



SEVENTH FRAMEWORK PROGRAMME



THEME [7]

Theme Title: Transport (including Aeronautics)

SuperGreen

**SUPPORTING EU'S FREIGHT TRANSPORT LOGISTICS ACTION
PLAN ON GREEN CORRIDORS ISSUES**

Grant agreement for: <Coordination and Support Actions (coordination)>

Grant agreement no.: TREN/FP7TR/233573/"SUPERGREEN"

Deliverable D2.5

Definition of Areas for Improvement

Due date of deliverable: 15 July 2011

Actual submission date: 18 July 2011 (revised: 30 Aug. 2011)

Organisation name of lead partner for this deliverable: Sito Oy

Document ID number: 02-25-RD-2011-03-01-1

REVISIONS/DOCUMENT HISTORY:

Index	Date	Authors	Reviewers	Subject
0	15.7.2011	S. Rönkkö, SITO et al.	Humberto Moyano, Alkis John Corres	Internal review
1	18.8.2011	As above	H. Psaraftis, NTUA	Revision taking on board comments from Commission

CLASSIFICATION AND APPROVAL

Classification: **R** Public (PU)

DEFINITION

Nature of the deliverable:

R = Report, **P** = Prototype, **D** = Demonstrator, **O** = Other

Dissemination level:

PU = Public

PP = Restricted to other programme participants (including the Commission Services).

RE = Restricted to a group specified by the consortium (including the Commission Services).

CO = Confidential; only for members of the consortium (including the Commission Services).

Confidential for the Duration of the Project:

After final project approval by the EC, status for reports classified ‘Confidential for the Duration of the Project’ are automatically down-graded to ‘Public’.

Confidentiality:

This document’s status was converted to ‘Public’ after approval by the SuperGreen Consortium and the European Commission. The document can be distributed or used in whole or in part after appropriate acknowledgment of the source.

Document summary information

Authors and contributors

Initials	Author	Organisation	Role
S.R	Sanni Rönkkö	SITO	Author
I.S	Ilkka Salanne	SITO	Author
R.V.	Raisa Valli	SITO	Reviewer
G.P	George Panagakos	NTUA	Contributor
J.S	Juha Schweighofer	VIA	Contributor
A.S	Andrea Schoen	SCH	Contributor
P.A	Paulus T. Aditjandra	UNEW	Contributor
S.F	Sara Fozza	DAPP	Contributor

Revision history

Rev.	Who	Date	Comment
0	All	15.7.2011	Final report to be sent to Commission
1	S.R	18.8.2011	Response to Commission's comments
2			

Quality Control

	Name	Date
Checked by WP leader	Ilkka Salanne	29.6.2011
Checked by internal reviewer	Humberto Moyano	8.7.2011
Checked by internal reviewer	Alkis John Corres	8.7.2011

APPROVAL

All partners of the project consortium via a return email have approved the final version of this SuperGreen Deliverable.

ACKNOWLEDGMENT



Funding for the SuperGreen project has been provided by the European Commission (DG-MOVE) and by partners' own funds, in the context of Grant Agreement No. TREN/FP7TR/233573/"SUPERGREEN".

DISCLAIMER

Use of any knowledge, information or data contained in this document shall be at the users sole risk. Neither the SuperGreen Consortium nor any of its members, their officers, employees or agents shall be liable or responsible, in negligence or otherwise, for any loss, damage or expense sustained by any person as a result of the use, in any manner or form, of any knowledge, information or data contained in this document, or due to any inaccuracy, omission or error contained herein.

The European Commission shall not in any way be liable or responsible for the use of any such knowledge, information or data, or of the consequences thereof.

Table of Contents

LIST OF FIGURES.....	5
LIST OF TABLES.....	6
LIST OF ABBREVIATIONS.....	7
EXECUTIVE SUMMARY	8
1 INTRODUCTION	9
2 OBJECTIVES.....	10
2.1 OBJECTIVES OF THE SUPERGREEN PROJECT.....	10
2.2 OBJECTIVES OF WORK PACKAGE 2 AND TASK 2.5.....	10
3 METHODOLOGY OVERVIEW.....	12
4 SUMMARY AND EVALUATIONS OF WORK PACKAGE 2.....	14
4.1 TASK 2.1 SELECTION OF CORRIDORS	14
4.1.1 Objectives and methodology.....	14
4.1.2 Results	15
4.1.3 Conclusions and evaluation.....	18
4.2 TASK 2.2 DEFINITION OF BENCHMARK INDICATORS & METHODOLOGY	19
4.2.1 Objectives and methodology.....	19
4.2.2 Results	19
4.2.3 Conclusions and evaluation.....	21
4.3 TASK 2.3 EFFECTS OF CHANGES IN OPERATIONAL & REGULATORY ENVIRONMENT	22
4.3.1 Objectives and methodology.....	22
4.3.2 Results	23
4.4 TASK 2.4 BENCHMARKING OF GREEN CORRIDORS	26
4.4.1 Objectives and methodology.....	26
4.4.1 Results	28
4.4.2 Conclusions and evaluation.....	31
5 CORRIDOR SPECIFIC MAJOR BOTTLENECKS AND DEVELOPMENT AREAS.....	32
5.1 BRENNER	32
5.2 FINIS TERRAE	35
5.3 CLOVERLEAF	38
5.4 EDELWEISS	45
5.5 NUREYEV.....	49
5.6 STRAUSS.....	52
5.7 TWO SEAS.....	58
5.8 MARE NOSTRUM.....	59
5.9 SILK WAY.....	62
6 COMMON DEVELOPMENT AREAS	66
6.1 COMMON OPERATIONAL DEVELOPMENT AREAS.....	66
6.2 COMMON DEVELOPMENT AREAS RELATED TO POLICIES, LEGISLATION AND REGULATIONS	67
6.3 COMMON DEVELOPMENT AREAS RELATED TO INFRASTRUCTURE.....	68
6.4 COMMON DEVELOPMENT AREAS RELATED TO ICT AND TRANSPORTATION TECHNOLOGY	69
7 BEST PRACTICES.....	71
7.1 OPERATIONAL	71
7.2 POLICIES, LEGISLATION AND REGULATIONS.....	75
7.3 INFRASTRUCTURE	79
7.4 ICT AND TRANSPORTATION TECHNOLOGY.....	81
8 SUMMARY AND CONCLUSIONS	87

List of Figures

Figure 1 Overview of Task 2.5.	13
Figure 2 Summary of Work Package 2	14
Figure 3 Corridor selection process	15
Figure 4 The final selection of SuperGreen corridors for the purpose of this project	18
Figure 5 Task 2.4 framework	26
Figure 6 SuperGreen corridors in metro map	27
Figure 7 Brenner corridor	32
Figure 8 Finis Terrae corridor	35
Figure 9 Cloverleaf Corridor	38
Figure 10 Total annual vehicle delay per mile for the slowest 10% journey	40
Figure 11 UK coastal and road freight routes	42
Figure 12 Daily sum of freight trains from 2007, 2015 and 2030	43
Figure 13 Edelweiss corridor	45
Figure 14 Nureyev corridor	49
Figure 15 Strauss corridor	52
Figure 16 Strauss corridor, TEN-T Priority Axis 18. Schedule of removal of bottle necks	53
Figure 17 Challenges, strategic goals and corresponding research pillars and topics for IWT	57
Figure 18 Two Seas corridor	58
Figure 19 Mare Nostrum corridor	60
Figure 20 Silk Way corridor	63
Figure 21 Operational bottlenecks and development areas	66
Figure 22 Bottlenecks and development areas related to policies, legislation and regulations	67
Figure 23 Bottlenecks and development areas related to infrastructure	68
Figure 24 Bottlenecks and development areas related to ICT and transportation technology	69
Figure 25 Different types of carbon footprint (adapted from Piecyk, 2010)	74
Figure 26 Vertical and horizontal dimensions of carbon foot printing (Piecyk, 2010)	74
Figure 27 KPI evaluation and grouping in Work Package 2	87
Figure 29 The need for harmonisation of ICT and regulations in Supply Chains.	89
Figure 30 Most favourable areas for improving sustainability	91

List of Tables

Table 1 Pre-Selected corridors	17
Table 2 The final selection of SuperGreen corridors	18
Table 3 Initial list of SuperGreen KPIs	22
Table 4 Final set of KPIs used for benchmarking	30
Table 5 SuperGreen benchmarks for corridors	31

List of Abbreviations

- CCNR – Central Commission for the Navigation of the Rhine
- CESAR – Intermodal operators' joint transport monitoring and information system
- DfT – UK Department of Transport
- DoRIS – Donau River Information Services
- DSS – Deep Sea Shipping
- EEDI – Energy Efficiency Design Index
- EPCH – Europorte Channel
- ERFA – European Rail Freight Association
- ERTMS – The European Railway Traffic Management System
- ETCS – European Train Control System
- HGV – Heavy Good Vehicle
- HS1 – High Speed 1 (high-speed railway line running from London through Kent to the British end of the Channel Tunnel)
- HS2 – High Speed 2 (new high speed rail services between London and Scotland)
- ICT – Information and Communication Technology
- IMO – International Maritime Organization's
- IRIS – Implementation of River Information Services
- IWT – Inland Waterway Transport
- KPI – Key Performance Indicator
- LHV – Long and heavy vehicle
- LPI – Logistics Performance index
- LSP – Logistics Service Provider
- MAUT – Germany's LKW-Maut, Lastkraftwagen-Maut, literally 'truck-toll'
- NAIDES – Integrated European action program for inland waterway transport
- PLATINA – Platform for the Implementation of NAIADES
- RIS – River Information Service
- SSS – Short Sea Shipping
- TERFN – Trans-European Rail Freight Network
- UTC – Urban Traffic Control
- VMS – Variable Message Signs
- WCML – West Coast Main Line
- WSV – German Waterways and Shipping Administration

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 through Europe. The project's web site is www.supergreenproject.eu. This report concerns Work Package 2 and Task 2.5.

The complete work package, Benchmarking Green Corridors, involves a set of Tasks from Task 2.1 to 2.5 that form a systematic approach for the evaluation, selection, and development of the green corridor concept. In Task 2.1, the first Task of the Work Package, 9 corridors were selected for further development in the project. In Task 2.2 a benchmarking methodology was defined and the original list of KPIs was established. In Task 2.3 the effects of changes in operational and regulatory environment were surveyed and assessed using these KPIs. Next, in Task 2.4, benchmarking of the SuperGreen corridors using the KPIs was carried out. According to the results of that exercise the biggest bottleneck against development of corridor or transport chain level KPIs is the inadequate statistical information on transports. Ensuring the availability of transport data is the first step in developing more confident indicators. In the final and conclusive Task 2.5 the work done so far in the Work Package 2 is summarized.

Major bottlenecks in greening each one of the SuperGreen corridors were defined. Based on this and in combination with the work done in other work packages of the project, common development areas for all corridors were defined. Development areas were identified in the following groups: Operations; Policies, regulations and legislation; Infrastructure; and ICT & technology. The major development areas concern new ICT systems, improvement of railway operations (infrastructure, operational, ICT), harmonisation of national regulations, improvement of customs procedures, hinterland connections, and adequate capacity in all transport networks and transfer points. Improvements towards sustainability are needed in each one of the corridors for different purposes.

Several good practises to improve sustainability were also identified in all corridors and in all transport modes: inland waterway, rail, road, short sea shipping, deep sea shipping and intermodal. The problem that arose was the lack of harmonisation and co-operation. These are vital elements that are needed to be addressed in order to make use of the good practices more widely.

Based on the identified common development areas and best practices the most favourable areas for improving sustainability are: Improvement of green supply chain design and management, harmonization and development of policies and regulations, development and harmonization of transport infrastructure and transport technology, harmonization and development of ICT solutions and transport documents, improvement of transparency of information and increase of co-operation in supply chains and transport systems and ensuring supply of good quality labour.

This report concludes Work Package 2 giving valuable information to other work packages in the SuperGreen project.

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 through Europe.

The purpose of this document is to describe the work completed in Work Package 2 under Task 2.5. The objective of Task 2.5 is to provide the summary, evaluation, and grouping of the Key Performance Indicators, KPIs, and the description of the major bottlenecks in the agenda of greening transport chains in selected corridors. The common development areas for all transport corridors are defined and the total summary is made based on the overall results of earlier tasks in Work Package 2.

Task 2.5 started on 15th of January 2011 as planned and is concluded with this report due 15th of July 2011. There have been seven partners involved in this task. The partners involved were: Sito Ltd (task leader), National Technical University of Athens, D'Appolonia S.p.A., via Donau - Österreichische Wasserstrassen GmbH, NewRail - Newcastle University, Lloyd's Register-Fairplay Research and DB Schenker.

In Section 2 of this report the objectives of the SuperGreen project, Work Package 2 and Task 2.5 are described.

Section 3 describes the methodology applied for Task 2.5.

Section 4 presents the summaries and evaluation of all the previous tasks in Work Package 2.

Section 5 contains the description of the major bottlenecks and development areas along SuperGreen corridors. In Section 6, an analysis and description of the common development areas of all corridors are presented.

In Section 7, preliminary information regarding best practices on the most favourable areas for improving the sustainability of the transport chains of the selected corridors are given.

Section 8 presents a summary and evaluation of the findings of Task 2.5. This section concludes the whole Work Package 2 and recommendations are given for the development of further work packages.

2 Objectives

2.1 Objectives of the SuperGreen project

The EU Commission's Freight Transport Logistics Action Plan¹ 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 2 and Task 2.5

The objective of Work Package 2 (WP 2) is to determine the major development needs and possibilities for the greening of transport chains in selected transport corridors. It also provides information on Key Performance Indicators (KPIs) suitable for assessing the economic efficiency, social acceptance and environmental sustainability of green corridors. The work is based on indicators developed for monitoring the sustainable development goals of the European Union. WP 2 utilises the work done and taking place in member states on supply chain accounting and reporting, as well as testing sustainable development

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

indicators for spatial and social planning. They will describe the current situation, the sustainability, as well as the future development aspects of the transport corridors. This work package provides basic information concerning subsequent work packages.

This work package is expected to produce the following information:

- General description of the EU's potential Green Corridors: preliminary definition, describing and grouping the most relevant corridors according to transport volumes, transport modes, infrastructure and the average length of transport chains.
- Selection of most important corridors among those defined as part of TEN-T, given prioritised criteria, for further information acquisition.
- Defining and grouping the benchmark indicators (key performance indicators).
- Clarification of the general and specific corridor changes in operational and regulatory environment that may hinder or promote the green logistics improvements in selected corridors.
- Description of the state of selected corridors using the defined indicators from the greening of transport's point of view.
- Description of future aspects of the corridors.
- Grouping and assessing the corridors using the benchmark indicators.
- Description of the major bottlenecks against the greening of transport chains in selected corridors.
- Description of the most effective areas for improving sustainability of transport chains in selected corridors.
- Definition of the common development aspects for all transport corridors.

The complete work package, Benchmarking Green Corridors, involves a set of tasks from Task 2.1 to 2.5 that form a systematic approach for the evaluation, selection, and development of a green corridor concept.

The objective of Task 2.5 is to provide the summary, evaluation, and grouping of the KPIs and the description of major bottlenecks in the greening of transport chains in selected corridors. Preliminary information were collected regarding best practices of the most favourable areas for improving the sustainability of transport chains of the selected corridors. The common development areas for all transport corridors are defined and the total summary is made based on the overall results of earlier tasks, Tasks 2.1-2.4, in Work Package 2.

3 Methodology overview

This section gives a general overview of the methodology used in Task 2.5, with details being shown in subsequent sections.

First a summary and evaluation of all previous tasks within Work Package 2 i.e. Task 2.1, Task 2.2, Task 2.3 and Task 2.4 are carried out. The summary consists of short description of the objectives, methods and content of the task together with the description of main results against objectives of the task. Evaluation and conclusions are carried out on the basis of how the results serve the other tasks of WP 2 and the overall goals of the Super Green project and the EU's Logistics Action Plan (the development of Green Corridor concept).

Based on the information provided and activities performed under Tasks 2.2 “Definition of Benchmark Indicators & methodology” and Task 2.4 “Benchmarking of Green Corridors”, a summary of the KPIs is presented.

Major bottlenecks are described for each SuperGreen corridor. Then corridor specific development areas are defined. Bottlenecks and development areas are grouped as follows:

- Operational (as an example related to customs, procedures of Supply Chain Management, transport/logistics operations and strategies etc.)
- Policies, legislation and regulations
- Infrastructure
- ICT
- Transportation technology
- Other major bottlenecks and development areas (geographical etc.)

After the bottlenecks have been identified separately for each corridor the results are analysed and common development areas for all corridors are identified. In addition a separate information collection and analysis of materials concerning specifically common/general development areas is performed, because the previous task concentrates only on corridor specific development areas.

The successful cases and best practices are identified in selected corridors. Analyses are made for finding out the successful cases and best practices that could be transferred to other corridors. The overarching objective is to clarify the most favourable areas for targeting the development measures for increasing sustainability. This will form the basis for continuing work in work packages WP3 (green technologies), WP4 (green ICT), WP5 (directions for further work) and WP6 (policy recommendations).

Finally conclusions of the Work Package 2 are presented. These include recommendations for the development of further work packages.

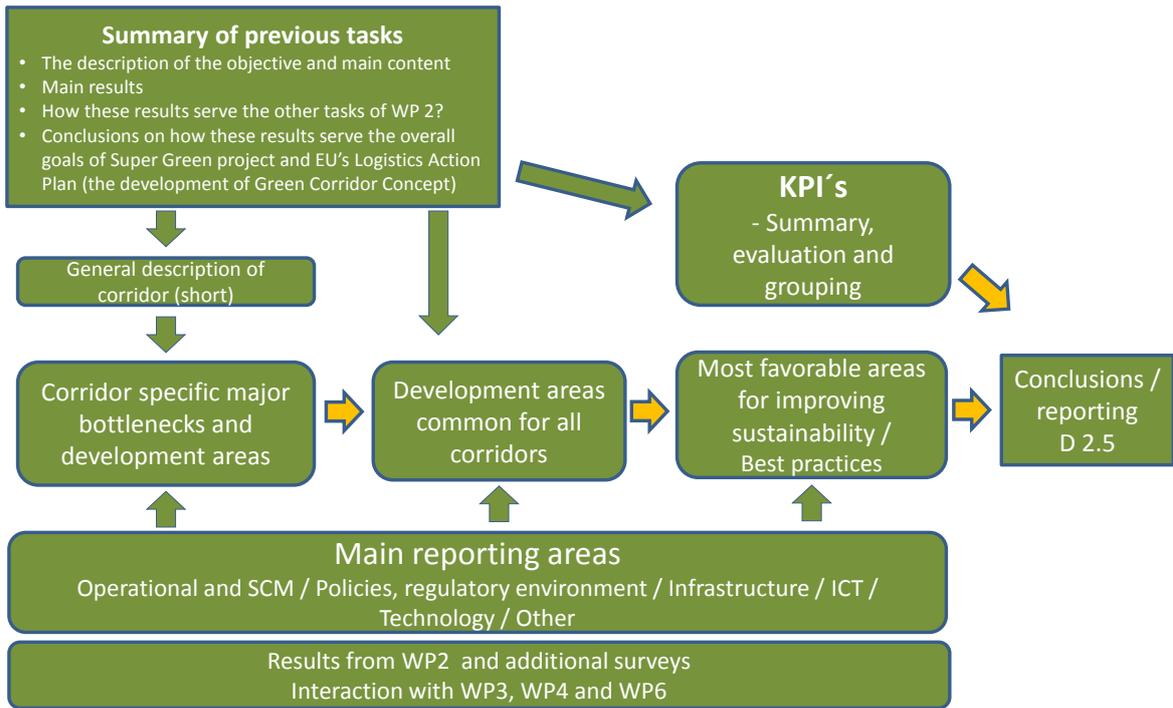


Figure 1 Overview of Task 2.5.

4 Summary and evaluations of Work Package 2

Work Package 2 and the whole SuperGreen project started with Task 2.1, where 9 corridors were selected for further processing in this and other work packages of the project. In the next task, Task 2.2, a set of initial KPIs was produced. Effects of changes in operational and regulatory environment that could promote or hinder the implementation of green corridors were then estimated in Task 2.3. The effects were assessed through the initial KPIs introduced in the Task 2.2.

Next, in Task 2.4, stakeholder consultations on KPIs were carried out in several forms; workshops, meetings, questionnaires. Based on the feedback received, the initial KPIs were further developed and the indicators used in benchmarking were defined. Benchmarking analysis was then performed for the 6 corridors.

Task 2.5 provides the summary and evaluation of the results achieved so far, along with the definition of main development areas in the greening of transport corridors. The proceeding and the main content of WP 2 are described in the following figure.

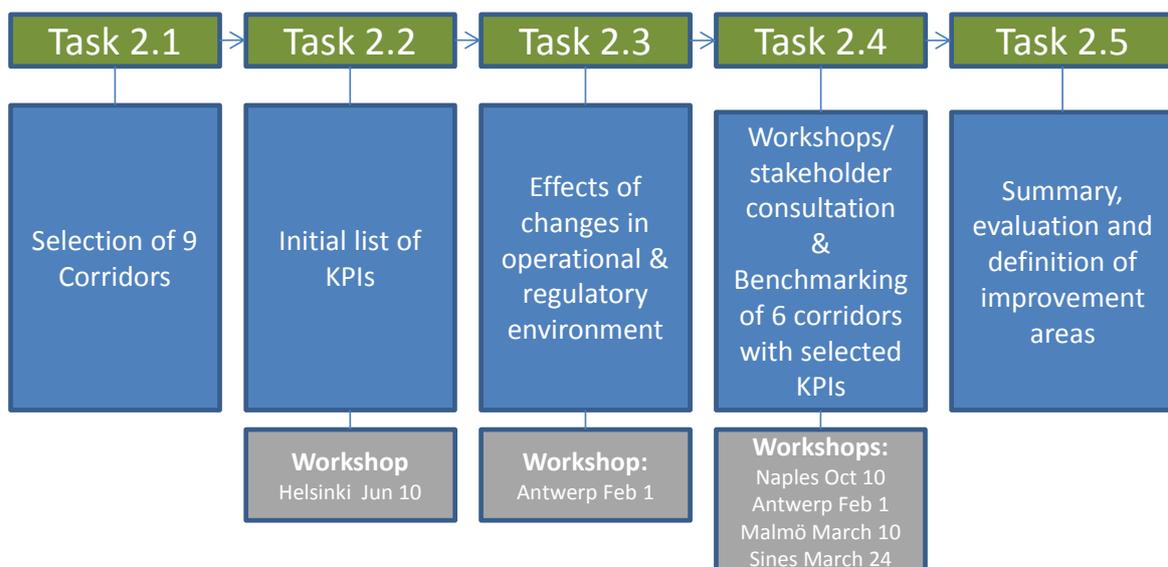


Figure 2 Summary of Work Package 2

4.1 Task 2.1 Selection of Corridors

4.1.1 Objectives and methodology

The objective of Task 2.1 was the selection of corridors for further activities in the project. This was achieved through a two-phase process as stated in the DoW. First a pre-selection of 10-15 corridors was made. Based on the pre-selection, a final selection of 9 corridors was carried out.

The selection process should by no mean imply any “green” endorsement by the consortium or the Commission, with respect to any criteria, environmental, economic, or other. The selection was made only for the purposes of the work to be performed under this project. The selected corridors will act as a basis for the definition of the benchmarks

taxonomy to be developed. The entire selection process is shown schematically in Figure 3.

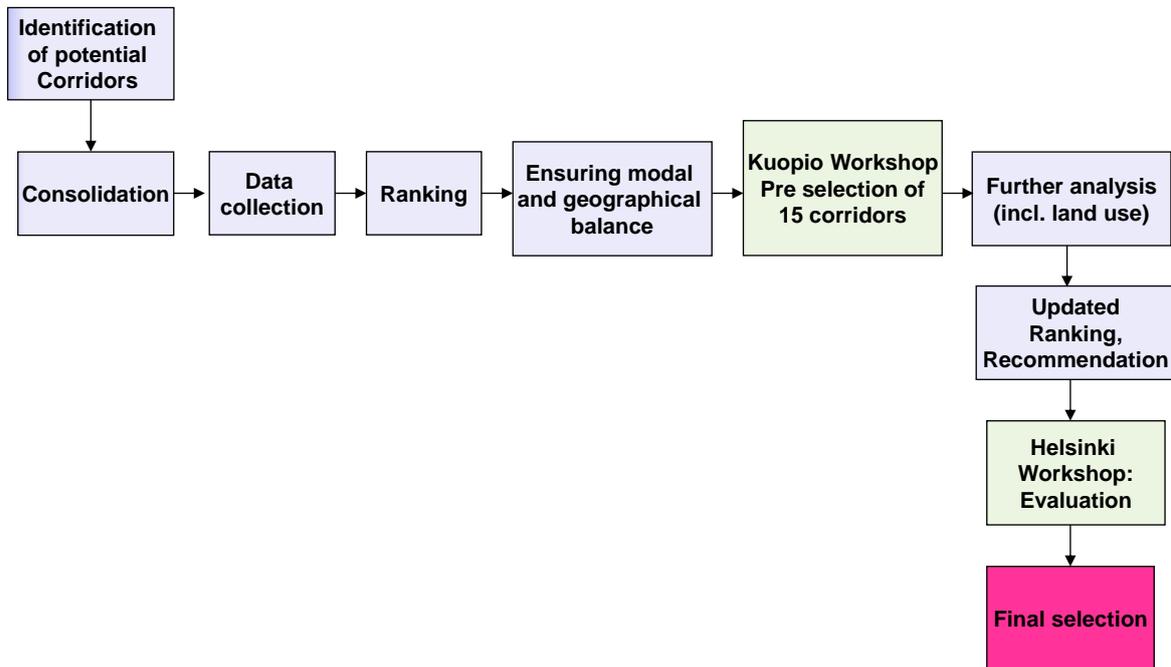


Figure 3 Corridor selection process

4.1.2 Results

The selection of corridors was firstly based on the current TEN-T network. As a first step to the process, the 30 priority projects identified by the EU Member States and included in the Community guidelines for the development of the TEN-T as projects of European interest were listed. In addition to the TEN-T network, the set of Pan-European transport corridors were considered. Where applicable, a combination of TEN-T and Pan European corridors was made. These corridors formed the basis for the next step of the selection process. This first corridor list was distributed to all SuperGreen partners. They were asked to add transport corridors that they considered important and submit their suggestions supported by proper argumentation. With these later suggestions incorporated, a list of some 60 corridors was compiled.

Next, these 60 corridors were grouped together and overlapping corridors were combined. A new list of 45 corridors was formed as a result of this consolidation. The corridors were then grouped by transport mode and geographical area. A map of these 45 corridors was produced. With the help of this map, some further consolidation was done. This resulted in a list of 30 corridors which were considered in the pre-selection process.

In order to advance to the next stage, information on the 30 listed corridor groups was needed. The collection of information was assigned to the SuperGreen partners participating in Task 2.1. The allocation was based on the partners' input foreseen by the DoW and the interest they showed for specific corridors and/or areas. Data on each corridor was collected, using the Corridor Card as a structured reporting model. As expected, the collected information varied widely in terms of content and volume. The availability and quality of information also varied significantly depending on the type of data required. Furthermore, data was more readily available for some corridors than others.

The information gathered was analysed and sorted in order to prepare for an internal pre-selection working meeting, whose objective was to pre-select 10–15 corridors as the basis for the next step. This analysis involved three initial criteria, namely the total length of the corridor, the number of inhabitants of major cities along the corridor and, the number and seriousness of relevant bottlenecks identified. Corridors were sorted and scored on the basis of the three elements mentioned above. The so derived scores were used as input during the pre-selection workshop.

The pre-selection workshop was arranged in Kuopio, Finland, on 30 March 2010. The aim was to pre-select 10-15 corridors for further work. During the workshop, the spread sheet with corridor length, population and bottlenecks derived was extended to include the other set of criteria mentioned in the DoW, namely:

- transport volume,
- types of goods and multimodality,
- geographical preconditions,
- used transport and information technology, and
- Supply chain management and transport clients.

The evaluation and assessment, based on what information was available in the corridor cards, transport volume maps and the specific knowledge of partners on the corridors, was done on a qualitative basis using the Delphi method.

The pre-selection started by selecting from each geographical group the corridor with the highest score. The nine groups are those mentioned in the DoW and listed below:

- The Iberian and/or Italian peninsula (1)
- Scandinavia (2)
- Inter-Mediterranean (3)
- Corridors linking Scandinavia with the Baltic countries, Poland and Germany (4)
- Hamburg- Le Havre range (5)
- Corridors between the UK and the European continent (6)
- Corridors between the Balkans and Central Europe (7)
- Corridors between the EU and Russia (8)
- Deep sea corridors (Far East to Europe and North America) (9)

This resulted in 9 corridors. The next step was to check the modal balance. According to the DoW, it was necessary to have at least 3 corridors in each one of the modal groups listed below:

- Land based corridors
- Corridors that are alternatives to road (short sea-road-rail-IWT-intermodal)
- Corridors with non-European trade partners (deep sea-road-rail-intermodal).

