize on a technological and electronic platform all the information, documents and processes concerning the different stakeholders participating at the ports functions, allowing the flow of information through a single channel, thus obtaining the needed clearances. The ShortSeaXLM is a useful ICT for standardization of information flow, but can be characterised as a sub system of a complete port community system. The distinction of these systems based on performance is extremely difficult and depends on the operational environment and the implemented features. Under these assumptions and for the purpose of WP4 the JUP, single Window, Fretis and Port Community ICTs will be treated as identical e- administrative systems.

The improvement potential of the above issues is not possible to evaluate in detail at this stage. This will, however, be subject to further work in WP4.

5.7 Emission footprint calculator system

Based on the interviews with freight and logistics practitioners, the term "emission footprint calculator system" is considered relatively confusing. The related technology / ICT devices are neither well known. Referring to the literature, this confusion was not entirely a surprise as McKinnon (2007) acknowledged that the CO_2 freight emission estimation varies depending on some partly controversial underlying assumption. Another issue is that different countries can have different emission related impact; for example in France and Switzerland where only a small proportion of the electricity is produced using fossil fuels, the carbon intensity of electrified rail freight services is thus very low (IRU, 2002). Furthermore, there was some confusion if this calculator was intended for emission per se or for environmental impact as a whole as at the ‘sensor’ section, examples of shock, thermo and noise were introduced. That in turn initiated discussions on the overall environmental impact from road freight.

It is difficult to measure emissions of particulates precisely, because of their ultra-fine nature. Measuring these particles when the vehicle is stationary is difficult enough; measuring them under different driving conditions and speeds introduces additional complexities (Cullinane and Edwards, 2010). For this reason, Green truck which is designed to use at least partly, if not all, alternative fuel vehicles, is the way ahead as the obvious choice among other options.

5.8 Overall summary and conclusions

Table 9 on next page summarises the top three ICTs in each of the seven clusters. All the ICTs identified in Task 4.2 were evaluated based on two different aspects: the usability of the applications and the environmental & cost efficiency (based on SuperGreen KPIs). The ranking in the table is based on the calculated averages of usability and efficiency. A table with the average values of all 54 ICTs can be found as Appendix 2.

Based on the same calculation of averages, the most potential systems for each transport mode can be identified:

- Road: Navigation system for trucks
- Rail: Traffic flow optimisation (ERTMS)
- Inland Waterways: CHD
- Sea: Port Community Systems
- Intermodal: RFID

Table 9 Top three ICT applications per cluster

ICT Applications	Availability	Efficiency	Total
Expert charging systems			
Unified Electronic toll system (CHD)	2,75	2,46	2,61
Congestion Charging	2,83	2,23	2,53
Toll amount depending on the pollutant category	2,17	2,23	2,20
Broadcasting, monitoring & communication systems			
Broadband communication (WiFi/WiMAX, digital VHF)	3,00	3,00	3,00
Intelligent Transportation System (ITS)	3,00	3,00	3,00
Navigation system for trucks	3,00	2,86	2,93
Broacasting systems (TMC, TMCpro, TPEG, DVB, DAB)	3,00	2,86	2,93
Centralised transportation management systems			
Traffic flow optimization	2,89	2,86	2,87
Traffic control systems(TMC pro/TMC Plus, GPS/GSM)	3,00	2,69	2,84
Traffic signalling optimization	3,00	2,49	2,74
Decentralised transportation management systems			
Speed limits depending on CO2 values	3,00	2,21	2,61
Intelligent Speed Adaption (ISA)	2,67	2,39	2,53
Platooning	2,33	2,32	2,33
Safety systems			
Speed limiter	2,63	2,15	2,39
Road weather information systems	2,33	2,39	2,36
Braking assistant systems	2,46	2,05	2,26
E-Administrative Systems			
Single Window Solution	1,50	2,65	2,08
Port Community Systems	1,50	2,65	2,08
ShortSeaXML	1,50	2,61	2,06
Emissions footprint calculator systems			
Green Trucks	2,75	2,18	2,46
Sensors (shock, thermo, noise)	2,67	2,21	2,44
Anonymised sensor data gateway	1,50	2,00	1,75

Table 11 on next page presents the best three ICT on each of the nine SuperGreen corridors. The results vary a lot from corridor to corridor. Only broadcasting systems (TMC, TMCpro, TPEG, DVB, DAB) are in the top 3 for several corridors, in total in five different corridors. RFID, VTS, AIS, Broadband communication (WiFi/WiMAX, digital VHF) and ERTMS are in top 3 in two corridors. All the other systems are ranked in top 3 only in one corridor.

In the Table 11 ten highest ranking ICTs of the 54 evaluated are presented. It should be noted that all these ten ICTs belong to either the "Broadcasting, monitoring and communication systems" cluster or to the "Centralised transportation management systems" cluster.

Table 10 Top 3 ICT for SuperGreen corridors

	Availability	Efficiency	Total
Mare Nostrum			
RFID	2,67	2,57	2,62
Electronic Traffic Management: VTS/VTMIS	2,39	2,42	2,40
Automatic Identiciftion System (AIS)	2,59	2,22	2,40
Brenner			
Intelligent Transportation System (ITS)	3,00	3,00	3,00
Broacasting systems (TMC, TMCpro, TPEG, DVB, DAB)	3,00	2,86	2,93
Traffic flow optimization	2,89	2,86	2,87
Two Seas			
Broadband communication (WiFi/WiMAX, digital VHF)	3,00	3,00	3,00
Navigation system for trucks	3,00	2,86	2,93
Broacasting systems (TMC, TMCpro, TPEG, DVB, DAB)	3,00	2,86	2,93
Silk Way			
Broadband communication (WiFi/WiMAX, digital VHF)	3,00	3,00	3,00
Traffic control systems (TMC pro/TMC Plus, GPS/GSM)	3,00	2,69	2,84
ERTMS	2,58	2,82	2,70
Edelweiss			
Broacasting systems (TMC, TMCpro, TPEG, DVB, DAB)	3,00	2,86	2,93
Route guidance systems, Personal navigation assistant	3,00	2,71	2,86
Mobile radio systems (GSM; SMS; GPRS; UMTS)	2,67	3,00	2,83
Finis Terrae			
ERTMS	2,58	2,82	2,70
RFID	2,67	2,57	2,62
Electronic Traffic Management: VTS/VTMIS	2,39	2,42	2,40
Strauss			
Unified Electronic toll system (CHD)	2,75	2,46	2,61
Fairway Information Service (FIS)	2,33	2,64	2,49
River Information Service (RIS)	2,17	2,76	2,46
Nureyev			
IBNet	2,33	2,57	2,45
Automatic Identiciftion System (AIS)	2,59	2,22	2,40
Fretis	1,50	2,61	2,05
Cloverleaf			
Traffic control systems, (TMC pro/TMC Plus, GPS/GSM)	3,00	2,69	2,84
Anonymised sensor data gateway	1,50	2,00	1,75

