full speed ahead

LOSAMEDCHEM

How could the logistics and the safety of the transports of chemicals be improved in the Mediterranean area

Part 02 | Volume 01

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L'Europe en Méditerranée
Europe in the Mediterranean

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At the end of this phase of the activities, I would like to express my satisfaction for the results achieved by the various partners of LOSAMEDCHEM project and that are included in this volume. Specifically, it seems to me that the feasibility studies, elaborated by the project partners, are characterized by a most particular attention to the concreteness.

It is very important to underline that these feasibility studies respond to the needs identified during the previous technical phase, SWOT Analysis, which revealed the needs that each area has in the transportation of chemical goods.

Finally I strongly believe that these studies will find a possible realization, even because of their dissemination through this publication and I also believe that the territories involved by these studies can obtain significant benefits from them.

Counsellor responsible for EU policies for the Province of Novara

Giuseppe Antonio Policaro

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Project LOSAMEDCHEM: Logistics and Safety of Chemical products in the Mediterranean area

Preface

The Mediterranean basin has grown during the last 20 years to become one of the world crucial traffic areas: the globalization of commercial relations, especially with Far- and Middle East has promoted the maritime transport of both finished goods and raw materials.

Nevertheless, the competitiveness of the Mediterranean regional countries, and in particular of the harbors, has lagged in their development, when compared with the equivalent structure in North Europe.

Another negative issue characterizing the Mediterranean region is the growing unbalance between road transportation and other transport modalities: rail is losing percentage of traffic, and intermodality is painfully trying to advance: yet results are very modest.

Furthermore, chemical industry is affected by deficits in the development of chemical clusters; one of the major reasons being the insufficient level reached by transport infrastructure.

There is a lot to do in terms of harmonization among different regions in the fields of transport regulations and laws across Europe and the coordination of transport related decision is still insufficient.

Moreover, the conceptual development of technologies for the goods transportation using different transport media is very limited, and cargo traffic has always lower priority when compared to passenger traffic, particularly when rail modality is examined.

Finally, especially among harbors, there is no trend towards a significant cooperation, but instead local competition prevents collective approach to share improvements, both technical and organizational, so it increases the efficiency gap between North and South Europe.

Transnational cooperation is vital for achieving improved logistics, which means reducing costs, offering better reliability and flexibility and enhancing safety, what is of utmost importance when dangerous goods (about 1/3 of the whole chemical production) are involved.

Chemistry, on the other hand, is one of the most globalized industrial branches, and logistic plays a fundamental role in its expansion.

In order to react to these critical aspects, it was considered necessary to initiate an international co-operation process, bringing together, in a broad partnership, different Mediterranean countries, with their relevant stakeholders, and starting a common project, where analysis of the current situation was the first step.

Then, promoting the transnational transfer of know-how and good practices, and taking into account the most significant results of the analytical phase, the Partners produced some feasibility studies, tackling issues that constitute the most critical logistic aspects and defining transnational projects, with the target of individuating common solutions for common needs.

The last step is the definition of a joint strategic plan, supported by Partners from the different countries, in order to ensure a continuation of the logistic proposed solutions agreed upon, and to share a cooperative vision of future infrastructural interventions and a coordinated program of their implementation.

Main project target

Taking into account the considerations contained in the previous chapter, main objectives of the LOSAMEDCHEM project are:

1. to promote the cooperation among the chemical districts in the Mediterranean area, between them and the main harbor areas, in order to enhance the competitiveness of the Mediterranean chemical industry

2. to improve the integration between harbors and their hinterland, sustaining as much as possible the intermodal transportation, and facilitating the shift of freight traffic from road to rail and waterways

3. to increase the overall efficiency of the chemical logistics in the Mediterranean basin, also thanks to the dissemination of the Best Practices

4. to reduce the environmental pollution and increase safety in the transportation of chemical goods and especially of dangerous materials

5. to support the harmonization of the different traffic regulations/norms that are currently in vigor in the Mediterranean countries/regions.

Project partners

Partners of different Mediterranean regions participate in this project, ensuring a good implementation of project activities and a global vision of the current status of the chemical industry and chemical logistics in this area.

Lead Partner is Novara Province (Italy).

Other partners are:

- FEPORTS - Port Institute for Studies and Cooperation of the Valencian Region (Spain)
- The General Council of the Chambers of Catalunya (Spain)
- The Thessaloniki Chamber of Commerce and Industry (Greece)
- The Port Authority of Genova (Italy)
- The Port authority of Trieste (Italy)
- The Port Authority of Koper (Slovenia)
- The University of Maribor (Slovenia)
- The Local Councils' Association of Malta

The scientific coordination of the LOSAMEDCHEM project is responsibility of Sviluppo Chimica (Milan), the operational project arm of Federchimica (Federation of Chemical Industries).

Altogether, the Partners are committed to establish a deep and intensive cooperation to improve the current conditions for chemical industry and especially for chemical logistics, and provide examples and suggestions for suitable actions in the near future.

Relevant Stakeholders, in particular chemical companies and logistic service providers, are also key actors in this project.

Project activities and timing

The LOSAMEDCHEM project has been approved in April 2010, and its development will last from June, 1st, 2010 until May, 31st, 2013.

The project overall budget is about 1.6 Million Euros.

Project activities encompass 5 Work-packages:

- Work-package 1 corresponds to Project Management
- Work-package 2 includes all dissemination activities that will be provided during the entire project development
- Work-package 3 focused, in the first year of the project, on the analysis of the current situation and on the identification of the most critical areas/urgent interventions, and also of the existing Best Practices
- Work-package 4 was devoted to the preparation of investments, and concentrated on the implementation of feasibility studies for infrastructural projects of transnational significance
- The Work-package 5 finally focuses on the strategy development for guaranteeing future continuation of the main project outputs and the mainstreaming activities.

Introduction

All LOSAMEDCHEM Partners have provided feasibility proposals that are collected in this book.

Most of them refer to a single thematic development; some (like Trieste) take into account not only the main focus but also some complementary issues. However, the analysis of these subjects is not so detailed. Finally, Valencia and Thessaloniki each propose of three feasibility studies, which are very solid and are discussed from both a technical and economic perspective.

According to their dominant themes, the feasibility proposals can be aggregated in 3 major groups that are analyzed in the following chapters.

Group 1

More particularly, in their main proposal, FEPORTS Valencia and the Thessaloniki Chamber of Commerce and Industry deal with a strategic development of their harbor areas; suggesting the implementation of a new logistic intermodal hub, to be located in a different coastal site but not far from the main harbor.

Both these proposals are taking into consideration the realization of large harbor infrastructures, where multimodality plays an important role; the relevant investments are very significant as well as the realization time schedule. It is obvious that the political involvement for finding the necessary funds for such projects is obligatory.

The proposal of Maribor University approaches a completely different aspect: the evaluation, in monetary terms, of the social risk connected with the transportation of chemical goods (especially dangerous materials).

A rigorous methodology for calculating this risk is applied to the road and rail routes connecting the port of Koper to the city of Maribor, which can be considered a good example of a connection harbor – hinterland.

This methodology for traffic risk assessment could be used by Authorities, when evaluating costs/benefits arising from a modal shift (road to rail).

In the Trieste Conference, held on January $24^{th}/25^{th}$, 2013, FEPORTS Valencia, the Thessaloniki Chamber of Commerce and Industry and the Maribor University agreed on a cooperation on the themes covered by their aforementioned projects: new harbor infrastructures, multimodality, harbor/hinterland interconnection and relevant sustainability.

Group 2

The proposals from Port Authority of Koper, Port Authority of Trieste, Union of Chambers of Commerce of Catalonia – Barcelona and Local Councils' Authority of Malta, deal with the management of hazardous goods, inside and around the harbor area. In detail, Koper feasibility refers to the implementation of a storage area for dangerous goods in the space provided to general warehousing for merchandises entering/leaving the port.

A section of the proposal is referred to the illustration of the paths that trucks transporting dangerous goods must follow from port quay to warehouse and vice versa.

Also the feasibility study of Trieste discusses the monitoring of the dangerous goods flow in/out the port and also the developing of a dangerous goods management system; completed with procedures for harbor access control and for emergencies reactions.

What is distinctive in this proposal is the intention to integrate this system with the national logistic network (UIRNet): this aspect will be better examined in the following GROUP 3 Chapter.

Barcelona's proposal is, more than a feasibility project, a preliminary study for defining the parameters that should be taken into account, in order to establish the correct site where to implement a set of facilities concerning the hazardous goods logistics.

The proposal of Malta's LCA refers to an ICT collaboration tool, supported by the Local Councils' Association, to ensure chemical safety within the transportation supply chain in Malta.

It consists of an on-line linked portal, with nine linked interfaces, providing different users (members of the system) with two different objective levels: strategic and operational.

The system will also support the management of emergency situations, the training of the involved personnel and will act as a reporting tool.

Moreover, Valencia and Thessaloniki, in their minor feasibilities, are dealing with the safety and security issues inside the harbors and in the contiguous areas.

Therefore all the aforementioned Partners have confirmed, in the Trieste Conference, their interest in cooperating towards a project continuation that could encompass a set of solutions for the safety/security issues that are commonly considered fundamental for the sustainability of the ports themselves and the contiguous areas.

Group 3

There is a third group of feasibility proposals, presented by the Port Authorities of Genoa and Trieste and by Novara Province which are specifically related to ICT systems development/integration with a national logistic platform.

Particularly:

Genoa proposal refers to the implementation of a system for monitoring and, if the case, intervening on the traffic flow of chemical (dangerous) goods on the land routes (especially road routes), which can interest different realities (e.g. ports and inland logistic hubs).

Final objective of the proposal is to provide, at a centralized level, visibility and traceability of the traffic flow, especially for safety and security reasons.

The feasibility foresees the integration of the ICT systems operating at different nodes involved in the traffic flow, in order to make them interoperable, and their integration with the UIRNet platform, supported by the Italian Transport Ministry, which operates as the national logistic network.

Trieste proposal also intends to integrate the local different subsystems with the national logistic network UIRNet, which acting as a common platform, allows the automated interchange of data among different systems and, therefore, can extend the monitoring action on the transporting vehicles to the contiguous regions, and the information exchange between logistic platform and relevant in/out vehicles.

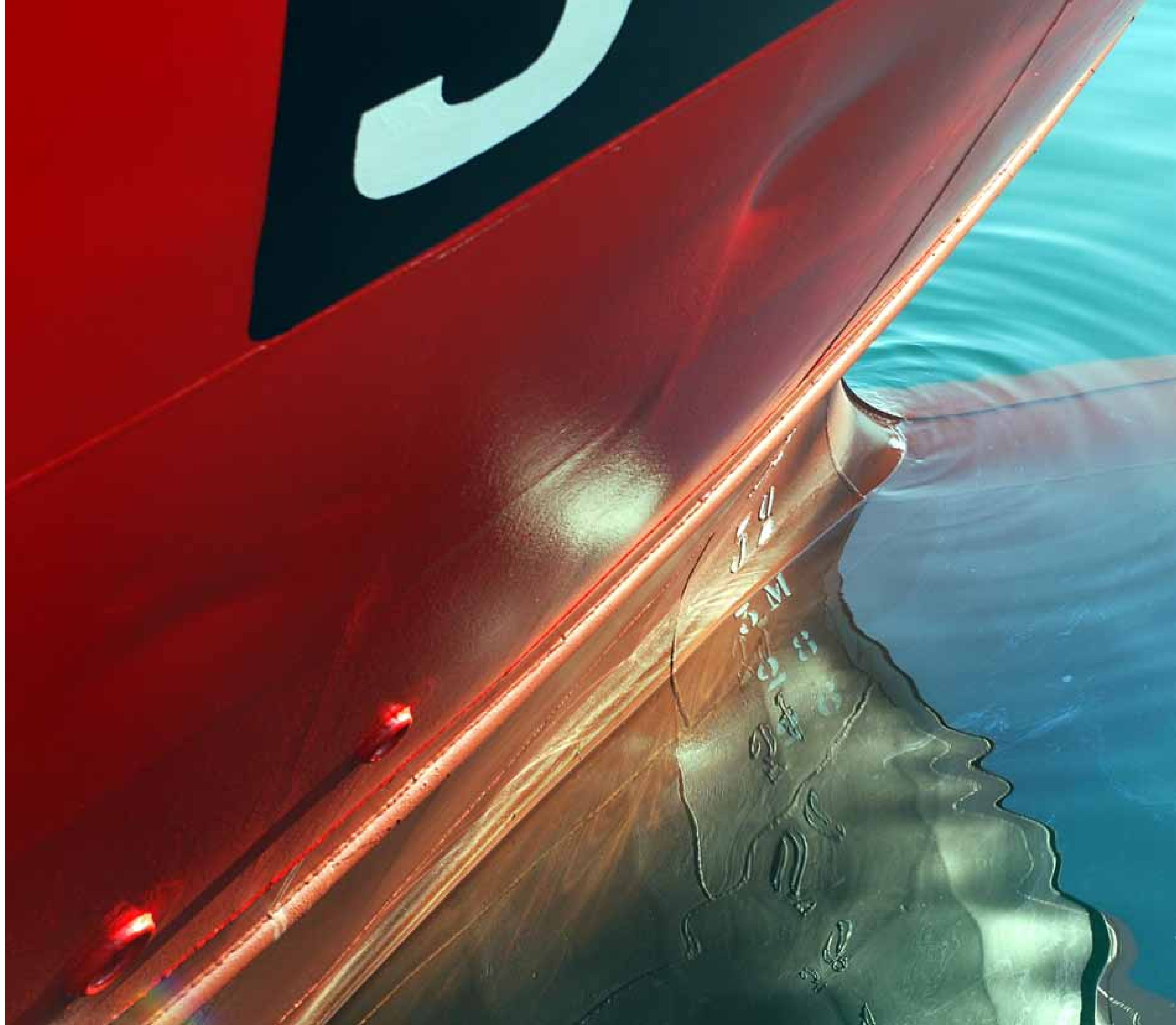
Finally, Novara's proposal, defined as a prefeasibility since some official commitments from some of the relevant Stakeholders lack, foresees the interface between UIRNet and the proprietary system (WOLT) of the Novara intermodal hub (CIM) and interfaces that predictably will bring easy interoperability between the two systems.