The remaining 6 corridors (so as to reach the target number of 15) were selected on the basis of the modal balance, the scoring and by merging corridors when possible. The final list of 15 pre-selected corridors is presented in Table 1.

A more detailed analysis was made on the 15 pre-selected corridors to support the final selection of 9 corridors. First in order to get homogeneous data related to land use aspects, calculations on the urban land use around the 15 pre-selected corridors were made using the CORINE Land Cover spatial dataset. Urban areas were chosen for the calculation because they can always be regarded as areas sensitive to the external effects of transport. Within a buffer radius of 20 kilometres from the median line of each corridor, the total area

of urban land cover was calculated and this was put in relation to the total area of land. The Natura 2000 spatial dataset available from the European Environment Agency was used in a way similar to the CORINE Land Cover dataset. Natura 2000 is the key instrument to protect biodiversity in the European Union. The share of Natura 2000 areas as a percentage of the total buffer area within the 20 km radius was calculated along each corridor, thereby producing a comparable index for sensitive natural areas.

Table 1 Pre-Selected corridors

CORRIDOR		Transport Mode
BerPal	Berlin-Munich-Salzburg-Verona/Milan-Bologna-Naples-Messina-Palermo, Branch A: Salzburg-Villach-Trieste (Tauern axis) Branch B: Bologna-Ancona/Bari/Brindisi-Igoumenitsa/Patras-Athens	Rail/Road/SSS
MadPar	Madrid-Gijon-Saint Nazaire-Paris Branch A: Madrid-Lisboa	Rail/Road/SSS
GenRot	Lyons/Genoa-Basle-Duisburg-Rotterdam/Antwerpen	Rail
CorMun	Cork-Dublin-Belfast-Stranraer Branch A: Munchen-Friedewald-Nuneaton Branch B: West Coast Main line	Rail/Road/ SSS
CopHel	Nordic triangle railway/road axis including the Oresund fixed link	Rail/Road/SSS
MilMal	Malmö-Milan via Fehmambelt	Rail/Road/SSS
VieGda	Gdansk-Warsaw-Brno/Bratislava-Vienna	Rail/Road
WarHel	Warsaw-Kaunas-Riga-Tallinn-Helsinki + extension Kaunas-Minsk-Kiev	Rail/Road/ SSS
RotMos	Motorway of Baltic sea, St. Petersburg-Moscow	Rail/Road/SSS
ParNizh	Berlin-Warsaw-Minsk-Moscow-Nizhny Novgorod Branch A: Warsaw-Lodz-Paris Branch B: Mechelen-Rotterdam-Amsterdam-Hanover-Warsaw-St. Petersburg-Moscow	Road
RhiDan	Rhine/Meuse-Main-Danube inland waterway axis Branch: Betuwe line	Rail/IWW
AthDre	Igoumenitsa/Patras-Athens-Sofia-Budapest-Vienna-Prague-Nurnberg/Dresden	Rail/Road
SinOde	Odessa-Constanta-Bourgas-Istanbul-Piraeus-Gioia Tauro-Cagliari-La Spezia-Marseille- (Barcelona/Valencia)-Sines Branch: Piraeus-Trieste	SSS
CNHam	Shanghai-Le Havre/Rotterdam-Hamburg/Gothenburg-Gdansk-Baltic ports-Russia Branch: Xiangtang-Beijing-Mongolia-Russia-Belarus-Poland-Hamburg	Rail/Deep sea
USAGot	Gothenburg-Halifax-New York-New Jersey-Baltimore-Portsmouth	Deep sea

For the final selection of the corridors, a workshop was arranged in Helsinki, Finland on 28 June 2010. The objective of that workshop was firstly, to assist in the selection of 9 corridors for further project work and secondly, to produce information for forthcoming tasks and work packages. Prior to the Helsinki workshop, two recommendations were made for the final selection in order to boost the discussion and help the final selection. A group of relevant stakeholders were invited to the workshop. A total of 87 people from 18 European countries attended the workshop, of which 56 were outside the SuperGreen consortium, confirming the great public interest on the matter.

Valuable comments were received from the participating stakeholders and the Advisory Committee members during the workshop. Based on this feedback the final selection was made at the Project Management Committee (PMC) meeting held one day after the Helsinki workshop. Last but not least, it was decided to introduce more pleasant and memorable “nicknames” for the nine SuperGreen corridors in parallel with the acronyms used so far. The selected corridors and their nicknames are presented in Table 2 and Figure 4 below.

Table 2 The final selection of SuperGreen corridors

FINAL CORRIDOR SELECTION		
Nicknames	Acronym	Corridor Description
Brenner	BerPal	Malmö-Trelleborg-Rostock/Sassnitz-Berlin-Munich-Salzburg-Verona-Bologna-Naples-Messina-Palermo Branch A: Salzburg-Villach-Trieste (Tauern axis) Branch B: Bologna-Ancona/Bari/Brindisi-Igoumenitsa/Patras-Athens
Finis Terrae	MadPar	Madrid-Gijon-Saint Nazaire-Paris Branch A: Madrid-Lisboa
Cloverleaf	CorMun	Cork-Dublin-Belfast-Stranraer Branch A: Munchen-Friedewald-Nuneaton Branch B: West Coast Main line
Edelweiss	HelGen	Helsinki-Turku-Stockholm-Oslo-Göteborg-Malmö-Copenhagen (Nordic triangle including the Oresund fixed link)-Fehmarnbelt - Milan - Genoa
Nureyev	RotMos	Motorway of Baltic sea Branch: St. Petersburg-Moscow-Minsk-Klaipeda
Strauss	RhiDan	Rhine/Meuse-Main-Danube inland waterway axis Branch A: Betuwe line Branch B: Frankfurt-Paris
Two Seas	AthDre	Igoumenitsa/Patras-Athens-Sofia-Budapest-Vienna-Prague-Nurnberg/Dresden-Hamburg
Mare Nostrum	SinOde	Odessa-Constanta-Bourgas-Istanbul-Piraeus-Gioia Tauro-Cagliari-La Spezia-Marseille-(Barcelona/Valencia)-Sines Branch A: Algeciras-Valencia-Barcelona-Marseille-Lyon Branch B: Piraeus-Trieste
Silk Way	CNHam	Shanghai-Le Havre/Rotterdam-Hamburg/Gothenburg-Gdansk-Baltic ports-Russia Branch: Xiangtang-Beijing-Mongolia-Russia-Belarus-Poland-Hamburg

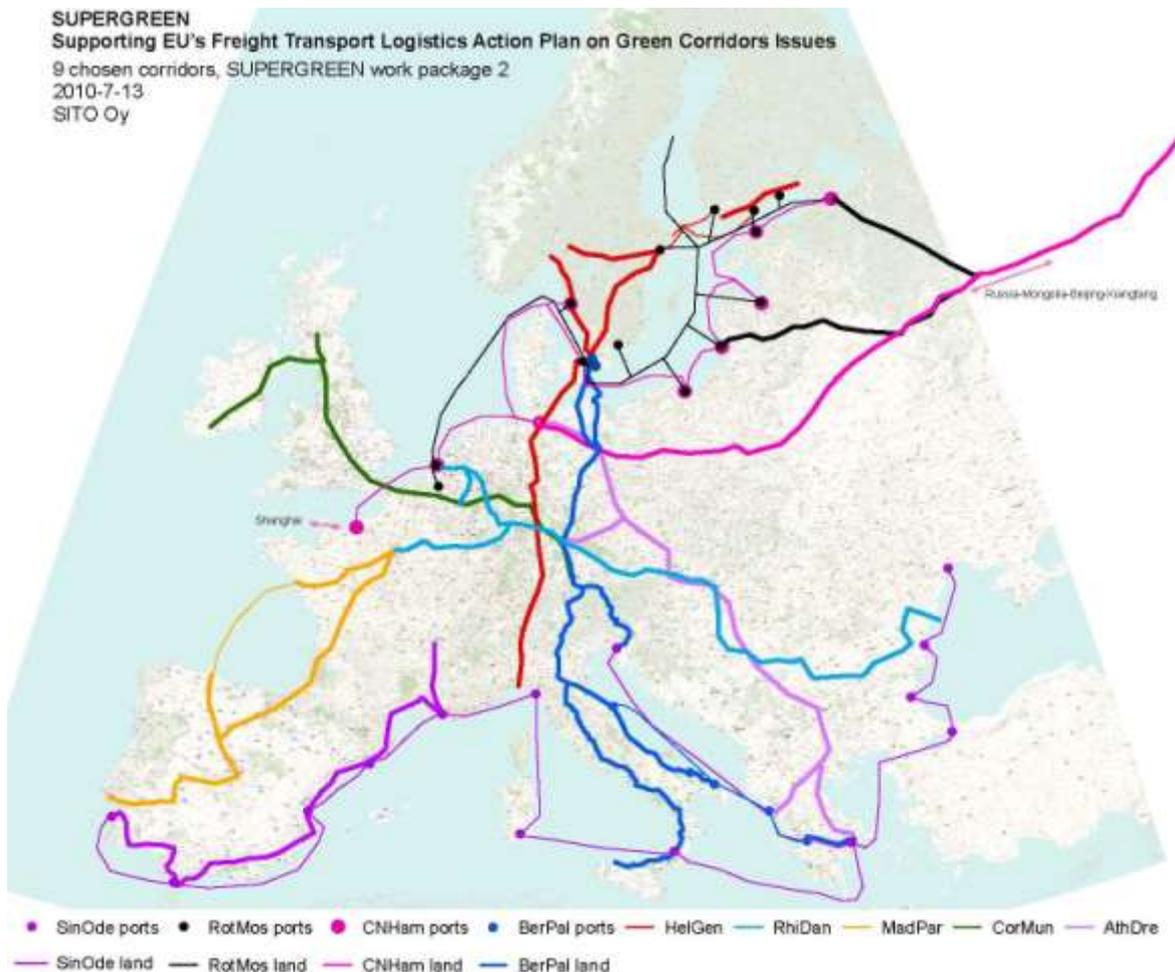


Figure 4 The final selection of SuperGreen corridors for the purpose of this project

4.1.3 Conclusions and evaluation

The selected set of corridors provided a fertile testing ground for the methodology and Key Performance Indicators (KPIs), which were to be developed under Task 2.2 of the project.

It has to be recalled that one of the criteria that was used to select the above corridors was their “greening potential”, that is, the potential for improvement in at least some of their segments according to environmental criteria. Balance in geographical coverage and in modal mix was also considered as important.

The selection of the 9 corridors was made only for the purposes of the SuperGreen project and by no means implies any endorsement, direct or indirect, either by the SuperGreen consortium or by the European Commission, of these corridors vis-à-vis any other corridor, with respect to any criteria, environmental, economic, or other. Resources available were the main determinant of the number of corridors chosen.

4.2 Task 2.2 Definition of Benchmark Indicators & methodology

4.2.1 Objectives and methodology

Task 2.2 provided information on Key Performance Indicators (KPIs) suitable for assessing the economic efficiency, social acceptance and environmental sustainability of green corridors. The KPIs need to cover the environmental, technical, economic, social and spatial planning aspects of intermodal freight transport and should be able to reflect the success factors of logistics chains and corridors against the sustainable development goals of the European Union. KPIs aim to assist in obtaining a clear and analytical picture of the current state and the development needs in “greening” transport chains along the selected SuperGreen corridors.

In Task 2.2 a 20-step methodology was created to guide the process of the definition of KPIs and the actual benchmarking of the SuperGreen corridors. This methodology could be summarized in three major phases. First phase included review of other studies and projects. In the second phase the initial list of SuperGreen KPIs was put together. The third phase consisted of piloting the initial KPIs and revision. The third phase was carried out during Task 2.4.

4.2.2 Results

The first phase included the identification of the characteristics that the KPIs would need to have. These characteristics included that the KPIs preferably should be quantitative or at minimum comparable to allow for meaningful results and they should serve the purpose of the project, i.e. they should be useful.

This was followed by a review of relevant literature and research already done in the field. Projects reviewed in more detail were the BE Logic project which aimed at improving efficiency within and across different modes of transport and supporting the development of a quality logistics system. This was done through the benchmarking of transport policy, transport chains and inland/sea terminals.

The InteGRail project (Intelligent Integration of Railway Systems) addressed the growing demand for an efficient and integrated railway system in Europe and developed a method to assess the performance of railways. The project developed an IT platform that allows the main actors to share information on the performance of their processes, making them able to optimise their contribution to the overall railway performance goals. For the evaluation of the effects a KPI assessment tool was used.

Another reviewed project is the Shipping KPI project which in its first phase aimed at establishing an international standard for measuring performance in shipping leading to increased transparency on quality, safety and environment performance in ship operation, enhanced governance in ship operation and future regulatory developments in shipping.

The International Maritime Organization's (IMO) Marine Environment Protection Committee (MEPC) agreed in its 59th meeting on interim guidelines on a method for the calculation of Energy Efficiency Design Index (EEDI) for new ships. For different vessel types reference lines are produced. The EEDI for a new ship is to be compared with the reference line and if the ship is above or not sufficiently below the reference line the ship will not be allowed to operate.

NTM stands for the Network for Transport and Environment and works for the standardization of environmental performance assessments. The work is addressed through calculation models for greenhouse gases and regulated emissions of transport chains through four working groups, namely Goods & Logistics, Fuels, Transport & Procurement and Travel. The work is on-going and is currently being further enhanced to handle assessments at corridor level.

The project Ecological Transport and IT (EcoTransIT) is a calculation tool that identifies the environmental impacts of freight transportation in terms of direct energy consumption and emissions during the operation of vehicles involved in freight transport – so called tank-to-wheel). The tool also calculates the indirect energy consumption and emissions related to the production, transportation and distribution of energy required for operating the vehicles – so called well-to-tank.

Also reviewed were a number of other calculators such as the project for the Calculation of external costs for goods transport developed a tool for these calculations. Others were the COMPASS tool (comparison tool for co-modal transport assessments), the NP Should cost calculator, the IMTIS calculator and the GIFT model.

Projects that had the objective of finding best practices in logistics were also reviewed as well as KPI experiences from other sectors of the society. Five projects were looked at for best practices. These were PROMIT, PLATINA, BESTLOG, BE Logic and the Swedish Green Corridors.

The inventory of KPI experiences from other sectors of the society narrowed in on three organizations; The World Resources Institute, the World Business Council for Sustainable Development and the European Environment Agency.

In the second phase, building on the gained insight from the first phase, a gross list of performance indicators was put together for further review and filtering within the task group. The performance indicators were thereafter further described and grouped into areas. The need for input data was identified and a set of initial KPIs was selected.

The five KPI areas are Efficiency, Service Quality, Environmental Sustainability, Infrastructural Sufficiency and Social Issues.

- *Efficiency*, with KPIs on absolute and relative unit costs. Absolute unit costs are expressed in € per ton for the entire stretch from the origin to the destination and relative unit costs are expressed in € per ton-kilometre for the entire stretch.
- *Service Quality*, with KPIs on transport time, reliability, ICT applications, frequency of service, cargo security and cargo safety. Transport time refers to the total time in hours;

reliability is here expressed as the percentage of on-time deliveries. ICT applications are a little more complex to measure, but are here the weighted assessed result of four indicators, namely: availability of tracking services on nodes/links, integration & functionality of tracking services, availability of other ICT services on nodes/links, and integration & functionality of other ICT services. The frequency of service describes the number of shipments available per week for each individual transport solution. Cargo security is about damage due to unlawful acts such as thefts or roadside robbery. Cargo safety refers to incidents that result in the damage of goods transported.

- *Environmental Sustainability*, with KPIs on greenhouse gases and polluters. The greenhouse gases or carbon footprint is here limited to the emissions of CO₂-equivalent. The unit is grams of CO₂ per ton-km. It is recognised that the polluters are many, but here three are chosen, namely Nitrogen Oxides: grams NO_x per ton-km, Sulphur Oxides: grams SO_x per ton-km and Particle Matter PM: grams PM_{2.5} per ton-km.
- *Infrastructural Sufficiency*, with KPIs on congestion and bottlenecks. Congestion is a cause of delay. Average delays should be assessed per transport solution. The KPI for bottlenecks is the assessed result of an inventory of different types of bottlenecks per transport solution, which are further divided into a few categories reflecting the seriousness of each type of bottleneck. The objective of this set of KPIs is to find major bottlenecks per transport mode within corridors and estimate the seriousness of these bottlenecks.
- *Social Issues*, with KPIs on corridor land use, safety and noise. Land use is expressed by % of urban areas over total corridor area, and % of Natura 2000 areas over total corridor area. Safety here refers to the incident rate of accidents and/or fatalities. The unit is percent of total number of shipments. Noise pollution is commonly defined as the excessive or annoying degree of unwanted sound in a particular area. The acceptable noise level is set to 50 dB except for trains which is 55 db. The unit for the KPI on noise is percent of the total distance that is exposed to noise levels above the 50/55 dB limit.

For each KPI of the above list, a description of the input values needed for its calculation and the exact formula to be used have been defined. The values and estimates can be qualitative or quantitative depending on the nature of KPIs. The initial list of SuperGreen KPIs together with the description of input and output units can be seen in Table 3.

In the third phase, which followed after the finalization of Task 2.2, the initial set of KPIs was presented to stakeholders and the Commission. Feedback received was assessed and evaluated. This was followed by a pilot test on a selected corridor. Obstacles were identified and measures reviewed. This led to a revision of the initial set of KPIs.

4.2.3 Conclusions and evaluation

The KPIs developed in this task were used in subsequent phases of WP2 of the SuperGreen project. This was particularly the case in Task 2.4.

The results of Task 2.2 assist in the provision of a framework for the overall benchmarking of green corridors. They form an integral part of studies that address topics that are of importance to the further development of Green Corridors. As a further consequence, the results from Task 2.2 are the key to the drafting of policy recommendations at a European level for further development of Green Corridors.

Table 3 Initial list of SuperGreen KPIs

KPI	Input unit	Output unit
Efficiency		
Absolute costs	ton, €	€/ton
Relative costs	ton, €, km	€/ton-km
Service quality		
Transport time	hours	hours
Reliability	Total number of shipments, On-time deliveries	%
ICT appl.	Availability, integration & functionality of cargo tracking & other services	graded scale
Frequency	Services per week	number
Cargo security	Total number of shipments, Security incidents	%
Cargo safety	Total number of shipments, Cargo safety incidents	%
Environmental sustainability		
CO ₂ emissions	ton, km	g/ton-km
NO _x emissions	kg, km	g/1,000 ton-km
SO _x emissions	kg, km	g/1,000 ton-km
PM emissions	kg, km	g/1,000 ton-km
Infrastructural sufficiency		
Congestion	ton, km, Average delay	hours/ton-km
Bottlenecks	number & category	graded scale
Social		
Corridor land use	Share of distance per area type	percent
Traffic safety	Traffic safety incidents	percent
Noise	Share of distance above level	percent

4.3 Task 2.3 Effects of Changes in Operational & Regulatory Environment

4.3.1 Objectives and methodology

Task 2.3 aimed at identifying changes that could promote or hinder the implementation of green corridors, providing input to subsequent tasks of the project. The specific objectives of the task were to review the operational and regulatory environment, identify the most significant changes that take place thereto, and assess their effects on green corridor development through the proposed KPIs.

The method followed was a survey based on research works and other existing information. A list of 242 potentially relevant to green corridor development documents

was composed, and their review was assigned to the task partners. Following a first screening, 59 of these documents were actually reviewed and a specially designed document fiche was filled out for each one of them. In addition to document identity, the fiche covered:

- the document objectives,
- its main findings / results achieved,
- its relevance to green corridor development, and
- measures / changes suggested or introduced by the document.

About 400 changes were reported altogether through the document fiches. They were then scrutinised in order to exclude those repeated and to bundle those that were very detailed in nature to something broader. The aim was to come up with a number of definitive changes that are neither too broad in nature, nor too detailed, allowing a meaningful and yet manageable assessment of their effects. About 80 such changes resulted from this process.

The identified changes were analysed and grouped under the following themes:

- Business environment
- Trends in logistics
- Public policies
- Operations
- Infrastructure development
- Technology development
- International regulations

Their effects on green corridor development were assessed using the KPIs defined in Task 2.2. The assessment was based on the content of the document and the experience and professional expertise of the reviewer.

Aiming at their evaluation and validation, the resulting changes and their effects were presented at the second regional SuperGreen workshop, especially arranged for this purpose in Antwerp, Belgium on 1 February 2011. The stakeholder feedback received was incorporated in Deliverable D2.3.

4.3.2 Results

The identified changes and their effects were summarised in tables. The summary tables were presented by theme in the Antwerp workshop and formed the basis for discussions with the stakeholders. The final tables can be found in Sections 3 to 9 of Deliverable D2.3. They incorporate the feedback received during the workshop.

The main conclusions of Task 2.3 have been grouped in those referring to the EU transport policy in general, and the more specific ones concerning the green corridors.

EU transport policy

All identified barriers to green corridor development have been adequately addressed by the various policy documents reviewed. Of particular importance are the administrative barriers addressed by the Freight Transport Logistics Action Plan. In general, the legal framework is pretty much in place. Special attention should be given to the enforcement of existing legislation.

The corridor approach, as it has been emerged during the last decade, is an effective way to address the fragmented nature of European transport networks, especially in the rail sector. The necessary international cooperation among the Commission, the Member States, regional and local authorities, infrastructure owners and managers, transport operators, terminal owners/managers, and financiers can more effectively be achieved if focused on a corridor level. The same applies in relation to wider transport policy objectives like modal integration and internalisation of external costs. Furthermore, the corridor structure allows the voluntary involvement of shippers and transport operators to committing themselves to reducing their carbon footprint, especially if accompanied with a “green” labelling system.

The effectiveness of transport policy is enhanced by employing packages of complementary instruments. Very important is the role of technology (in particular commercially viable alternative fuels) for the long run, and of ICT applications for the immediate future. The significance of educating, informing and involving the greater public in transport policies is a precondition for their effectiveness.

Over-regulating is an issue that should not be overlooked, since improvements in one aspect might create problems in another. Three such cases were identified in the literature survey performed under Task 2.3, all concerning maritime transport and non-EU institutions. The first one is the Energy Efficiency Design Index (EEDI) formula of the International Maritime Organisation (IMO), which if adopted, might lead to the construction of underpowered ships which, in their attempt to go faster or just maintain speed in bad weather, might emit disproportionately more CO₂. The second one concerns the US suggested requirement for 100% scanning of US-bound containers, which can create bottlenecks and have significant adverse effects on transport time and costs through reduced port throughput capacity. The third one is the IMO’s suggestion to reduce the maximum sulphur content of fuel oil burnt by ships from 1% to 0.1% as from 1 January 2015 in Sulphur Emission Control Areas (SECAs) which, if applied, could lead to a ‘back-shift’ from short sea shipping to road transport with effects opposite to those intended.

Given the fact that the European Commission has acknowledged this last danger of over-regulation, actions towards provision of financial instruments aimed at avoiding such ‘back-shift’ was proposed during the Antwerp workshop. A possibility worth assessing by the European Commission is the amendment of the new Marco Polo programme to include such schemes.

Green corridors

Valuable lessons can be drawn from Regulation No 913/2010, which introduced the freight-oriented corridors:

Firstly, the Regulation separates the criteria for establishing a freight-oriented corridor from the indicators monitored after its establishment. In fact, while the establishment criteria are defined by the Regulation, the indicators to be monitored are left for the corridor’s management to decide with only broad directions given. This is a logic that can be followed for the green corridors, too.

Secondly, one of the establishment criteria is the definition of a freight-oriented corridor: *a corridor crossing the territory of at least three Member States or of two Member States if the distance between the terminals served by the freight corridor is greater than 500 km.*

Although there is no need to expand this definition to the green corridors, it certainly provides a guideline to this end.

Thirdly, in recognition of the multiplicity of entities involved, the Regulation sets up a detailed governance structure, including representatives of the Member State authorities, Infrastructure Managers, Railway Undertakings and terminal owners/managers. To simplify communication with applicants and other interested parties, the establishment of a one-stop-shop is foreseen. Both the international governance structure and the one-stop-shop provided for by the Regulation can be features for the green corridor governance, with minor adjustments where needed.

Fourthly, the Regulation prescribes a number of implementation measures including:

- a) a market study,
- b) an implementation plan describing the characteristics of the freight corridor, including:
 - bottlenecks,
 - the programme of measures necessary for creating the freight corridor, and
 - the objectives for the freight corridor, in particular in terms of service quality and its capacity,
- c) an investment plan including financial requirements and sources of finance,
- d) a deployment plan relating to the interoperable systems along the freight corridor,
- e) a performance monitoring mechanism,
- f) a user satisfaction survey, and
- g) the requirement to update all the above periodically.

All these requirements tie very well with the green corridor concept and should be retained. There is a need for drafting a blueprint handbook on governance, operations and monitoring of green corridors.

In relation to the criteria for labelling a particular corridor as “green”, it is suggested that the Commission assesses the possibility of including as prerequisites:

- the fair and non-discriminatory access requirement of the Freight Transport Logistics Action Plan, and
- the internalisation of external costs, which for the time being remains voluntary.

In this way, green corridors in addition to being a field for experimenting with innovative transport technologies and advanced ICT applications, can become a field for experimenting with EU transport policies, too. This is in line with the core network concept proposed for the new TEN-T guidelines, which by placing emphasis on the European added value of the transport networks and their integration, in a way that combines efficiency targets with the sustainable development goals of the EU, basically extends the green corridor concept across all Europe.

Another conclusion concerns the role of intermodal terminals and freight villages in the development of green corridors. The demonstrated shift of competition from among individual enterprises to among supply chains necessitates optimising performance at the chain level and this is impossible without nodes permitting the effective and efficient modal interconnection.

Finally, based on the additional references to KPIs and methodological approaches identified during the extensive literature review undertaken in the framework of Task 2.3, the following suggestions were made:

- In the implementation phase of green corridors, the KPI structure could be expanded to include:
 - logistics competence
 - accessibility of the network (ease with which the intermodal transport system can be used)
 - customer satisfaction
 - interoperability/harmonisation issues
 - different indicators for each target group.
- The KPIs on emissions, congestion and accidents should include absolute in addition to relative units.

The findings of Task 2.3 are of particular importance to the implementation of the green corridor concept and the related policy issues. As such they constitute valuable input for subsequent tasks of the project and particularly for WP6.

4.4 Task 2.4 Benchmarking of Green Corridors

4.4.1 Objectives and methodology

Task 2.4, Benchmarking of Green Corridors, had the following two main objectives and links to other task of the work package:

- The description of the corridors in detail, mainly based on the information from the corridor selection task (Task 2.1),
- The evaluation either in a quantitative or qualitative manner of the KPIs defined in Task 2.2.

In fact, in order to carry out a successful benchmarking of the green corridors, input from Tasks 2.1 and 2.2 was needed as illustrated in the following picture that show the input and output of the task:

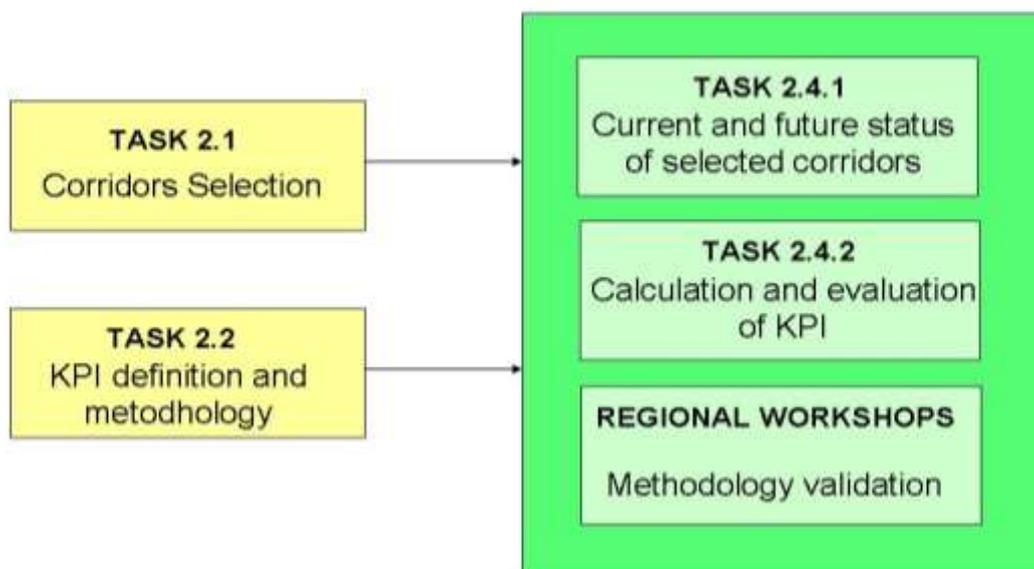


Figure 5 Task 2.4 framework

As a very first step in Task 2.4, the most important nodes were identified along the nine corridors selected in Task 2.1. A specific corridor origin/destination matrix was created

with all nodes representing possible origins and destinations of the corridor. Per each relation the transport modes have been identified to describe the corridor. After that a network matrix was compiled for each corridor. After the completion of the matrices, a simplified map style (the so-called metro map) for describing the corridors was created.

The data collection for the benchmarking task was carried out in two phases - first the general data collection was carried out and then specific data required by tools and/or formulae was collected during the calculation of the KPIs.