Table 11 Top 10 ICT for greening supply chains

	ICT Applications	Availability	Efficiency	Total
1	Intelligent Transportation System (Broadcasting, monitoring & communication systems)	3,00	3,00	3,00
1	Broadband communication (Broadcasting, monitoring & communication systems)	3,00	3,00	3,00
3	Navigation system for trucks (Broadcasting, monitoring & communication systems)	3,00	2,86	2,93
3	Broacasting systems (Broadcasting, monitoring & communication systems)	3,00	2,86	2,93
5	Traffic flow optimization (Centralised transportation management systems)	2,89	2,86	2,87
6	Route guidance systems (Broadcasting, monitoring & communication systems)	3,00	2,71	2,86
7	Traffic control systems (Centralised transportation management systems)	3,00	2,69	2,84
8	Mobile radio systems (Broadcasting, monitoring & communication systems)	2,67	3,00	2,83
9	Traffic signalling optimization (Centralised transportation management systems)	3,00	2,49	2,74
10	ERTMS (Centralised transportation management systems)	2,58	2,82	2,70
10	Caesar (Centralised transportation management systems)	2,40	3,00	2,70

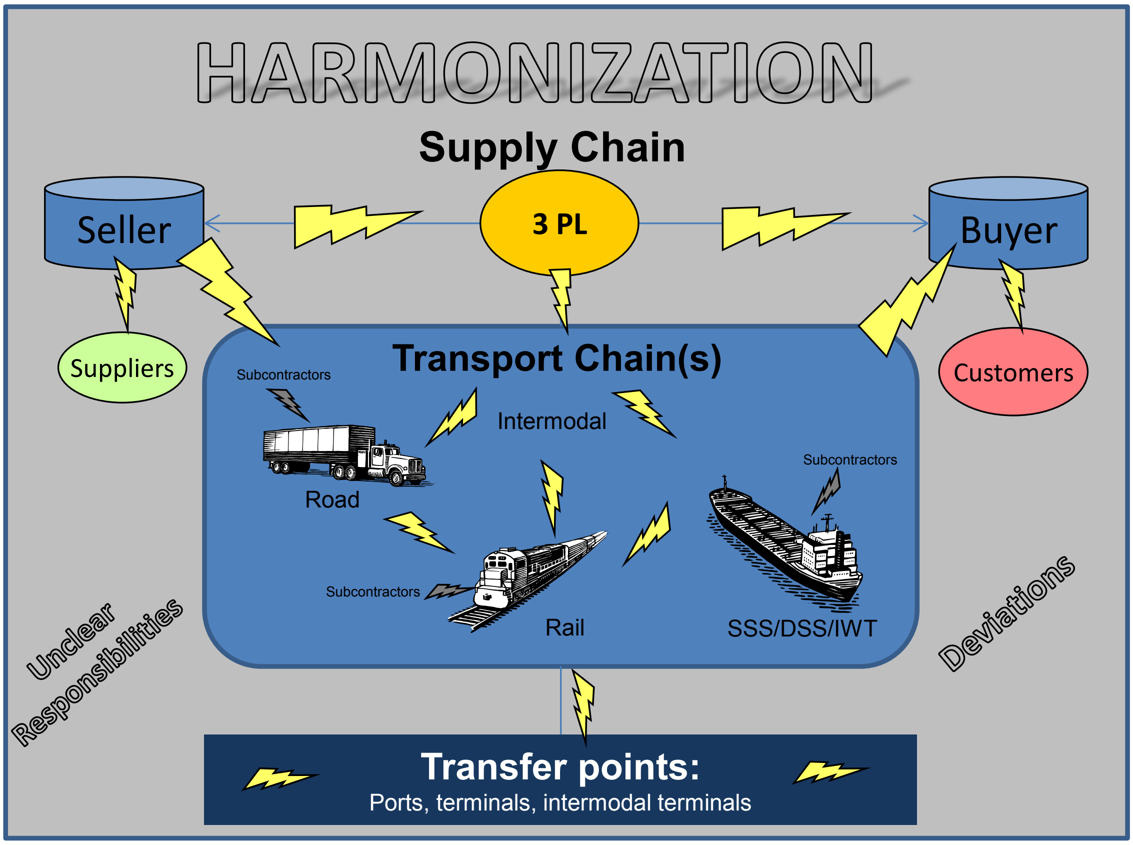

Figure 13 ICTs and supply chain

Figure 13 describes the different actors within supply chain and the numerous spots where exchange of information takes places (indicated with yellow lightings). Deviations in transport chains generate problems in the information exchange. The same applies when responsibilities between stakeholders are unclear. The use of so called random subcontractors may increase problems in responsibilities and information exchange as well. Problems in co-operation and data interchange between transport clients and transport operators are reported in many studies.

Applications that belong to "Broadcasting, monitoring and communication systems" cluster all have common features in being able to serve the complete supply chain and not just the single transport chains or transfer points. This fact supports the results achieved in the evaluations done in Task 4.3. Averages calculated for each cluster also shows that ICTs with the best potential for greening belong to "Broadcasting, monitoring & communication systems" or to "Centralised transportation management systems" clusters:

- Broadcasting, monitoring & communication systems – average 2,55
- Centralised transportation management systems – average 2,51
- Decentralised transportation management systems – average 2,49
- Expert charging systems – average 2,45
- Emissions footprint calculator systems – average 2,22
- Safety systems – average 2,06
- E-Administrative Systems – average 2,04

Finally Figure 14 presents the highest ranking ICT from each cluster. The transport mode can also be seen together with the corridors in which the ICT is currently in use.