Another integration opportunity of UIRNet is that involves the big refinery close to Novara (SARPOM), which is interested in a more controlled management of the arrival time of the road tank containers in its loading facilities.

Integrating UIRNet and proprietary software (of both CIM and SARPOM) will certainly produce a significant improvement of the operations both to c/o CIM and to the refinery.

The ICT integration process with a common logistic network platform (in this case, with UIRNet), is the third area of cooperation, among the three aforementioned Partners, as stated in the Trieste Conference.

The main objective of these aggregations is first to prepare and then to carry out the most crucial phase of the "Strategies" component of the LOSAMEDCHEM Project, which is the creation of "Discussion Groups". The main task is to facilitate the decisional paths, both at the technical/administrative and political level, in order to get the financial resources; and/or to promote the regulatory modifications, both necessary for the concrete implementation of the feasibility proposals, already supported by the aggregated working teams.



Province of Novara
LOSAMEDCHEM
Pre-feasibility study

PROVINCIA
DI NOVARA

AUTHORS
Marcello Tadini
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Project cofinanced by the European Regional Development Fund

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1. Geographical and infrastructural sight

The Province of Novara territory is located at the cross of two European Corridors: TEN-T V Lisbona-Kiev and XXIV Genova-Rotterdam. The city of Novara benefits from strong connections with the main viary axis of northern Italy: the motorway A4 Torino-Milano and the A26 Genova-Gravellona Toce and the Malpensa Airport.

Railways on the territory follow three main directions (double track electrified lines): Torino-Milano high speed train railway line, Torino-Milano line and Milano-Simplon line (by Sesto Calende and Arona).

There are other electrified lines, defined by Rete Ferroviaria Italiana (RFI) as complementary: (Mortara-Novara-Vignale, Vignale-Arona and Vignale-Domodossola) and Ferrovie Nord Milano (FNM) Novara-Malpensa-Saronno.

Moreover Province of Novara is connected with international railway lines by the Frejus tunnel (towards France), and Simplon and Gotthard tunnels (towards Switzerland). Thus, infrastructures in Novara Province appear highly developed.

The XXIV corridor (Fig. 1) origins in Rotterdam and Antwerpen, two of the main European harbors in the North Sea. The Corridor paths move following a southwest direction and join each other in Koln. Then the single path continues to Frankfurt am Mein and then (south direction) to Mannheim e Karlsruhe. Afterwards the Corridor enters in France in Alsace region passing through Strasbourg and Mulhouse. Then the Corridor enters Switzerland and splits into two branches: the west one enters in Italy by Loetschberg and Simplon tunnels passes Novara and ends its path in Genova through Novara-Alessandria-Genova line. The east one enters through Gotthard and Monte Ceneri tunnels enters in Italy in Como and ends in Genova by Milano-Genova line (Fig. 2).

Fig.1: XXIV Corridor path

Source: DG TREN, European Commission, 2005

Fig.2: Representation of XXIV Corridor southern part

Source: Oddone, 2012

The end of works in Loetschberg tunnel and nearly the completion works for the new Gotthard tunnel (Fig. 3) will bring a strong enhancement of railways capacity for freight traffics through Italy-Switzerland connections, from current value of 24 mil. tons per year to a theoretical value of 55 mil. tons per year.[1]

[1] Referred to global freight traffics both for Simplon and Gotthard tunnel (source: Alpinfo).

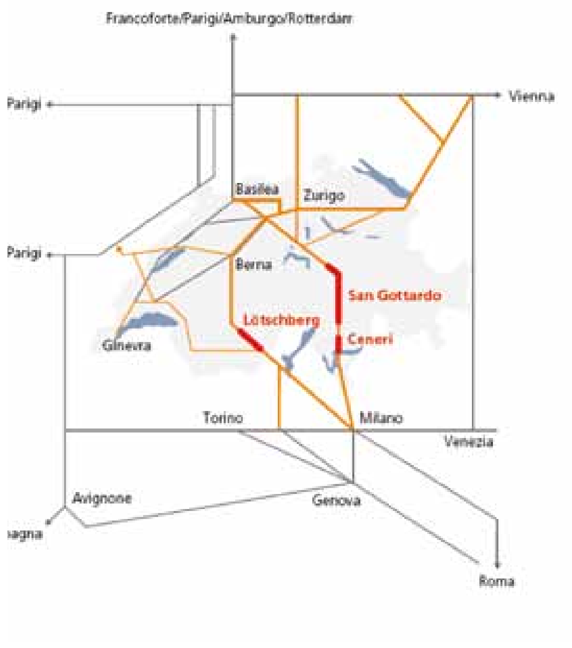


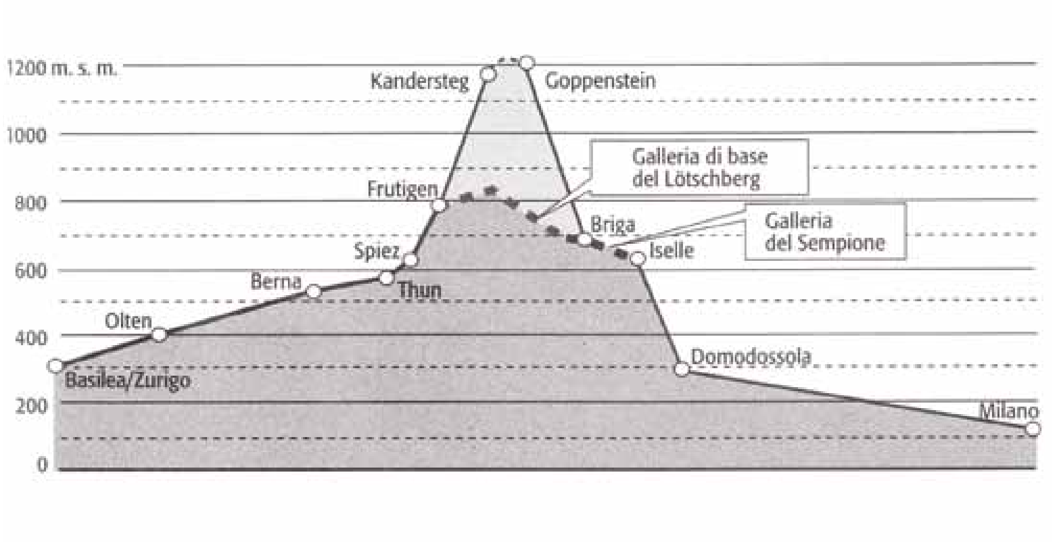
Fig. 3: Railway lines related to Simplon/Loetschberg and Gothard tunnels

Source: Alptransit Gotthard, 2012

Loetschberg tunnel (34,6 km long) has been completed in 2007 after 8 years and now operates on railway lines from Novara and Milano. These lines are joined into a single one near Domodossola arriving at Iselle (Italy's border with Switzerland). The line then continues to Switzerland (Brig) through Simplon tunnel. After few kilometers the railway line enters into Loetschberg tunnel starting in Raron and ending in Frutingen (Fig. 4).

Fig. 4: Loetschberg and Simplon tunnel outlines

Source: Testoni, 2005



About 120 trains (both freight and passengers) travel through the new tunnel per day, while the previous situation was 40 trains per day and 7 mil. tons per year of freight. Loetschberg has also brought a more intensive use of Simplon tunnel (recently revamped).

On the other branch of XXIV Corridor (Gotthard tunnel) works are still in progress and they are expected to end in 2015. The scope of such relevant project is the growth of railway traffic from 150 trains per day to 200 and the reduction of travelling time. Travellling time for Milano-Zurich is expected to be reduced from 3 hrs and 40 minutes to 2 hrs and 40 minutes.

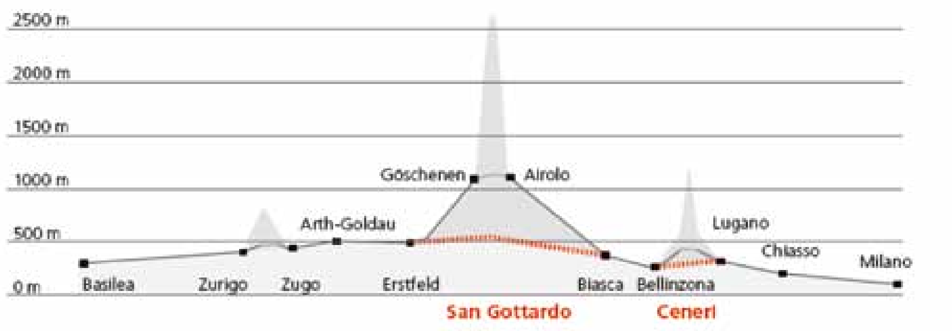
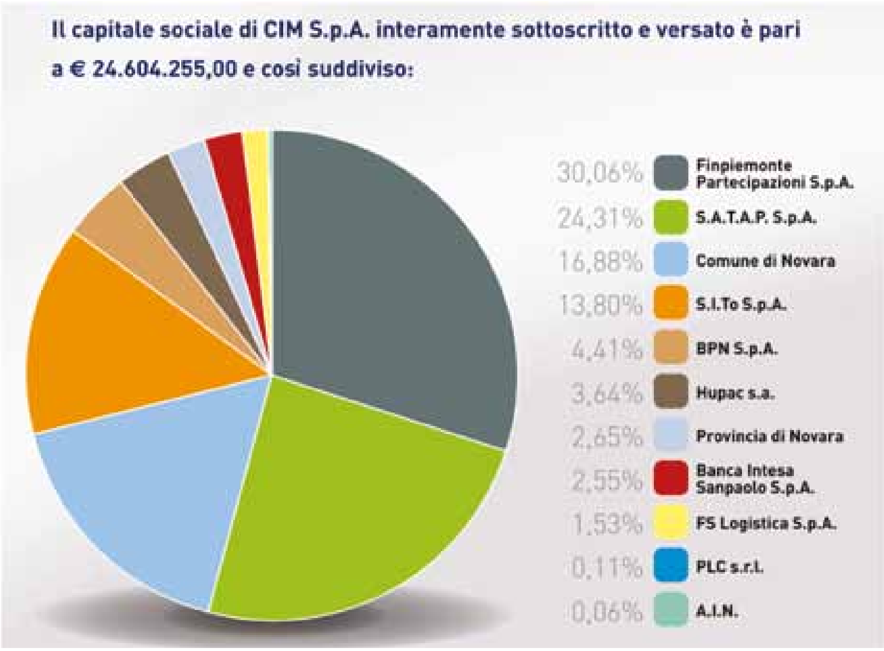


Fig. 5: Gotthard and Monte Ceneri tunnel outlines

Source: Alptransit Gotthard, 2012

2. Novara CIM freight village and Boschetto railway terminal



The relevant presence of infrastructures in Novara Province brought good conditions for Novara CIM freight village development in 1995. CIM is owned by the company CIM S.p.a., whose shareholders are represented in Fig. 6.

Fig. 6: Shareholders of CIM S.p.a.

Source: Piano Strategico di Sviluppo Industriale 2011-2019, CIM S.p.a.

The freight village lies on a 600.000 sqm area: 170.000 sqm are used by the intermodal terminal made of 7 rail tracks (length: 600 m) where mobile stakers operate. Freight village is supplied with a 3.000 sqm building (office use) and 3 warehouses (66.000 sqm): M1 (4.000 smq), M2 (24.500 smq), M3 (37.500 smq). A maintenance and repair centre for road trailers and wagons is also supplied (Fig. 7).

Fig. 7: CIM S.p.a. aerial sight

Source: http://online.stradeeautostrade.it

Eurogateway, a CIM subsidiary, manages handling operations in the freight village and in the Boschetto terminal area where CIM operates. Railway companies now operating in CIM-Boschetto are: Trenitalia, SBB Cargo Italia, DB Schenker, Crossrail, Captrain, NordCargo e CFI.

Most important traffics are with North Sea area, especially the Rotterdam harbor (24 trains roundtrip per week).

Traffic along XXIV Corridor by Simplon tunnel is clearly the most relevant (51,5% of Simplon freight traffic is arriving/departing at CIM). The Piedmontese line toward the Sempione is the best one in terms of maximum height allowed for the intermodal transport unit (UTI); allowing a maximum height of 4100 mm for semi-trailers under the 2500 mm width and a maximum height for the swap bodies of 3250 mm. This allows the transport of High Cube containers (2895 mm) on standard load wagons.