First the partners collected general information about links in the corridors. The objective was the description of each corridor segment identified. Per each segment, in fact, all the modes of transport have been considered and analysed. Information such as distances of different modes, typical road transport routes, green technologies, ICT & ITS solutions and policy interventions were collected. In addition, first attempts were made to find data about freight volumes.

Next, collection of specific data required to complete the benchmarking task was carried out. Right in the beginning it was obvious that the data will be rather difficult to get and it will require a lot of efforts.

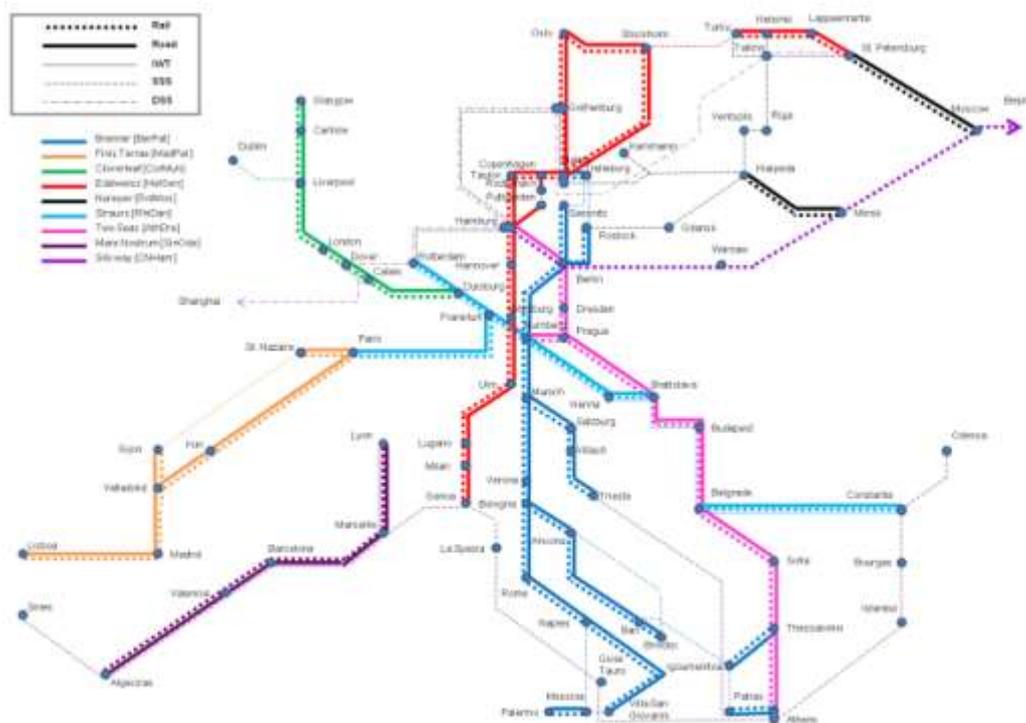


Figure 6 SuperGreen corridors in metro map

Due to limited resources for research and in order to ensure better data acquisition the data collection was targeted on six corridors ensuring a modal and geographical balance as much as possible:

- Brenner,
- Cloverleaf,
- Nureyev,
- Mare Nostrum,
- Strauss,
- Silk Way.

It should be noted here that the limitation to 6 corridors pertains to Task 2.4. In other project tasks (including Task 2.5) and other work packages, all 9 corridors are active.

The following guideline of six steps was developed for the information collection and KPI estimations:

Step 1 - Identification of the critical corridor segment (major link that cannot be bypassed like link between Munich and Verona on Brenner corridor)

Step 2 - The identification of cargo flows (freight volumes and type of goods) along the critical segment

Step 3 - Selection of 4-5 typical cargoes being transported along the critical segment of the corridor

Step 4 - Selection of typical transport chains for each selected type of cargo

Step 5 - Description of vehicles used and emission calculations using EcoTransIT model (www.ecotransit.org)

Step 6 - Evaluation of selected KPIs by interviews of companies (with good knowledge of the defined cargo flows and transport chains) and/or based on the existing studies.

4.4.1 Results

The Brenner Corridor has been considered in the analysis as the “first” pilot corridor for testing the applicability of the methodology due to the fact that this corridor has been studied the most before.

In order to get data and information on the transport chains, 52 companies (among which 32 transport operators and 12 Freight Villages) and 5 experts have been contacted. The response rate was low. On 52 companies contacted only 20% provided information. At the end of the analysis, 15 transport chains were considered to be useful for the study.

Among the main difficulties met in this activity was the lack of availability of interviewees to provide confidential information and data; often they had no time to collaborate or they had no available resources and information to provide. Among all the data and information required, the most difficult data to obtain were the cost and freight volume.

In addition to the data gathered from the different companies and experts, EcoTransIT World was used for estimating emissions on identified transport chains.

In Brenner corridor the test calculation was made for aggregation of the sample results to corridor level KPIs. After this analysis, a conclusion was made that the aggregation should be left aside due to several misleading factors and lack of consistent data for precise calculations. The transport chain level input data was not consistent since it included a mixture of qualitative and quantitative input values used in the KPI evaluation.

The aggregation does not make a distinction between modes of transport and different types of transport chains are averaged. Moreover, the chosen transport chains have very different characteristics and volumes. As the aggregation is based on the selection of a set of sample transport chains, the result of the calculation is strongly affected by the KPIs from those transport chains that have high freight volumes. Therefore, the corridor level KPIs do not fairly represent the corridor due to the fact that the aggregation is based on a small number of samples.

KPI review

Parallel to the information collection and interviews, further filtering of KPIs was carried out. In order to ensure the quality of the outcome and the general acceptance of the results, regular consultations with the stakeholders were required. For this purpose, a series of regional workshops were planned in order to consult on the progress and next steps of the task. The final methodology and the set of the KPIs to be used for the benchmarking evolved throughout the task and each workshop was used to consult the stakeholders on the progress.

The four planned regional workshops took place as follows:

- Nola/Naples, Italy on 19 October 2010
- Antwerp, Belgium on 1 February 2011
- Malmö, Sweden on 10 March 2011
- Sines, Portugal on 24 March 2011

After consulting with stakeholders during workshops in Nola/Naples and Antwerp and the Advisory Committee members, the consortium made a decision to filter the KPIs and to categorise them in three “importance levels”: (a) the KPI must be included in the study, (b) the KPI could preferably be included in the study or (c) the KPI can be excluded from the study. The filtering was carried out by all partners that were involved in the project as each partner was asked to express their opinion on each KPI.

All stakeholders and the Advisory Committee emphasized that the purpose of the filtering process should be to narrow down the number of KPIs, make the set simpler and easier to use and target the collection of data on specific fields. To that effect it was decided to evaluate only the KPIs ranked as ‘must be included’ in the benchmarking study. The final set of KPIs and the methodology were presented during the third regional workshop in Malmö for approval by the stakeholders. The final set of the KPIs used for benchmarking is presented in Table 4.

It should be noted that the presented set of KPIs does not include KPIs that belong to the ‘infrastructure KPI’ category. Even the ‘infrastructural sufficiency KPI’ was considered to belong to group (b) and was not used in the ensuing benchmarking exercise of Task 2.4. Even so, the consortium is currently contemplating ways to see how this issue can be revisited in the context of other project work packages (mainly WP3 and WP4).

Table 4 Final set of KPIs used for benchmarking

Indicator	Unit
CO2 emissions	g/ton-km
SOx emissions	g/1000 ton-km
Relative transport cost	€/ton-km
Transport time	hours
Frequency, services per year	number
Reliability, on time deliveries	%

Final results of benchmarking

The results of benchmarking on the six selected corridors (Brenner, Cloverleaf, Nureyev, Strauss, Mare Nostrum and Silk Way), have been evaluated using the recommended final set of KPIs, as this was formulated after the workshop in Malmö, and the methodology described in previous steps.

For each corridor a number of transport chains were identified. It varies between 6 and 16 and the quality level of the input data was also different. The biggest challenge for the partners in this task was to carry out the interviews. The willingness to collaborate from the industry side was relatively low and the rate of responses that the partners received to their requests was way below 40%.

However, with the assistance of the interviewees who participated in the survey, the partners were able to identify the critical segments of the corridors, select the typical cargo that passes the segment and collect data on the transport chains. The non-environmental KPIs were either evaluated qualitatively or quantitatively and emissions were calculated with the online calculator EcoTransIT World, except for the Strauss corridor where results from the Planco study 2007 were used. The EcoTransIT tool turned out to be not sufficiently reliable for inland waterway transport applications.

The benchmarks for the corridors were set using minimum and maximum values of the KPIs, e.g. the value of the KPI differs for each transport chain, and the benchmarks are set using extreme values of those KPIs. The SuperGreen transport operations related benchmarks are summarised in Table 5. A distinction has been made between different modes of transport. Although the benchmarks are closely related to freight transport operations, infrastructural improvements and the greening effects can also be assessed in the future tasks of the project using the same KPIs.

Table 5 SuperGreen benchmarks for corridors

Corridor name	Mode of transport	CO2 (g/tkm)	SOx (g/tkm)	Cost (€/tkm)	Average speed (km/h)	Reliability %	Frequency x times/year
Brenner	Intermodal	10.62-42.11	0.020-0.140	0.03-0.09	9-41	95-99	26-624
	Road	46.51-71.86	0.050-0.080	0.05-0.06	19-40	25-99	52-2600
	Rail	9.49-17.61	0.040-0.090	0.05-0.80	44-98	60-95	208-572
	SSS	16,99	0.050-0.120	0.04-0.05	23	100	52-520
Cloverleaf	Road	68,81	0,091	0,06	40-60	80-90	4680
	Rail	13.14-18.46	0.014-0.021	0.05-0.09	45-65	90-98	156-364
Nureyev	Intermodal	13.43-33.36	0.030-0.150	0.10-0.18	13-42	80-90	156-360
	SSS	5.65-15.60	0.070-0.140	0.05-0.06	15-28	90-99	52-360
Strauss	IWT	9.86-22.80	0.013-0.031	0.02-0.44	-	-	-
Mare Nostrum	SSS	6.44-27.26	0.092-0.400	0.003-0.200	17	90-95	52-416
	DSS	15,22	0,22	-	-	-	-
Silk Way	Rail	41	-	0,05	26	-	-
	DSS	12,5	-	0,004	20-23	-	-

4.4.2 Conclusions and evaluation

The major result of the Task 2.4 is the benchmark of six selected corridors (Brenner, Cloverleaf, Nureyev, Strauss, Mare Nostrum and Silk Way) as the base of a final set of KPIs.

The final methodology and the set of the KPIs to be used for the benchmarking evolved throughout the task and specific workshops were used to consult the stakeholders on the progress of the activities. In fact, a regular consultation with stakeholders has been set up in order to ensure the quality of the outcome and the general acceptance of the results. For this reason a plenary workshop was organised in Helsinki for the selection of the corridors and four regional workshops were organised for the definition and approval of the final KPI set.

The benchmark of the corridors represents the input for further analysis of the project like the creation of the baseline for the benchmark of Green Corridors in relation to Green Technologies and smart ICT applications.

5 Corridor specific major bottlenecks and development areas

We note here by way of introduction that ‘bottlenecks’ is one of the components of the ‘infrastructural sufficiency KPI’. In that sense, the analysis of this section may be relevant within a possible consideration of infrastructure KPIs in this project.

Below is the analysis, corridor by corridor.

5.1 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.

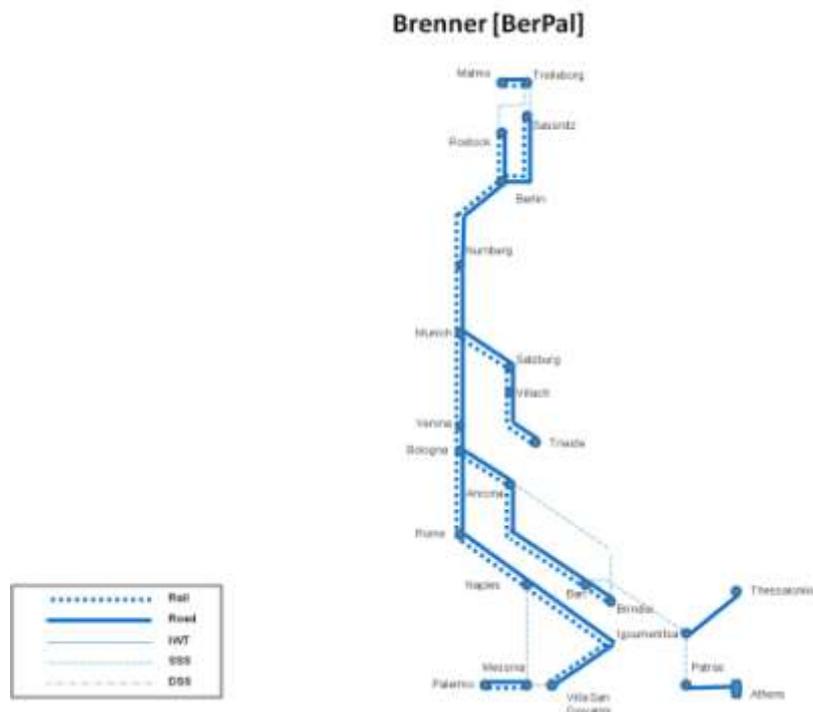


Figure 7 Brenner corridor

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 %.

Operational bottlenecks and development areas

The frequent presence of traffic in the roads does not allow regular circulation of goods. This often causes delays to the delivery of the consignment and consequently decreases efficiency and quality of the offered service. Furthermore the high traffic volumes on roads contribute to increased emissions of pollutants.

Acoustic and chemical pollution feel like a major social problem at European and world-wide level, therefore new actions to reduce traffic on the roads will contribute to improve also the quality of the life (zone of the Brenner Pass).

The great affluence of people in tourist areas during summer causes discomfort and delays in boarding trucks on ships; this is mainly due to the great traffic around the port area and to the boarding priority dedicated to tourists in these months (e.g., Port of Brindisi in Italy and Port of Patras in Greece).

The intrusion of illegal immigrants in trucks is a problem along the Brenner Corridor. These people have become so skilful in intrusion that the drivers very rarely notice their presence before reaching destination.

The change of traction and signalling systems at the borders between European railway networks still reduces effectiveness; at these spots, traction locomotives and drivers should be changed producing delays to the circulation. Multi-current and multi signalling locomotives (and sometimes the application of ETCS) are used to resolve this issue; however, shift of personnel has often to take place, still.

Bottlenecks and development areas related to policies, legislation and regulations

The already mentioned operational bottlenecks regarding traffic and emissions can be solved through appropriate traffic regulations and through policies of maximum allowable emissions in order to push the use of ecological means. The Brenner region has already been recognized as a particularly environmentally sensitive area in accordance with Directive 2008/50 on air quality. Furthermore, Directive 2006/38 (Eurovignette) allows applying a mark-up for cross-financing that is also linked to the sensitive mountainous areas. Finally, reference is made to the Alpine Convention that aims at protecting the alpine range and has a series of protocols, amongst the traffic protocol, that have recently been signed and ratified. Also the Commission is a party to this multilateral treaty.

The simplification of the procedures necessary to obtain the documentation needed to access the railway terminals would mitigate the relative queues, providing remarkable improvements in the environment and the quality of the services offered. Serious problems have been reported due to the lack of qualified staff. Differences in permits and regulations represent another cause of delays. In Greece, the liberalisation process of train operations is very much delayed, adversely affecting the overall efficiency of railroad transport in the whole country and the possibilities of modal shift from road to rail. During the interviews performed in the scope of Task 2.4, limitations in the railway circulation in Italy have been highlighted (its line allows only trains of 1100 gross tons).

Infrastructural bottlenecks and development areas

Deficits in transport infrastructures relevant to goods transport, mainly in Italy and Greece: Future bottlenecks generated by low capacity and road surface condition problems have been modelled up to 2030 (Petersen M.S. et.al. 2009). The results of the analysis foresee three bottlenecks on the corridor, close to Florence, Rome and Naples.

Frequent traffic jams due to insufficient road infrastructures capacity: This has been evidenced in particular along the Brenner Tunnel and in the segment between Forlì-Bologna.

Localization of the port of Patras inside the urban centre of the city causes problems for increasing passenger and freight traffic, while traffic related nuisance inflicts to the population living near the port.

Regarding the rail network, an analysis has been done on future infrastructure improvements up to 2030; the results show an increase on rail freight transport of 78% with respect to the baseline scenario (2008) (Petersen M.S. et. al., 2009). On the existing freight railways along the axis some bottlenecks are present in the baseline scenario: slot restriction in Milan conurbation, slot restriction from Verona to Wörgl and from Munich to Nurnberg. By 2030 the bottleneck from Verona to Wörgl will probably be solved but an electrification bottleneck between Nurnberg and Cheb could be still present.

Several projects are on-going along the corridor, in order to upgrade and modernize the current network. In particular, the Brenner Tunnel and two bridges (Ebensfeld-Erfurt, Messina) are under design or construction phase. Moreover, double track and high-speed railway lines are under construction and the port of Patras will be relocated in order to ensure sufficient in-land space and good connection to the intercity network.

Bottlenecks and development areas related to ICT and transportation technology

The bottlenecks present along the Brenner Corridor that can be solved using ICT technologies are relevant to road and rail transport. Important contributions to possible solutions can be achieved by means of new ICT applications, which are expected to solve or to attenuate problems. As an example, the introduction of VMS (Variable Message Signs) can inform beforehand the drivers of the problem (traffic congestion, delays, bottlenecks on road, etc.), so that they can revise their routing decisions.

Regarding rail transport, a technological contribution is necessary, in order to alleviate the obstacle imposed by the various systems of traction used in the national networks. ERTMS (The European Railway Traffic Management System) will be introduced on the Munich-Verona rail line starting from 2015.

Other bottlenecks and development areas

The Alps are an example of natural geographic barrier. The strong slopes negatively affect average speeds. This disadvantage has been noticed along the railway line Erfurt - Nurnberg and along the Brenner Pass.

During the winter in the area of the Baltic Sea the ice often create circulation problems and delays.

Brenner bottlenecks and development areas, summary:

Operational: Congestion, interoperability problems on railways (change of traction, different control, signaling and command systems), safety & security (illegal immigrants)

Policies, legislation and regulations: Traffic regulations and policies for pollution management (sulphur, etc.), lack of harmonization of national regulations

Infrastructure: Capacity limitations of rail and road networks, slot restriction on the rail network and different gauges

ICT and transportation technology: Need to develop new ICT systems, introduction of VMS, implementation of ERTMS, lack of harmonization of systems and data

Other: the Alps, winter weather / ice conditions

5.2 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.

Finis terrae [MadPar]

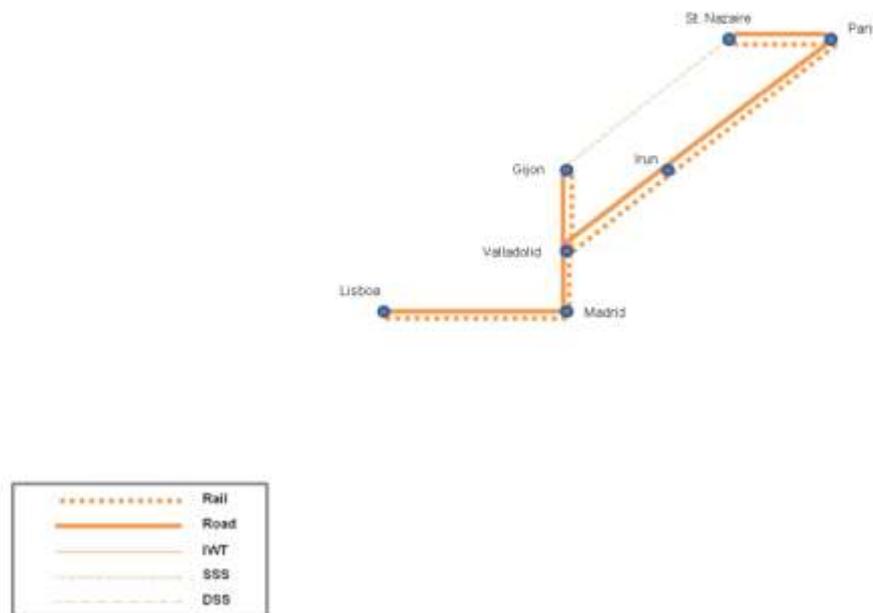


Figure 8 Finis Terrae corridor

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.

Operational bottlenecks and development areas

With the exception of problems related to road congestion, which are due to capacity limitations of the road and rail networks and are intensified by the major geographical barrier of the Pyrenees (see below), the most important operational bottleneck relates to interoperability issues of the Spanish and French railways.

Spanish network is using 3 different rail gauges: FEVE (width 1m), RENFE (1.6m) and AVE (2m). Only AVE is compatible with French railway network, but it is transporting only passengers. The cargo (and passengers) is moved by FEVE and RENFE systems. This fact alone creates operational bottlenecks at the cross-border areas. In addition, Spain and France have different train control and command systems. ERTMS (European Railway Traffic Management System) is being deployed in the new high speed rail connections under construction in order to alleviate this bottleneck and improve the competitiveness of rail transport.

Bottlenecks and development areas related to policies, legislation and regulations

The bottlenecks reported concern the harmonization of national regulations on operational standards and certification of the professional skills of transport personnel which, apply to the entire European Union. One example of this kind of difference in legislation is the driving and resting times of truck drives. According to the Spanish road transport legislation each truck can be driven by 2 drivers in shifts of 8h each. According to the France road transport regulation a resting time of 8h after 8h of driving is required. In practice this means that each truck needs 3 drivers in France.

Infrastructural bottlenecks and development areas

Both road and rail transport through the Pyrenees exhibit serious bottlenecks related to infrastructure. There are only two main highways for trucks crossing the Pyrenees. Each one of highways A7 and A8 handles about 10,000 trucks every day. It is fair to say that, when crossing the Pyrenees, the road capacity is close to its maximum, creating serious congestion problems. The opening of the trans-Pyrenean rail link in 2013 (see below) is expected to alleviate the problem, although by 2020, about 17,000 additional lorries are expected to cross the Pyrenees every day. The border point Irun, Spain is a major bottleneck especially during Bank holidays as trucks are not allowed to pass on these days. Usually this means a one day delay in the lead times. A further alleviation is expected from the proposed short-sea-shipping connection Gijon-Nantes, which intends to capture between three and five per cent of the road traffic passing through the western part of the Pyrenees.

Road congestion also affects the efficiency of freight transport operations around Paris due to the high population density of this area.

In addition to capacity limitations mostly on the cross-border section Vitoria-Dax, rail transport between the Iberian Peninsula and the rest of Europe is hampered by the incompatible rail gauge of the Spanish and Portuguese networks. These bottlenecks are being addressed by three Priority Projects of TEN-T:

- Priority Project 3 (High speed rail axis of southwest Europe) will link major cities on the Iberian Peninsula with the French high-speed network, bringing the Spanish capital to within four hours of the French border. The new lines will slash current journey times by as much as 60 %, providing significant new competition to both air and road transport on key routes. From Madrid, two branches – Atlantic and Mediterranean – will connect to the French high speed rail network. The cross-border French–Spanish sections will be combined passenger and freight lines. Significant additional trans-Pyrenean freight capacity – up to 25 million tonnes per year on each branch – will be created in the long term. Planned completion – 2015.
- Priority Project 16 (Freight railway axis Sines/Algeciras-Madrid-Paris) is a high-capacity line, linking the Sines and Algeciras container terminal ports with the Spanish and French rail networks. The rail access route to the ports will be built with interoperable sleepers so as to allow operations in Iberian gauge in the first stage (coherent with the freight rail network in Spain and Portugal), but ready for the future conversion to the “European” gauge. Planned completion – 2013. The project will also include the construction of a long-distance tunnel through the Pyrenees, in order to eventually link it with the branch of the Grand Project du Sud-Ouest towards Toulouse. Several possible alignments are under consideration for this link. The project will significantly increase rail’s share of international freight on this crowded route, improving connections between southern and northern Europe. The construction of this new line will enable rail to achieve a 30 % share of the land transport market in the Pyrenees. Works on this new cross-border section will start after 2013.
- Priority Project 21 (Motorways of the sea - MoS). In 2007 the French and Spanish Governments launched a State Aid Call to give subvention to new MoS services in the Atlantic Side connecting Spain and France, in order to help road traffic at Irun in the Basque region. Shipping companies presented four proposals out of which 2 was approved: the service connecting Madrid-Gijon-Nantes-Paris by LD Lines, and the service connecting Algeciras-Vigo-Nantes-Rotterdam by Hispano Francesa Maritima. The first service was launched in September 2010, and the second service is expected to be operative during 2012. Both France and Spain gives €15m to each service. The Nantes-Gijon got another € 4.2 m from Marco Polo modal shift MoS-FRES Project. The second State Aid Call was launched in 2010 and is still under evaluation.

Bottlenecks and development areas related to ICT and transportation technology

The deployment of ERTMS has been identified as an important development area for the Finis Terrae corridor.

Other bottlenecks and development areas

The Pyrenees, a range of mountains in southwest Europe that forms a natural border between France and Spain, constitutes a major geographical barrier for the corridor. It separates the Iberian Peninsula from the rest of continental Europe, and extends for about 491 km from the Bay of Biscay (Cap Higer) to the Mediterranean Sea (Cap de Creus).

The rarity and great elevation of passes is a conspicuous feature of the Pyrenean scenery. Low passes are lacking, and the principal roads and the railroads between France and Spain run only in the lowlands at the western and eastern ends of the Pyrenees, near sea level. Between the two ends of the range, the only passes worth mentioning are the Col de la Perche, between the valley of the Têt and the valley of the Segre, and the Port d'Envalira, the highest mountain pass in the Pyrenees and one of the highest points of the European road network.

Finis Terrae bottlenecks and development areas, summary:

Operational: *Interoperability problems on railways (change of traction, different control, signaling and command systems),*

Policies, legislation and regulations: *Lack of harmonization of national regulations*

Infrastructure: *Capacity limitations of the road and rail networks, slot restriction on the rail network and different gauges, road congestion / insufficient road infrastructures capacity,*

ICT and transportation technology: *Implementation of ERTMS*

Other: *the Pyrenees*

5.3 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 (See Figure 9).

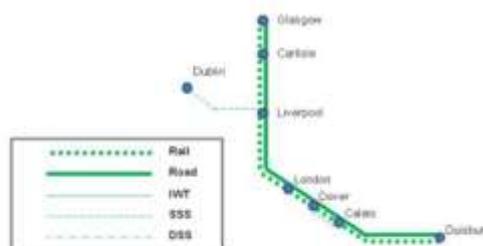


Figure 9 Cloverleaf Corridor

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.

Operational bottlenecks and development areas

As the freight modal split of the Cloverleaf corridor is mainly dominated by road, illustration of the road traffic can be seen in Figure 10 below. DfT (2010) noted that there is limited or even no benefit in removing trucks from areas with low levels of congestion such as rural motorways but modal shift can be achieved by removing trucks from highly congested roads.

Figure 10 demonstrates the main road network in England that highlighted the most congested corridors that have the potential to be shifted to different modes (rail/water) (DfT, 2010). Some congested segments between Liverpool and London belong to the Cloverleaf corridor. The segment between Liverpool and the Midlands (Birmingham area) shows red lines for both directions that indicate 10,000 up to more than 14,000 hours per mile delay while London ring road (M25) also shows a similar pattern.

There are no reported bottlenecks at Channel Tunnel and Liverpool – Dublin corridor. The main bottleneck reported out of UK is road traffic around cities and within town. For rail operation, the main bottlenecks are in places where there is only one track, so infrastructure problem.