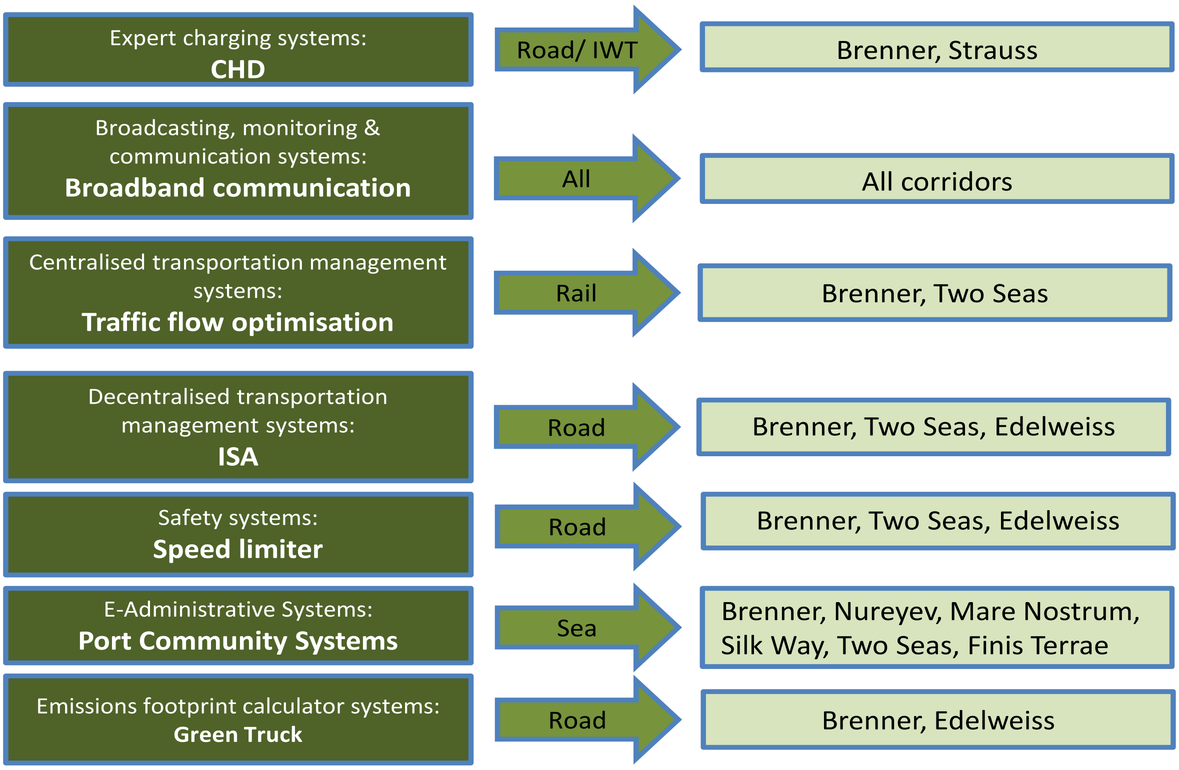

Figure 14 Summary: ICTs with highest potential for greening

The results from this Task 4.3 will be further considered in among others in the last task in this work package: Task 4.4 Benchmark Green Corridors with smart ICT. The method concerning the evaluation of environmental performance of different ICTs from supply chain perspective was developed in this task. This method can be used and further developed in other EU –projects. It covers both important aspects for greening the supply chains: visibility and efficiency aspects.

References

Castagnetti, F. (ed) (2008) *NEWOPERA The rail freight dedicated lines concept.* Final Report. The European Freight and Logistics Leaders Forum (F&L). Brussels.

Cullinane, S. and Edwards, J. (2010) Assessing the environmental impacts of freight transport in *Green Logistics – Improving the environmental sustainability of logistics*, eds.: A McKinnon, S. Cullinane, M. Browne and A. Whiteing. Page: 31-48. The Chartered Institute of Logistics and Transport (UK). Kogan Page.

EC (2008) Preparatory study for an impact assessment for a rail network giving priority to freight. Brussels: European Commission, DG-TREN.

Emissionsklassenanteile am Bestand der Sattelzugmaschinen und Lkw über 7,5 t zGG; Bundesverband Güterkraftverkehr Logistik und Entsorgung (BGL) e.V.; 2010; source: http://www.vvwl.de/data/editor/File/2__emissionsklassen_tabelle.pdf

Entwicklung der Leerkilometer-Anteile deutscher Lkw 1998 – 2010; Bundesverband Güterkraftverkehr Logistik und Entsorgung (BGL) e.V.; 2011; source: http://www.bgl-ev.de/images/daten/leerfahrten/kilometer.pdf

Dersin, P. (2008) NEWOPERA Final Conference: The operating and technical dimension. *Presentation at NewOPERA Final Conference*. Brussels, 30 September 2008.

Holmen, B.A. and Niemeier, D.A. (2003) Air quality in *Handbook of Transport and Environment*, eds. D.A. Hensher and K.J. Button. Chapter 4. Elsevier, Oxford.

IRU (2002) *Comparative Analysis of Energy Consumption and CO_2 Emissions of Road Transport and Combined Transport Road/Rail*. International Road Transport Union, Geneva.

ITS Finland (2012) [WWW] <URL: http://www.its-finland.fi/> [Accessed 15.3.2012]

Lindner, T. and Zimmermann, U. (2005) Cost optimal periodic train scheduling. *Mathematical Methods of Operations Research.* 62: 281–295.

McKinnon, A. and Piecyk, M. (2009) Measurement of CO_2 Emissions from Road Freight Transport: A review of UK Experience. *Energy Policy* 37(10): 3733-3742.

McKinnon, A. (2007) *CO_2 Emissions from Freight Transport in the UK.* Report prepared for the Climate Change Working Group of the Commission for Integrated Transport (CfIT). Logistics ResearchCentre Heriot-Watt University Edinburgh.

Schabert, H. (2006) Technical requirements and innovations in rail freight in *Europe's rail freight market* pp:175-189. Community of European Railway and Infrastructure Companies (CER). Eurail press

Signal Operations and Maintenance ANNUAL REPORT OF 2008 ACTIVITIES; Seattle Department of Transportation; 2008; source: http://www.seattle.gov/transportation/docs/signals_sdot_2008_pages_revised.pdf

Verkehrsinformationsagentur Bayern VIB; Pollesch, Peter; Oberste Baubehörde im Bayerischen Staatsministerium des Innern; 2002; source: http://www.its-munich.de/pdf/Verkehrstelematik/5-VIB_Bayern-Pollesch.pdf

Vinck, K. (2006) Developing European freight corridors with ERTMS – new European political initiatives in *Europe's rail freight market* pp:79-89

Wirkungen der Lkw-Maut — Ergebnisse und Potenziale; Doll, Claus, Fraunhofer Institut System- und Innovationsforschung, 2007

Zacharioudakis et al. (2011) SuperGreen Deliverable D4.1 *Identify smart ICT and information flows* v1: Year 1 report (revised). 20 April 2011. EU FP7 funded project.

Zacharioudakis et al., (2011) *"Define application areas for smart ICT"* SuperGreen project Deliverable D4.2, Document number 04-20-RD-2011-01-01-3.