The SWOT analysis for development plans carried out by CIM S.p.a., shows that the most important strength is the geographical position. The possibility to create relations with Ligurian harbors is seen as one the most interesting opportunity, if correctly developed. As showed in the study, the main weakness is due to current poor intermodal terminal facilities which could cause a freight traffic loss.

CIM facilities are completely full up at present time and 23 companies are operating: Ewals Cargo, Huktra, Arco Spedizioni, Hessers, etc

.

2.1. Boschetto railway terminal

Boschetto railway terminal (about 300.000 smq area) is adjoining to CIM freight village and is linked to Novara RFI railway station by 2 railway tracks: the one in north direction connected to Novara-Torino-Frejus line and to lines towards Simplon and Gotthard, and the other in south direction is connected to Novara-Trecate-Milano and Novara-Mortara-Alessandria-Genova lines. At present time the large Boschetto terminal area is quite under used and needs some renovations.

Overall trains handling in CIM and Boschetto terminal (for the part managed by Eurogateway) is listed below (data taken from interviews with CIM staff):

Weekly traffic (roundtrip) from/to CIM intermodal terminal

- 24 trains Rotterdam/Novara
- 15 trains Belgium/Novara
- 3 trains Gennevilliers/Novara
- 3 trains Daventry/Novara
- 3 trains Hams-Hall/Novara
- 5 trains Genk/Novara
- 3 trains Duisburg-Koln/Novara
- 3 trains Travemunde/Novara

Weekly traffic from/to Boschetto railway terminal

- 5 trains Pomezia/Novara
- 7 trains Genk Haven/Novara
- 5 trains Le Havre/Novara
- 5 trains Noisy/Novara
- 3 trains Muizen/Novara
- 3 trains Brindisi/Novara
- 3 trains Bari-Bologna/Novara

The figure below (Fig. 8) shows the current configuration of CIM freight village and Boschetto terminal.

Fig. 8: CIM – Boschetto current layout

Source: elaboration of Tadini M.

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3. CIM – Boschetto area development plans

CIM is currently working in southern area (160.000 sqm) of Boschetto terminal. Renovations in that area will probably lead to reorganization of the Rolling Highway terminal which could be moved in the western area, near to FNM station (no official decision on terminal repositioning has been taken by RFI). Renovations will require new roads to the terminal gates: a new road in the northern side of the terminal will be provided using the already existing roads, built during the works on high speed railway train.

These near term renovations plans in Boschetto terminal will create in the existing CIM area (CIM West) new spaces, where it is expected the construction of 2 new 600 m long railway tracks equipped with a straddle carrier.

In long term development, they are proposed plans of a new railway track connection to the existing lines. This will allow trains to enter Boschetto area by-passing the Novara RFI passenger station.

Finally, it is expected the construction of a 90.000 sqm new area (CIM North) where it is going to be built a vehicle maintenance service and a new warehouse of 5.000 sqm of the covered area.

3.1. CIM freight village traffic forecasts

CIM traffic forecasts explained below have been taken from Piano Strategico di Sviluppo Industriale 2011-2015-2019 (as shown in Fig. 9). Keeping current shares in the Simplon direction and considering the 2020 scenario, CIM could handle up to 300.000 UTI per year, almost doubling the current traffic volume. Moreover considering the 2015 deadline for Gotthard tunnel completion works, in a 2020 scenario CIM is supposed to receive up to 289.130 UTI per year from Gotthard (50% of differential freight traffic from current scenario to 2020 scenario), 108.696 UTI per year from Genova, 36.522 UTI per year from Savona and 61.304 UTI per year from France through Frejus (10% of differential freight traffic from current scenario to 2020 scenario).

Incrementi attesi traffico merci (tonnellate anno)

Direttrice	Tonnellate 2010	Tonnellate 2020	%	Tonnellate Differenziale		%	Traffico potenziale nuove UTI	
Traforo Gottardo	16.000.000	29.300.000	83%	13.300.000		50	289.130	410.043
Traforo Loetschberg	7.000.000	12.400.000	77%	5.400.000	5.000.000 UTI totali	51,5	120.913	
Traforo Frejus	5.000.000	19.100.000	280%	14.100.000		10	61.304	
Porti Genova (contenitori)	17.000.000	42.000.000	140%	25.000.000	2.900.000 UTI nuove	10	108.696	
Porto Savona (contenitori)	2.800.000	11.200.000	300%	8.400.000		10	36.522	
totale	47.800.000	114.000.000	162,80%	66.200.000		subtotale	616.565	
Aeroporto Malpensa	407.000	645.000	58%	238.000	28.000 UTI totali			
Terminal Novara	2010	2020	%		Previsione UIRR	attuali	200.000	200.000
Traffico Intermodale Novara	4.500.000	13.522.500	200,5%		587.934 UTI anno	totale	816.565	610.043

Fonti: COWI DG TRAIN, Alptransit, Autorità Portuale di Genova, Autorità Portuale Savona, MAERSK, ENAC, UIRR

Fig. 9: 2010- 2020 traffic forecast scenario

Source: Piano Strategico di Sviluppo Industriale 2011-2015-2019, CIM S.p.a.

Obviously all these growth hypotheses that would substantially multiply by four the present operational capacity will be carefully checked with actual evidence in terms of demand. In particular, the question of the effective possibility to receive the remarkable amount of traffic from Gotthard (almost 300.000 UTI/year) is not only related with current freight village facilities (as shown by the SWOT analysis made by CIM S.p.a.), but it also involves aspects even more important, since there are serious reservations about the ability of the Lombardy railway network to absorb the type and the quantity of railway traffic coming from Gotthard.

The traffic through Gotthard has, in fact, a bottle-neck in Italian section in which the traffic capacity stands at 190 trains/day concerning that 250 trains per day allowed along the Helvetian section.

Below (Fig. 10) it is given a representation of the north Italian railway network capacity across the main mountain border.

Even assuming the choice to create in CIM a new intermodal terminal specific for Gotthard traffic forecasts (which would arise on the line Novara-Saronno FNM) a strong need will be the RFI response about the Lombardy rail network capacity to bring down freights from Gotthard tunnel as well as the planning of new dedicated terminal in the Lombardy region.

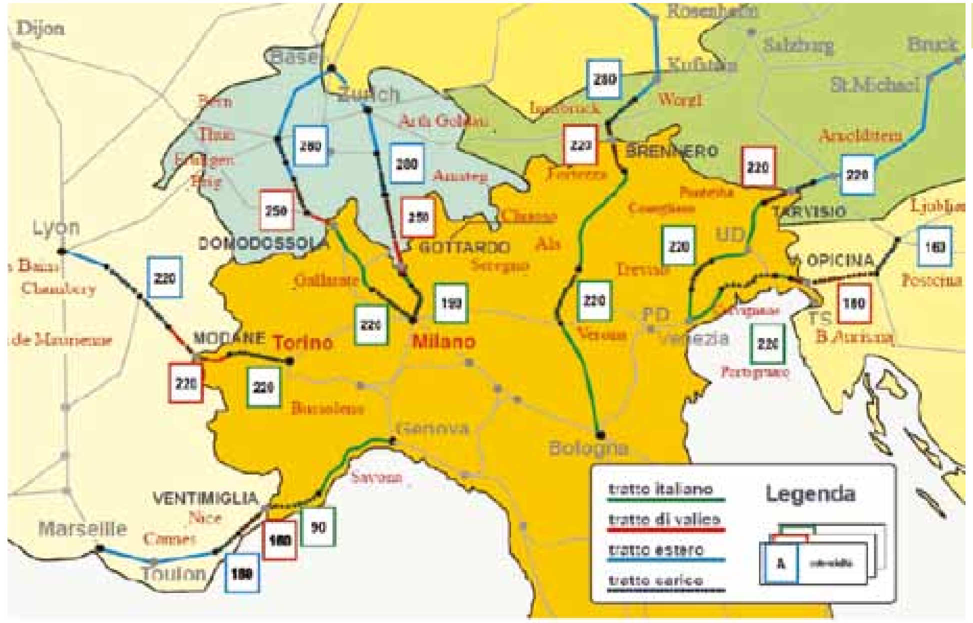


Fig. 10: Current railway network capacity (trains/day)

Source: Dallari F., Curi S., 2011

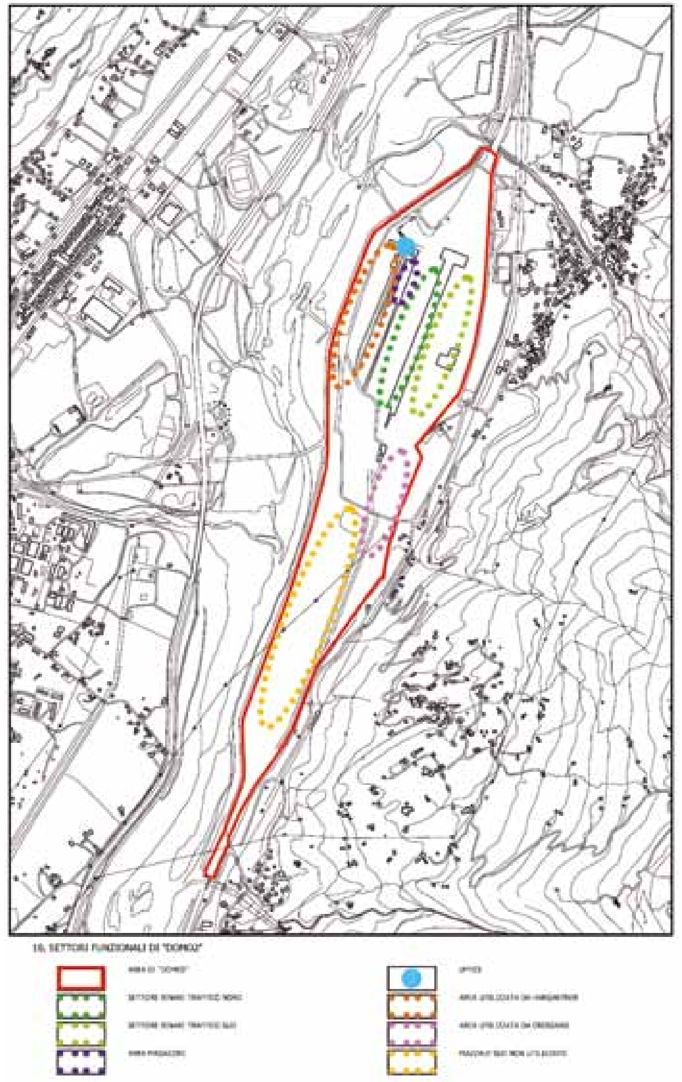
A remarkable threat concerns the possibility that a lack of response on the part of RFI will lead to a creation of a dedicated intermodal terminal at the south of Gotthard tunnel, still in Helvetian territory. This would void completely the potential benefits coming from railway traffic instead of heavy road traffic, further worsening the traffic conditions in the already congested roads of Lombardy.

3.2. Domo II railway terminal

Domo II railway terminal (Fig. 11) was built in the early 90s and is located in Beura-Cardezza (few kms south Domodossola). It is the first Italian railway terminal for trains from Simplon tunnel. The terminal lies on a very large area (900.000 smq) and it is provided with 64 tracks (length from 600 to 1000 m). It is divided into 2 parts of almost equal dimension. In the north part, there are terminals of the 2 logistic companies now operating: Crossrail and Hangartner. The southern part (although fenced) has never been built.

Fig. 11: Domo II railway terminal plan representation

Source: Saia, 2007



Currently the terminal appears deeply under used and the relevant availability of tracks and spaces could bring a future revamping operation with 2 new possible activities:

• Train disassembling and recomposition as the most part of Italian railway paths does not allow transit for trains with typical length exceeding 750 m;

• Departure station of the Rolling Highway: The Rolling Highway service (Novara-Freiburg im Brisgau) currently consists of 61 round trip trains per week. Once evaluated the potential market demand, Domo II could represent the new departure/arrival point for some weekly trips now starting/arriving in Novara.

Both these two revamping hypothesis could help Boschetto-Cim area to reduce its traffic congestion.

4. Genova port: current situation and development plans

The upgrading project of the XXIV Corridor is designed to efficiently connect the Mediterranean Sea with the North Sea.

Currently, the freight traffic along this corridor is made for 75% by road transport and the European objective is to double until 2020 the capacity of rail transport. The southern part of this railway line in particular operates the following lines: Basel-Bern-Simplon-Novara-Genova and Basel-Zurich-Gotthard-Milano-Genova.

Genova is the largest Italian harbor with almost 52 mil. tons of traded goods in 2010. In Genoa stands freight flows from/to the Far East for 37% of the total traffic in TEUs (served by 8 lines), from/to the America (15% of the total, served by 9 lines) and from/to Africa (15% of the total, served by 11 lines).

The Port lies along a 22 km coastline (also including Cristoforo Colombo airport) spreading westward from the basin of the Old Port, at the center of the city. The port has 21 private operating terminals, equipped to receive any type of vessel for all types of goods: containerized cargo, perishable products, metals, forest products, dry bulk and oil products. The present structure, as depicted in the figure below (Fig. 12), has emerged in 1997 with the opening of the western part, the Voltri Terminal Europa.

The total harbor area is approximately 7 mil. sqm, with several gates at the main access roads.