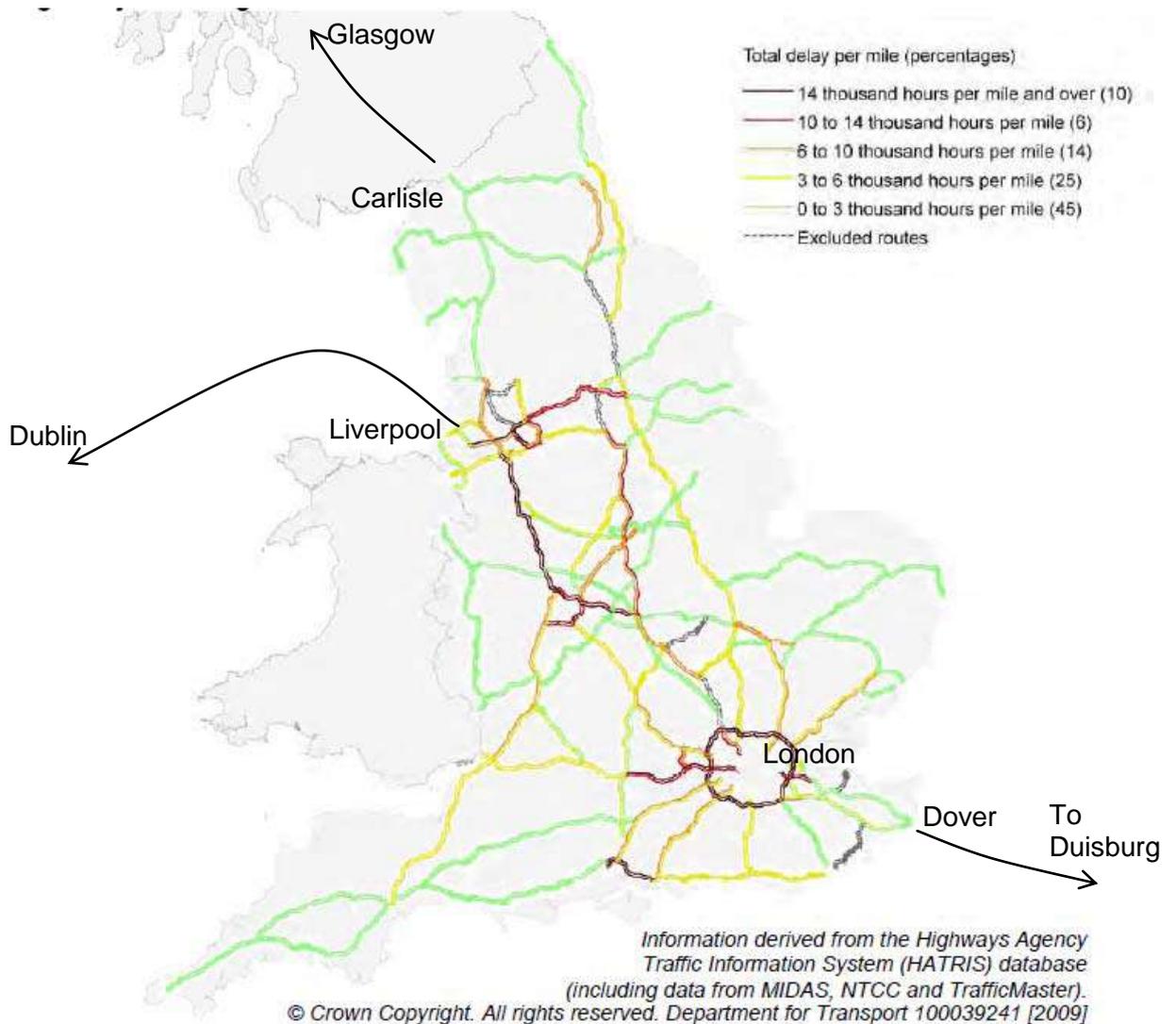


Figure 10 Total annual vehicle delay per mile for the slowest 10% journey

(Source: Road Statistics 2008: Traffic, Speeds and Congestion, DfT – Source: DfT, 2010)

Bottlenecks and development areas related to policies, legislation and regulations

Freight by Water and MDS Transmodal expect considerable future growth in container feeder traffic – approximately 5% per annum between now and 2030 (MDS Transmodal, 2007 and Sea and Water, 2008). This market is typically where customers prefer accompanied freight providing security and knowledge of whereabouts and delivery time data. The availability of ‘track and trace’ systems may enable the rail industry to start offering a service that can compete. Knowledge equipment requirements are key to determining the addressability of this market. The majority of the UK rail network does not have gauge clearance to allow lorries to be carried on trains meaning that a swap body solution or containerising product at source would be required for the majority of Ro Ro.

The Stobart/DB-Schenker ‘orange train’ which went into operation in October 2009 bringing fruit from Spain to Barking and eventually Widnes and sending pallets and other goods on the return journey to Spain is a case in point of movement that used to be by Ro

Ro vehicles and has now been altered to swap bodies. The service is estimated to generate savings of 8,625 tonnes of CO₂ emissions per annum and is the longest train journey in Europe by single operator and the first fully refrigerated train service to use the Eurotunnel (DfT, 2010). The switch from accompanied Ro Ro to swap-bodies especially with the use of the Channel Tunnel could become significant over the next decade providing services remain reliable and tunnel charges are acceptable. The relative cost of fuel and labour are likely to be major factors in the economics of the switch.

A major step change in the amount of lorries on the corridor between Liverpool and Dover (through M20) would occur if freight can use the HS1 (High Speed Train) rail route which has GB1 gauge.

Goods trains are in competition with most of the other modes of freight transport in operation between continental Europe and the United Kingdom. Intermodal train services compete directly with road transport and maritime transport on container ships. Intense competition in the cross-Channel freight market between road haulage companies, especially companies based in continental Europe, puts constant pressure on freight rates, making it more difficult for the railway companies to compete. The goods transported by freight trains are mainly heavy, low value items for which speed of delivery is not generally a primary consideration.

From the three types of freight trains that were in operation through Channel Tunnel in the year 2000, only the intermodal trains are still in operation up to date. The conventional trains carrying palletised goods have disappeared and the trains transporting new cars are dead. One of the reasons identified for this downturn is because operators wanted to defend their core business. In year 2000, there were five rail freight operators running through the Channel tunnel but only one operator left by now. The only intermodal operator that is still in operation is Transfesa, a sharing ownership of family run business (49%) and RENFE (20%). EPCH noted that there is an alarming decline in freight traffic across Europe (>30%). The annual tonnage transported through Tunnel is less than 2% of the potential market between Continental Europe and the UK. There is an issue of complexity of setting up cross border rail transport in Europe despite the successive reorganisation of operating structures for cross-Channel freight in the UK. There is also a lack of competitiveness of rail versus road transport (due in particular to the fixed cost of border infrastructures) and moreover financial difficulties of rail freight in France.

The optimism by the way comes from the EPCH that extended training of drivers, developed routes with EP France and ET acquire GBRf. Deutsche Bahn announced setting up of a European container network. Last but not least, SNCF freight is working to develop its own European network.

Having noted that Channel Tunnel is a critical segment of the Cloverleaf corridor, the results from the interview from SuperGreen Task 2.4 surprisingly shows no issue at all with the channel tunnel traffic. We also believe that this is because UK is surrounded by the sea with many ports (see Figure 11), and the link connection from Europe mainland to the UK as well as in the opposite direction can be substituted easily with short sea shipping. Another issue is the cost of rail freight caused by the insufficient volumes and low value goods transported by rail.

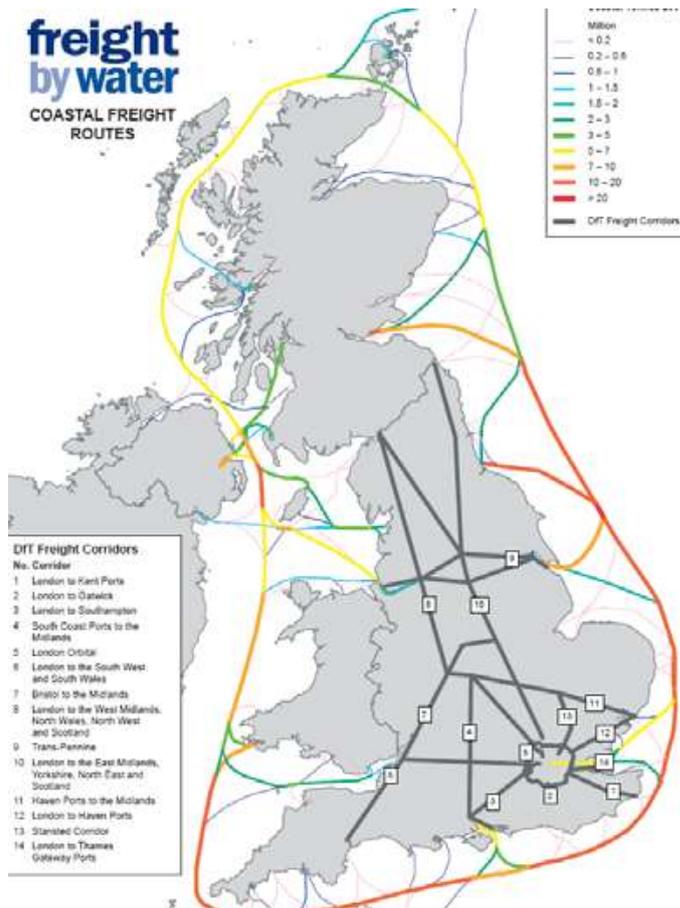


Figure 11 UK coastal and road freight routes

(Source: DfT, 2010)

For the Liverpool – Dublin corridor, IEA (2009) reported that BG Freight Line was strongly critical of the UK and Irish Light Dues regimes. Such dues were not charged elsewhere in Europe. Recent increases would mean that each 366 TEU vessel operating into UK or Irish waters would pay € 7716.78 light dues a year. The lower frequency services operated by each Lo-lo vessel compared to a Ro-Ro vessel meant that such costs were greater per cargo unit. The regime was also a dis-incentive for deep-sea vessels to come to UK or Irish ports, but to feed those markets via continental ports.

DfT study (2010) identified that there may be good potential for the development of future cross European rail services, particularly as now that pan European transport company DB Schenker owns the UK’s largest rail freight provider, formerly called English Welsh and Scottish railways and following the purchase of the third largest rail freight provider (GB Railfreight) by Eurotunnel. However, it was also noted that the Rail Freight Group have expressed concerns that a market dominant service supplier may not offer competitive pricing over the long haul (ibid).

Infrastructural bottlenecks and development areas

The rail network provides good access to the majority of key freight destinations within the UK; however, there are specific routes where industry experts and consultees have indicated a lack of capacity as reported in the DfT freight modal choice study (2010). Of particular concern is where the capacity issues arise through the competing demands of freight and passenger users as within the West Coast Main Line (WCML) that connect

Liverpool to the Midlands (Birmingham) and around London south ring road. Both segments are part of the Cloverleaf corridor.

The Freight Route Utilisation Strategy (Network Rail, 2007) highlighted some capacity gaps due to the expected growth in deep-sea boxes. The WCML has undergone a major refurbishment in order to increase the capacity and improve passenger journey times. If the High Speed 2 (HS2) scheme goes ahead it will free up some capacity on the WCML for additional freight services. Network capability for freight is made up of gauge, route availability and capacity that are under 2030 development of DfT Strategic Freight Network Programme (DfT, 2010).

The maps below show how the daily sum of freight trains is forecast to increase from 2007 to 2015 and to 2030 (See Figure 12). The orangey reddish coloured lines in the figure indicate higher volume of rail freight occurs within the railway network; it is obvious that the segments connecting London through Midlands, passed Liverpool and northbound to Glasgow are either orange or red demonstrating the busiest segments within the entire country.

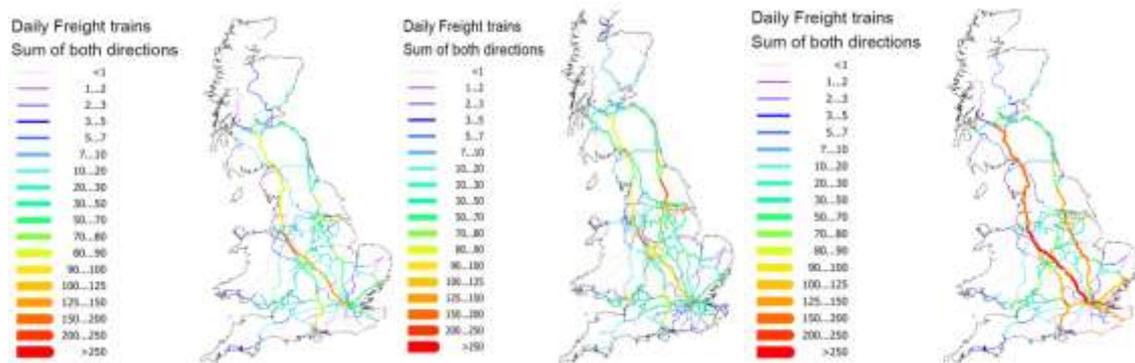


Figure 12 Daily sum of freight trains from 2007, 2015 and 2030

(Source: MDS Transmodal, 2009)

Much of the UK rail network has a mixed traffic (freight and passenger) capability although some sections of the network are designated as freight only routes whilst on others the level of capability is such that freight is currently restricted or de barred from specific routes. However, these sections of the network, when compared to overall network mileage within the UK, are small (DfT, 2010).

Journey times are one of the biggest infrastructure barriers for growth for train paths on the West Coast Main Line (WCML). The amount of time which a freight train spends awaiting a slot on a main line is often lengthy and what could be a 5 hour transit time can often be up to 8 hours due to the time spent by train in passing loops allowing express passenger services to pass but this problem has been identified and trying to be addressed by DfT (DfT, 2010). Further mitigation could include electrification on lines leading in to WCML and innovation on the part of the rail freight industry (ibid).

Rail electrification is another infrastructure development undergoing in the UK rail profile. Approximately 33% of the British rail network is currently electrified though none of the proposed lines are within the Cloverleaf Corridor.

Bottlenecks and development areas related to ICT and transportation technology

Rail carriers are reported to have improved communication on consignment tracking, so this may be useful approach for ICT – through a GPS system – to play a role. This can also be applied to timetabling that generally avoids congestion and delay with the real time information service.

The interview data from Task 2.4 shows that some of the respondents are not using ICT to help their freight operations. The road freight operators reported full use of ICT of tracking/navigation system and this was reported helpful to help the trailer driver to anticipate bottlenecks. For rail operators, respondent reported use of ICT in its operation that is a terminal operation processing system and a loading level software between Glasgow and Midlands. This initiative can be introduced to other rail freight operators that do not use the system.

Reported congested area from Task 2.4 at around London M25, Kennedy Tunnel at Antwerp and other major ring roads including the one in Venlo, the Netherlands (one of the biggest centre for logistics in Europe) would benefit from the introduction of traffic signalling/control.

In anticipating road congestion, traffic signalling/control through urban traffic control (UTC) is commonly used in many UK cities and keeps growing in use by number. The system permits vehicle detection to be deployed at a much higher density than has previously been possible. Traffic signalling/control on average reduces delays by approximately 20% over typical fixed time system and reduces the journey time of up to 8% across the whole road network. This system also has a fuel saving potential of up to 20% (CTR, 2010).

UK HGVs represent 24% and vans 12% of the total domestic greenhouse gases and therefore are reviewed of its potential for improvement to meet low carbon technologies. A recent study funded by UK Department for Transport (DfT) by Ricardo (2010) review HGV technology low carbon application that are grouped into three different themes: vehicle, powertrain and fuel. The study shows that aerodynamic trailers, electric bodies and vehicle platooning have the greatest CO₂ reduction potential of the HGV vehicle type. Additionally electric drives, fuel cells and full hybrids are important components that support greener powertrain technologies type. Moreover, biogas, biofuels and hydrogen are the greatest lifecycle CO₂ benefit of the fuel technologies (Ricardo, 2010).

The technology based measure to anticipate bottlenecks may be tested in conjunction with a number of pricing measure such as road-user charging, fuel price variations and subsidies (ibid).

Other bottlenecks and development areas

Despite the fact that Britain is surrounded by water, it is not seen as a major bottleneck. In Task 2.4 it is indicated that channel tunnel does not represent a critical bottleneck within the corridor as shippers can and often do prefer to use alternative routes by SSS calling at the ports like Hull to bypass expensive channel tunnel and congested area surrounding London. The channel is underutilised by freight in terms of capacity and slots.

Cloverleaf bottlenecks and development areas, summary:

Operational: Congestion, modal shift: SSS to rail / road to rail/ SSS

Policies, legislation and regulations: Ensuring and enabling modal shift

Infrastructure: Road congestion / insufficient road infrastructures capacity, rail electrification of non-electrified rail stretches / monorail tracks

ICT and transportation technology: Need to develop new ICT systems, HGV design using low carbon technologies, traffic signaling/ control at urban areas

Other: “Island” countries, dependency of SSS

5.4 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.

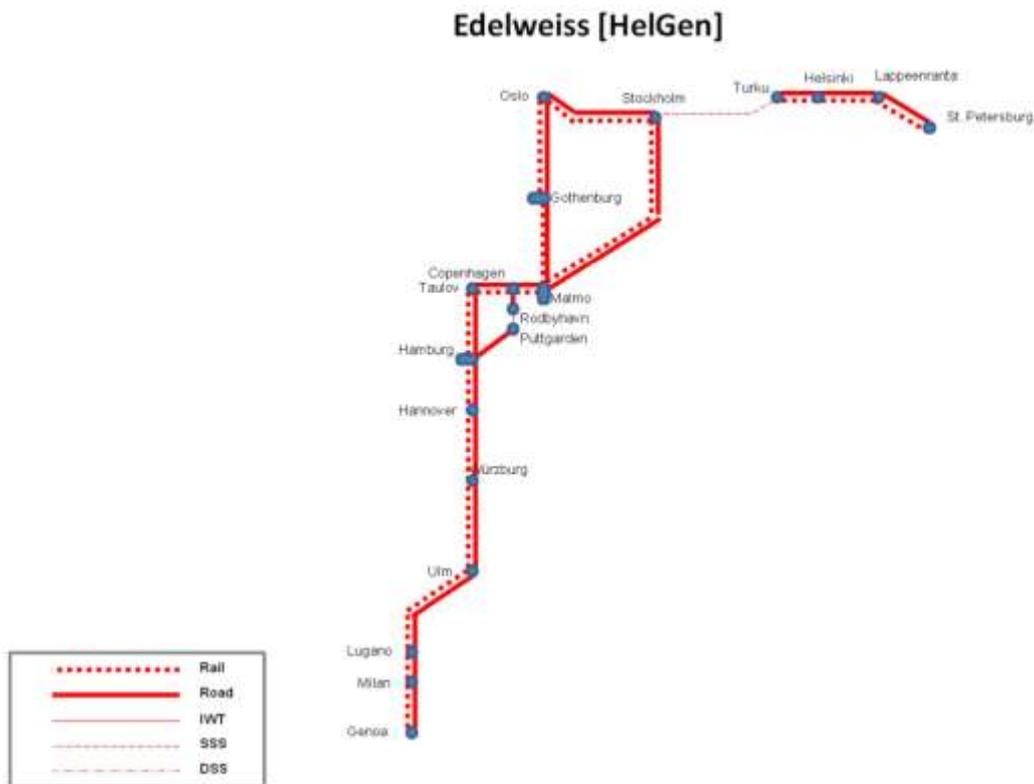


Figure 13 Edelweiss corridor

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.

Operational bottlenecks and development areas

One bottleneck along the corridor occurs at the border between Austria and Italy and is related to the different traction systems used by the national railway networks (3000V CC in Italy, 15000V 16 2/3 Hz in Austria), which causes the necessity of changing the traction locomotive and the drivers at the border, with substantial delays.

Bottlenecks and development areas related to policies, legislation, and regulations

Regulations applied to road transport (and congestion) are expected to increase demand for rail transport and enlarge the share of rail in freight transport in the EU. Directive 96/53/EC regulates weights and dimensions of HGVs. The longer and heavier trucks (LHV) are being used for domestic freight transport in Finland and Sweden. Lorry combinations of up to 25,25 m in length and up to 60 t weight are allowed. The future of the LHVs in Europe is still uncertain. LHVs form a threat to the competitive position of the rail sector and decrease the modal shift from road to rail.

Infrastructural bottlenecks and development areas

The rail gauge of the Finnish and Russian networks is different from the gauge of the Swedish network, which is coherent to the “European” one. This fact creates operational bottlenecks at the cross-border areas between Finland and Sweden. As Finland has the same gauge as Russia, at the border between Finland and Russia this is an advantage rather than a disadvantage.

Currently the infrastructure capacity along the corridor is limited on both road and rail. There are on-going projects to improve road and rail infrastructure. Electrification of some rail segments and expansion of some stretches from a single to double line are the main areas of rail infrastructure improvement. The expansion of motorway sections along the corridor is the main objective in terms of road transport.

The Fehmarn strait between Denmark and Germany is a major bottleneck. Today there are several ferry lines connecting the two countries. A trip takes around 45 minutes and the ferry capacity is not enough, waiting time occurs. One major project to fasten and increase the capacity over the Fehmarn strait is the building of a tunnel. This is called the Fehmarn fixed link. The fixed link closes the gap between the Scandinavian and European rail networks. In the future, freight trains will be able to avoid the 160 km longer detour via the Great Belt. This will create a strong transport corridor between the Öresund region in Denmark/Sweden and Hamburg in Germany. Travel time will decrease from 45 minutes with ferry plus waiting time to around ten minutes. Construction work is scheduled to start in 2014. The opening of the Fixed Link is anticipated for the end of 2020. The capacity of this fixed link will probably be constraining the overall corridor capacity.

In Sweden works on the routes Stockholm-Oslo and Copenhagen-Oslo are progressing well with a number of projects already in construction and others in preparation. Regarding the connection Stockholm-Copenhagen, preparations for a bypass in Stockholm are on-going while some bottlenecks remain on the section between Södertälje and Stockholm. Close to Gothenburg, the capacity of the existing motorway will be increased and improvements on rail and road connections to the port will be done. These road projects are planned in the recently decided master plan for infrastructure 2010-2021.

There are also a number of major rail projects going on including the "Citybanan project" (Stockholm) and, on the Copenhagen-Oslo line, the tunnel Hallandsåsen, Gothenburg-Trollhättan and Falkenberg. Others are in the preparation phase (e.g. Ostlänken Södertälje-Linköping on the Stockholm- Copenhagen line). In Malmö, the construction of a double track tunnel (City Tunnel) below its centre, equipped with ERTMS was opened in December 2010. It greatly facilitates traffic in the city and the connections with the Öresund Bridge.

In Finland the Vuosaari harbour line, including a tunnel to the new port, was completed in 2008 and the Kerava-Lahti rail section in 2006. Construction of the new 18 km Ring Rail line started in 2008 and works will last until 2014. The project will connect Helsinki airport to the city centre and includes an eight km long tunnel with two tubes passing under the airport. Investment works are underway regarding the lines Lahti-Luumaki-Vainikkala and Kouvola-Kotka/Hamina. There will also be improvements in the future on the lines Turku-Helsinki, Helsinki-Riihimäki and Hyvinkää- Hanko. The projects will be completed progressively until 2019.

In Denmark several projects are going on, many of them aim to improve the infrastructure related to Rødbyhavn. There will be electrification of the Ringsted-Rødbyhavn rail segment. Rail stretches from Vordingborg to the Masnedø and from Orehoved to Rødbyhavn will be expanded to two tracks. Additional necessary expansion and the required environmental optimisation of the existing E 47 motorway between Rødbyhavn and Sakskøbing will also be done.

Many German infrastructure projects aim to release bottlenecks that relate to the Puttgarden connection and the traffic situation in Bayern and the Alps. B 207 (E 47) between Heiligenhafen and Puttgarden will be a four-lane federal motorway. The rail connection Lübeck-Puttgarden will be electrified.

Bottlenecks and development areas related to ICT and transportation technology

The implementation of ERTMS on the Swedish parts of the Edelweiss corridor is running according to the Swedish Implementation Plan. In Stockholm, a double track, six kilometre long tunnel (Citybanan) is under construction (2009-2017) to facilitate commuter traffic. The new City tunnel in Malmö is equipped with ERTMS. In Finland ERTMS has progressed with GSM-R installations. Wider ETCS (European Train Control System) implementation will start at the end of this decade at the earliest.

There is a general development that inter-modal transport chains will grow and this will drive new ICT systems. Industries in northern Europe have a need to compensate for their peripheral location. As a consequence, transport operators have been early adopters of all innovations that help to compensate for this disadvantage. Thus are these highly relevant for this corridor.

Other bottlenecks and development areas

One major bottleneck is the Baltic Sea with ice during the winter. During the winter 2010-2011 the situation was severe with a lot of vessels stuck in the ice and not enough ice breakers to keep the fairways open. Due to the hard winter this year, discussions in both Sweden and Finland are going on about how to improve the efficiency the coming years. Better planning and optimisation of the use of icebreakers is a must, but more icebreakers will probably be needed if more hard winters will come.

Weather conditions are sometimes a problem as well. During winter in particular, weather conditions such as snow, storms and blizzards may cause delays and traffic problems in all corridor countries and for both road, rail and ferry traffic.

Edelweiss bottlenecks and development areas, summary:

Operational: Interoperability problems on railways (change of traction, different control, signaling and command systems)

Policies, legislation and regulations: Longer and heavier trucks (60tms, 25.25m) only allowed in Finland and Sweden

Infrastructure: Capacity limitations of rail and road networks, slot restriction on the rail network and different gauges, rail electrification of non-electrified rail stretches / monorail tracks

ICT and transportation technology: Implementation of ERTMS.

Other: Winter weather/ ice condition

5.5 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.

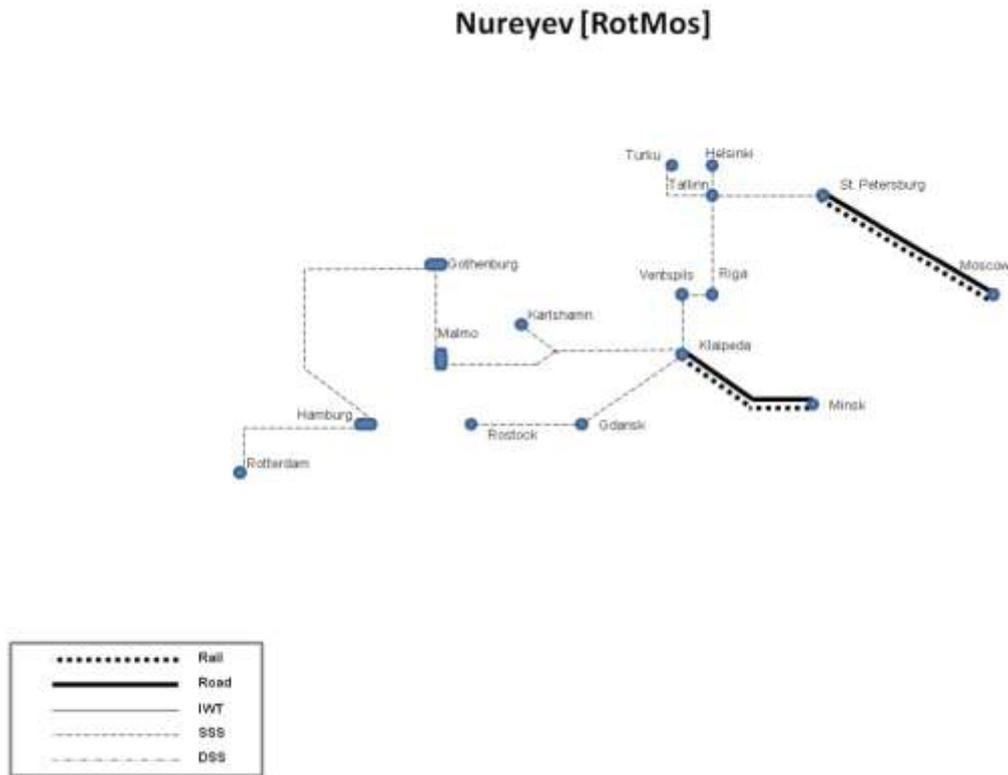


Figure 14 Nureyev corridor

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.

Operational bottlenecks and development areas

The major bottlenecks related to this corridor are problems related to border crossings between the EU and Russia and road congestion resulting therefrom. When the waiting times in the border grow, the queues in both sides of the borders are growing. In worst times the queues in Finland can be tens of kilometres long and there is not enough space to park all the vehicles in queue. This causes also problems to local traffic and habitants.

Currently a lot of the traffic is going through the Finnish harbours /borders as the harbours in the Baltic countries lack the proper equipment.

In the Baltic Sea the traffic volumes are estimated to grow rapidly and especially the oil transportation from Russia is expected to increase. This will mean larger vessels and growing risks for accidents. As the Baltic Sea is extremely sensible the effects of a major oil accident can be devastating.

Bottlenecks and development areas related to policies, legislation and regulations

One major development area along the Nureyev is the Russian Customs. The delays in border crossings along the Russian border are heavily affected by the ineffectiveness of the Russian Customs. However it is not possible to identify one single reason for the ineffectiveness and diverse procedures. There are issues like culture, history, traditions, habits and attitudes which have an effect. One of the biggest issues is corruption. Slowly the Customs procedures have become stable, but still the double invoicing and different interpretations and enforcements are causing problems.

IMO (International Maritime Organisation) is setting new quality requirements for maritime fuels. In Baltic Sea this would mean cutting the sulphur content of ship fuel to 0.1% by 2015 (currently the cap is 1%). However in addition to the Baltic Sea the limit would apply only in North Sea and English Channel (Emission Controlled Areas) and this will put member states in position of inequality. It has been assessed by some Member States and organizations that the effects would dramatically weaken the competitiveness of industry and shipping in Northern Europe. For example in Finland this would mean an increase in sea freight charges by around 30-50%, the added expenses would be around 500 – 1000 million euros annually for export and import. The new regulation can also lead to back shift from sea to road and to the associated adverse effects to the environment.

Infrastructural bottlenecks and development areas

The rail and road connections from Klaipeda Seaport are insufficiently developed. In addition inland waterways transport is underdeveloped. The road from Klaipeda to Minsk is heavily congested. There are upgrading projects which aim to improve the current status. Also the rail network between Klaipeda and Minsk is approaching its capacity. There is an upgrading project which aims to improve the infrastructure and allows the speed of 160 km/h.

In general the hinterland connections are vital for functional intermodal transport system. Around the Baltic Sea the connections from / to ports are generally in a good level, but there is still room to improve, especially with railway and inland waterway connections. In addition for example in Poland also the road connections need to be improved.

The monorail track in the Finnish Russian border causes bottlenecks, because of the big volumes of the transit traffic via Finland to Russia. Also the capacity of the rail track is often causing problems.