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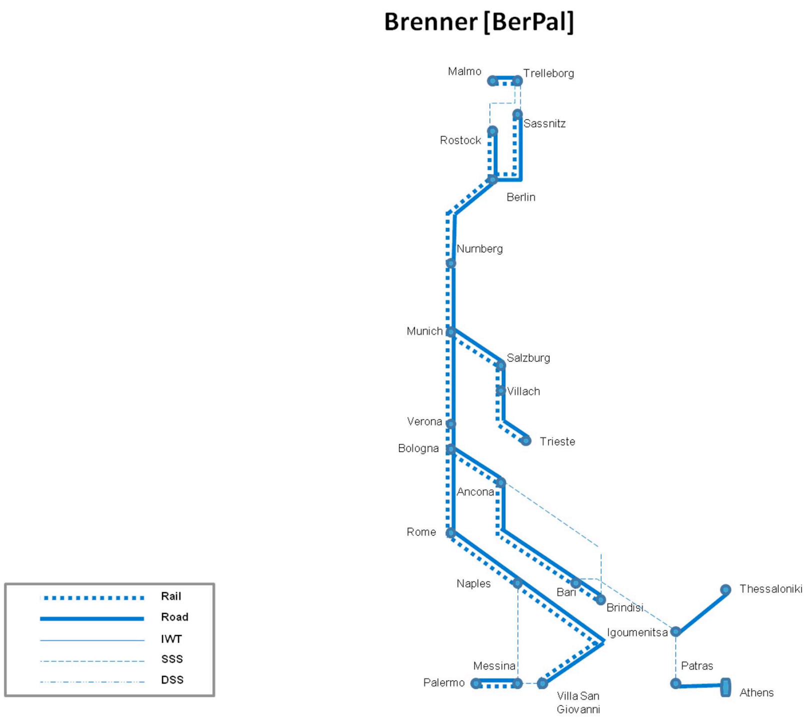
Appendix 1

Brenner

The Brenner Corridor is relevant for goods transport from Sweden through Germany to Italy (Palermo) and Greece (Athens). It includes crossing of the Alps through the Brenner Pass, as well as the Baltic, Ionian and Adriatic seas. It also includes the Tauern axis. The corridor is mainly rail and road-based but there are also parts handled by short sea shipping, such as Trelleborg to Rostock-Sassnitz; Naples to Palermo; and Patras-Igoumenitsa to Brindisi-Bari-Ancona.

The high capacity railway axis Berlin-Verona/Milan-Bologna-Naples-Messina-Palermo is an important north-south crossing of the Alps. The axis, crossing three nations, i.e., Germany, Austria and Italy, represents an important link among European areas and could aid a modal shift from road to rail in the mountainous region.

The Brenner Pass is the most important route for road freight transport crossing the Alps. In 2004 42.7 million tonnes went through the Brenner Pass. One fourth of all road freight crossing the Alps pass through the Brenner tunnel, more than 30 million tonnes each year (2004, Cooperation on Alpine Railway Corridors 2006). Thus the modal split for road was more than 70 %.

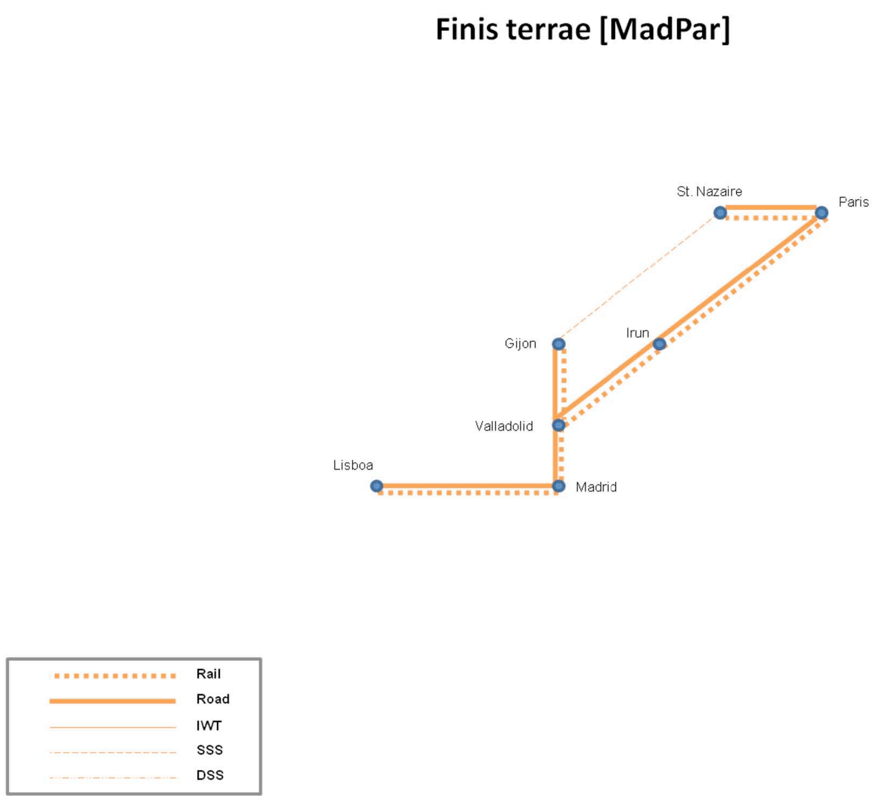


Finis Terrae

This is a corridor linking the Iberian Peninsula to mainland Europe. Countries involved are Portugal, Spain and France. The corridor typically handles cargo from the western part of the Iberian Peninsula (Madrid/Lisbon), into Paris and towards central Europe, including the Benelux and Ruhr region.

The corridor supports road, rail, inland waterway, short sea shipping and combinations of these transport modes. Freight traffic is currently running mainly by road or by sea with approximately 2% of goods being transported by rail.

There are two TEN-T priority projects (PP3 and PP16) along the corridor. They aim to improve the rail connections. There are also on-going projects aiming to improve the road network (Zaragoza-Pau). Short sea shipping and a combination of different transport modes are also encouraged by the Motorway of the Seas project Gijon-Nantes. In addition, there is an ERTMS project aiming to replace the different national train control and command systems.



Cloverleaf

The Cloverleaf corridor is passing through mainly the British part of the UK and through the Channel Tunnel to France via Calais and directly to Duisburg in Germany. The corridor segment in Europe mainland includes passing through Belgium and the Netherlands. The Britain and Ireland segments include:

- Glasgow – Carlisle – Liverpool – London – Dover

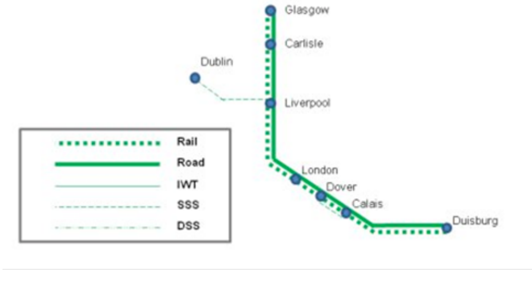
- Liverpool – Dublin

The corridor between Glasgow and Dover is mainly served by road and rail which also continue to connect to Continent Europe through Channel Tunnel and directly to Duisburg in Germany. Short sea shipping is the only available connection between Liverpool and Dublin segment.