Fig. 12: Genova harbour area

Source: Autorità Portuale di Genova, 2011

4.1. Port freight flows

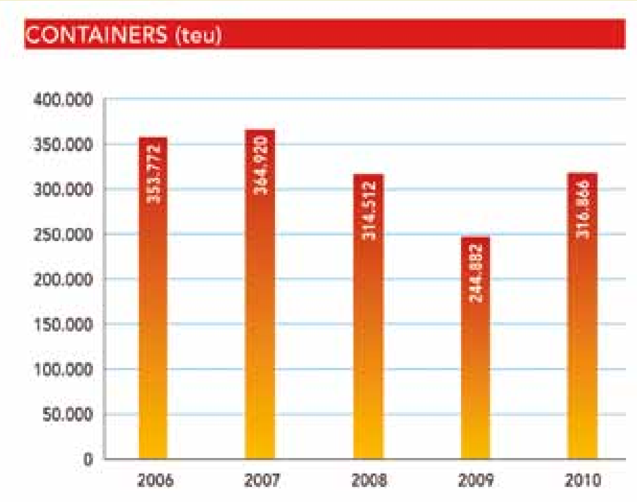
As shown in Fig. 12 and noted in the paragraph above, the port of Genova is made up of various terminals.

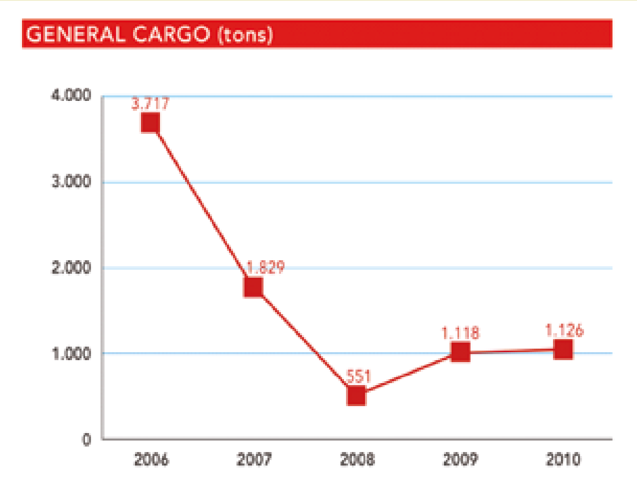
From a specific point of interest, SECH terminals, VTE, Rebora, Messina, as well as terminals for petroleum products are mentioned in the boxes below.

SECH

The SECH terminal (Southern European Container Hub) is a container terminal located near calata Sanità. It covers an area of 205.000 sqm and it is equipped with a quay of 500 m. It is directly connected with the main roads, being close to the highway west of Genoa and the Campasso railway hub. The terminal has 3 rail tracks of 370 m each.

In 2010 a revamping project started during which cranes were modified to ensure operability with ships up to 10.000 TEUs each.

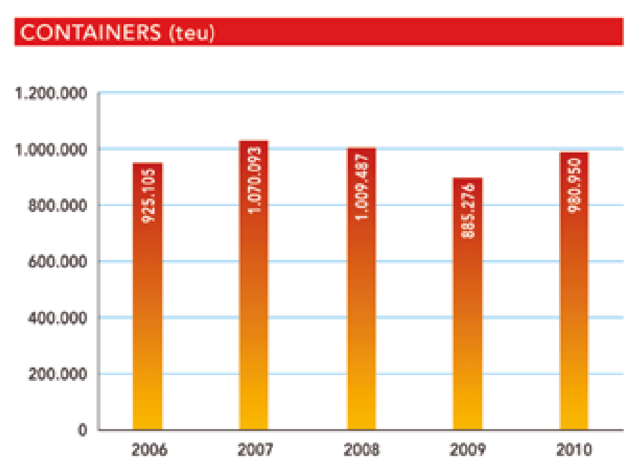


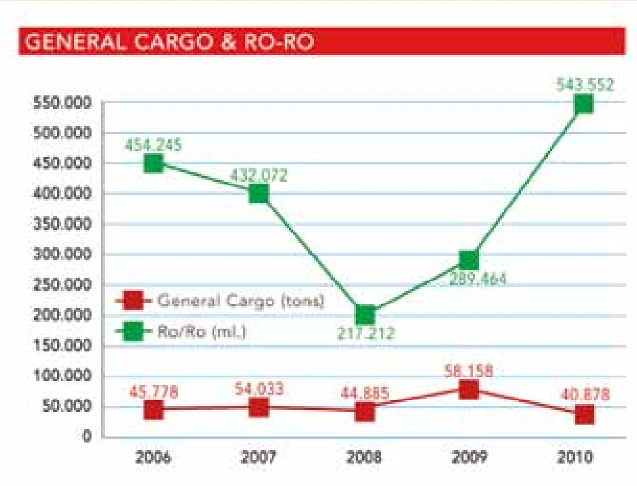


VTE

The terminal, owned by PSAGroup (Singapore), covers an area of 1.100.000 sqm and it is provided with 20.000 sqm of covered warehouses. The space for loading and unloading consists of 6 docks 1450 m each and 8 berths (3 for Roll-On Roll-Off traffic).

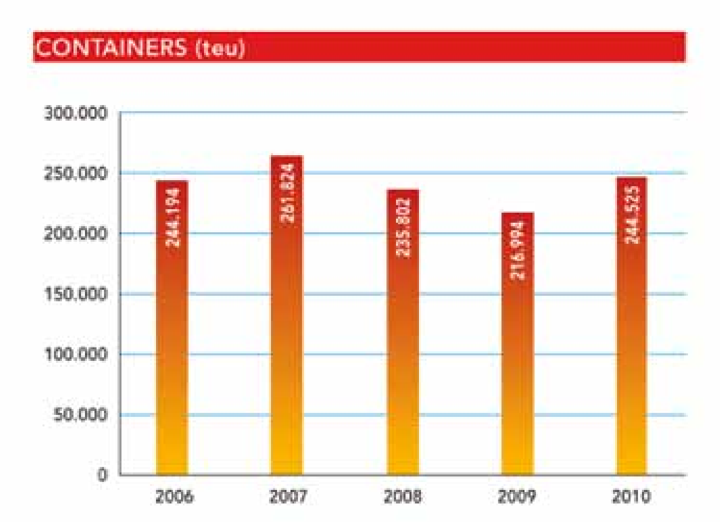
The internal road network is directly linked to the junction from the highway at Voltri, allowing quick access to the motorways A10 and A26. The railway system of the terminal consists of 8 tracks of 650 m each, and is directly connected to the line Genova-Ventimiglia and Genova-Ovada line which can support trains with "high cube" containers without lowered cars.

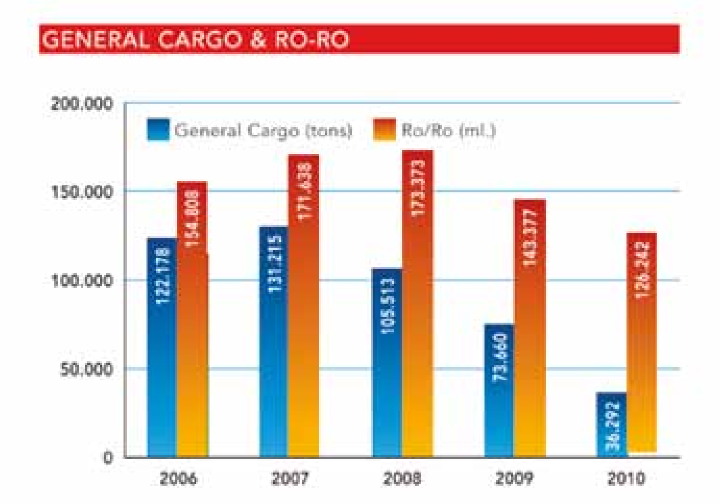




MESSINA

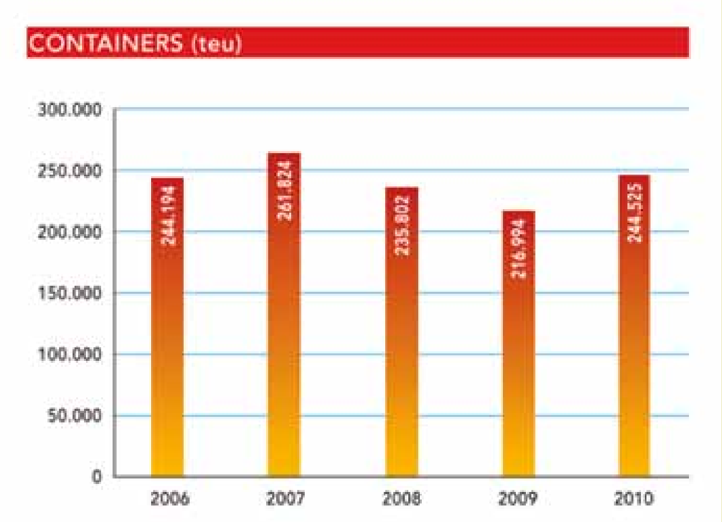
he terminal, located in the historic area of the port of Genova at Ponti and Nino Ronco Canepa, has an area of approximately 250.000 sqm with a quay of 1600 m with 6 berths. The railway terminal train consists of 5 tracks of 440 m each.

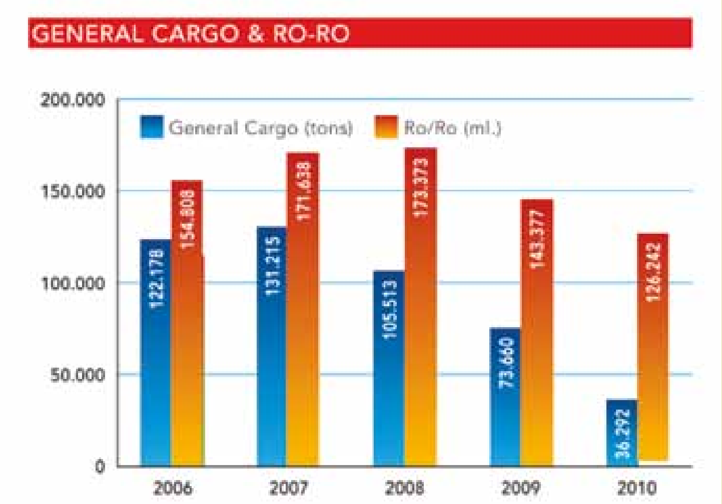




SPINELLI/REBORA

The terminal, owned by Spinelli Group, is located at Calata Inglese, Massaua and Ponte Etiopia. It covers an area of 140.000 sqm (9.000 sqm covered warehousing). Some renovations (started in 2010) leaded the terminal to a further increase of 8.000 sqm and to the creation of a specific area for dangerous goods storage and to a second rail connection.

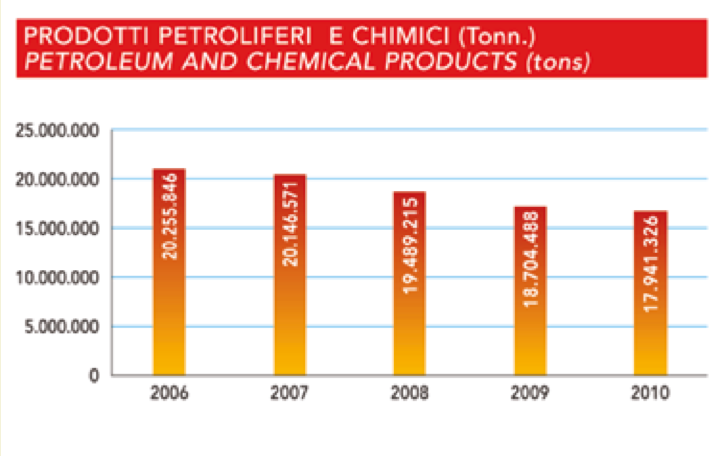




PORTO PETROLI DI GENOVA S.p.a.

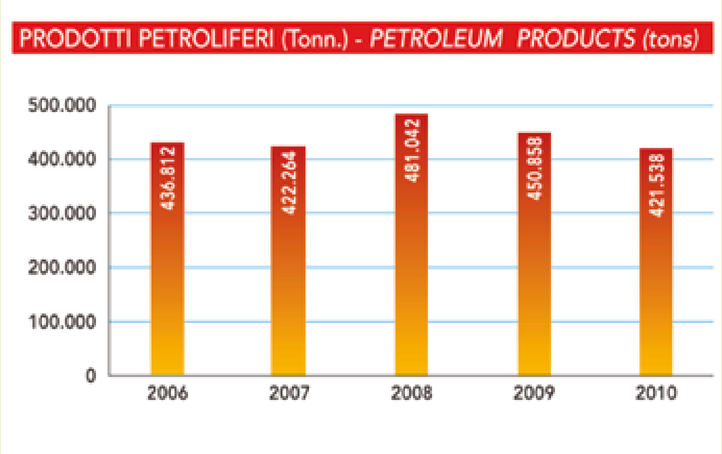
The oil port of Multedo covers an area of 124.000 sqm, composed of a quay of 385 m and four piers to harbor vessels up to 130.000 tpl.

Through a network of pipelines, the major refineries and oil depots in northern Italy are supplied with a share of about 17% of the total crude oil processed and almost 22% of overall Italian consumption of petroleum products.



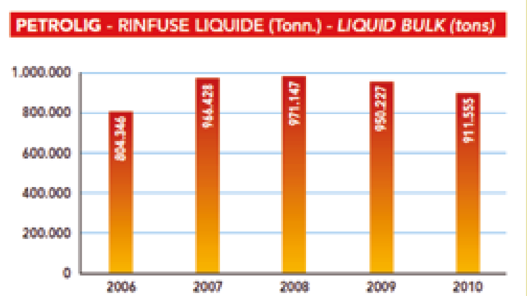
GETOIL S.r.l.