In Russia the capacity of the harbours is the biggest bottleneck especially in import traffic. This is the main reason why a lot of the Russian traffic runs through Finland and other countries. The fact that import and export modal flows are imbalanced makes the situation even worse. Import is mostly managed with containers, trucks or trailers, while export is mainly bulk. The approach paths of the Russian ports along the Baltic Sea are not optimal. For example the sea route running to the harbour of St. Petersburg needs constant dredging

and limits the vessel size to 14 000 – 16 000 DWT. The fact that the harbour is located in the metropolitan area limits the possibilities to enlarge the harbour. Therefore the development of the harbour is extremely difficult.

To overcome the problems with the current harbours there is a massive construction work on-going in Ust Luga. The port of Ust Luga will become the biggest harbour in the Gulf of Finland. When ready, in 2015, the port will handle 3, 0 million TEUs, 360 000 cars and 50 million tons of oil every year. The total handling capacity of the port is planned to be 120 million tons. The aim is to build a harbour which can handle all kinds of cargo in the future.

Bottlenecks and development areas related to ICT

To overcome the challenges brought up by the ice situation during the winter and the fact that the area is highly sensible there are several ICT systems in place to guide the traffic along the Baltic Sea. The systems include among others: Mandatory Ship Reporting System (GOFREP), Vessel traffic service (VTS), Automatic Identification System (AIS), Vessel Traffic Management and Information Systems (VTMIS) The work is on-going and new systems to help the situation are developed constantly.

The technical equipment in the border stations of the Baltic countries is underdeveloped. This slows down remarkably the broader crossings. Also there is room to improve in taking into use effective surveillance techniques for goods and vehicles in Customs along the whole corridor. Also the ICT solutions for helping the custom procedures between Finland and Russia have been developed.

Other major bottlenecks and development areas

A major part of Nureyev runs in Baltic Sea. During the winter especially in the Northern part of the corridor ice conditions can be rather difficult and cause some delays. This concerns Estonian, Finnish and Russian ports. There are not enough ice breakers in the Baltic countries or in Russia which can handle the situation. This causes problems especially during harsh winters. The area around St Petersburg is also problematic as there is heavy traffic but during winter only one fairway can be used. The ice conditions are often difficult and last usually 2–3 months, during harsh winters even longer.

Nureyev bottlenecks and development areas, summary:

Operational: Border crossings, increase of maritime transports, risks of severe accidents

Policies, legislation and regulations: Regulations and policies for pollution management (sulphur, etc.), complex Customs procedures

Infrastructure: Capacity limitations of rail and road networks, slot restriction on the rail network and different gauges, rail electrification of non-electrified rail stretches / monorail tracks, ports and port capacity, road and rail hinterland connections of ports

ICT and transportation technology: Need to develop new ICT systems, Customs surveillance

Other: Winter weather/ ice conditions, “Island” countries, dependency of SSS

5.6 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).

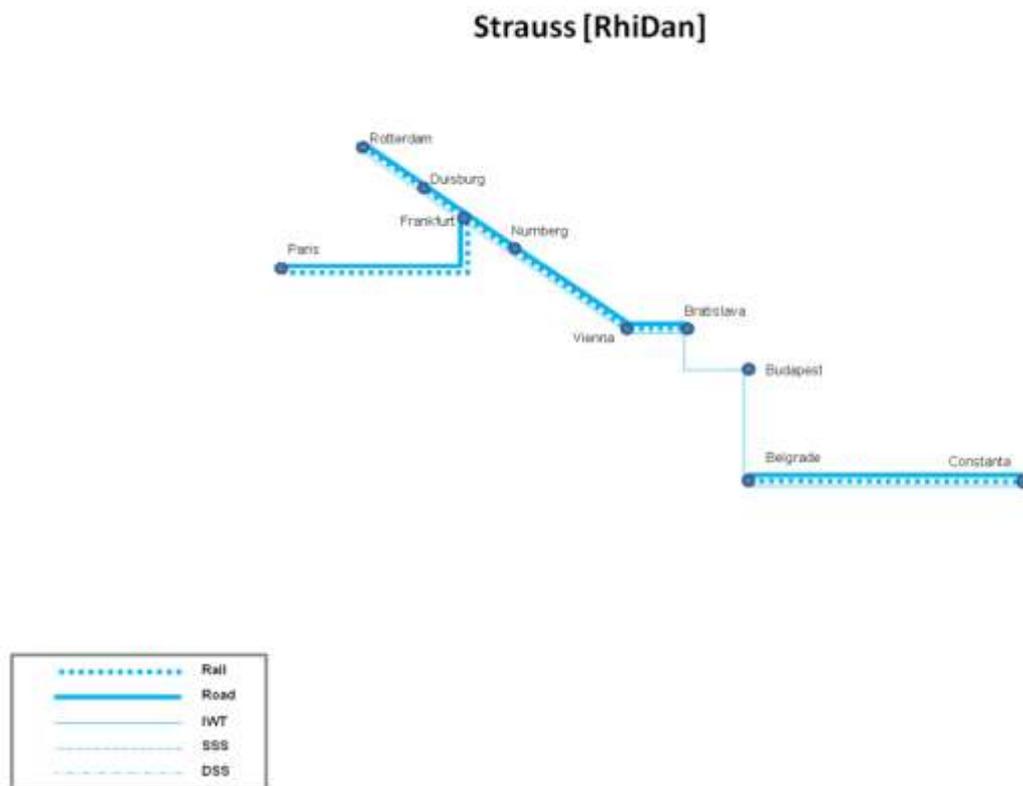


Figure 15 Strauss corridor

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.



Figure 16 Strauss corridor, TEN-T Priority Axis 18. Schedule of removal of bottle necks (Source: European Commission, DG TREN, 2009).

Operational bottlenecks and development areas

In the study on administrative barriers (NEA, 2008) it was found for example that for almost all countries of the study barriers were identified related to the financing of investments in vessels, and also in a number of countries barriers seem to exist with regard to insurance of vessels. Problems mentioned with respect to financing are amongst others: lack of harmonization of the conditions of financing and insurance between countries, problems with convincing banks of profitability prospects, limited experience of banks on IWT industry, lack of support of authorities (e.g. with regard to taxes, to subventions, to state guarantees etc.).

Although many barriers were mentioned as relating to infrastructure, few qualified as regulatory or administrative. The most important ones which do so and which are common barriers are problems with local or port authorities: port dues, limiting opening times of ports or facilities in port and reducing number of facilities (e.g. rest areas in ports) and problems with infrastructure planning processes.

Especially on the Danube many problems related to the lack of harmonisation of procedures with non-EU countries, causing amongst others, border crossing delays, were mentioned. Further, the lack of a common IWT language was mentioned as a problem for operators in international transport. In air and sea transport English is used as a common language.

Bottlenecks and development areas related to policies, legislation and regulations

Furthermore, related to inland ship/certification, the study on administrative barriers found that in a number of countries companies are not satisfied with the performance of the inspection authorities. Instances of long delays in obtaining certificates, mistakes etc. were noted in various countries, and are considered to be a significant barrier.

The lack of standard/harmonised job profiles corresponding to manning/crew requirements is also seen as a barrier in some countries and, also related to this type of barriers, the problem of non-compliance with regulation on resting and sailing times was mentioned in a number of countries to be a significant barrier. This is also a barrier which tends to make competition between companies unfair.

While there has been a substantial reduction of barriers as a consequence of freeing the market in the 1990s, many new types of barriers have emerged again. In particular the category of problems related to various developments in society (increased environmental, food safety, security concerns etc.) has increased in the past few years.

Amongst others, new barriers encompass quality systems like GMP, EBIS, ISO-systems, waste transport requirements, dangerous goods treatment etc.

In many cases the rules/administrative requirements in this new category are to a large extent of a commercial nature (forms of self-regulation of other market parties). In many Member States the responsible authorities have also taken measures to reduce the administrative burden of the industry. However, the possibilities to reduce these are limited when market parties impose restrictions on themselves or when the type of regulations or administrative requirements originates not in the industry itself.

Infrastructural bottlenecks and development areas

Major bottlenecks relate to insufficient lock capacities on the river Meuse and water depths on the Danube. These bottlenecks do not hinder navigation, but a removal of these bottlenecks will improve the transport performance of inland navigation significantly.

The removal of major bottlenecks relates to:

- Belgian-Dutch section: increase of lock capacity on river Meuse (class VIb)
- German section: provision of water depth of 2.5 m at Straubing-Vilshofen
- Austrian section: provision of water depth of 2.8 m south of Vienna
- Serbian section: removal of temporary railway bridge at Novi Sad (height and width)
- Hungarian section: removal of fords and bottlenecks between Szob and Mohacs
- Bulgarian and Romanian sections: improvement of navigation conditions.

For the rail freight transport, according to the summary of the Planco study (Planco, 2007), many nodes on the German railway network are overloaded, like the lines of Karlsruhe – Basel, and Emmerich – Duisburg. As stated in this study, there are planned network extensions that will relieve a number of overloaded sections, but even on the major routes, a high number of sections will remain with capacity utilisation rates between 80 and 110 %. If the capacity utilisation rate exceeds 80%, the delivery time extends significantly. For example, transit time at a utilization rate of 95% is by 20% longer than for a route with a low capacity utilisation level.

In the Danube region a significant growth in transport demand is expected. However, the railway connections are still in such a poor condition that they are not expected to be capable of sufficiently coping with this demand (Berger, 2008).

Bottlenecks and development areas related to ICT

River Information Services in the Rhine-Main-Danube corridor is regulated by Directive 2005/44/EC, which defines binding rules for data communication and RIS equipment as well as the minimum level of River Information Services for RIS implementations.

In the Rhine-Main-Danube corridor, the main bottlenecks in River Information Services are the following:

- Inland Electronic Navigational Charts (IENCs) are available for the entire corridor. The infrastructure bottlenecks however require charts including actual depth data and dynamic water-level-models, which are only provided in some countries already.
- Notices to Skippers are provided by all administrations at a national level. A task force is working towards the international exchange of such Notices to Skippers information, so that a skipper does not have to search at the RIS centres on the route.
- Electronic Reporting of cargo and voyage data facilitates the cooperation with authorities and relieves from administrative burden. The systems are however not fully operational in all countries, moreover data exchange among countries still needs to be developed.
- Vessel Tracking and Tracing is done by means of the Inland Automatic Identification System (Inland AIS). A recent survey showed that most vessels will be equipped with such devices by 2013; the seamless shore-infrastructure will however not be ready by then. Such seamless infrastructure would be required for tracking and tracing for traffic management and logistics information services.

The major bottleneck in the SuperGreen context is that information services for logistics are still in their infancy. There are some national pilot systems in operation; EU-research such as RISING is dealing with the development of such services as well. Administrations and the private sector are however urged to work on this topic further, so that those services can be provided seamlessly throughout the entire corridor.

Bottlenecks and development areas related to transportation technology

The average age of the European inland waterway fleet is rather high. New vessels are often built according to standard designs developed decades ago. However, there are many technical alternatives for improvement of the existing fleet related to hydrodynamics as well as engine systems. With respect to hydrodynamics improved propulsive efficiency and manoeuvrability as well as reduced resistance are most important and may be achieved with already existing technologies. With respect to engine systems the most important areas for modernisation are the reduction of fuel consumption and exhaust gas emissions as well as compliance with very strict future emission regulations, and transition to usage of alternative fuels to diesel or marine gas oil.

In particular, the following aspects are considered as core elements for the strengthening of the European inland waterway transport system:

- Modernisation of the fleet, focussing on existing vessels as well as new buildings and allowing for technology transfer from other modes of transport (e.g. automotive industry, deep sea shipping)
- Further improvement of energy and cost efficiency as well as environmental performance as short- and mid-term goals as well as transition to the ‘after fossil-fuel-area’ as long-term goal
- Strategies to further develop new market segments e.g. general cargo based on standardized transport units covering both, hinterland transport of maritime cargo flows as well as continental cargo flows
- Adaptation to the requirements of the ADN regulations related to the transportation of dangerous goods
- Safe navigation under more complex conditions of operation (e.g. water level fluctuations, increasing vessel sizes etc.)

In the FP7 EU project PLATINA the Strategic Research Agenda for Inland Waterway Transport was elaborated in agreement with major representatives of the European inland waterway transport sector, describing the sector specific research and development needs. An overview of the comprehensive research and development needs is given in the Figure 17.

5.7 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.

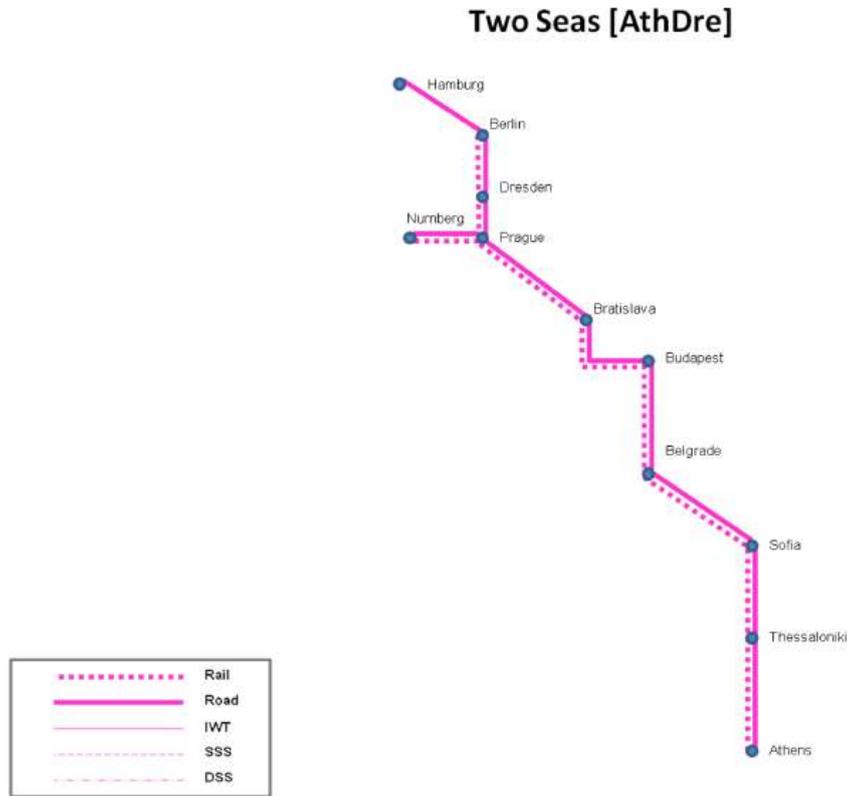


Figure 18 Two Seas corridor

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

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.

Operational bottlenecks and development areas

Presence of high traffic volumes has been pointed out along the border crossing between countries as Germany and Czech Republic, Czech Republic and Slovakia, Slovakia and Hungary, Bulgaria and Greece.

Bottlenecks and development areas related to policies, legislation and regulations

Many problems have been pointed out along the border crossing due to inadequate capacity of clearance facilities, meticulous bureaucratic custom clearance procedures, inadequate opening times and understaffed counters at the custom offices.

In many cases, like between Germany and Czech Republic, Czech Republic and Slovakia, Slovakia and Hungary, Bulgaria and Greece, the payment of additional fees is requested on the road network and on the rail network between Germany and Czech Republic.

Infrastructural bottlenecks and development areas

On the main axis of the rail network between Germany and Czech Republic, investments for strengthening the superstructure for the use of trains with new technologies are foreseen. The main objective is to reduce the journey time between Berlin-Prague. In Slovakia the rail network concerning the corridor is in relatively good condition and a general modernisation is not being considered at present. In Hungary, continuous efforts to upgrade the entire section of motorway and rail network to current standards are on-going.

The port traffic at the Port of Thessaloniki has steadily increased. A big investment programme is scheduled for the modernisation and expansion of the port, providing the port with a new direct access to the national and international road and rail network. A feasibility study and a master plan for a logistics and distribution centre development are completed.

In Germany the Port of Hamburg reached its limits with respect to container handling and face enormous difficulties in hinterland transport.

The future road situation has been modelled (Petersen M.S., et.al. 2009) in order to highlight possible bottlenecks that will arise before 2030. Bottlenecks consisting of capacity and road condition problems are foreseen on the corridor, in the Prague and Bratislava regions.

Two Seas bottlenecks and development areas, summary:

Operational: Border crossings

Policies, legislation and regulations: Inadequate capacity of facilities at the border crossing

Infrastructure: Capacity limitations of rail and road networks, road congestion / insufficient road infrastructures capacity, ports and port capacity, road and rail hinterland connections of ports

ICT and transportation technology: Need to develop new ICT systems

5.8 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.

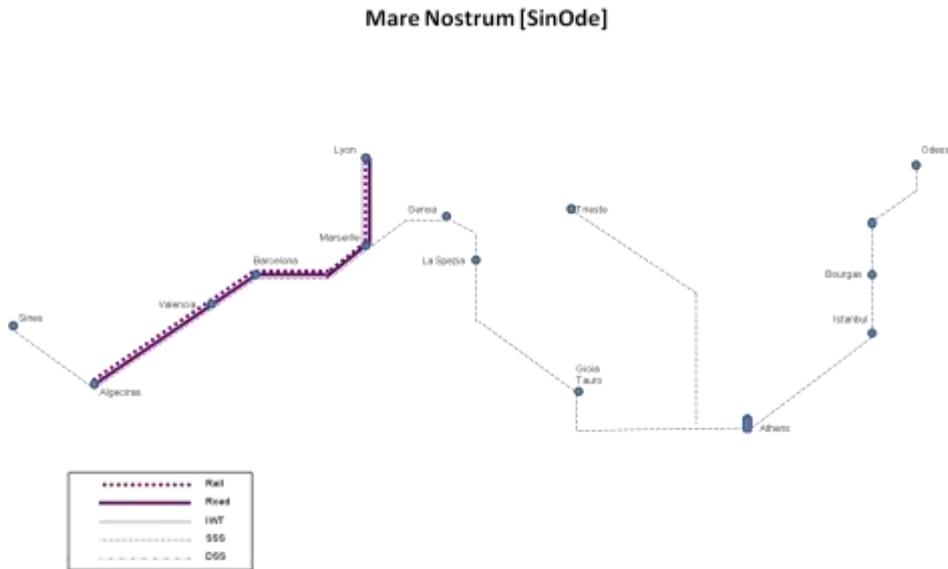


Figure 19 Mare Nostrum corridor

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 Algeiras-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.

Operational bottlenecks and development areas

Being mostly maritime corridor, the Mare Nostrum corridor suffers from the problems that characterise this mode of transport. The administrative procedures for maritime transport are too often unnecessarily complex, redundant and not harmonised between countries or ports. Operations for incoming and outgoing vessels to/from ports are slowed down, generating higher costs, and loading and unloading operations tend to be delayed.

The following types of bottlenecks have been identified:

- In some ports certain customs documents have to be given in original to a customs office, which might be located far away from the quay, and the opening times or the location of customs office may cause logistical problems.
- In some ports, unloading of a ship can start only after all documentary formalities have been completed, which can take up to half a day.
- Language difficulties are another bottleneck as some authorities in ports refuse ship manifests and certificates in languages other than their own.
- Pilotage services also can be a serious problem. Vessels on short-sea-shipping runs call regularly at the same ports, and their masters are familiar with the physical features. Nonetheless, in many cases pilot assistance is compulsory. While some countries do offer a Pilotage Exemption Certificate (PEC), there are often national requirements that make a PEC difficult to obtain.

- Electronic manifests are not universally accepted by all ports in the EU. Only 55% of ports use electronic systems for handling ship and cargo information, with the use of fax and telephone still common.
- Only a few Member States have a national single window approach. The linkage between the SafeSeaNet and the port networks is very limited, and data exchange happens when the national authorities ask for it. The exchange of electronic messages between ports is practically non-existent.

It follows that administrative simplification is a development area where significant efficiency gains can be achieved at a relatively low cost.

A second operational problem is the growing shortage of maritime professionals concerning both officers and ratings. It entails the risk of losing the critical mass of human resources that sustains the competitiveness of the European maritime industries in general.

The Mediterranean Sea is very sensitive vis-a-vis environmental catastrophes from ship accidents. Due to the transport of hazardous goods (especially oil and liquefied gas) accidents and their resulting pollution can be severe.

Bottlenecks and development areas related to policies, legislation and regulations

A wide set of mainly EU legislation made up of customs and transport rules, veterinary and plant-protection regulations, and formalities for vessels arriving in or departing from European ports have been identified as a major hindrance to intra-EU maritime transport.

Customs formalities for vessels sailing only between EU ports can be simplified so that ships from another EU port transporting Community goods would not have to present a proof of Community status.

Regulations on dangerous goods are less favourable for sea transport than for road transport. This fact, combined with a certain degree of overlap between bodies of technical legislation, often renders sea transport not an option and dangerous goods are transferred by road or rail.

Infrastructural bottlenecks and development areas

Two infrastructure related bottlenecks were identified in Task 2.4. The first one concerns capacity problems of existing port facilities. Insufficient cargo loading/unloading and handling capacities at the ports damage the efficiency of transport chains involving maritime transport and prevent the shift to more environmentally friendly modes.

The second one is related to the road and rail hinterland connections of the ports. Insufficient capacity of such connections causes serious congestion problems not only to the transport networks of the areas surrounding the ports but in some cases to the ports themselves. The usual proximity of ports to dense urban areas magnifies the negative effects of such congestion. The provision of freight oriented road and rail connections to the ports has been suggested as a possible solution to this problem. However, the availability of land and public acceptability to construct new infrastructures will remain a great challenge, while urbanisation in the region is expected to continue.

Bottlenecks and development areas related to ICT and transportation technology

Concerning ICT, the use of satellite based applications for maritime surveillance was identified in Task 2.4 as a potential development area. Such a system would be part of the

e-Maritime Initiative and develop into an integrated EU system providing e-services at the different levels of the transport chain. In that regard, the system should be able to interface with the e-Freight, e-Customs and the ICT systems of the other modes, allowing the users to track and trace the cargo not only during the waterborne part of the journey, but across all transport modes in a true spirit of co-modality.

Furthermore, ICT applications can seriously improve the quality of life at sea in areas such as on-board healthcare, distance learning and personal communications. They can also reduce the administrative burden on masters and senior officers on board ships.

Mare Nostrum bottlenecks and development areas, summary:

Operational: *Complex administrative processes, shortage of maritime professionals, risks of severe accidents*

Policies, legislation and regulations: *Complex Customs procedures, complex rules on carriage of dangerous goods by sea*

Infrastructure: *Ports and port capacity, road and rail hinterland connections of ports*

ICT and transportation technology: *Need for satellite-based ICT applications (e.g. cargo tracking and tracing, e-maritime/e-freight/e-customs, distance learning)*

5.9 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 transshipments 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.

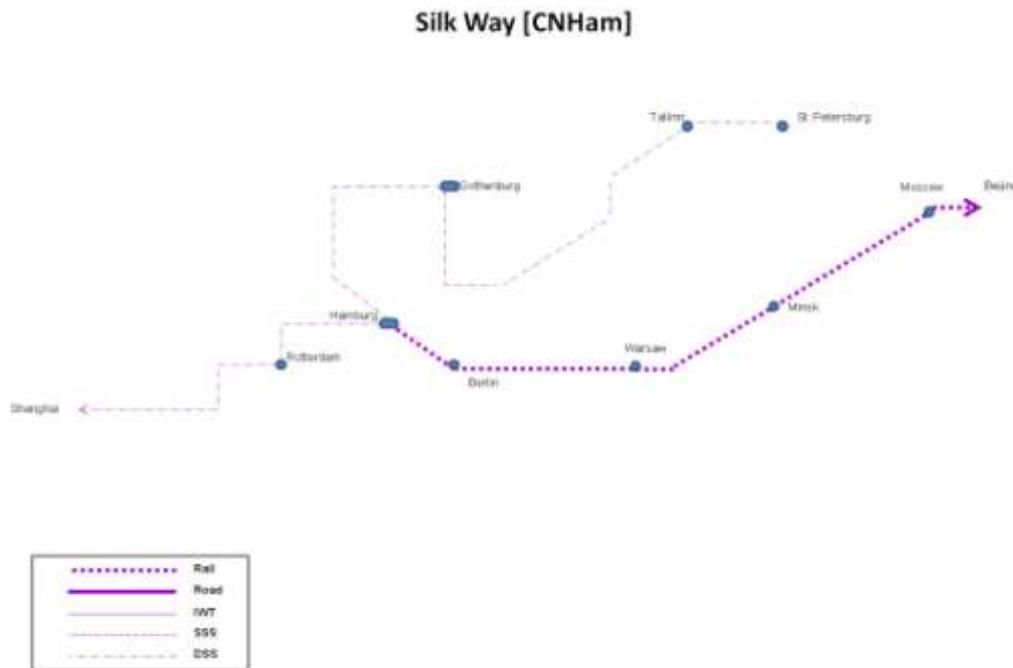


Figure 20 Silk Way corridor

Operational bottlenecks and development areas

As the rail route runs through several countries, there are delays caused by border crossings, inspections and different formalities. Especially the crossing from Russian gauges to European gauges when leaving Russia and customs clearance procedures when entering into the EU.

Security of cargo travelling such large distances is one bottleneck, also due to considerable time spent in distant regions. In the Aden Bay there is a security problem due to the increasing numbers of piracy incidents on vessels.

The routing of Silk Way on rail (“Transeurasia Express”) ex Asia (Shanghai/Beijing) to Germany (Hamburg/Nuremberg) was/is one of the major issues for improvement. The original track led via Mongolia and Russia. Due to political negotiations, it is now possible to route across Kazakhstan which reduces the whole route by more than 1,000 km. Also, several metropolitan areas in China can be connected to the train.

The re-routing also forked the route before entering Western Europe. One route crosses the border from Russia into Latvia and leads through the Baltic Sea/Short Sea to Hamburg. Key data for such routing by test trains Urumqi (China) – Hamburg:

- Total distance: 5.806 km
- Time of transit: 10 days 20 hrs 46 min
- Average speed: ca. 30 km/h (534 km/day)

- Border crossings: Kazakhstan at Dostyk – Alashankou: 21 hrs 25 min, Russia at Petropavlosk: 4 hrs 28 min, Latvia/EU entrance at Zilupe: no information, Baltic sea at port of Ventspils

One route crosses the border from Russia via Ukraine and Slovak Republic into the Czech Republic (Pardubice), final leg to Nuremberg. Key data for such routing by test trains Shenzhen (China) – Pardubice (- Nuremberg):

- Total distance: 12,360 km
- Time of transit: 21 days 20 hrs 12 min
- Average speed: 21.5 km/h (516.7 km/days)
- Border crossings: Kazakhstan at Dostyk – Alashankou: 15 hrs 27 min, Russia at Iletsk: 6 hrs 40 min, EU entrance at Bryansk-Lgovsky/customs inspections: 3 days 13 hrs 50 min

Bottlenecks and development areas related to policies, legislation and regulations

EU and CIS countries use different bills of lading in rail transports, EU according to CIM law and Eastern Europe according to SMGS law. Poland accepts B/Ls compliant to both laws. Since 2003, rail organisations such as OTIF (CIT) and OSShD are working together with the EU commission on a joint B/L which shall also apply as customs document. Such integrated CIM/SMGS B/L applies to block trains as well as to combined rail/road transports.

Advantages of such integration:

- Simplifying of commercial processing, avoiding of mistakes/errors due to re-issuing of the B/L at border crossing and customs clearance (EU-CIS)
- Acceleration of border activities and reduction of total transit time
- Cost advantage for customers
- Acceleration of customs clearance when acknowledged as customs document
- Enabling continuous corridor management and flow of information
- Enabling of one stop rail service

Further improvements still needed:

- Application gaps for integrated B/L to be checked and removed (as the integrated B/L will not apply to all SGMS rail systems)
- Cost intense extension and adjustment of IT systems required
- B/L shall also apply to L/C business
- Only 1 border stop for all checks + customs clearance per border crossing

Infrastructural bottlenecks and development areas

The rail connection has not yet become a common transport corridor for goods between Asia and Europe. The entire railway line is fully electrified. The primary obstacle is the fact that there are two gauge breaks.

Congestion at ports, particularly during peak seasons, may cause considerable delays for container carriers due to waiting time for available quay space and crane capacity. This may also have an effect on the European feeder traffic.

Railway terminals also differ in terms of the ability to handle particularly long trains. This means that some terminals have to divide long freight trains into smaller segments before

being able to initiate the (un)loading process. To what extent this particular service suffers from this bottleneck is subject for further investigation.

Bottlenecks and development areas related to ICT and transportation technology

Data reception should be combined together with measures of intervention. The current GPS system on board the train enables regular tracking and the sensors enable geo-fencing, temperature and shock control etc. However, a system/routine needs to be in place how to intervene in case of error signals (f.e., if the shipment is damaged or leaves the track). In case of security problems, f.e., the local police need to be informed and intervene, respectively. For the moment, security staff needs to accompany the train along the whole route.

All involved parties (rail carriers, related authorities, service providers) should have access to a common data (tracking and tracing) platform. Especially border authorities/customs should receive messages of appropriately prior to train arrivals, documents should be submitted and checked before arrival. The data platform increases visibility on where which train is going to pass/arrive in both directions. Planning-related data could be generated this way and be made available to all stakeholders. Status messages could be generated regularly. Integration of IT systems is mandatory to run a cross-continental rail system.