The main corridor of Cloverleaf is spanning between Glasgow in Scotland and Dover in England and the modal split is characterised by road based freight movement with 67% share (163 billion ton kilometres (b t-kms) – DfT, 2009) and with rail and water share being 9% (21 b t-kms) and 20% (50 b t-kms) respectively. A recent freight modal choice study conducted by UK Department of Transport (DfT, 2010) indicates that there are freight flows with potential for modal shift. The report identifies that increasing modal choice in favour of rail and water may be of benefit to society. A number of road network corridors used in the study which had been investigated and modelled are also part of the Cloverleaf corridor segments.

Channel Tunnel has the capacity for 10 million ton per annum but served only just over 1 million tonnes per annum of freight through rail services out of the 19 million tonnes. It was reported that in 1998 a 3.14 million tonnes of freight reached the highest recorded capacity used (Walker and Croassland, 2011).

The segment between Liverpool and Dublin is served only by short sea shipping (SSS). The statistics of how much freight flows between Liverpool and Dublin is relatively unclear but the Ro Ro per day statistics at Liverpool port is near to 20 million tonnes with more than 60% of the share being due to unaccompanied HGVs including ship borne port to port trailers. The remaining share is for road goods vehicles (DfT, 2010). Additionally it was reported that since the abolition of the dock labour scheme in 1989, the cargo volumes increased from 9 million tonnes to 34 million tonnes in 2008 (IEA, 2009). 8 million tonnes of this is short sea and the recently introduced MSC Lines, Liverpool – Antwerp service will add 120,000 units to throughput per annum. Another source reported that the international hauliers in Ireland are starting to avoid travelling across UK, partly as a result of new powers awarded to the UK Vehicle and Operator Services Agency (International Freighting Weekly, 2009). IFW indicate this is a starting point of shift towards direct ferry services to the mainland Europe.



Edelweiss

Edelweiss is combination of the two corridors Nordic triangle railway/road axis including the Öresund fixed link (TEN-T Priority Projects 12 and 11) and Malmö-Milan via Fehmarn belt. It connects Helsinki with Milan. The corridor goes through six countries: Finland, Sweden, Denmark, Germany, Austria and Italy. It can serve both rail and road transport and also has sea legs between Finland and Sweden, Sweden and Denmark and Denmark and Germany. There is also a fixed link between Sweden and Denmark, the Öresund bridge.

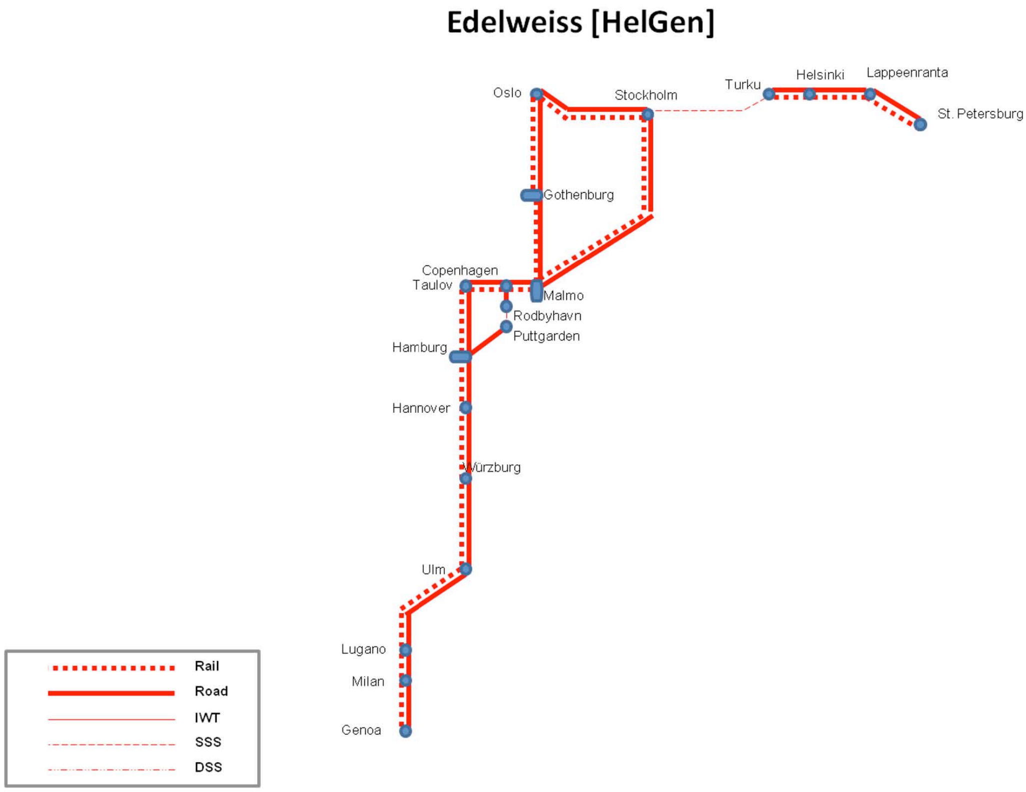
The Nordic Triangle aims to improve the road, rail, and maritime infrastructure of Sweden and Finland. It will contribute to overcome the remoteness of Sweden and Finland from the centre of European continent and to help to integrate these outlying regions into the European Union. Principal objective is to improve the land based access of passengers and freight of the Nordic countries to Central Europe. The project will reduce journey times, increase capacity, enable better streamlining of traffic flows and also will improve environmental conditions and safety.

On the land side there is a combination of four-lane and two-lane road transport, and single-track rail segments on the route. The corridor will support a combination of road and rail transport. However one aim is to move transports from road to rail.

A great number of road and rail projects are on-going in Sweden and Finland to improve the situation of the Nordic Triangle. The more important on-going or planned projects concern the areas near or in the big cities of Stockholm, Gothenburg, Malmö, Helsinki, the new high speed line Stockholm-Gothenburg and the improvement of road and rail connections from Helsinki to the Russian border.

With its central position in Europe, Germany is an important transportation hub along this corridor. This is reflected in its dense and modern transportation networks. Germany has established a polycentric network of high-speed trains. The InterCity Express or ICE is the most advanced service category of the Deutsche Bahn and serves major German cities as well as destinations in neighbour countries.