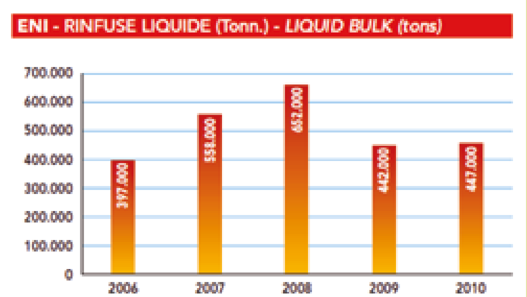
The terminal Getoil at Calata Giaccone lies on a surface of 4.200 sqm in which there are 8 insulated and heated tanks insulated for a total volume of 10.000 cm.



PETROLIG S.r.l./ENI S.p.a.

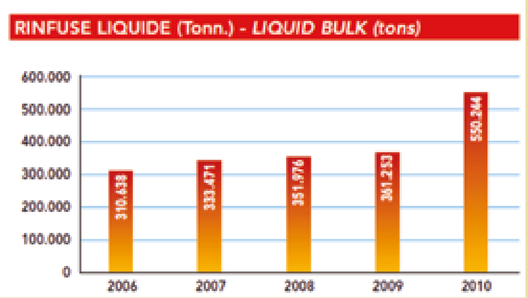
The Petrolig/Eni terminal is located at Calata Canzio and lies on an area of 22.000 sqm with a quay and a railway junction of 300 m both. It has 10 tanks for a total capacity of 80.000 cm.





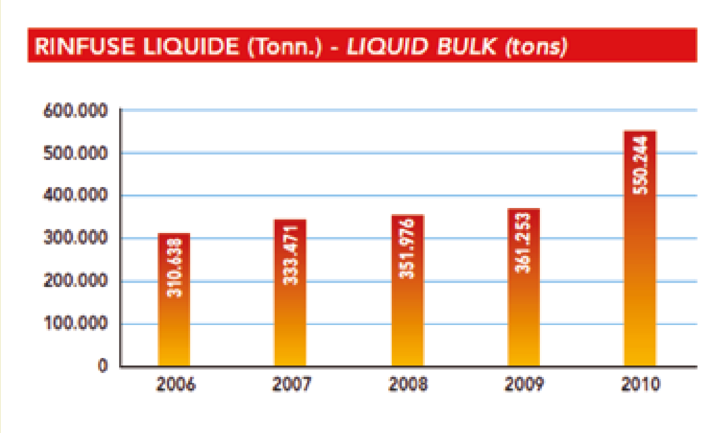
SILOMAR S.p.a.

Silomar terminal with a total capacity of 78.000 mc (stainless steel heated tanks) is intended for the storage of vegetable and mineral oils and biodiesel with a flash point over than 65 °C. The terminal is equipped with a railway junction.



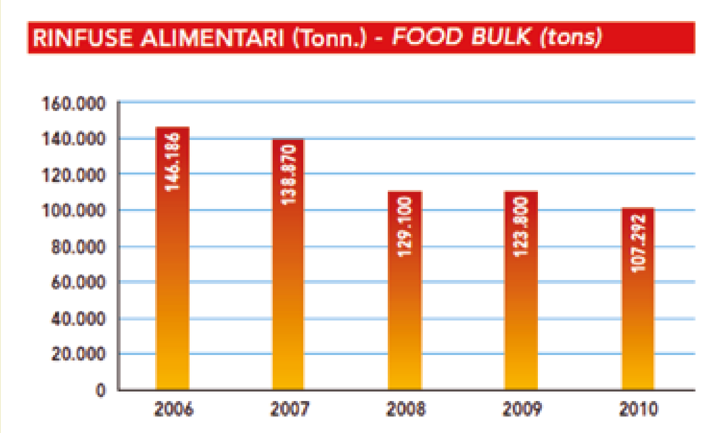
SAAR DEPOSITI PORTUALI S.p.a.

The terminal Saar, located at Calata Sanità, covers an area of over 30.000 sqm and has 96 tanks for 107.000 cm. The main stored products are vegetable oils. It has 2 berths and a railway junction.



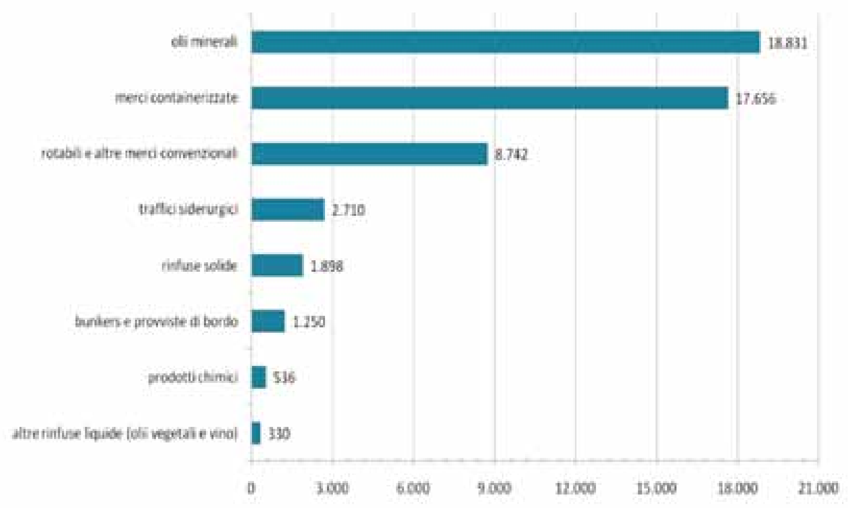
SAMPIERDARENA OLII S.r.l.

The Sampierdarena Olii terminal is located at Calata Mogadiscio few hundred meters away from Genova Ovest motorway toll gate. It lies on an area of 11.000 sqm and it has a storage capacity of 35.000 cm. It has 4 berths and a railway junction.



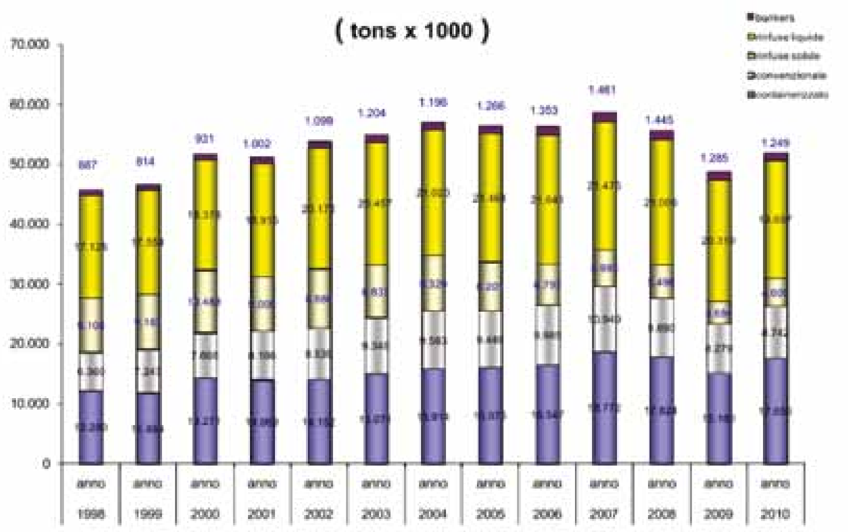
From a general point of view, the data (yearly values) on overall handling provided by the Port Authority are shown in Fig. 13 and 14. The preponderance of trades concerning oil products and containerized cargo is clear, and this is more evident looking at the significant infrastructure development of petroleum terminals and at the large freight volumes handled especially from terminal VTE and SECH (Fig 15 and 16).

Fig. 13: Freight type shares (thousands t, 2010 data)



Source: Autorità Portuale di Genova, 2011

Fig. 14: Freight transport mode shares (thousands t, 2010 data)



Source: Autorità Portuale di Genova, 2011

Fig. 15: VTE terminal

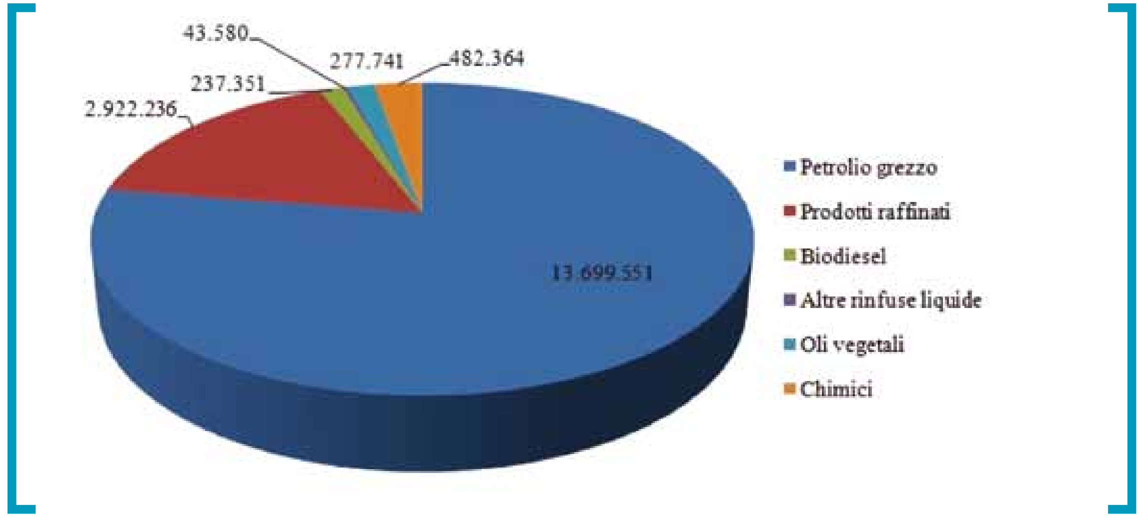
Source: http://www.vte.it

Fig. 16: SECH terminal

Source: http://www.sech.it/

Liquid bulk cargoes (with the exception of oil products and vegetable oils) amounted to approximately 500.000 tons per year in 2011 (Fig. 17). It must be noted that, in order to assess the overall handling of chemicals in the port, the quota (not available in reports) related to containerized chemicals should be added. In VTE, SECH, Messina, and Spinelli/Rebora terminals are available storage slots for 20 feet containers containing chemicals, respectively: 1000, 405, 305 and 106.

Fig. 17: Liquid bulks (unloaded quantities, thousands t, 2011 data)



Source: data from http://www.assocostieri.it/censimento2011

The morphological aspects of the Genova territory (and in general of all the Ligurian inlands) deeply limit the possibilities for a real efficient railway network as it happens in other European ports. This aspect involves the port area (the lengths of rail tracks in terminals are rather small) and the railway lines towards the north direction which are very steep (often requiring a double locomotive pulling), with turn radius and tunnel shapes that impose limitations in the train compositions.

To support the activities in the Genova Port, a container terminal (Rivalta Terminal Europa, RTE) at the Interporto of Rivalta Scrivia (AL) is operating since 2009. It is connected with the VTE terminal by a shuttle train. This shuttling, exclusively for containers, consists of 2 roundtrip trains per day from Monday to Saturday, each consisting of 12 double-lowered wagons. The custom service is located in Rivalta and the containers arrive at RTE without customer clearance to speed up the transport.

These infrastructural limitations for the rail transport lead to a prevalence of road traffic to/from the Port, this is clearly shown by data on heavy traffic on the motorway network A26 and A7, compared with A4 and A21 (Fig. 18).

Fig. 18: Heavy load traffic (theoretical daily average vehicles)

Source: AISCAT, 2011

Motorway section	Theoretical daily average vehicles
Milano – Serravalle – A7	8.957
Serravalle – Genova – A7	6.893
Gravellona – Alessandria – A26	3.565
Alessandria – Voltri – A26	8.170
Torino – Milano – A4	11.954
Torino – Piacenza – A21	10.147

The port is also connected by a double pipeline to Eni refinery in Sannazzaro de Burgondi (PV), which has a refining capacity of 190.000 barrels per day of crude oil. From the refinery several pipelines depart to refined products depots (see dashed lines in Fig. 19), one of which returns to the port of Genova.