Silk Way bottlenecks and development areas, summary:

Operational: *Interoperability problems on railways (change of traction, different control, signaling and command systems), border crossings, safety & security (piracy)*

Policies, legislation and regulations: *Lack of harmonization of national regulations, complex Customs procedures*

Infrastructure: *Ports and port capacity, railway terminals capability of handle long trains*

ICT and Transportation technology: *Need for platform for routing and T&T information, lack of harmonization of systems and data*

6 Common development areas

Common development areas are derived from the corridor specific bottlenecks identified in the previous chapter. In addition bottlenecks have been identified based on the work done so far in other Work Packages of SuperGreen project, i.e. WP3, WP4 and WP6. The identified development areas are presented in four groups:

- Operational
- Policies, legislation and regulations
- Infrastructure
- ICT and transportation technology

For each group corridor specific bottlenecks identified have been combined and summarised in figures (Figures 21-24). Development areas related to more than one corridor are considered as important and described further. Additionally specific issues related to Inland Waterway Transports have been described, because there is only one IWT corridor (Strauss) among the corridors.

6.1 Common operational development areas

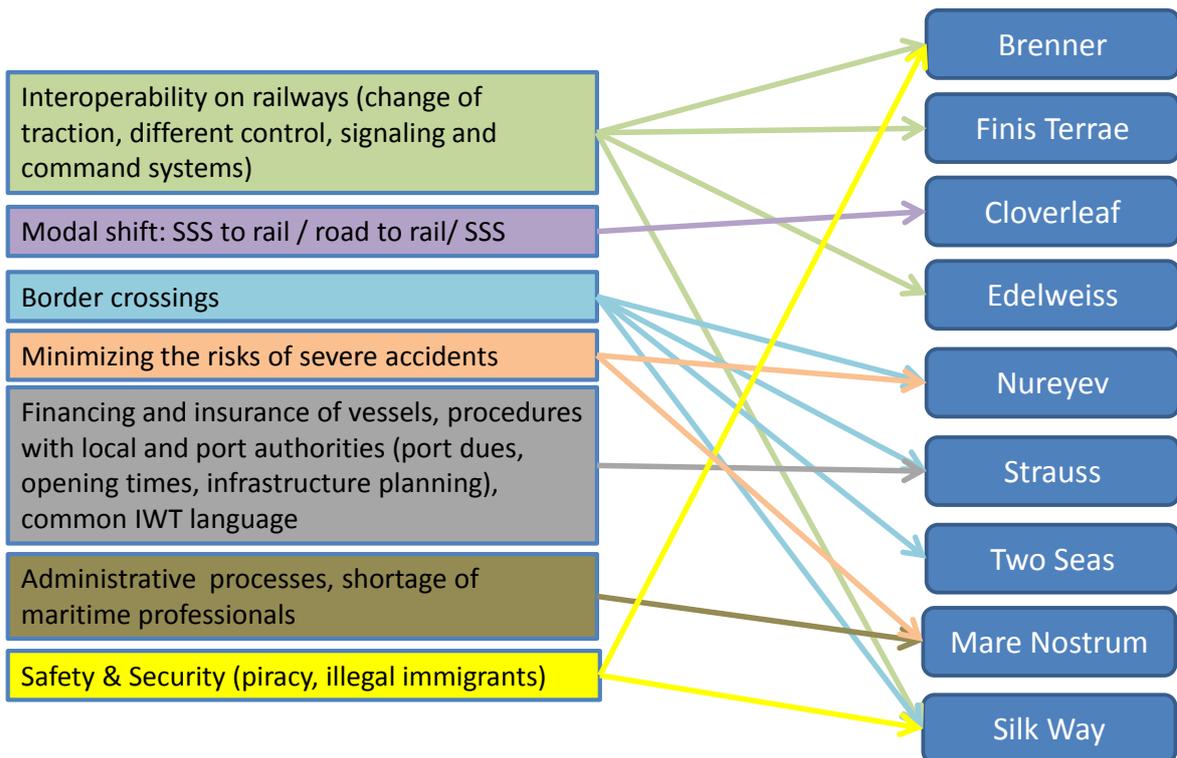


Figure 21 Operational bottlenecks and development areas

A shift to intermodality is realistically expected because of congested road infrastructure and environmental impacts of road transport. However, one major bottleneck in this regard is the interoperability problems on railways across the whole Europe. There are different control, signalling and command systems in different countries and this causes major bottlenecks in the international rail operations and may hinder the desired modal shift.

Border crossings between EU/non-EU countries are another major development area. Border crossings take a lot of time and extra work is required. There are unnecessary waiting times, lead times are longer, congestion increases and costs are higher.

Safety and security issues have also come up in several corridors. These are related to piracy and illegal immigrants as well as the sensitivity of the Baltic and Mediterranean Sea in case of severe accidents (for example oil tankers).

The development areas in IWT concern the financing of investments in vessels (profitability prospects, limited experience of banks on IWT industry, lack of support of authorities). Other development areas are related to the problems with local or port authorities (port dues, opening times of ports or decreasing number of facilities, infrastructure planning processes) and the lack of a common IWT language.

6.2 Common development areas related to policies, legislation and regulations

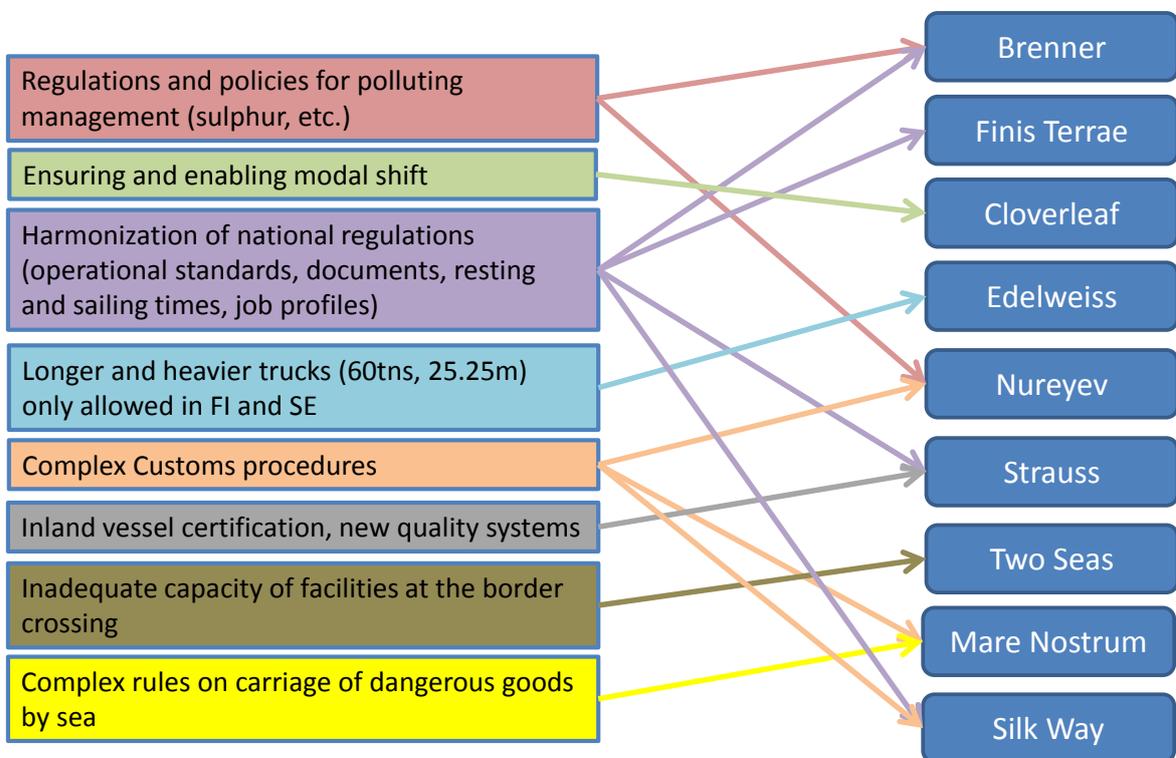


Figure 22 Bottlenecks and development areas related to policies, legislation and regulations

Common regulations and policies for decreasing emissions and pollution are needed. It is however extremely important that the final effects of the new regulations truly help in greening the transport corridors not the opposite (cf new sulphur limits). The effects of every new rule on transport costs, transport efficiency, modal shift possibilities, supply chain procedures, behaviour of transport clients etc. have to be studied extensively.

Harmonization of the different national regulations is seen as a major development need. The fact that there are several operational standards and different requirements for example for personnel causes unnecessary bottlenecks to international trade. Different modes of transport use different transport documents (CMR for road, Bill of Lading for maritime, etc...). Different documents also within the same mode of transport: EU and CIS countries use different bills of lading in rail transports etc. Harmonization of regulations is needed

also between the ports. This creates administrative costs especially for multimodal transport and puts it in an unfavourable position in comparison to single mode transport. To promote multimodal transport, it is therefore essential to create a single transport document for the carriage of goods in any mode.

Border crossing was seen as a major development area in the operational group as well. This naturally reflects also to other areas. In order to overcome the difficulties related to Customs procedures, development must be done also in legislation and regulations.

Main regulatory development needs in IWT are related to performance of the inspection authorities (long delays in obtaining certificates, mistakes etc.), the lack of harmonised job profiles corresponding to manning requirements and non-compliance with regulation on resting and sailing times.

6.3 Common development areas related to infrastructure

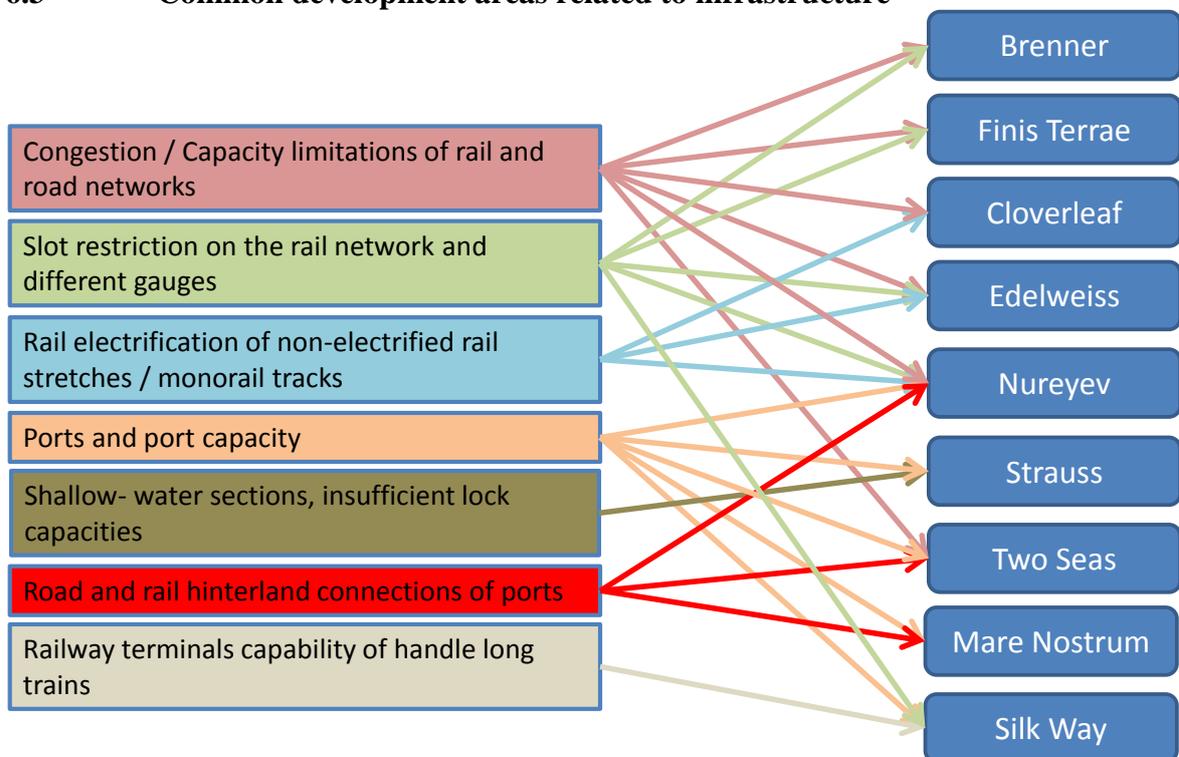


Figure 23 Bottlenecks and development areas related to infrastructure

Infrastructure development areas are mainly related to capacity. Capacity limitations cause congestion. There are capacity problems in the road network, rail network and ports. The capacity issue is clearly seen in all corridors and this is actually the only development area that has been identified in all SuperGreen corridors.

Interoperability on railways identified before as operational development area is related to infrastructure as well. Slot restrictions and different gauges in different countries cause bottlenecks to rail operations in many countries. In addition, the non-electrified rail stretches and monorail tracks are causing problems.

Hinterland connections from/to ports, both road and rail, are seen as a major development area as well. In order for intermodal transports chains that include waterborne leg to operate effectively the connections to / from ports must be good.

In IWT major bottlenecks relate to insufficient lock capacities on the river Meuse and low water depths on the Danube.

The following examples of infrastructure bottlenecks were identified in this project:

- The Brenner Tunnel
- Crossing of the Pyrenees
- The Fehmarn strait
- Ports of Patras, St. Petersburg and Hamburg
- Paris area
- West Coast Main Line
- Klaipeda- Minsk
- Insufficient lock capacities on the river Meuse
- Water depths on the Danube
- Rail connection Europe-Asia.

6.4 Common development areas related to ICT and transportation technology

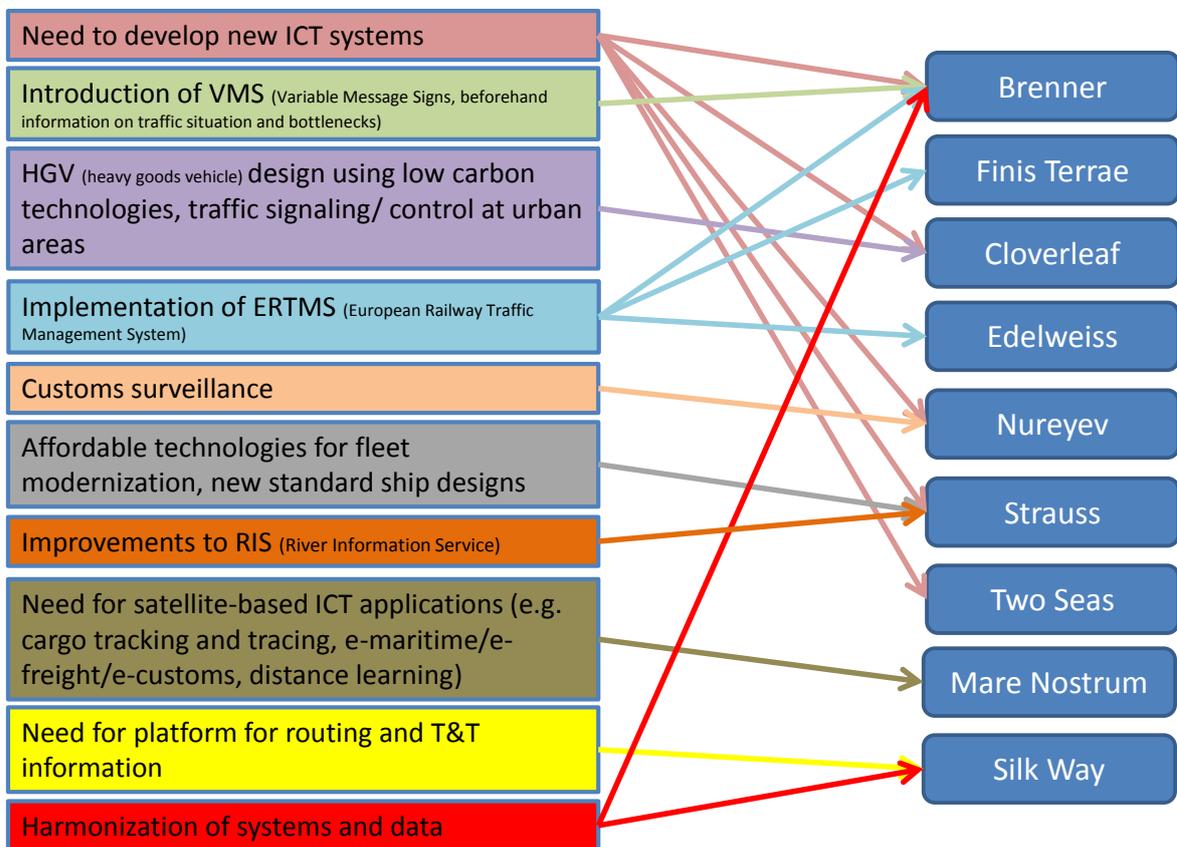


Figure 24 Bottlenecks and development areas related to ICT and transportation technology

Many of the identified development areas related to ICT and transportation technology along the SuperGreen corridors (Figure 24) were corridor specific, but it can be clearly noted that the need to develop new ICT systems was identified as a major development area in most of the corridors.

In addition to the new ICT systems, the implementation of European Railway Traffic Management System (ERTMS) was seen very important. Within Europe there are more than 20 different national train control and command systems, which constitute a major

technical barrier to international rail traffic. The ERTMS is a new signalling and management system for Europe, enabling interoperability throughout the European Rail Network, combining ETCS (control-command system) with GSM-R (radio system for voice and data communication). ERTMS aims at replacing these different train control and command systems in Europe. The deployment of ERTMS will enable the creation of a seamless European railway system and increase its competitiveness.

Different transport nodes use different ICT standards and protocols and this causes incompatibility and unnecessary bottlenecks. For example the ICTs for the port/vessel link are often either incompatible or unconnected with the ICTs operating at the port/truck link. An unexpected deviation of ETA (estimated time of arrival) of a vessel is very crucial information for truck operators. This will not be reported to the truck drivers, unless they decide to seek for that information, which may not be the case.

ICT systems integration would help ensure information succession and help towards optimum logistics operations. Most companies have their own stand-alone ICT solutions, which makes it difficult to provide continuous information about status and problems of the transport. In addition ICTs utility is strongly dependent on the level of technology that they use. The quality of information is increased when moving from static to dynamic systems. Manual input can lead to erroneous input and wrong data foundation.

Demand for inter-modal transport chains is growing and this will drive new ICT systems, tools and ways to handle the information. Sharing of logistics information among business partners and the integration of information systems will be prevalent along the whole supply chain. The simplification of freight and transport information exchange could substantially reduce the cost of multimodal transport and by this make it more attractive option.

There is a vision of a paper-free world where electronic flow of information is associated with the physical flow of goods. The possibility for actors in the supply chain to provide information only once – in electronic form – (‘single window’) and to have the goods and vehicles controlled only once and at the same place (‘one stop administrative shop’) together with the ability to track and trace freight along its journey across transport modes and to automate the exchange of content-related data for regulatory or commercial purposes is seen as a desirable future. Such development will require connecting and completing the networks for the exchange of information between administrations and for facilitating the access to this information by businesses. Emerging technologies such as radio frequency identification (RFID) and the use of global satellite navigation systems such as Galileo may help in making this possible.

7 Best practices

Successful cases and best practises to increase and improve sustainability have been identified in selected corridors. The good / best practises have been grouped into four different groups:

- Operational
- Policies, legislation and regulations
- Infrastructure
- ICT and transportation technology

A selection of the good practises based on the relevance to the SuperGreen project is given below.

7.1 Operational

Green supply chain is the objective for improving sustainability; it is a goods movement in the form of load or unit that preferably maintain the minimum impact to the environment. While full load chains are easier to be targeted (for improving their environmental performance) and thus exhibit lower greening potential, the part load ones with higher number of stakeholders involved comprise a more complex business.

Different transport modes can be ranked according to how green they are. Inland waterway transport is the most environmentally friendly mode of transport with the lowest CO₂ emissions. For the land transport, rail is most of the time ‘greener’ than road transport; this is especially true for long distance connection between ports/stations network. In the UK, where rail or water transport are viable options, the impacts per lorry load (known as external costs) of road are generally significantly higher than for rail and water, even after taking into account of the higher levels of taxation for roads (DfT, 2010).

The main drawback of sea, inland waterway and rail within the supply chain is that it is highly unlikely that they will serve the first and last mile of the trip. Therefore, they will benefit from improvement of the interchange points that facilitate multi-modality of transport chains. The use of ICT in rail is envisaged to contribute to greener transport but the critical question is how to optimise the route for minimum delay with minimum energy consumption.

To apply for example seaborne transports first of all an evaluation shall be made on which shipments are less time-sensitive, what is the cost impact (usually cheaper/cheapest way of transport), what is the time impact – especially comparing short sea shipping with truck transports and what are the load safety and security impacts: Ocean shipping might be threatened by piracy and adverse weather conditions. Short sea may suffer from adverse weather conditions as well. Such evaluation usually leads to the decision of being selected only for the transport of low value bulky cargoes for which losses are bearable. Willingness of shippers to thoroughly evaluate their portfolio according to sustainability KPIs is imperative to shift load to a slower mode of transport which also incurs certain additional regulations.

There are constantly on-going projects, which aim to increase the share of the “greener” transport modes and intermodal transports. In the Netherlands the entire supply chain of a

potential Inland Waterway Transport (IWT) customer was taken as advantage point, called Neutral Inland Waterway Transport oriented logistics advice. Analysis was made on the supply chain's sensitivity to IWT solutions. Concrete result was achieved as a shift of cargo from road to water. This good practice offers a comprehensive marketing approach, including promotion tours as a means of identification of shippers with inland navigation sensitive supply chains. A supply chain redesign process follows the initial approach, naturally in close cooperation with the logistic management of the potential user. Key success factors with this kind of approach are personal approach and direct contact with potential clients, individual analysis of supply chains and customised solutions, result driven measurable and highly visible process and extension of network of the industry.

Another example is the container services now available on the Danube. Nord Marine was the first company to start an international container service line on the Danube in 2005. The transport volume in this international line (Constanta-Ruse-Drobeta Turnu Severin-Pancevo-Belgrade) has increased year by year from 342 containers in 2005 to 2,780 containers in 2009. In 2006 this was followed by Mainrom Line (Constanta-Giurgiu Free Zone-Constanta) barge service which enables transportation of containers down the Danube River, and by that offering a new enhanced alternative to the road and rail transportation. It consists of 2 barges (100 TEU capacity / barge), and a pusher boat with a hydraulic wheelhouse. Today there are 2-4 convoy transports each month. The newest player in this is Helogistics Holding with new weekly container line between Constanta-Budapest-Constanta (HELO1) with the operational start on August 2010.

In the retail sector, the supermarket giant ASDA (part of US based Wal-Mart supermarket chain) uses rail for general merchandise and clothing products between the Midlands (around Birmingham area) and central Scotland (near Glasgow). Tesco (the largest supermarket chain in the UK) is similarly using rail between the Midlands and central Scotland and reportedly saving more than 7 million road kilometres per annum that leads to around 6,000 fewer tonnes of CO₂ being emitted each year (Woodburn and Whiteing, 2010).

One of the key strategies in road transports has to refer to the consolidation of shipments in the biggest available trucks, i.e., 40-60 ton trucks. The effect of such consolidation would be tremendous. Currently, long haul trucks are only filled by an average of ca. 45% of their weight capacity. Although a full truck is the most cost-efficient for a logistics provider, it is not feasible to avoid asymmetric transports which imply empty space within a single individual operational network. In addition, a truck is capped rather by volume than by weight which provides the challenge of a well-planned cargo mix (i.e., combining light and heavy goods). Transport units (trucks) in operation could be considerably reduced by intelligent planning and consolidation. In combination with the 25,25 m Euro combi, the potential to reduce units could be more than 33%, i.e. two Euro combi replace three ordinary 40 ton trucks, plus the effect of additional joint consolidation. In addition to modal shifts according to a.m. priorities, the reduction potential is even higher.

In order to make this possible, it should be imperative that at both ends in the 3-4PL business, coordination and long-term planning takes place. Shippers have to align their flows of goods along the major Transeuropean axis (TEN-T/green corridors) in terms of symmetry and cargo mix. LSPs need to combine their networks along such routes and create models of a fair share of earnings from their services.

In addition, the same approach of consolidation should apply to the “last mile”, i.e. city logistics: Shippers and LSPs shall coordinate certain time windows in which consolidated goods may enter a city. As an example, the city of Gothenburg is partner in the Swedish KNEG program on future creation of carbon free transport. The mid-term target is to reduce 50% of specific transport emissions (per tkm) until 2020. One key success factors is the partnering with LSPs, wholesalers and scientific institutions to take out a sustainable city logistics program.

Harris et al. (2010) otherwise noted that traditional supply chain management focuses primarily on market and manufacturing issues, and transport has typically been considered as a rather marginal activity. They proposed for future research to address issues such as:

- Determine and categorize all the sources of uncertainty that affect the supply chain and transport;
- Consider the root causes and fundamental effects of each type of uncertainty;
- Determine where each type of uncertainty originates from, whether in transport operations or other parts of the supply chain;
- Determine the impact of the causes of uncertainty on green logistics performance;
- Prioritise the causes of uncertainty and develop solutions, including flexibility strategies, to mitigate their implications;
- Explore the full range of uncertainty, primarily related to the external environment, such as commodity availability, product prices, international trade regulations, taxes and duties.

The Dutch Ministry of Transport launched the programme “The new sailing” for the inland waterway sector, to reduce the CO₂ emissions by inland shipping by 5% as per 1 January 2011 compared to the 2007 level. The Programme aims at influencing the behaviour of shipping crew, resulting in more energy efficient sailing, through the following programme components:

- training and education: learn how to sail energy efficiently,
- technical assistance tools: development and subsidisation of tools for fuel monitoring,
- fuel savings competition.

In addition to this, a platform of shipping companies has been established, through which communication to the sector was done, and games and competitions were organised. Since the end of 2010, the programme was transferred to EICB (European Innovation Centre Inland shipping), who has continued the programme afterwards.

Key success factors have been the provision of a platform, ensuring a pro-active participation of shipping companies. Proactive involvement of interested individuals by asking for their ideas on how to save fuel has also been identified as important. Fuel savings competition has increased the willingness of individual crew members to contribute as well as a special website allows to monitoring the position of the participants in the ranking list (<http://www.ikvaarzuinig.nl>).

Carbon Auditing

McKinnon (2010) has pleaded scepticism on environmental sustainability for logistics of how companies around the world promoting their green credential. He argued that it is difficult to gauge a link that reflects a true desire to help the environment as much as enhancing public relations (Ibid). That said, ‘the corporate support for Green is as much as for the potential to sell new products and technologies as it is about saving the planet’

(McKinnon quoting Gilmore, 2008). Furthermore, the challenge now is for companies to instil green principles into strategic planning of logistics and coordinate environmental management at strategic, commercial, operational and functional decisions' making.

Piecyk (2010) reported an investigation of how companies can be guided to get through carbon auditing for their supply chain products. She illustrated three types of carbon footprint: at a product (either a good or a service), a single company or a supply chain level as can be seen in Figure 25.

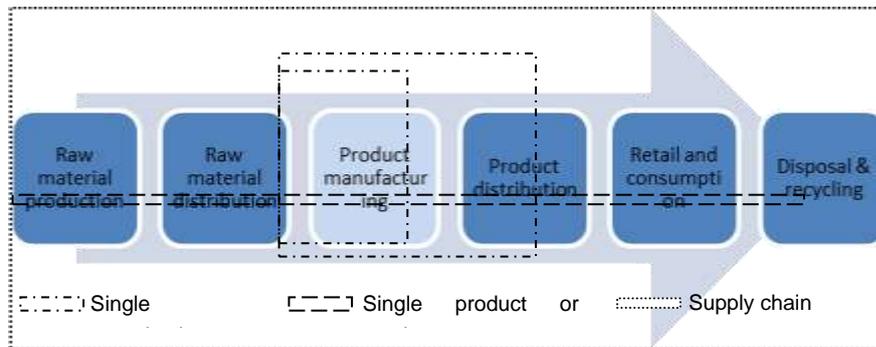


Figure 25 Different types of carbon footprint (adapted from Piecyk, 2010)

Moreover, Piecyk reported that the available published guidelines differ in their details but the main assumptions and methodologies are similar. The widely adopted principles are: relevance, completeness, consistency, accuracy and transparency (source: WBCD/WRI, 2004; ISO 14064-2, 2006; British Standards Institution, 2008 – as cited in Piecyk, 2010).

Despite being a relatively new concept, the carbon auditing of business activities has been developed both vertically and horizontally as shown in Figure 26. The vertical axis involves extension of disaggregating emissions by business unit, process, industry activity and eventually product, thus giving managers deeper understanding of the carbon-generating characteristics of their businesses. In parallel, the horizontal axis involves extension of carbon foot printing individual companies across supply chains, thus making it possible to track the emissions released at different stages of the production and distribution of an individual product.