Typically, the cargoes transported along the corridor are unitised cargo (containerised or in trailer). The main types of goods are bulk products, agricultural products, manufactured products, miscellaneous articles, wood products, cork, textiles, chemicals and paper.



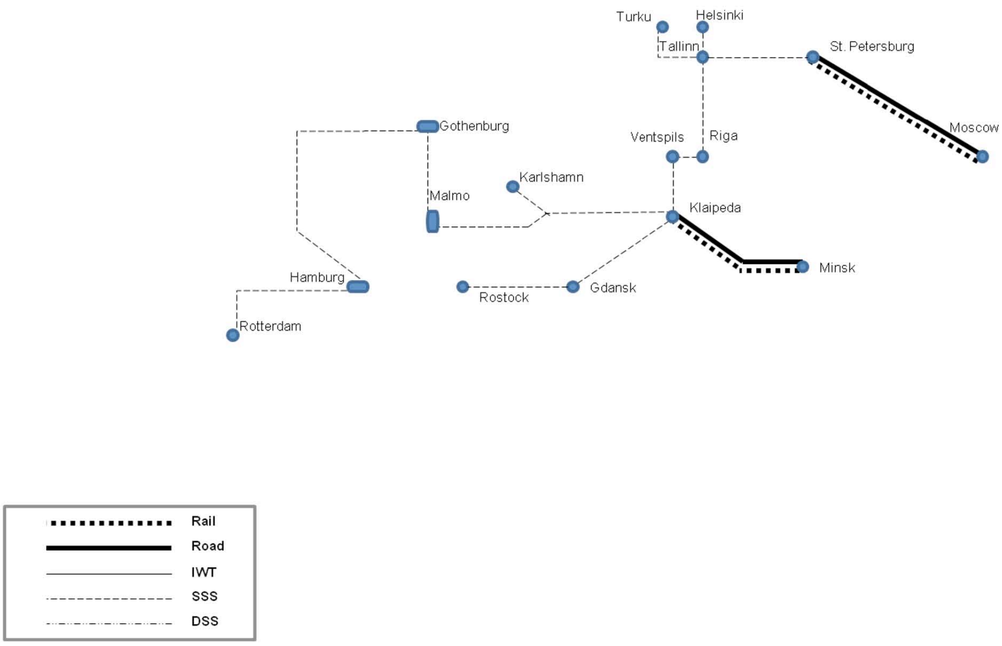
Nureyev

Nureyev corridor includes a short sea shipping route connecting Russia to Europe, as well as land based routes to and from ports at each end. Nureyev is based on the TEN-T priority project 21, Motorway of Baltic Seas.

All countries around the Baltic Sea are involved in this 4,500 kilometre corridor. Helsinki, St. Petersburg, Gothenburg, Hamburg and Rotterdam are the biggest ports along the corridor. The vast metropolitan area of Moscow is also included. Most of the ports of the region have excellent inland connections by rail and road. In Rotterdam, inland waterway connections are excellent via the Meuse and Rhine rivers.

The Baltic Sea is characterised by special natural conditions. In comparison to other seas the Baltic Sea is quite small and shallow with an average depth of 55m. Furthermore its inflow by the North Sea is narrow therefore water stays quite long in the Baltic Sea before it is replaced by new water from the North Sea. That is why the area is highly sensible. [Baltic Sea Portal (2011)] For the traffic, additional challenges are brought by the numerous islands located all over the Baltic Sea.

Nureyev [RotMos]



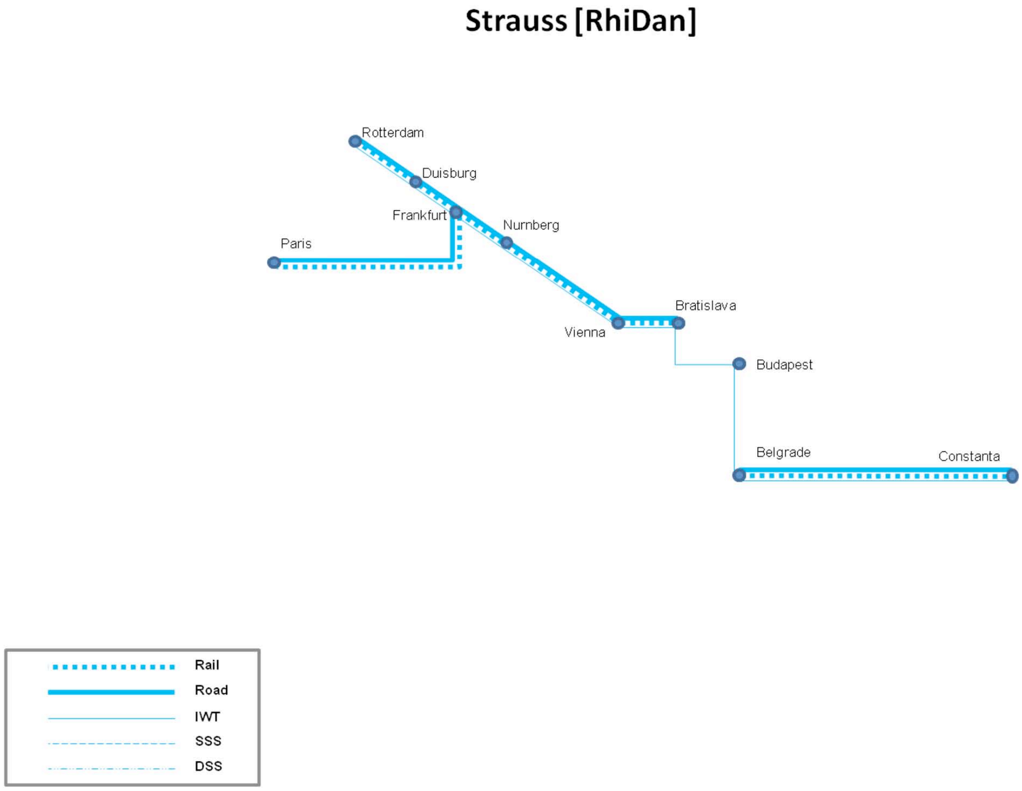
Strauss

The Strauss corridor, being represented to a large part by the TEN-T Priority Axis 18, crosses Europe transversally from the North Sea at Rotterdam to the Black Sea in Romania. The Meuse and the Rhine rivers are the entrance gates for the Belgian and the Dutch inland waterways to this Priority Project corridor. Through the Main River and the Main-Danube Canal, the Rhine River is connected to the Danube that flows until the Black Sea. With a length of approximately 3500 km this corridor is one of the longest ones in the Trans European Transport Network and crosses European Union countries (The Netherlands, Belgium, Germany, Austria, Slovakia, Hungary, Romania, Bulgaria) as well as non EU ones (Croatia, Republic of Serbia, Moldova and Ukraine).