Fig. 19: Pipeline network in northern Italy

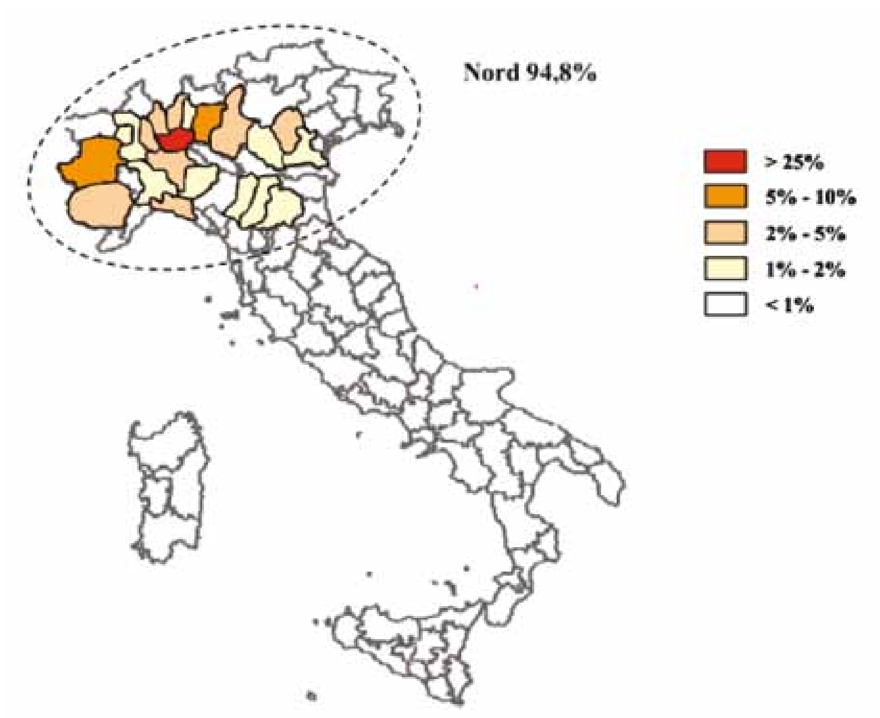
Source: http://www.assocostieri.it

5. Relations between Novara province and Genova port

The network of commercial relations between the major companies in the Province of Novara and Genova port area is rather weak. In this scenario, the main actor is SARPOM Refinery of San Martino di Trecate. This is the only company with railway freight traffic towards Genova, consisting of 5 trains per week with tank wagons containing fuel oil for ship engines. This current traffic is also expected to increase as, at the moment, the refinery itself uses part of the fuel oil deriving from refining process (in addition to the refining gases) for heat generation. In the future, the refinery will increase, due to environmental issues (emissions of particulate matters in atmosphere) the use of methane for heat generation, replacing the fuel oil that will therefore be available for sale.

As shown in 2.1, there is currently no other railway freight traffic with the Ligurian ports. The share of railway traffic towards the Novara area can be defined as a rebound of the solid relations existing between the western Lombardy area (Milano logistic region) and the Ligurian ports, in particular to the connections of Genova with Segrate, Melzo and Arluno, of La Spezia with Rho, Melzo and Savona with Mortara (Fig 20). The Lombardy destinations represent the 44% of total TEUs moved in Genova (774.000 TEUs in 2010).

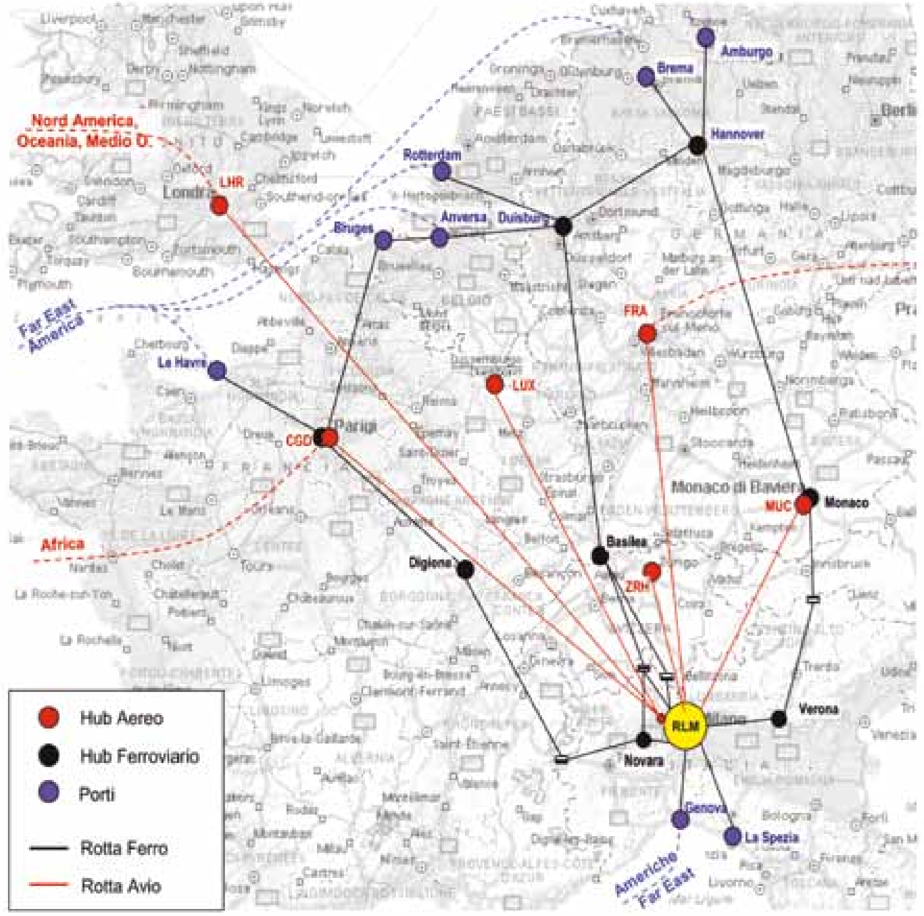
Fig. 20: Commercial flow destinations (provinces) from Genova Port



Source: Dallari F., Curi S., 2011

These solid relations with the Milano logistic region (RLM) are substantially the only railway relations to/from Genova along the axis of the Corridor XXIV, as shown in Fig. 21.

Fig. 21: Existing freight traffic (railway) along the XXIV Corridor



Source: Centro di Ricerca sulla Logistica, Università Carlo Cattaneo LIUC, 2011

A significant reason for the consolidated trades towards Lombardy is the presence in the port of container terminal owned by companies also managing intermodal terminals in the Milano area. Trades between the Novara province and the port area are difficult to estimate since they are occurred by road transport. It is therefore clear that trade concerning chemicals is a subset of this fragmented part.

5.1. Chemical companies in Novara with commercial connection with Genova port

The main chemical industries in Novara province have been interviewed. In addition to the already mentioned Sarpom refinery, which is certainly the main player in the Ligurian ports (more than 6 million t/year of crude oil, coming from Vado Ligure (SV) by pipeline), there are other significant industries within the 2 chemical districts of San Martino di Trecate and Sant'Agabio Novara industrial area. In the boxes below, it can be found some major findings related to the connections with Genova port.

Idrosol

Company of the FAR Group. The Novara plant produces sodium hydrosulphite (bleaching agent commonly used by textile and paper industry, A. D. R. class 4.2) in different purity grade. About 30% of production (22.000 t/year) is sold in Italy; other part is for export.

The export share has different destinations: EU, Central America, Turkey, North Africa and Far East. Part of the goods intended for non-EU countries passes through the port of Genova (terminal depending on vessel availability at the time of shipment).

It should also be noted, though of local interest, that the Novara plant (provided with internal railway terminal) is no more allowed to receive raw materials from its supplier Esseco. This is the consequence of policy changes in freight traffic management adopted from Italian railway company FS Group.

The other share of the raw material, mainly sodium hydroxide comes from French suppliers or from the Rosignano Solvay plant, the sodium formiate comes from the near Polioli plant in Vercelli, also belonging to FAR Group.

Esseco

A Company which operates in sulphur chemistry and is located in the industrial area of San Martino di Trecate. The main raw material (sulphur) comes essentially from hydrocarbons desulphurization, primary from the adjoining Sarpom refinery. Among the main products are: sulphur dioxide (350 t/week transferred entirely at Idrosol, see above), sulphuric acid, sulphites.

Part of the production (containerized goods, quantities and types unknown) is sent to Genova in two ways: direct road transport to Genova or intermodal transport from Rho (MI) intermodal terminal.

Aditya Birla Columbian Chemicals

Company located in San Martino di Trecate industrial area. The production consists of carbon black obtained from heavy fuels, residues of the oil refining process. The main supplier (by internal pipeline) is SARPOM refinery but there are also other suppliers. In this case, the raw material arrives by ship at the Ravenna port (where Columbian has storage tanks) and then by road tankers in Trecate.

The final product is mainly shipped in UK but few quantities are sent to Turkey and USA through the Genova port. The entity of these trades is about 10 containers per month.

Other relevant chemical plant has currently no relations with the Ligurian ports. As example, Radici Chimica in its Novara plant produces approximately 80.000 t/year of 6.6 nylon polymer, intended in equal parts to Italian (road transport) and German market (intermodal transport from the Busto Arsizio-Gallarate terminal) for textile and automotive industry. Since 2005, raw materials are transported by rail to the Boschetto railway terminal (which is connected with Radici plant). Raw materials consist of 25.000 t/year of ammonia from Ferrara, 40.000 t/year of adiponitrile (1-4 dicyanobuthane) from France and 55.000 t/year of cyclohexanol from Mantova. These quantities mean 1 tank train per week for each raw material.

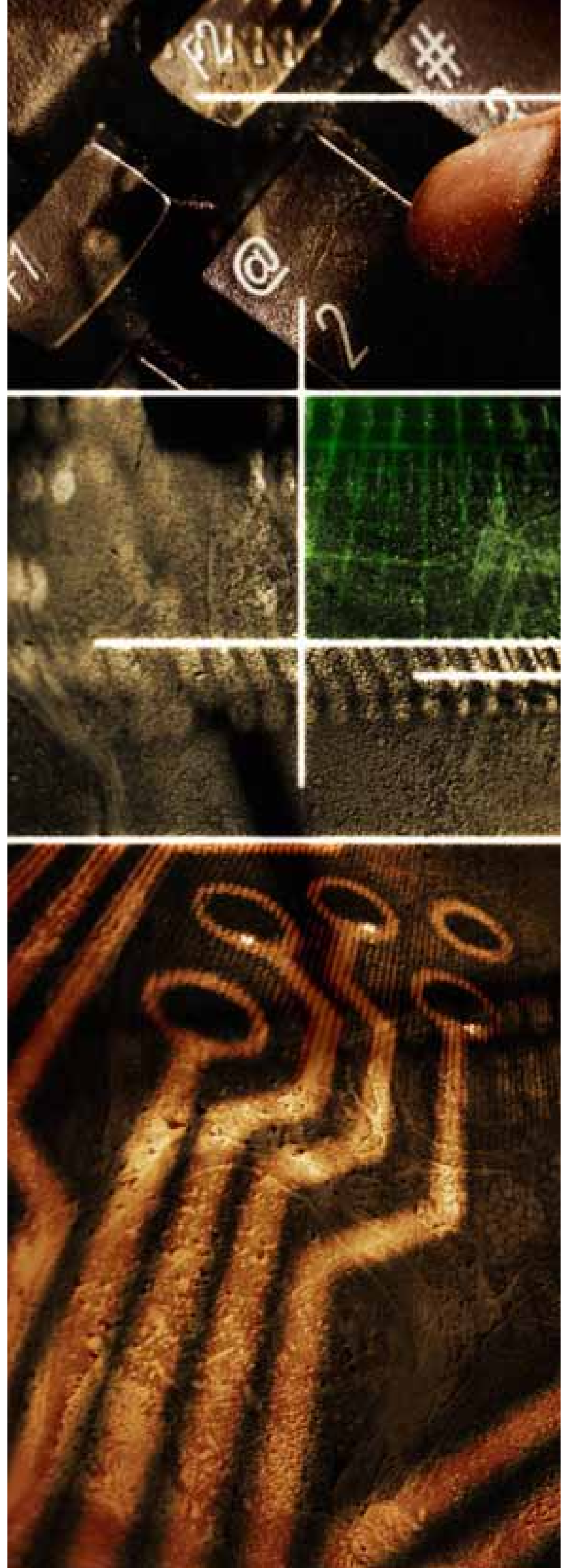
6. LOSAMEDCHEM feasibility study options

In order to improve the supply offer for chemical goods transport in the Novara province territory, some options for pre-feasibility study have been presented. Options 1 and 2 are related to renovations already in progress in CIM-Boschetto area, while option 3 and 4 are related with local implementation hypothesis of “best practices” found in other northern Italy logistic areas.

1. Relocation within the Boschetto terminal of the Radici Chimica terminal and refurbishing of the new dedicated area. As emerged from the interview with the company Radici the safety in the terminal area has to be improved, considering especially the dangerousness of the arrival of the raw materials at terminal. The terminal area is currently without fencing and alarm system and it is also dimly lit during the night.

2. Relocation of the Rolling Highway terminal with redefinition of the new road access. This service (intermodal way of transport across Switzerland from Novara to Freiburg im Brisgau where trucks are entirely loaded on train and their drivers can rest in the passenger wagon), is particularly appreciated by chemical companies and therefore has been mentioned as a local “best practice” in the previous step of LOSAMEDCHEM project. The redefinition of spaces for Rolling Highway terminal, as well as the timelines for completion of the work, may be the subject of study, given the importance of this service.

3. Implementation of a shuttle service for railway transport of chemical goods from Genova port area. This hypothesis, designed to strengthen the terminal part of the Corridor XXIV, could be interesting,



considering the traffic prediction in CIM Strategic Plan for Industrial Development 2011-2015-2019, where (as already pointed out) about 110.000 UTI per year should come to Genova port. This option could be assumed by following the existing example of the shuttle service operating since June 2011 between the freight village of Mortara (PV) and Vado Ligure – Savona port. The shuttle service currently consists of 4 roundtrip trains per week for the carriage of rail tanks mainly transshipped at Mortara freight village on trains to the Benelux countries and Germany (Ruhr area). The service is provided by an intermodal operator (Shuttlewise) which is also involved in the shuttle service Mortara-Rotterdam (5 roundtrip trains per week, operating since 2009) and Mortara-Krefeld (5 roundtrip rains per week, operating since 2012).