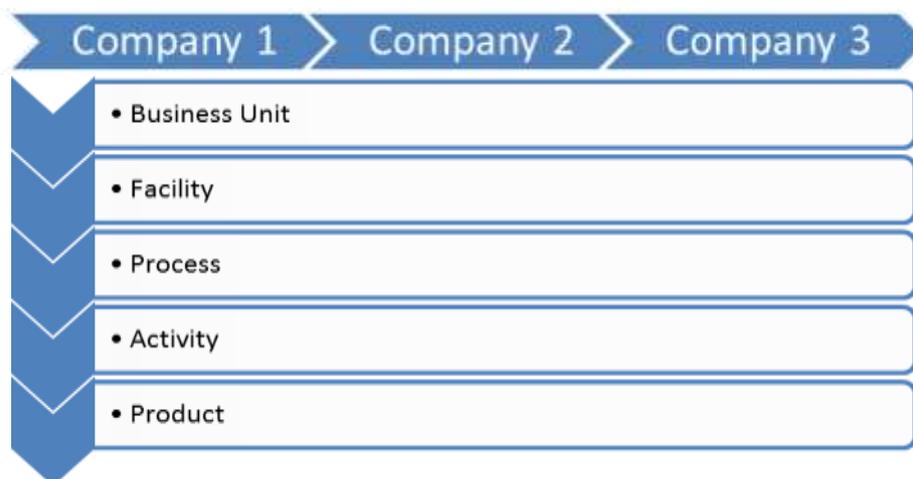


Figure 26 Vertical and horizontal dimensions of carbon foot printing (Piecyk, 2010)

However, although carbon auditing received a warm welcome from the industry and some pilots involving labelling consumer products such as potato crisps and fruit juice, there

appears issues of high cost of product-level carbon auditing of supply chains and uncertainty about consumer responses to the carbon labelling. These in turn creates doubt that such practice will be widely adopted for the future as also echoed from Piecyk study's conclusion.

Best practices / Operational

1. Increase share of the “greener” transport modes and intermodal transports:

- Neutral inland waterway transport oriented logistics advice – Rising awareness with respect to the application of inland waterway transport in supply chains by direct contact with potential customers and individual supply chain analysis results in a wider acceptance of inland waterway transport solutions and cargo shift from e.g. road to water.*
- Existing container services on the Danube constitute the basis for the implementation of container services on the Danube on a large scale e.g. similar to the ones on the Rhine, contributing to intermodal transport solutions there.*
- Full loads of rail wagon within the designated corridor with smaller number of stakeholders involved – Simpler system allows simpler management and thus easily targeted towards improvement of efficient and green logistics.*

2. Consolidation via shippers' and LSPs (road) – This is a key to use Green Corridors in a basic sustainable way.

3. “The new sailing” – Energy efficient sailing offers significant potential for reduction of fuel consumption and CO₂ emissions at relatively low cost and being applicable immediately.

4. Carbon auditing of companies, supply chains and products – Disaggregating emissions can help managers to have a deeper understanding of the carbon-generating characteristics of their business.

7.2 Policies, legislation and regulations

Policies, legislation and regulations are in most cases transport mode specific. Based on this, this chapter has been divided according to the transport mode. Examples of the important Directives and programmes are presented which aim to identify existing problems and offer specific solutions to eliminate them.

In order to succeed it has been vital that the work is based on a thorough assessment and an extensive consultation with both political stakeholders and the sector. All the relevant actors in the sector should be brought together in a multi-disciplinary knowledge network.

Waterborne transports

In January 2006, the multi-annual European Action Programme for Inland Waterway Transport, NAIDES, which aims at promoting inland waterway transport in Europe, was launched. The programme includes recommendations for actions to be taken between 2006 and 2013 by the European Community, its Member States and other parties concerned. NAIADES sets the frame for a comprehensive IWT policy by focusing on five strategic interdependent areas: Markets, Fleet, Jobs & Skills, Image, and Infrastructure. These key areas are rounded off by considerations for modernising the organisational structure of the

IWT sector. Such modernisation is deemed necessary to assist the implementation of NAIADES. The main objective of PLATINA (Platform for the Implementation of NAIADES) is to support the implementation of the NAIADES by:

- Providing technical, organisational and financial support for targeted policy actions
- Building on strong interrelations with existing expert groups, projects and initiatives.

The *Directive 2009/30/EC* concerns the specification of petrol, diesel and gas-oil, the introduction of a mechanism to monitor and reduce greenhouse gas emissions as well as the specification of fuel used by inland waterway vessels. From January 1st, 2011, the maximum permissible sulphur content of gas oils and other liquid fuels to be used for inland waterway vessels shall not exceed 10 mg/kg. This decision, which is part of EU efforts to green the economy is a major breakthrough, and will have a major impact on the promotion of inland waterway transport which has always been advocating its green image. Clean fuel will enable a smooth switch to new-generation, energy-efficient engines which will save even more CO₂. Furthermore, clean fuel will allow the installation of emission reduction devices cutting harmful NO_x and PM emissions by 85-95%, further reducing the impact of inland waterway vessels on air quality.

The *Directive 2006/87/EC*, Technical requirements for inland waterway vessels, is intended to promote European river transport by improving the technical harmonisation of vessels. It is designed to lay down a high level of safety equivalent to that for shipping on the Rhine. To achieve this, it provides for the introduction of a Community certificate for inland waterway vessels in each Member State, to be issued by the competent authorities, authorising them to operate on Community waterways including the Rhine.

The Central Commission for the Navigation of the Rhine (CCNR) adopted the emission regulations of Stage I in spring 2000, and one year later the basic outlines for a revision of the existing regulations with much stricter emission limits to be introduced within 6 up to 8 years as Stage II regulations. The Stage I regulations were in force for all diesel engines to be installed in inland waterway vessels operating on the Rhine since 2003. The Stage II regulations entered into force as from July 1st, 2007.

The IMO approach to cut down sulphur emissions in dedicated areas by close to 99% is an important step towards cleaner shipping. However, it needs to be backed by incentives for modal shifts to seaborne transports and/or an additional MAUT for avoiding sea-routes. Basically, whenever a seaborne route cuts down a transport by more than 100%, a certain incentive/restriction to shift to truck shall apply. It is again the willingness of shippers to go for sustainable transports. The cost impact hereby needs to be bearable.

Rail

The EU railway freight policy benefits from the revitalisation of railways policy as stated at the 2001 White Paper. The pillars behind this policy are termed the 'three railway packages' that comprise a number of Directives Packages. The first package launched on 15 March 2003 the Trans-European Rail Freight Network (TERFN) based on the provision of the Railway Directive 91/440/EEC of 1991, permitting open access for national rail services across EU. The second package, adopted on 23 January 2002 consists of measures to revitalise the railways by building an integrated European railway area, in particular by opening up more quickly the international rail-freight market, by proposing a new directive on railway safety and the establishment of a European Railway Agency. The third package

adopted on 3 March 2004, proposes the introduction of a certification system for locomotive drivers.

Despite the progress made by the subsequent railway packages and directives since the launch of the first railway packages, it was reported that the implementation of the prescriptive approach has not been followed by many EU countries (EC, 2010). The EC sent formal notices to 24 EU member states on 26 June 2008 regarding their failure to properly implement the First Railway Package legislation. The EC contents that ‘The creation of an integrated railway market is a key factor in boosting its efficiency and competitiveness, as well as a further step in ensuring sustainable mobility in Europe’.

European Rail Freight Association (ERFA) noted the extent of failure of the first railway package uptake by the EU member states that includes obstacles such as (New Europe, 2010):

- Infrastructure managers are discriminating against new entrants in terms of slots, resources, information and service provision;
- Requests to use certain infrastructure sections are not answered or prohibited;
- Energy supply conditions are not transparent and not liberalised;
- Shunting services are priced excessively by the incumbent monopoly supplier;
- Independent service providers are prevented from entering certain market sections;
- Safety certifications are awarded for limited infrastructure sections only;
- Access to terminals is refused or priced in a prohibitive way;
- Infrastructure sections are closed or dismantled at short or without prior notice;
- Complaints of competitors are not treated by regulatory authorities;
- The return of wagons to workshops is priced excessively;
- State railways are protected against bankruptcy by law;
- Discrimination and non-transparent access conditions are imposed on workshops and terminals for their connection to the national state railway only;
- Subsidies are given to the national state railway only;
- Incumbents act de facto as legislator, regulator and operator;
- Freight facilities and services are transferred to the national incumbent.

The above list indicates that rail freight issues are political rather than technical. The following paragraph links to the SuperGreen corridors that also exhibited some of the problems mentioned above.

From the Brenner corridor evidence it was documented that the change of traction and signalling systems at the borders between European railway networks is causing delays and thus reduces effectiveness. At these places (countries’ borders), traction locomotives and drivers have to be changed, resulting in longer train stops. While the multi current and multi signalling locomotives (and sometimes the European Train Control System - ETCS) are applied to overcome the technical problem, shift of personnel at borders still remains a barrier to effectiveness of rail operation. The rail freight cross border operation issue is also echoed in Seidelmann (2010) that reported problems with rail operation including:

- lack of infrastructure manager’s independence from railway operators;
- insufficient implementation of the directive’s rules on track access charging (such as absence of a performance regime to improve the performance of the railway network and lack of infrastructure manager’s incentives to reduce costs and charges);
- failure to set up independent regulatory body with strong powers to remedy competition problems in the railway sector;

- exemption of foreign road freight driver to cross international border as opposed to the train driver.

Cloverleaf corridor evidence shows that there is a downturn of the rail freight volume within the Eurotunnel connecting UK and Europe mainland despite the forecasted increase of rail freight volume within the London – Midlands – Liverpool – Glasgow network by 2030. However, a new strategy to stimulate the rail freight operation through Channel Tunnel was proposed by Eurotunnel Group in 2007 (Walker and Crossland, 2011). The proposed strategy covers 3 issues namely: a development of free access for all goods train operators; dealing effectively with border restrictions; and a simplified and competitive pricing policy.

It was reported that there is an issue of complexity of setting up cross border rail transport in Europe despite the successive reorganisation of operating structures for cross-Channel freight in the UK. There is also a lack of competitiveness of rail versus road transport (due in particular to the fixed cost of border infrastructures) and moreover financial difficulties of rail freight in France.

Europorte Channel (EPCH) noted that there is an alarming decline in freight across Europe but envisaged that extended training of drivers, developed routes with EP France, ET acquisition of GBRf, the setting up of a European container network by Deutsche Bahn as announced recently and the development of its own European network by SNCF are some of the indicators of improvement.

Road

The legal framework needs to be provided for coordination of private LSPs' operations, especially with reference to European Antitrust law. A respective regulation shall have the following implications and targets:

- A legally safe corridor for joint transport coordination and consolidation approaches and negotiations of the transport provider industry;
- Incentives for joint efforts to comply with sustainability KPIs: less emissions, less social impacts, reduction of transports (miles), validated by an independent third party.
- Green label: An, esp. applicable for image purposes, incentive could be the development of a green label which indicates "sustainable consolidation".
- City logistics may be backed by communal law on restrictions of transports into/from the inner city area and by incentives for partners in a city logistics program.
- Preference routing regulations: There could be a kind of "inverse" MAUT system for using "Green Corridors" for consolidated truck shipments. Trucks with more than 80% loads (axle weight) on a round trip (i.e. both directions within a corridor) may receive credit points. Such credit points could be balanced against MAUT fees or other comparable taxes.

Such regulations are only reasonable on a European framework which is carried out by all countries, at least the countries which are part (transit) of the selected corridors. Also, the transport industry needs to identify them as a win-win approach and not as an impediment for their business.

Intermodal

UIRR reported that EU transport policy supports intermodal transport although from the 40 years observation of road-rail combined transport in Europe one can conclude that the

winner in goods transport is road freight that meets the logistical requirements of speed, flexibility and reliability (delivery on time) for most high-value goods (Seidelmann, 2010).

Business economists in the field of transport have estimated that the minimum distance required for combined road-rail-road traffic to be economically viable – depending on circumstances – is 300 to 450 km (Seidelmann, 2010). The greater the distance, the more profitable is combined transport. In Europe however, route distances of over 450 km are mostly only achievable in international traffic.

Best practices / Policies, legislation and regulations

1. NAIADES and PLATINA – The action programme NAIADES is the most important common basis for a comprehensive inland waterway transport policy on European level. The Platform for the Implementation of NAIADES brings together a large number of most relevant actors in the European Union.

2. Directive 2009/30 EC – Limits the maximum sulphur content of fuels to be used in IWT to 10mg/kg, is the basis for a significant reduction of SOX emissions as well as the application of highly effective emission reduction technologies, e.g. particulate matter filters, demanding low sulphur fuel.

3. Revitalization of railways policy through railway packages – Towards the launch of the 4th railway package so far.

4. Penalty to countries that breach the EC railway Directives.

5. Channel Tunnel rail freight investigation - Increase usage rate of capacity (less than 10%).

6. Antitrust exemption for LSPs on network consolidation – Provides the basis for joint efforts of the logistics industry.

7. Incentives for using green corridors in a “best practice” way (“label”, “inverse MAUT” etc.) – Would model and operate green corridors in an intended way.

7.3 Infrastructure

Transport volumes are expected to grow in the future. More traffic is expected to move from road to rail, inland waterways and sea. This will mean the growth of combined transports as well. For combined transport to grow, infrastructure must grow accordingly. So far intermodal transport has consistently grown: international container traffic has streamlined, improved and reduced costs in the global goods trade at such an extent that world trade has grown dramatically. The past 12 years have seen annual growth of 3-4% in the global social product; 6-10% in international trade; and 9-10% in container traffic (Seidelmann, 2010). It is forecasted, despite the economic crisis in 2009, that, intermodal road-rail transport volume will reach 206 million tonnes by 2015 and 258 million by 2018. The reliability of these optimistic forecasts has already been seen in early 2010: the economic recovery, in comparison to the previous year, was so unexpected that some railway companies simply did not have sufficient wagons to meet increasing demand (Seidelmann, 2010).

The rail freight volume along the Brenner corridor is forecasted to increase by 78% in year 2030 against the baseline scenario of year 2008 (Petersen M.S et al., 2009). Electrification of some of the corridors including link between Nurnberg and Cheb are anticipated. In

addition, along Cloverleaf corridor, the rail freight volume is expected to double in year 2030 against the 2007 baseline (MDS Transmodal, 2009). Rail electrification is evident in the UK rail profile with 33% of all the rail network being electrified, albeit no development of this sort is programmed for the rail links of Cloverleaf. But the adoption of such approach would significantly improve the environmental performance and thus should be projected for the future.

There are also some restrictions in the inland waterways, which hinder the use of their full potential. Currently, the free-flowing section of the Danube between Vienna and the Austrian-Slovak border is a major bottleneck for inland navigation because of insufficient fairway depths and strongly varying fairway conditions. At the same time the continued deepening of the river bed (erosion) has a sustainable negative impact on the ecological balance of the Danube Floodplain National Park. In order to tackle these unfavourable conditions the “*Integrated River Engineering Project on the Danube East of Vienna*” was launched in 2002. The project aims at improving fairway conditions on the Danube section east of Vienna whilst at the same time taking into account the ecological requirements of the Danube Floodplain National Park.

The International Commission for the Protection of the Danube River (ICPDR) has linked up in 2007 with the Danube Navigation Commission, and the International Commission for the Protection of the Sava River Basin to initiate an intense, cross-sectorial discussion process, which led to a “*Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin*”. The “Joint Statement” provides a guiding document for the maintenance of the current inland waterways, as well as for future infrastructure projects.

Related to short and deep sea shipping one basic infrastructure backing the sulphur emission control regulation shall be the availability of port electricity (“cold ironing”). Such electricity is hardly available in European ports. Also, many ports (Germany, Eastern Europe) are fed by a public electricity mix which is primarily based on fossil energy. Here off-shore wind power platforms may serve to provide renewable electricity. As they are usually quite close to ports, the electricity could be transported by underground cables. This measure would back in turn the EU targeted increase of the renewable energy share of public electricity mix in European countries. Port authorities and terminal operators need to work closely hand in hand with renewable energy providers and ocean vessel carriers. Regulatory incentives may back such an approach.

For road transports one of the key infrastructure measures is the extension of road capacities along the Green Corridors for especially 25,25 metres truck (the so-called Euro combi). This also implies the removal of major bottlenecks, especially at key tunnels (Eurotunnel and Brenner). It should be evaluated which sections of the corridors could have an additional dedicated truck lane for the Euro combi. This would also add to security and safety KPIs as well as lead times. One of the key success factors of such an approach is the conceptual integration of such infrastructure improvement. Without a supported coordination/consolidation platform with regulatory backing such improvement may have the adverse effect of shifting load back from rail to road.

The *Green Motorway project*, the construction work of the E18 motorway from Helsinki, Finland towards east, is on-going in the Edelweiss corridor. It is a development project with green prospects and with many ways of developing environmentally friendly traffic and transport infrastructure. The project acts as a pilot and the aim is that in the future the

concept could be internationally applicable. The project is done by the government and municipalities in cooperation with enterprises such as Fortum, Neste Oil, Ensto, St1 and Falck. (Finnish Transport Agency 2011, Green Motorway 2011)

The planning of the motorway has taken account of conservation of the environment, the possibilities offered by ecological building and development of the use of new forms of energy for traffic. The project is promoting the development and introduction of renewable forms of energy in traffic and road maintenance (construction of soil and solar energy using road and other transport structures, services for electric vehicles etc.). Efforts will be made to ensure that the E18 will constitute a test bed and showcase for renewable forms of energy, new bio-fuels and electric motoring. Disturbances caused by the motorway and its traffic have been greatly mitigated by the extensive use of noise control, groundwater protection, tunnels and many bridges for plants and animals. Road aesthetics will be emphasised in bridge columns, noise barriers, lighting and landmarks all along the route. Ecological construction will be favoured in its creation. The aim is to make use of local resources such as wood and rock to build the road. (Finnish Transport Agency 2011, Green Motorway 2011)

Best practices / Infrastructure

1. *Electrification of all rail network.*
2. *River Engineering Project on the Danube East of Vienna – The integrated approach creates a genuine win-win situation between inland navigation and the environment thereby aligning navigational and ecological interests.*
3. *The Joint Statement - The different interests of the various stakeholders are taken into account with respect to the maintenance of current waterways and future infrastructure projects.*
4. *Port electricity (cold ironing) facilities in ports, fed by renewable energy – Alternative of low sulphur fuel limitations which helps to prevent shifting back from sea to road.*
5. *Extension of road capacities along the Green Corridors for Euro combi trucks (esp. 25,25 m trucks).*
6. *Green Motorway Concept.*

7.4 ICT and transportation technology

Key success factors in implementing new ICT systems and technologies are user-friendliness and possibility to tailor services according to individual needs. The key users play a major part in this regard. Feedback from key users will provide valuable input and will help in getting wider acceptance. Cost is naturally one of the main issues. Usage free of charge will make the systems even more attractive. Easy application in other regions and consolidation of up-to-date data across all regional boundaries are important as well. The key system components and services should be based on the standards of the European Union and other relevant organisations. This way it is ensured that the systems are compliant with European regulations. When planning and implementing new technology solutions, it is important to have good cooperation between partners from different sectors and the willingness of partners to support the project with own funding. Compliance with strictest emission regulations should be taken into consideration in order to ensure that the new technology will lead to greener transportation.

For short and deep sea shipping the necessary technology is available. The operational basis, Europe-wide, is the challenge. Especially for the smart container concept, an IT platform of tracking and tracing container loads shall be run by a third party or a joint initiative of ocean vessel and ship carriers. Such platforms are already available on company level. However, the applicability to a large scale of containers which in turn is not partisan to a certain carrier would enable a much higher efficiency and sustainability of such technology as it is (and must be) based on container turnarounds. A success factor is the demand of the shippers for a kind of medium value mode of transport. In addition, carriers need to experience cost (earnings) advantages by investing in sensors to their containers. A “public” platform in turn could reduce the costs by the number of users via a licensed application.

Examples of SuperGreen corridor specific improvement areas can be found from the Brenner rail corridor which is characterised with an important high capacity Western European north-south railway axis that crosses 3 border countries: Germany, Austria and Italy. Introduction of cross-border interoperability systems are envisaged to improve the existing system. Cloverleaf rail corridor is characterised with HS1 connecting Europe mainland and the UK. The introduction of international time schedule would be of benefit. Pathfinder ICT system helps to facilitate and speed up the communication about international time schedules between the Railway Infrastructure Companies in Europe (Zacharioudakis et al., 2011).

European Rail Traffic Management System (ERMTS) is a major European project partnership between the railway stakeholders industry, EU and Global System for Mobile Communications by Rail (GSM-R) industry. ERTMS aims to overcome a multitude of different railway operation styles, train control and signalling system within European Railway network. (Zacharioudakis et al., 2011) While the implementation of ERMTS has been reported with positive and negative reactions from rail stakeholders (Brigginshaw, 2010), it is in the EU interest to ensure safe rail traffic as well as solving interoperability problems of Inter-European rail traffic. The European Train Control System (ETCS) component of ERMTS (of the two – the other system is GSM-R, a radio system providing voice and data communication between the track and the train), is able to estimate all relevant parameters to optimise the operation including maximum speed, speed profile of the line, speed reductions at interlocking and temporary speed restrictions when in full supervision mode. This in turn promotes the superiority of rail performance over any other modes.

The FMS standard initiative of major truck manufacturing companies can be referred as a best practice approach for data transparency. Daimler, MAN, Scania, Volvo, DAF, Iveco and Renault partnered in an initiative to share and make transparent truck operation related data which contain all the key parameters for truck operation supervision and respective KPIs relevant for sustainability (speed, fuel consumption, idle time etc.).

In addition, there shall be a common platform for freight exchange, especially for the daily spot market. Such platform could be enabled and provided by a third party: Every free space along the corridors in a truck shall be notified to such platform and the platform supervision shall match current loading demands with such available space notifications. The IT is already fully available on company-level. It should be available on a supra-level throughout Europe. Success factors are the regulatory framework to extend private industry initiatives to the whole transport sectors and basically all stakeholders in it.

The IRIS (Implementation of River Information Services) Europe initiative focuses on the coordinated implementation of RIS in Europe. The main objective of starting and proceeding with the harmonised implementation of RIS on European level is to enhance safety, efficiency, environmental-friendliness and thus the attractiveness of inland navigation beyond individual country borders. IRIS Europe I addressed the elimination of existing bottlenecks in intelligent infrastructure on European waterways and defined additional functionality for River Information Services in the Danube and Rhine-Seine regions. Innovative River Information Services such as traffic and transport information exchange, hull data exchange and calamity abatement were validated by means of interconnected pilot installations. Its successor, the IRIS Europe II project focuses on further enhancement and fine-tuning of RIS key technologies, services and applications. Key success factors include the broad cooperation at European level on further development of River Information Services.

In co-operation with Austria's Supreme Navigation Authority, via Donau in 2002 elaborated a RIS concept, realized by an Austrian system supplier. Donau River Information Services (DoRIS) offer both an information system based on AIS (Automatic Identification System) technology, as well as services for inland navigation which can be accessed via the DoRIS website (www.doris.bmvit.gv.at). In order to increase the acceptance for DoRIS, all vessels sailing on the Austrian Danube should be able to use the traffic information system. For this purpose, via Donau and the Federal Ministry for Transport, Innovation and Technology worked together on a special programme to make sure that a large percentage of vessels sailing on the Austrian Danube were equipped with Inland AIS Transponders. This regulation ensures that all vessels are aware of the traffic situation and that the vessel data is covered within the DoRIS system. Based on these data further services to increase traffic safety and efficiency of transport are offered.

ELWIS-Notices to Skippers: The German Waterways and Shipping Administration (WSV, Wasserstraßenverwaltung) has a very extensive website - Electronic Waterway Information System (www.elwis.de) where different types of services are being offered, inter alia the "Notices to Skippers". The information, provided free of charge, contains fairway and traffic related messages, water level related messages with a 4 days forecast for the river Rhine and messages about the ice-situation. The WSV has designed an inventory for the harmonised description of all available mooring facilities across all national waterways, which is part of the 'Notices to Skippers'. The inventory aims at providing a full coverage of all waterways. A new information tool on current ice-developments on national waterways is provided: With an easy to use search machine an exact status of ice development on specific waterway stretches can be obtained online.

According to UIRR, efficient combined transport requires excellent organisation. Intermodal loading units, a transshipment system, road and rail vehicles – are all not simply a matter of being compatible (which is ensured through standardisation). The organisation of service schedules and capacity must also be linked. UIRR (as reported by Seidelmann, 2010) reported that intermodal transport, despite still using paper documents carrying important information, has promoted digitalisation of transport data. Internet is the common way for bookings in intermodal transport.

For a complex transport chain, intermodal operators have set up a joint transport monitoring and information system together with UIRR, which has been operating under the name CESAR. It monitors all the important transport corridors on the north-south

European axis and processes data for each individual shipment, starting with booking and ending with delivery of the loading unit at the destination terminal (Seidelmann, 2010). As soon as a customer of one of the member companies of this data network books a place on a train, a data folder is created for the journey. All future events (such as the arrival of the loading onto the intermodal train, arrival at the destination terminal of the intermodal train carrying unit etc.) are reported in the CESAR system by the responsible terminal operator and saved in the same folder. The ordering party can access this data network directly and see all the information in real time either via the booking reference number or the unique number of the loading unit. Many intermodal customers – primarily European hauliers – have set up a direct electronic data exchange between the CESAR system and their in-house information systems (ibid).

Since the CESAR network was established almost 500 customers have joined and 2/3 of all intermodal journeys on the European network are now saved and monitored in this information system. Every working day the CESAR system issue more than 55,000 reports on the status of the loading units currently being carried by the European intermodal operators connected to the system.

The e-Freight project aims at supporting strengthening of the internal market and competitiveness, improving regulation to create a more dynamic business environment and promoting sustainable development. The project will contribute to the goals of the Freight transport Logistics Action Plan and ITS Action Plan pertaining to the development of:

- A standard framework for freight information exchange covering all transport modes – the project will support development of open e-market places.
- A European Single Transport Document for carriage of goods with all the necessary legislative support, irrespective of mode – the project will investigate solutions that can be generated in the transport planning process and communicated to all involved parties.
- A Single Window (single access point) for administrative procedures in all modes - the project will be involved in development of Single Window in integration with SafeSeaNet (SSN) and e-Customs to support cooperation between administrations in security, safety and environmental risk management.
- Simple, harmonised border crossings for all modes of transport for EU member states.
- Simple procedures and the necessary infrastructure for establishing secure and efficient transport corridors between Europe, USA, and Asia – the project will provide transport chain management solutions assisting transport stakeholders to establish common end-to-end transportation processes incorporating regulations compliance and ‘intelligent’ monitoring and control.

To overcome the challenges brought up by the ice situation during the winter along the Baltic Sea and the fact that the area is highly sensible and transport volumes are growing fast there are several ICT systems in place to guide the traffic: Mandatory Ship Reporting System (GOFREP), Vessel traffic service (VTS), Automatic Identification System (AIS), Vessel Traffic Management and Information Systems (VTMIS).

The Cleanest Ship, part of the Sixth Framework Programme CREATING that focused on emissions, applied the following solutions to improve the environmental performance of inland navigation: an advisory cruise control, low sulphur fuel, selective catalytic reduction and a particulate matter filter. The project was carried out on the motor tank vessel ‘Victoria’, owned by BP and managed by “Verenigde Tankrederij” (VT).

The JOWI is an inland container ship which due to its new design revolutionised IWT in the Netherlands. Its size is nearly 400 TEU, and its first voyage took place in 1998. Shortly after 1998 a similar ship was put in place, the Amistade. The JOWI enabled the transport of large volumes of containers at competitive prices from Dutch seaports into the hinterland. Nowadays there are more similar ships sailing.

EPCH projected Channel tunnel growth through introduction of Lorries on Rail (Walker and Crosslands, 2011); the piggyback technique of putting a truck (or its trailer) directly onto a train, with or without its driver. The rolling road is a variant to rail road - the system is based on wagons with small wheels of 36 cm in diameter and was developed in Austria and Switzerland. EPCH envisages providing rolling road terminal in Frethun where HS1 offers potential for through tunnel rolling road to UK.

In Europe, the network of high speed lines, which was extended by a further 1,100 kilometres between 2006 and 2008, offers a sound alternative for rapid shipment of goods. Several major public and private companies in this business have teamed up with this in mind and founded CAREX (Cargo Rail Express) association where Eurotunnel also joined in in 2007. This will involve creating a network of services devoted to carrying airline-standard containers on-board trains running at 300 kph by 2014-2015 (Walker and Crosslands, 2011).

UK rail freight vehicles comprise of Class 66 locomotives that cover 80% of the 600 freight locomotives (AECOM, 2011). It represents 80% of the diesel locomotive market on the UK rail network's 21,000 miles and runs about 100,000 miles a year. For comparison, SuperGreen's Cloverleaf corridor that connects Duisburg to Glasgow with link to Dublin at Liverpool only represents about 790 miles of the segment. Electro Motive Diesel (EMD) are the manufacturer of the class 66 locomotive; there have been various modifications made to the Class 66 in operation across Europe including France, Scandinavia and Spain (Ibid).

The recent UK emissions benchmarking study on rail freight (AECOM, 2011) reported that EMD, the Class 66 locomotives manufacturer, have recommended the use of several operational interventions that can be undertaken to improve efficiency and reduce emissions. These include anti-idling promotion, use of telematics to ascertain fuel consumption, accurate planning and driver training (Ibid).