The main cargo types transported on the Rhine-Main-Danube axis are dry bulk, liquid bulk, high value goods and containers. The main cargo commodities transported on German waterways reflecting roughly the situation on the Rhine-Main-Danube axis in Germany are: traditional bulk cargo e.g. iron ore (55 %), medium-value cargo e.g. steel or construction materials (30 %) and high-value goods e.g. vehicles or manufactured goods in containers (15 %), in year 2006.

The main commodities transported on the Danube are: traditional bulk cargo e.g. iron ore (83 %), medium-value cargo e.g. steel or construction materials (15 %) and high-value goods e.g. vehicles or manufactured goods in containers (2 %), in year 2003.

The Rhine River and the Danube have significant free capacities for the transportation of cargo. E.g. approximately only 10 percent of the capacity of the Danube is utilized. Within a homogenous European Union including also the South-Eastern European countries and already by removal of the bottleneck between Vienna and Bratislava being underway as well as the one at Straubing-Vilshofen approximately a doubling of transport volumes to up to 80 million tons is expected for the Danube.

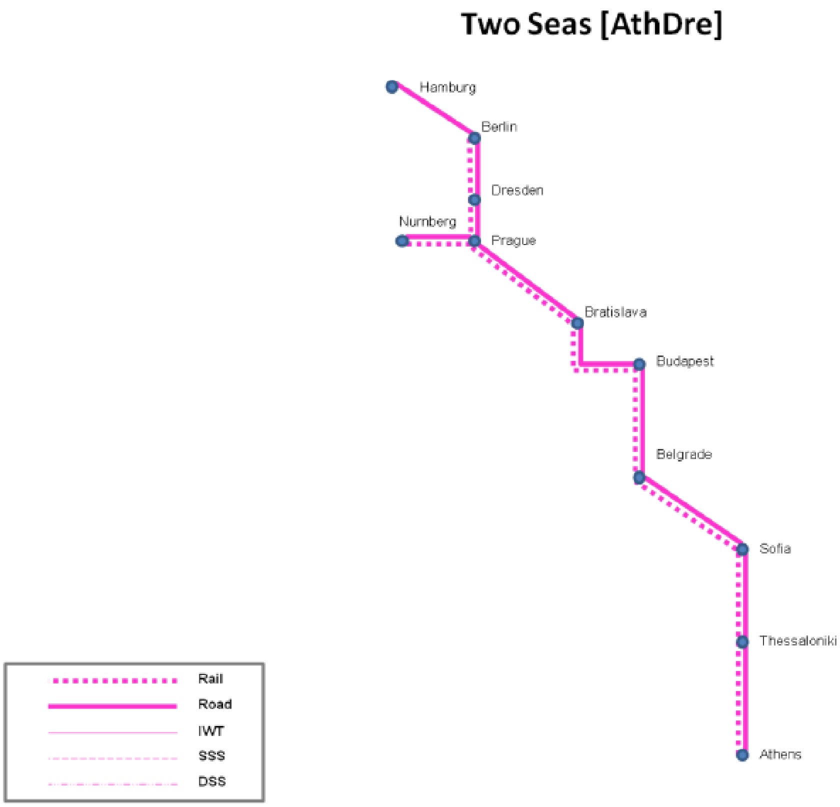


Two Seas

The Two Seas Corridor links the Baltic and the Mediterranean Seas connecting Greece and Germany through several European countries (Bulgaria, Serbia, Hungary, Slovakia, and Czech Republic). The corridor is mainly rail and road-based.

The central part of the corridor is represented by a part of the Pan-European corridor n° IV (Dresden, Prague, Budapest, Sofia and Constanţa).

The main road in this segment of the corridor is represented by the A17 highway; the name on the Czech side is D10, which represents a new central-European express motorway between Dresden and Prague. The new route is not yet finished completely but it is considered very important for the improvement of the link between Germany and the Czech Republic.



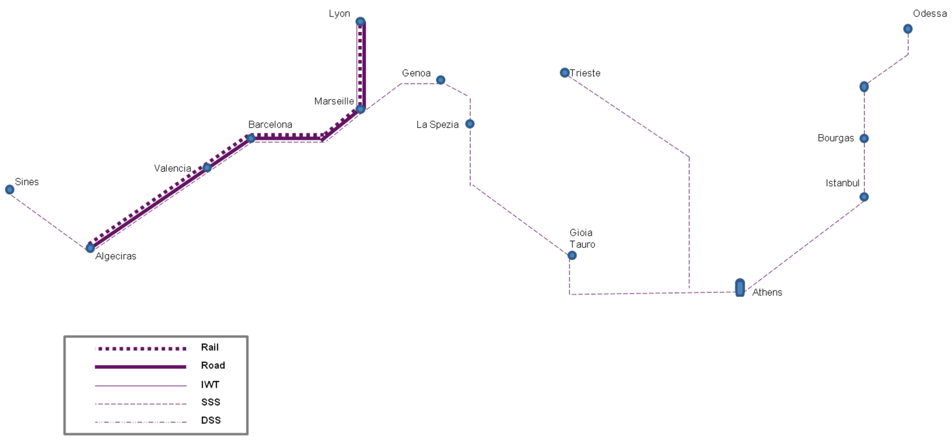
Mare Nostrum

The Mare Nostrum corridor includes Mediterranean and Black sea trade routes. There are nine countries involved in this approximately 6.000 kilometre mostly short sea shipping corridor: Ukraine, Romania, Bulgaria, Turkey, Greece, Italy, France, Spain and Portugal. The corridor serves a vast area, taking in a large part of the European Union's Eastern flank and its entire Southern part. It focuses on trades between the following ports: Odessa - Constanta - Bourgas - Istanbul - Athens - Trieste - Gioia Tauro - La Spezia - Genoa - Marseille - Barcelona - Valencia - Algeciras - Sines.

Based on stakeholder feedback received during the first plenary workshop of the project (organised in Helsinki, Finland on 28 June 2010), the road/rail land-based branch Algeciras -Valencia-Barcelona-Marseille-Lyon was added to the short sea shipping connections of the corridor.

Most ports along the corridor have good connections with all modes of transport. In addition, Odessa and Constanta have excellent connections to the inland areas via navigable rivers (Dnieper and Danube respectively). Although the current infrastructure and connections are rather good, there are currently several projects in progress that will provide new facilities for cargo handling and improve transport connections.