4. The Mortara terminal is connected via electrified junction to the RFI station of Mortara and is provided with 3 rails of (700 m in length). The structure which lies over an area of 700.000 sqm (500.000 dedicated to logistics and 110.000 for the intermodal terminal), has a potential of 9 trains per day and about 150.000 TEUs per year. The presence in the freight village of an international logistic operator for chemicals (Den Hartogh) represents a strong similarity with CIM where another important international chemical logistic company (Huktra) operates.

5. Implementation of an Information and Communication Technology system between Novara and Genova area with the aim to harmonize the Novara and Genova logistic hubs, strengthening and increasing efficiency in the last part of XXIV corridor.

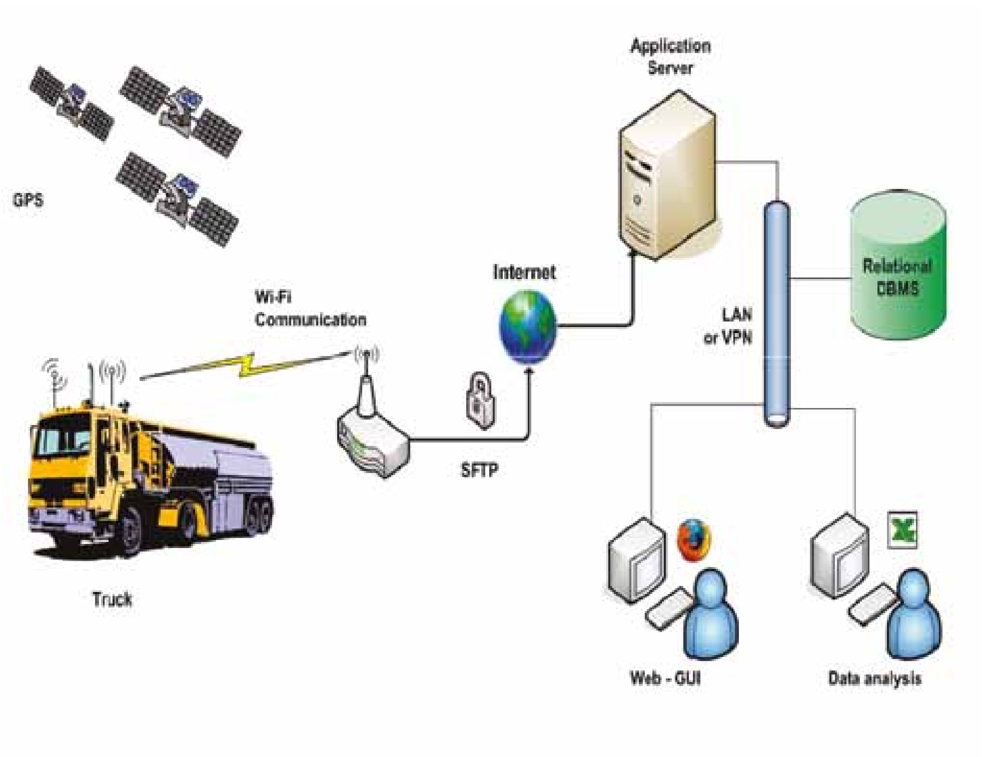
7. The role of Information and Communication Technologies in logistics

Italy is one of the EU countries with high density of internal traffic. The freight traffic is close to 250.000 million tons-km/year, 65% represented by road transport.

The issues related to this important compartment are very remarkable, as about 20% of the total CO_2 emissions in the EU is coming from road transport (while the whole compartment is about at 28%). In addition to global warming issue (CO_2 emissions), there are also serious and widespread health risks due to carbon monoxide, nitrogen oxides and particulate matter emissions, traffic jams and risks of road accident.

The definition of a harmonic transport policy with the aim to mitigate the negative aspects of road transport is therefore a strong priority for Europe. The implementation and the use of the Intelligent Transport Systems (ITS) could be part of the solution for the problems caused by road transport. Intelligent Transport Systems, based on Information Technology and Communications (ICT) tools, can collect, process, manage and transmit data related to vehicles and usability of road infrastructures. The electronic transport of goods (e-Freight) consists of a flow of electronic data and information (instead of paper documentation) which moves together with the physical movement of goods. The information systems allows to track and locate the goods traveling with different transport modes and automate the data exchange related to them (Fig. 22).

Fig. 22: Fleet management system layout



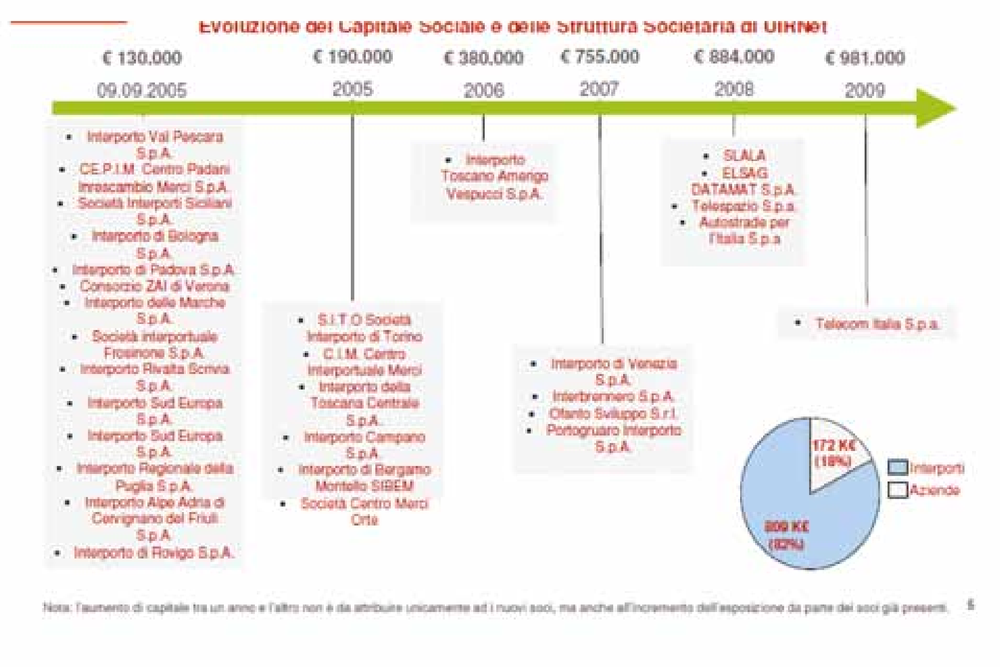
Source: ICT e logistica dell'autotrasporto, Università La Sapienza, 2010

These systems have increased safety during transportation and have improved the environmental performance of the logistics industry, thanks to the possibility of optimizing the loads and the paths, thus reducing the incidence of unloaded travels. In the UE, some projects in order to define a trans-national ITS architecture, such as Keystone Architecture Required for European Networks (KAREN), FRAME-NET and ACTIF (french initiative Architecture Cadaunore des Transports Intelligents en France to define a national architecture), have been carried out. The development and the dissemination of an ITS on a national scale, however, requires the definition of a strategic framework with solid guidelines in order to allow integration between different existing ITS. To reach this goal, the Ministry of Infrastructure and Transport, in September 2001, has promoted the ARTIST Project (Italian framework for a national ITS platform). The primary objective of ARTIST has been to provide to stakeholders (public bodies, bodies of standardization, private companies) the general design guidelines for an ITS compatible with the already existing national and European ITS. The ultimate goal of the ARTIST project was therefore to help the development of the ITS market, with particular attention to the interoperability between the different modes of transport. Taking from ARTIST project guidelines, the UIRNet project (platform for national logistic industry) was born.

7.1. UIRNet: the Italian ICT platform for logistics

The platform for logistics UIRNet was designed in 2005 by the Ministry of Transport and Infrastructure. To develop this product a company (UIRNet S.p.a.) whose company profile is summarized in Fig. 23, was founded.

Fig 23: UIRNet S.p.a. company profile (shareholders) evolution

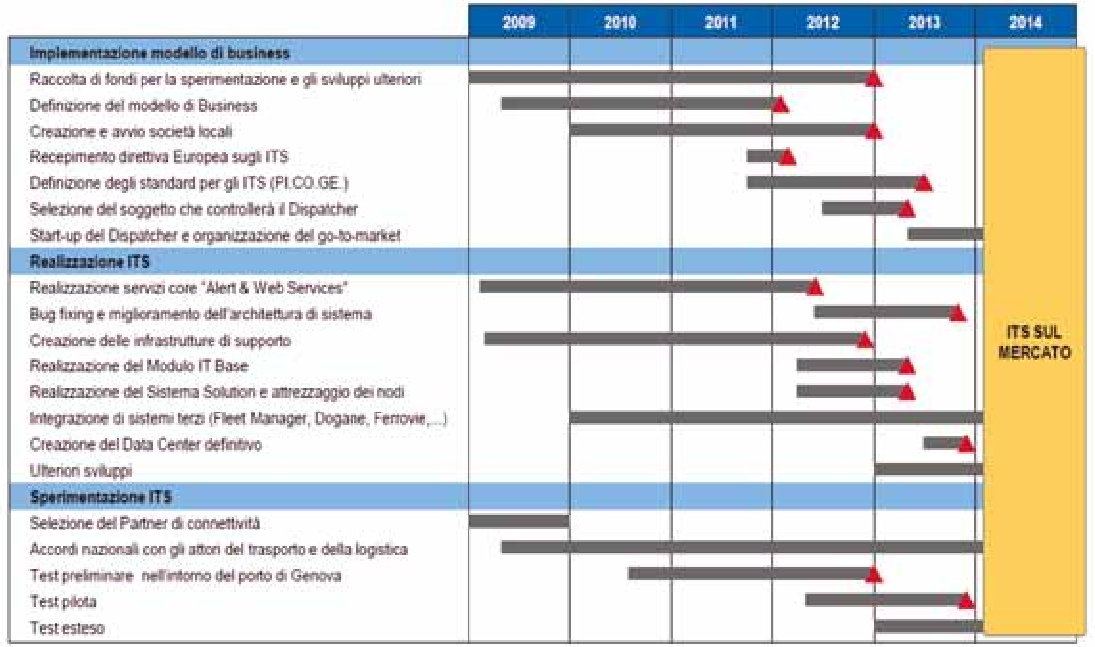


Source: UIRNet S.p.a.

The technology partners of UIRNet S.p.a. are: Elsag Datamat S.p.a., Telespazio S.p.a., Autostrade per l'Italia S.p.a.

UIRNet, which is next to the official presentation (in Fig. 24 is represented the timescale of development activities), proposes itself to offer services and solutions for different types of operators, in particular: conveyors (drivers, small and medium-sized enterprises equipped with vehicles for transport, large transportation companies), logistic companies, ports and freight villages.

Fig. 24: UIRNet project timetable



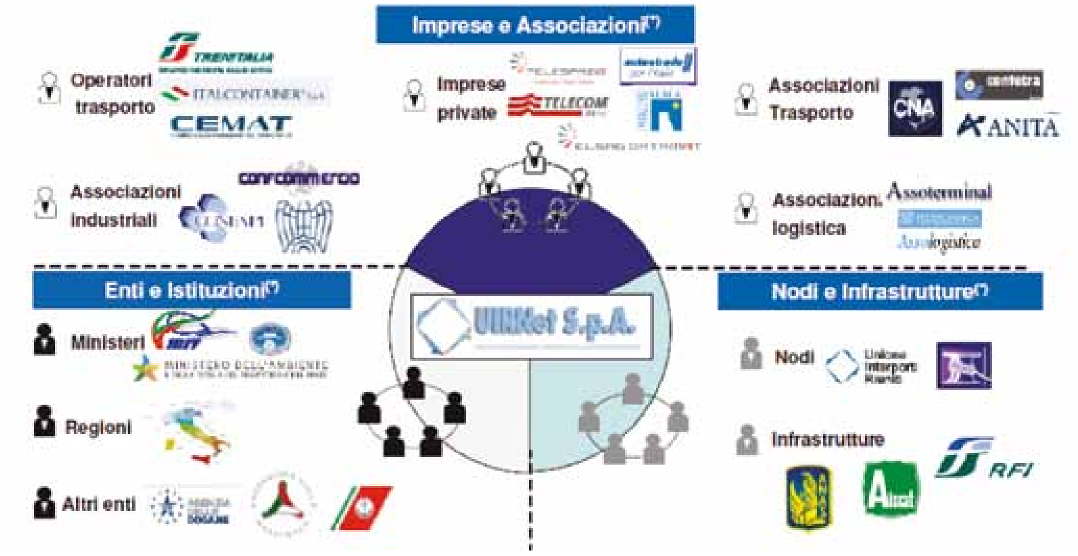
Source: UIRNet S.p.a.

In particular, the mission of the platform will be the improvement of the efficiency and security of the national logistics system, offering information to optimize the travel paths, the loads and the travel monitoring with systems of tracking and tracing. The main mode to reach this goal is the integration into a single computing platform of transporters and companies dealing with logistics. In Italy there are more than 3,3 mil. of freight vehicles (more than 800.000 with payload over 3,5 t). This market is characterized by a remarkable pulverization of transport enterprises: 64% of the operators is represented by individual entrepreneurs and over 94% of the companies has less than 10 vehicles.