Consultation with Freight operating companies concluded that technical innovations such as the adoption of Class 70 Powerful locomotives that are capable of pulling 30 wagons as opposed to the current capacity of 24 wagons under the Class 66 is envisaged (AECOM, 2011). Moreover, the implementation of 'Notch 8' modification to Classes 66, 67 and 60 resulting in Reduced Fuel consumption and Noise with no adverse impact on journey time (Ibid).

The following truck units shall be further developed and implemented:

- Euro combi, 25,25 m. The weight capacity (axles) could be confined to 26 tons to encourage consolidation of volume weight and not to shift back load from rail to road. Also, weight restriction has a safety/security implication.
- Alternative engines: hybrids (for distribution transports outside the inner city) and electrical small trucks (for city logistics) shall be further developed.

Such measures would combine several technical innovations for all key truck operations (long haul, collection/distribution of heavy load, city logistics/small load). For the Euro

combi there need to be a public acceptance and respective infrastructure is imperative to avoid safety issues. For the implementation of electrical cars, renewable energy sources need to be provided, especially in those countries with a fossil based power mix.

In short and deep sea shipping all state-of the art technology (propulsion, ship design, sustainable painting) shall be applied and promoted. In addition, GPS based sensors for container shipments shall be applied to a larger scale and therefore the respective IT middleware (servers) shall be extended and made available to carriers and shippers alike. As far as de-rated engines are considered (with reference to the EEDI), such measures shall apply only for vessels operated in corridors with rather stable weather conditions (i.e., not the Cape) and secure routes (i.e., not the Horn of Africa route). It is again the joint effort of the transport industry and all stakeholders to provide a framework for optimal use of such technologies.

Best practices / ICT and transportation technology

- 1. Sensor evaluation platform for “smart containers” – To make ocean shipping more transparent and open for semi-valuable goods.*
- 2. Pathfinder ICT system – To facilitate and speed up communication about international time schedules between the railway infrastructure companies in Europe.*
- 3. Introduction of cross-border interoperability systems / ERTMS-European Railway Traffic Management Systems.*
- 4. Share of FMS data by a common platform – All road ICT devices/operations should have access to dynamic data.*
- 5. Freight exchange platform – Provides the basis for network consolidation, especially on the daily spot market.*
- 6. Implementation of River Information Services in Europe – The IRIS Europe initiative constitutes the basis for a coordinated implementation of River Information Services and application of ICT in inland waterway transport on European level.*
- 7. Donau River Information Services – It constitutes the world’s first comprehensive operational RIS implementation compliant with European regulations.*
- 8. CESAR on intermodal transport European network.*
- 9. e-Freight - links the modes and facilitates logistics to ensure seamless flow of goods regardless of transport mode*
- 10. Cleanest Ship –IWT vessels improve environmental performance significantly by implementation of highly effective emission reduction technologies not commonly used yet.*
- 11. Large IWT vessels JOWI and Amistade – Benefiting economically and environmentally from their scale and creating the basis for further ultra-large vessels in IWT (L = 135 m).*
- 12. Benchmarking rail freight locomotive (through technical innovations, anti-idling actions, driver behavior change, fuel monitoring and operational improvements) – towards low carbon rail freight operation*
- 13. Electrical cars for city logistics – Provides clean cities.*
- 14. Alternative fuels/energy supply for sea – Complies with new IMO rules and prevent backshift to truck/road.*

8 Summary and Conclusions

The complete work package, Benchmarking Green Corridors, involves a set of tasks from Task 2.1 to 2.5 that form a systematic approach for the evaluation, and development of the green corridor concept. The aim of Task 2.5 was to make a summary of all previous tasks in the Work Package 2 and by that conclude this work package.

Nine corridors were selected for studying and a set of KPIs was defined, the effects of changes in operational and regulatory framework were estimated and the benchmarking exercise in six corridors was performed on the basis of the six most important KPIs: CO₂, SO_x, Relative Transport Costs, Transport Time, Frequency and Reliability.

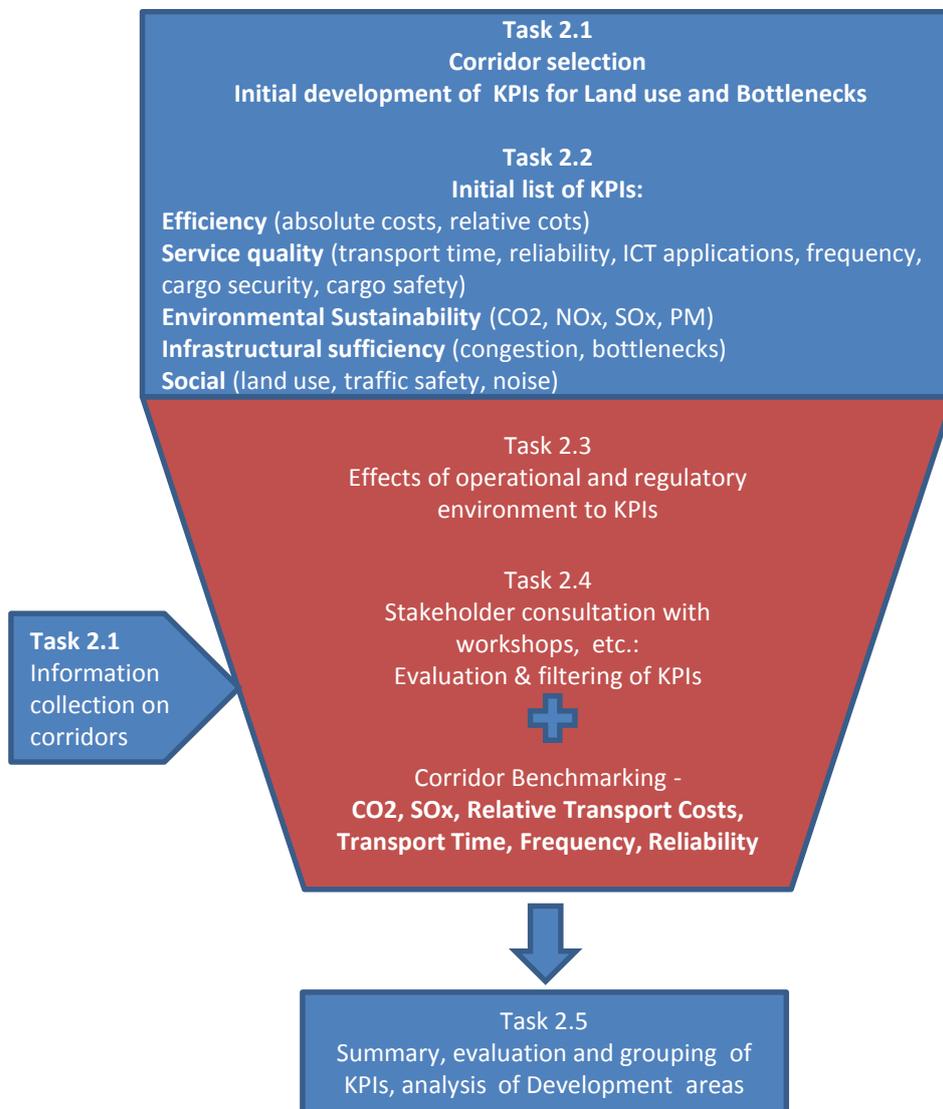


Figure 27 KPI evaluation and grouping in Work Package 2

Figure 27 presents the way KPIs have been evaluated and analysed on the course of Work Package 2 starting from Task 2.1. Information related to the KPIs was collected during all

tasks. The official initial list of KPI was formed in Task 2.2. The corridor selection of Task 2.1 was the basis for the benchmarking exercise in Task 2.4.

Based on the feedback received from a large group of stakeholders, emphasis in the future KPI development should be placed on the environmental aspects and the acceptable limits for KPI values indicating the greening rate of corridors. The issue of infrastructure KPIs has been viewed in this deliverable mainly in terms of “bottlenecks” associated with each corridor, that being one of the dimensions of the “infrastructural sufficiency KPI”. This issue will also receive appropriate consideration in the context of other work packages. It was also proposed that in the implementation phase of green corridors there should be commonly defined indicators for each target group. The time dimension of the KPIs should be taken into consideration in order to make the reasonable comparison of the values over time. Thus KPIs should be valued between certain time intervals.

However calculation of these kinds of KPIs would need reliable and harmonised (statistical) data (e.g. transport volumes per mode, type of goods transported etc.). Excessive data is necessary for a reliable performance assessment not only at a corridor but even at a transport chain level. At the moment this kind of common data is not available nor is widely accepted tools to make a proper benchmarking exercise. Collecting information by interviews or questionnaires is time consuming and the results cannot easily be compared over time. The existence of the necessary information and coherent data would make it easier to develop KPIs for assessing the greening rate of corridors. Ensuring availability of transport data is the first step in developing more confident indicators capable also of measuring corridor development over time.

A KPI based on statistical data on transports could be as an example the following: The share of SSS, IWT and rail transports on total transports along the corridor exhibiting together with existing infrastructure for different transport modes the potential for modal shift from road to water and rail transports.

One possibility for creating KPIs measuring the development over time is to establish corridor specific stakeholder group for each corridor (as an example “Brenner Group”) and then create common questionnaire for all corridor groups, which could be repeated as an example every second year. “Corridor groups” would be created for coordination of the development of environmental performance of transports and supply chains and for the development of data availability on transports. In establishing the corridor groups the data collected concerning different stakeholders during the SuperGreen -project could be used.

Although the KPIs selected during Tasks 2.2 and 2.4 were widely accepted by the stakeholders, there were some additional indicators that were suggested during the course of Work Package 2 for consideration in future projects. These suggestions are related to the following areas:

- Transport avoidance (this issue is related to supply chain design and management)
- Loading factor including return cargoes
- Degree of competition
- Transshipment time
- Interoperability / harmonization
- Customer satisfaction / customer service
- Capability of personnel / Logistics competence
- Accessibility of the network / ease of using intermodal transport

- Demand / market issues, territorial cohesion and European added value
- Use of existing country level indicators / data (for example the World Bank’s Logistics Performance Index, LPI, data on transport safety)

From the 3 rail corridors benchmarked in Task 2.4 (See Table 5), it is obvious that improvements towards sustainability are needed in each of the corridors for different purposes. The Brenner corridor, despite having quite high volume of freight and higher average top speed, shows very high variance of cost and reliability and deserves further investigation. The Cloverleaf corridor has reported a relatively high reliability within the corridor, but the reported average speed shows, that improvement can be made to the corridor to enhance the current performance. Similar evidence can be seen from Silk Way corridor, which demonstrates a relatively slow average speed of moving rail freight and deserves further investigation. In the intermodal corridors the big variance of emissions, costs, reliability and average speed are indicators that there are room for improvements towards optimising sustainability thresholds. High frequency of road transports on Cloverleaf may show rather high potential for modal shift from road to rail or sea.

These benchmarking results are in line with the results of the separate bottleneck survey carried out in Task 2.5. The benchmarking and the survey both indicate clearly similar bottlenecks and development areas. However the limited sample of information used in the benchmarking exercise does not allow making definitive conclusions. Only some indications of development needs can be seen.

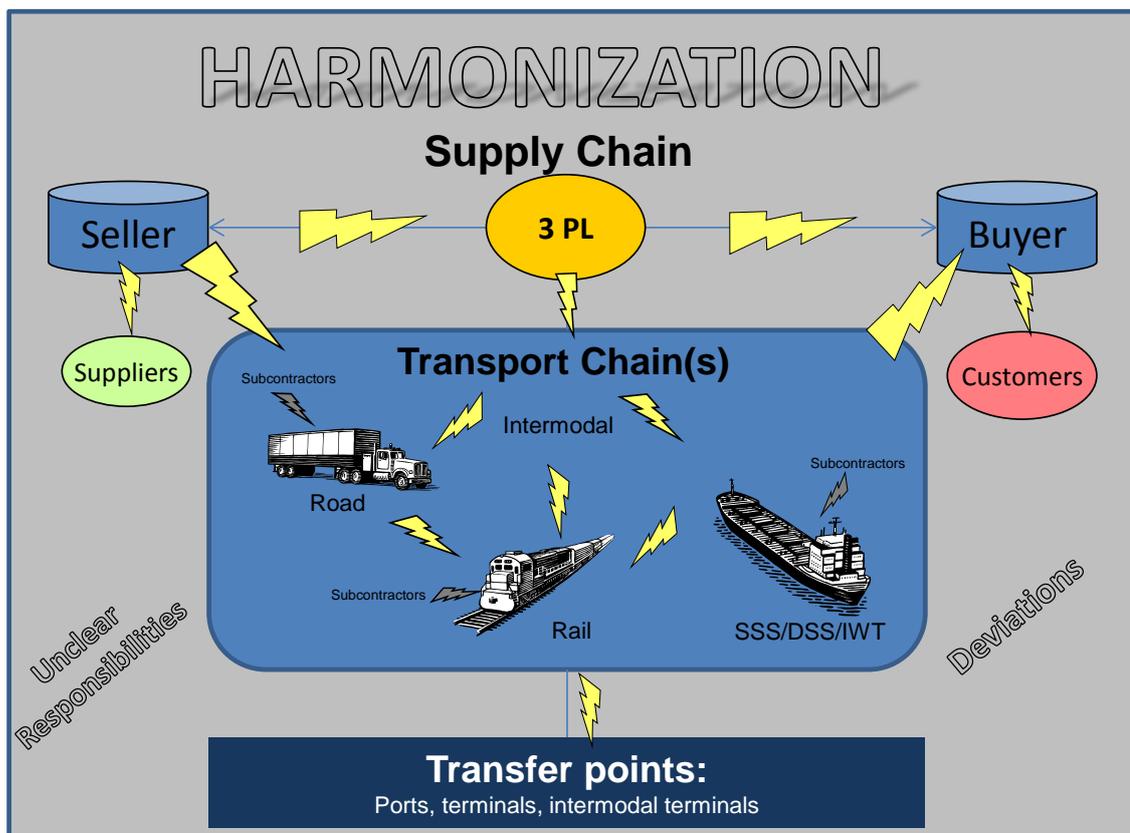


Figure 28 The need for harmonisation of ICT and regulations in Supply Chains.

Figure 28 describes the different actors within supply chain and the numerous spots where exchange of information takes places (indicated with yellow lightings) and where problems

may occur. As an example, deviations in transport chains generate problems in 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.

In the next page, Figure 29 summarizes the findings from the survey carried out during Task 2.5. The major common development areas and the best practices which facilitate the greening of transport corridors are presented. There are a lot of useful practices already developed. However many of these are not widely used because common desire and harmonisation is lacking. With improved co-operation and harmonisation in the supply chains the corridors would be greener.

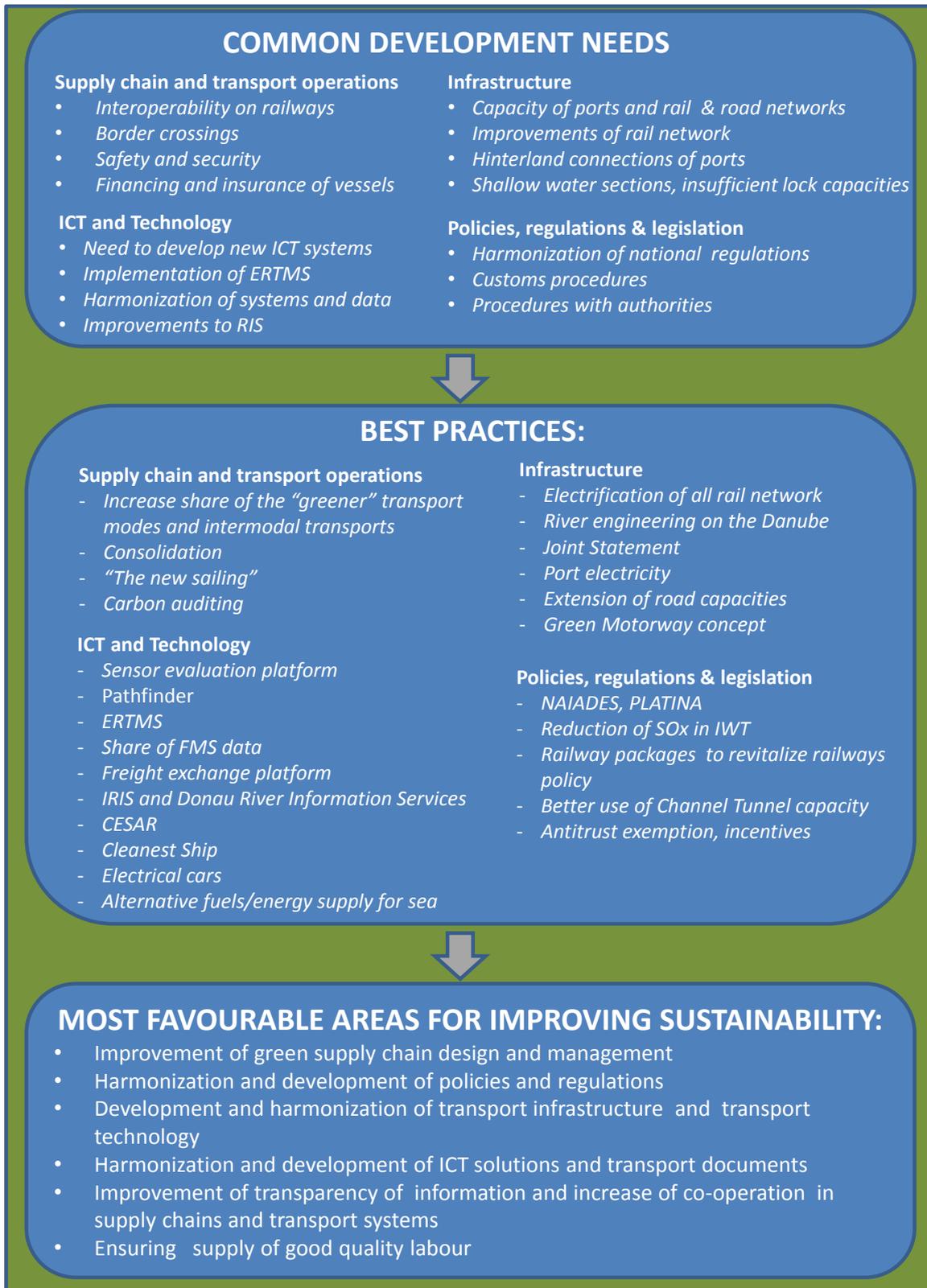


Figure 29 Most favourable areas for improving sustainability

This report concludes and finalises Work Package 2. It acts as a direct input for the other remaining work packages of the SuperGreen project.

References

- AECOM (2011) *Freight Best Practice – Emissions Benchmarking: Considering the Viability of Rail Freight Study*. March 2011 Department for Transport commissioned report. [WWW] <URL: http://www.freightbestpractice.org.uk/products/3705_7815_emissions-benchmarking--considering-the-viability-of-a-rail-freight-study.aspx> [Accessed: 27.6.2011]
- Baltic Sea Portal, [WWW] <URL: http://www.itameriportaali.fi/fi/fi_FI/etusivu/> [Accessed 23.3.2011]
- Berger (2008), *Draft of First Pool Master Plan for Romania*.
- Brigginshaw, D. (2010) IRJ summary of Signalling and Train Control 2010. *Global Transport Forum February 2010*. [WWW] <URL: <http://www.globaltransportforum.com/index.php/news/irj-summary-of-signalling-and-train-control-2010>> [Accessed 27.6.2011]
- CTR – Centre for Transport Research University of Aberdeen (2010) Transport technologies: state-of-the-art and future trends. *Presentation at the EPSRC ReVISION project (Regional Visions of Integrated Sustainable Infrastructure Optimised for Neighbourhoods) 1st Symposium* in London. April 2010. [WWW] <URL: <http://www.regionalvisions.ac.uk/ReVISIONS/download.aspx?p=16&resourceclassid=0&ix=4362>> [Accessed 12.5.2011]
- Department for Transport (2009) *Transport Statistics for Great Britain*. [WWW] <URL: <http://www.dft.gov.uk/pgr/statistics/datatablespublications/tsgb/>> [Accessed 12.5.2011]
- Department for Transport (2010) *Freight Modal Choice Study: Phase 1 Conclusions – Drawing Together Evidence Final Report*. Prepared by AECOM and ITS Leeds. [WWW] <URL: <http://www.dft.gov.uk/pgr/freight/freightmodalchoicestudy/pdf/mainreport.pdf>> [Accessed 12.5.2011]
- DfT (2008) *Choosing and developing a multi-modal solution*. Department for Transport (DfT). London.
- EC (2010) *IMPACT ASSESSMENT* Accompanying document to the Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a single European railway area (Recast). [WWW] <URL: http://ec.europa.eu/transport/rail/doc/impact_assessment_recast.pdf> [Accessed 12.5.2011]
- e-Freight (2011), [WWW] <URL: <http://www.efreightproject.eu/>> [Accessed 15.8.2011]
- EU Project PLATINA, *Strategic Research Agenda for Inland Waterway Transport*.
- European Commission (2009), DG TREN, *Progress Report 2009*, TEN–T Trans-European Transport Network, Implementation of the Priority Projects.

Finnish Transport Agency (2011), *European Road E18 conversion to motorway between Helsinki and Vaalimaa*, Centre for Economic Development, Transport and the Environment, Kaakkois-Suomi Region, Uusimaa Region, [WWW] <URL: <http://www.tiehallinto.fi/pls/wwwedit/docs/26350.PDF> > [Accessed 24.5.2011]

Green Motorway (2011), *LAUREA Vantaa Regional Unit Review*, [WWW] <URL: <http://www.laureavantaareview.com/index.php/region/51-region/205-the-green-motorway>> [Accessed 30.5.2011]

Harris, I. Rodriguez, V.S., Naim, M. and Mumford, C. (2010) Restructuring of logistics systems and supply chains in *Green Logistics – Improving the environmental sustainability of logistics*, 2010, eds.: A McKinnon, S. Cullinane, M. Browne and A. Whiteing. Page: 101-123. The Chartered Institute of Logistics and Transport (UK). Kogan Page.

Henttonen, M. (2007), *Venäjäntullin toiminta hyvän hallinnon periaatteiden valossa*, University of Tampere, Johtamistieteiden laitos, 2007

IEA – Irish Exporters Association (2009) Report on the 2nd European Short Sea Congress 30 June – 1 July 2009 Liverpool. [WWW] <URL: http://www.google.co.uk/url?sa=t&source=web&cd=9&ved=0CFIQFjAI&url=http%3A%2F%2Fwww.efreightproject.eu%2Fknowledge%2FDownloadFile.aspx%3FtableName%3DtblSubjectArticles%26field%3DPDF%2520Filename%26idField%3DsubjectArticleID%26id%3D140&rct=j&q=shortsea%20congress&ei=SBi4TbzFMsu4hAeExbiVDw&usg=AFQjCNFz-Cot7da6JPWNCpeZ9BDrZ_LTJQ > [Accessed 16.5.2011]

Ilves et al (2010). *Benchmarking of green corridors (Version 1)*. SuperGreen project Deliverable D2.4.1, Document number: 02-40-RD-2010-14-01-0.

Ilves et al (2010). *Benchmarking of green corridors*. SuperGreen project Deliverable D2.4.2, Document number: 02-40-RD-2011-14-02-0.

McKinnon, A. (2010) Environmental Sustainability A new priority for logistics managers in *Green Logistics – Improving the environmental sustainability of logistics*, 2010, eds.: A McKinnon, S. Cullinane, M. Browne and A. Whiteing. Page: 3-30. The Chartered Institute of Logistics and Transport (UK). Kogan Page.

IFW – International Freightling Weekly (2009) 28-09-2009. Cited from DfT, 2010.

MDS Transmodal (2007) *Update of UK Port Demand Forecasts to 2030 and Economic Transshipment study*. July 2007. [WWW] <URL: http://www.dft.gov.uk/pgr/shippingports/.../207015_Final_Report_2.pdf> [Accessed 20.4.2011]

MDS Transmodal (2009) Rail Freight Forecasts to 2030. Cited in DfT, 2010, *Freight Modal Choice Study: Phase 1 Conclusions – Drawing together evidence final report*, by AECOM and ITS Leeds.

Naiades (2011), [WWW] <URL: <http://www.naiades.info/good-practices/>> [Accessed 16 May 2011]

NEA (2008), Final Report for the “*Study on Administrative and Regulatory Barriers in the field of Inland Waterway Transport*” – Part A, produced for DG TREN.

Network Rail (2007) *Freight Utilisation Strategy*. [WWW] <URL: http://www.google.co.uk/url?sa=t&source=web&cd=2&ved=0CB8QFjAB&url=http%3A%2F%2Fwww.networkrail.co.uk%2Fbrowse%2520documents%2Frus%2520documents%2Froute%2520utilisation%2520strategies%2Ffreight%2Ffreight%2520rus.pdf&rct=j&q=Freight%20Utilisation%20Strategy&ei=Mx64TYjoMJGhQecydiMDw&usq=AFQjCNHzsMocJpox_kqp6ENsjpLgu1vpQ > [Accessed 20.4.2011]

New Europe (2010) *Rail Freight Liberalisation: A New Europe Policy Report*. Issue 868. 17 November 2010. [WWW] <URL: <http://www.neurope.eu/articles/Rail-Freight-Liberalisation-A-New-Europe-Policy-Report/103718.php>> [Accessed 20.4.2011]

Panagakos et al (2010) *Effects of changes in operational and regulatory environment*. SuperGreen project Deliverable D2.3, Document number: 02-30-RD-2011-01-01-3.

Piecyk, M. (2010) Carbon auditing of companies, supply chains and products in *Green Logistics – Improving the environmental sustainability of logistics*, 2010, eds.: A McKinnon, S. Cullinane, M. Browne and A. Whiteing. Page: 49-67. The Chartered Institute of Logistics and Transport (UK). Kogan Page.

Posti, A., Ruutikainen, P., Haapakangas, E-L., Tapaninen, U. (2009), *Tralia – Transitoliikenteen lisäarvopalvelut*, Publications from the Centre for Maritime Studies University of Turku, B164, ISBN 978-951-29-3896-4, 2009

Planco Consulting (2007) *Economical and Ecological Comparison of Transport Modes: Road, Railways, Inland Waterways* – Summary of Findings.

Puebla et al (2011). *Analysis of regulatory framework*. SuperGreen project Draft Deliverable D6.1, Document number: 06-61-RD-2010-05-01-0.

Pålsson et al (2010). *Definition of benchmark indicators and methodology*. SuperGreen project Draft Deliverable D2.2, Document number: 02-22-RD-2010-16-01-4

Ricardo (2010) *Review of Low Carbon Technologies for Heavy Goods Vehicles*. Prepared for Department for Transport. March 2010. [WWW] <URL: <http://www.dft.gov.uk/pgr/freight/lowcarbontechnologies/lowcarbon.pdf> > [Accessed 16.5.2011]

Saarinen, J. Venäjälle tuleva jätöisatama lisää öljyturman riskiä Suomenlahdella. *Helsingin Sanomat*, [WWW] <URL: <http://www.hs.fi/kotimaa/artikkeli/Ven%C3%A4j%C3%A4lle+tuleva+j%C3%A4ttisatama+lis%C3%A4%C3%A4+%C3%B6ljyturman+riski%C3%A4+Suomenlahdella/1135239956728>> [Accessed 12 April 2011]

Salanne et al (2010). *Selection of Corridors*. SuperGreen project Deliverable D2.1, Document number: 02-21-RD-2010-03-01-5.

Sea and Water (2008) *A vision Towards UK Freight Trends Towards 2018 and Beyond*. [WWW] <URL: <http://ria.org.ro/ria/file/VisionForUkFreight.pdf>> [Accessed 16.5.2011]

Seidelmann, C. (2010) *40 years of road-rail combined transport in Europe – from piggyback traffic to the intermodal transport system*. International Union of combined road-rail transport companies UIRR srl. Brussels.

Sulphur Siege (2011). *Nordicum –Scandinavian Business Magazine*, 2/2011, p. 22-25.

SuperGreen D24 (2011) Supporting document to the Deliverable 2.4: Summary of Benchmarking Results for Cloverleaf Corridor. NewRail – Centre for Railway Research Newcastle University.

Suomen Merimies Unioni (2011). Ust Luga. [WWW] <URL: http://www.smu.fi/itameri/venaja/venajan_satamat_suomenlahdella/ust-luga/> [Accessed 12 April 2011]

Zacharioudakis et al., (2011) “*Identify smart ICT and information flows*” SuperGreen project Draft Deliverable D4.1, Document number 04-10-RD-2011-01-01-1.

Walker, K. and Crosslands, N. (2011) EUROPORTE Channel. *Internal presentation at NewRail, School of Mechanical and Systems Engineering, Newcastle University*. 31 March 2011. Newcastle upon-Tyne, UK.

Woodburn, A. and Whiteing, A. (2010) Transferring freight to ‘greener’ transport modes in *Green Logistics – Improving the environmental sustainability of logistics*, 2010, eds.: A McKinnon, S. Cullinane, M. Browne and A. Whiteing. Page: 124-139. The Chartered Institute of Logistics and Transport (UK). Kogan Page.