Mare Nostrum [SinOde]

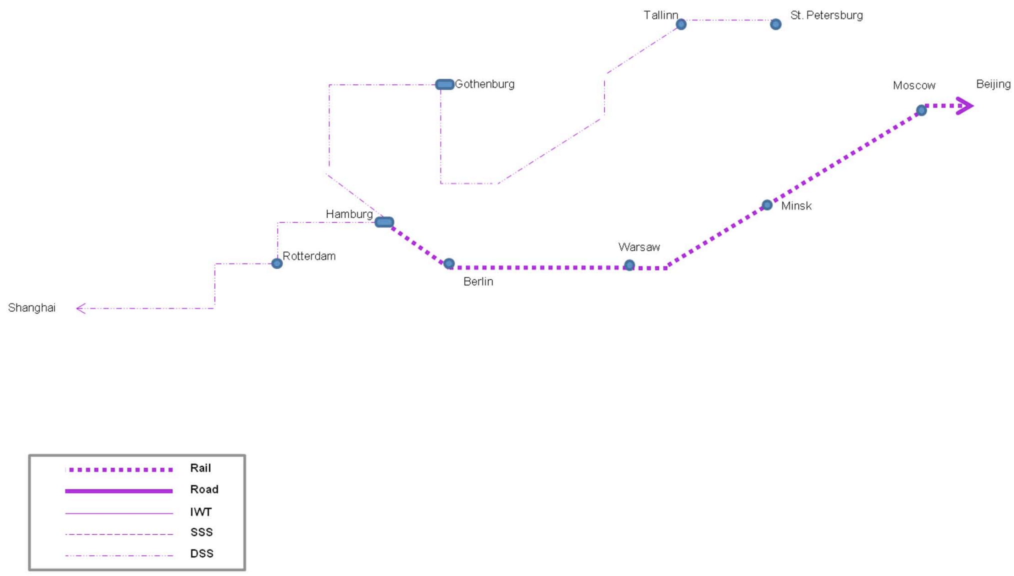


Silk Way

The Silk Way corridor consists of two main transport services linking the Far East with Europe. Today there are mainly two alternatives for shipping large transhipments of goods between the two regions, one being the deep sea service linking Shanghai to the Le-Havre-Hamburg region, while the other is the rail-link between Beijing and European Union. For cargo transport the rail link between Shanghai/ Beijing and for example to Duisburg take approximately 18 days from terminal to terminal. Although such a train service is not capable of transporting the same amount of goods in one shipment compared to a large container vessel, the transport time is considerably shorter compared to deep sea transport (taking approximately 35-40 days depending on average speed at sea).

The rail service is based on a regularly scheduled transport with a fixed route and departure days. Due to differences in rail gauges between Russia and China, a block train is formed in Zabaykalsk at the Russian/Chinese border with containers coming from Shanghai/Beijing. From Zabaykalsk the train travels en-route to the EU border at Brest/Malaszewicze. From here, connections are available to Duisburg (including all gateway connections), Hamburg, Warsaw, Prague and other destinations in Europe.

Silk Way [CNHam]



Appendix 2

ICT Applications	Availability	Efficiency	Total
Expert charging systems			
Congestion Charging	2,83	2,23	2,53
Unified Electronic toll system (CHD)	2,75	2,46	2,61
Toll amount depending on the pollutant category	2,17	2,23	2,20
Broadcasting, monitoring & communication systems			
Conducted communication systems	2,67	2,71	2,69
Car-to-X-Communication	2,67	2,57	2,62
Route guidance systems Personal navigation assistant	3,00	2,71	2,86
Head-up display	1,50	2,00	1,75
Navigation system for trucks	3,00	2,86	2,93
AMV Verkehrsmanagement Audio Mobil	2,33	2,71	2,52
Schenker Smartbox	1,67	2,29	1,98
Broadband communication (WiFi/WiMAX, digital VHF)	3,00	3,00	3,00
RFID	2,67	2,57	2,62
AGHEERA	1,67	2,57	2,12
Broacasting systems (TMC, TMCpro, TPEG, DVB, DAB)	3,00	2,86	2,93
Mobile radio systems (GSM; SMS; GPRS; UMTS)	2,67	3,00	2,83
Intelligent Transportation System (ITS)	3,00	3,00	3,00
GNSS (GPS, Glonass, Galileo)	2,92	2,28	2,60
Automatic Identiciftion System (AIS)	2,59	2,22	2,40
LRIT – Long Range Identification and Tracking, radar	2,57	2,14	2,35
SafeSeaNet	2,33	2,14	2,24
ENC/ECDIS	2,81	2,20	2,50
Centralised transportation management systems			
ERTMS	2,58	2,82	2,70
Traffic flow optimization	2,89	2,86	2,87
River Information Service (RIS)	2,17	2,76	2,46
Fairway Information Service (FIS)	2,33	2,64	2,49
Information for Law- enforcement (ILE)	1,76	2,30	2,03
International networking of national traffic control centres	1,87	2,49	2,18
Traffic signalling optimization	3,00	2,49	2,74
Traffic control systems (TMC pro/TMC Plus, GPS/GSM)	3,00	2,69	2,84

Caesar (or systems of individual operators)	2,40	3,00	2,70
IBNet	2,33	2,57	2,45
Electronic Traffic Management: VTS/VTMIS	2,39	2,42	2,40
OPTIMAR	1,83	2,71	2,27
Decentralised transportation management systems			
Platooning	2,33	2,32	2,33
Speed limits depending on CO2 values	3,00	2,21	2,61
Intelligent Speed Adaption (ISA)	2,67	2,39	2,53
Safety systems			
Road weather information systems	2,33	2,39	2,36
Speed limiter	2,63	2,15	2,39
Night Vision System	1,50	2,11	1,80
Distance control systems	1,71	2,04	1,87
Collision warning systems	2,08	2,04	2,06
Braking assistant systems	2,46	2,05	2,26
Lane Departure Warning (LDW)	1,88	2,08	1,98
Lane keeping assistant	1,96	2,04	2,00
Curve Speed Warning (CSW)	1,58	2,07	1,83
E-Administrative Systems			
Single Window Solution	1,50	2,65	2,08
Port Community Systems	1,50	2,65	2,08
JUP	1,33	2,57	1,95
Fretis	1,50	2,61	2,05
ShortSeaXML	1,50	2,61	2,06
Emissions footprint calculator systems			
Sensors (shock, thermo, noise)	2,67	2,21	2,44
Anonymised sensor data gateway	1,50	2,00	1,75
Green Trucks	2,75	2,18	2,46