In order to use the features offered by the UIRNet platform, trucks will be necessary equipped with an on board GPS tracking system. There are currently some experiments. The Interporto of Rivalta has equipped 90 semi-trailers with a GPS tracking system open to UIRNet platform, and Autamarocchi an important transport company with a significant presence at the port of Genova (about 300 vehicles), which has a voluntarily integrated part of its fleet in UIRNet system, thus making it "dynamically visible" on the platform UIRNet through integration between the platform itself and the already existing fleet management system within the company.

The widespread action of UIRNet is supposed to lead to a significant interaction with a large number of stakeholders, as shown in Fig. 25.

Fig. 25: UIRNet public/private stakeholders

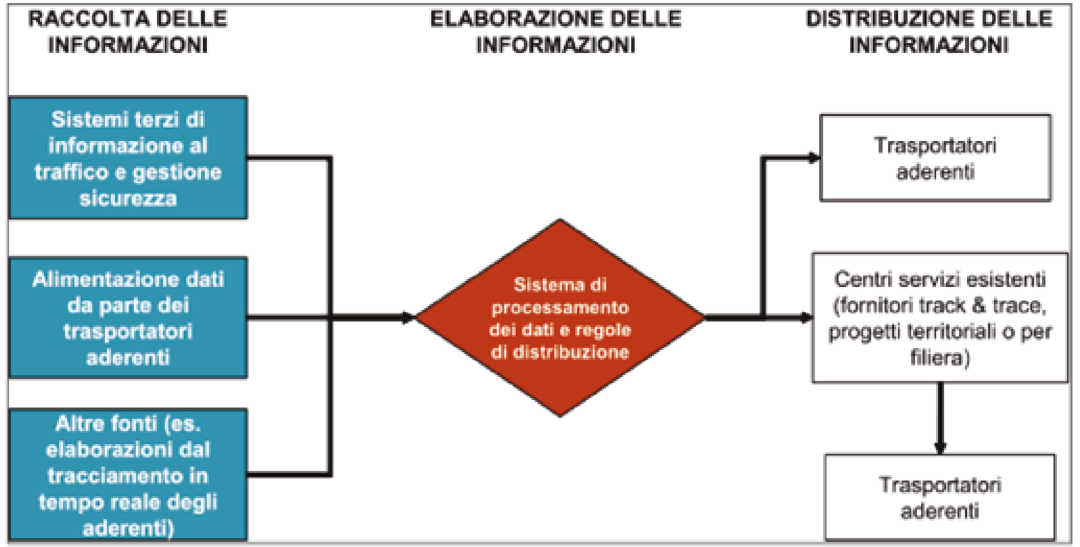


Source: UIRNet S.p.a.

Having to deal with the already existing ICT systems, UIRNet will be equipped with a middleware to help application-level integration with other ICT systems of large logistics operators and institutions such as: Polizia, Vigili del Fuoco, Protezione Civile, handlers of transport infrastructures, AISCAT, CCISS, etc. The platform will be able to manage flow of information relating to different areas:

- Information services (info-mobility): state of traffic and weather conditions, both during the organization of the journey and "real time" monitoring. Through the UIRNet service center it will be possible to check the status of the monitored transport (positioning and average speed) with the information exchanged with other service centers (CCISS, Polizia Stradale). The information flow is shown in Fig 26. The carrier holds the option to enable/disable the services of infomobility and tracking and tracing by calling the operating center or by sending a message (via SMS, mobile portal or email). In the case of monitoring service enabled, the vehicle position is checked at regular intervals and any faults (e.g. deviation from the original path) will be notified by the system and the operational center (named Situation Room), by contacting the driver can check the cause of the problem.

Fig. 26: Information flow management



Source: UIRNet S.p.a.

• Interoperability Services: services for supply and demand matching, reservation services and accessories provided by logistics companies and infrastructure managers, documentary information flow for goods. In this context, the system will provide: transport offer boards (provided by logistic operators) and transport request boards for companies, links to intermodal operators websites. There will also be implemented services for "last-minute" transport deals with notifications of availability by transporters to carry out loads during the trip (e.g., in case of unloaded returns).

• Booking Service: features allowing the booking of spaces for the loading and unloading operations and the ancillary activities. The reservation (and confirmation) will be performed via web through the reservation system, sending messages from mobile equipment or mobile phone. The functions associated with this service would include: booking of services for the transported goods, booking of loading/unloading operations at the logistical areas, custom services, and technical assistance for vehicles, and room reservation at any accommodation facility participating in the system UIRNet.

The alarms and information sending system (UIRNet Alert) will be available to the UIRNet users on any workstation equipped with a web access, while for the drivers the platform will be available on mobile phone (via call center, SMS, mobile portal) or by onboard multimedia equipment with a web connection.

UIRNet Alert will be interoperable with tracking and tracing systems for railways and maritime. In this way, the UIRNet platform, may also be useful in context of the intermodal transport to know the exact location (and the estimated arrival time) of trucks booked for the train composition. In Fig. 27 it is shown the portal user interface in monitoring mode.

Fig. 27: End user UIRNet interface

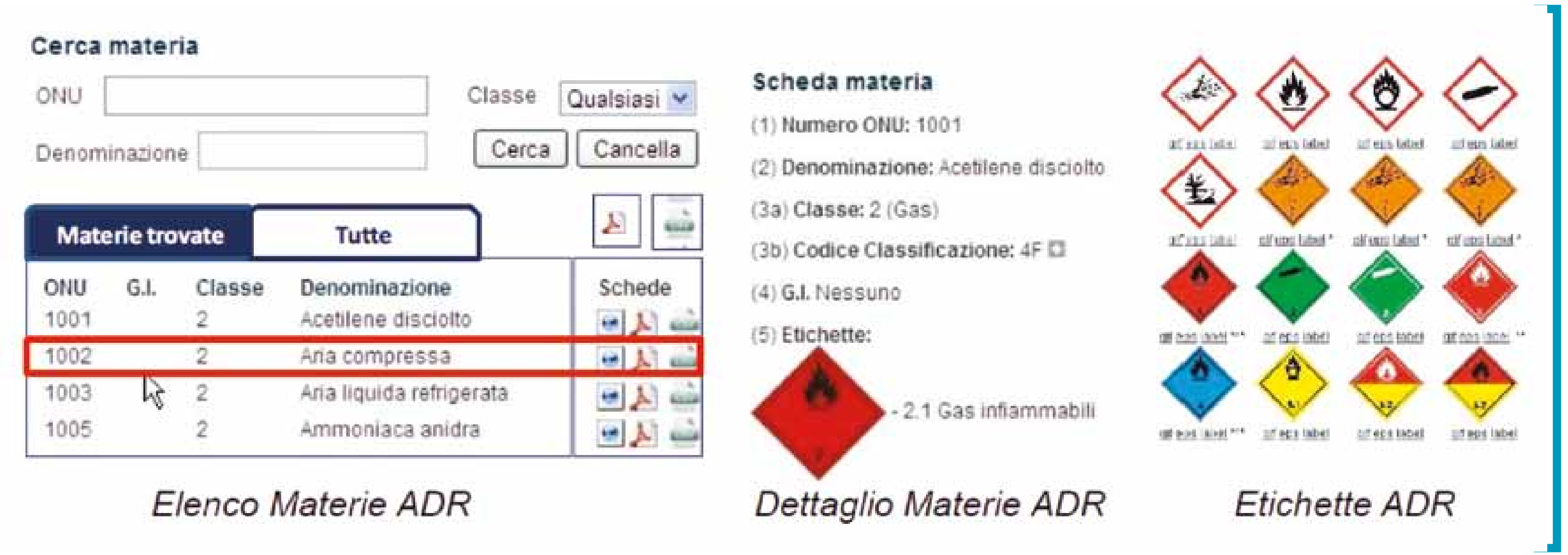
Source: UIRNet S.p.a.

A further important point of UIRNet platform will be the future implementation of a specific module for the management of dangerous goods transport which can be integrated with on board sensors (monitoring pressure and temperature) to detect any abnormality in the load and to transmit alarms. The management of dangerous goods system will allow to specialize the control system of the loads, including:

1. Complete tracking of dangerous goods with management of the acceptance, delivery, warehousing of goods classified as dangerous;

2. Report of the risks associated with dangerous goods with message board and risk management tools to predict and analyze the risks associated to hazardous substances (Fig. 28).

Fig. 28: A.D.R. substances database



Source: UIRNet S.p.a.

7.2. WOLT platform

WOLT (Web Oriented Logistic and Transport) platform was developed by Crosstec S.r.l. (subsidiary of CIM S.p.a.) in 2008 to trace the container paths within the railway terminal to optimize the handling. It is based on GPS positioning and Wi-Fi - GPRS transmission.

The architectural scheme adopted allows rapid development of new functionalities in different areas, thus reducing time and costs of the project.

The main points of the architecture are:

- Dynamic configuration of the information interface and multilingual customizable database;
- Profiles configuration with adaptable security options for users, roles and functions;
- Communication and document management services;
- Compliance to the World Wide Web Consortium standards (W3C) and compatibility with all browsers.

The framework offers several pre-configured elements:

- Reference template
- Integrated development environment
- Safety management
- Interactive help function;
- Dynamic menu
- Working groups and mailing list management
- Database for company data, products and services.

The activities to be performed are represented by WOLT in a structured way in connection with the resources responsible for the activity implementation. The actions to be taken can be generated in manual mode, automatically (through scheduling algorithms) or via the integration to the platform of external systems. The control panel provides operational plans containing the planned operations scheduled at different times (instant, day, week, month, year). Each action has a priority code and is managed through an information flow concerning the progress of the work.

WOLT platform adopted at Novara CIM freight village is GPS-based with Wi-Fi data transmission. The 12 mobile cranes (operating 24h/day) in CIM are equipped with a GPS system, a Wi-Fi connection and an on-board computer with touch screen. The entire area of the freight village is covered by a Wi-Fi connection using 6 antennas located on light towers. The technology allows to follow the mobile cranes in every moment and to recognize the loading and unloading operations, any stacks of containers and to detect possible false hooking. By acquiring this information, WOLT can virtualize a dynamic mapping of the terminal exactly suited to the existing situation. In addition to the reconstruction of all the paths of the freight inside the terminal, the system allows to manage information flows related to all the fields of interest for incoming goods, such as:

- customer
- sender
- recipient
- net weight
- tare
- driver
- vehicle license plate
- date of departure and arrival.

In addition to this information, it also provides the possibility to load other data, such as:

- identification of the crane operator inside the terminal
- hours of input and output
- presence of damage on the external case
- presence of goods under A.D.R.

WOLT is also able to provide information on type and dangerousness of the freight handled, giving indications where to store dangerous goods (CIM is provided with a specific storage area for dangerous goods).

Concerning compatibility with other ICT systems, WOLT is inter-operative with any system adopted by the rail operators.

7.3. E-Port platform

E-port is a project of the Port Authority of Genova aiming to computerize the documental exchange of cargo traffic. In the first phase the project (started in 2005) was targeted at the reorganization of the document management of the container exiting from terminals VTE and SECH. From 2007 onwards, the E-Port system has been extended, with appropriate adjustments, even to the other terminals, according to the different freight handled and to the different actors managing them. The first result of E-Port application has resulted in a considerable reorganization of exit procedures of containers in the VTE terminal allowing obtaining default timing during the import operations, a time reduction in the exit operations from the terminal of the heavy load vehicles. In a second phase (2007) the procedure of reservations for withdrawal of the SECH terminal has been fully computerized.

The E-Port system involves a plurality of actors operating in the port area: the ship forwarder, the terminal manager, the shipping agent, the customs agent, the gate operator and the lorry driver. This last category uses a booking procedure for the arrival time which is being integrated with UIRNet platform. Currently the platform is already in the experimental phase and it shows good potential reducing then transit time of vehicles to the container terminal at about 50%. E-Port allows to reduce the waiting times of trucks (generally caused by incomplete documentation) gathering in advance all the information required at the port, intercepting trucks moving to the loading/unloading bays, acquiring the documentation in electronic format and sending alarms in the case of incomplete documentation.

ICT options for pre-feasibility study

The choice of the Province of Novara, as a result of the previous submission of the feasibility options, is to pursue for the project LOSAMEDCHEM a theme related to the ICT. The willingness to increase the bonds to the port of Genova along the axis of the Corridor XXIV, narrows the field of investigation to the existing and conceivable links along this route. The main theme of research will be therefore the role of ICT, especially in the field of chemical logistics.

In particular appeared worthy of study the following points:

- ICT for railway transport on a specific existing railway connection expected to grow up: development of the relationship between SARPOM refinery and port of Genova with improvement in the systems communication between SARPOM, Trenitalia and Getoil oil terminal.
- ICT for road transport with potential applications: development of a relationship network between chemical companies in the Novara area with port of Genova (to which terminal?) and possibility of application of UIRNet platform to improve the freight transport management through UIRNet experimentation with logistic operators currently in charge of transferring goods.
- ICT for road transport: development of relations between the port of Genova and CIM freight village through the use of UIRNet platform as an integration between WOLT and E-Port. UIRNet could add some information for freight flows tracking.
- ICT for railway transport on a theoretical connection: hypothesis on ICT integration between port of Genova and CIM freight village to manage railway traffic between the 2 hubs.

8.1. Viable solutions for the implementation of UIRNet platform on a local scale

The analysis of the local scale, both from existing infrastructures and chemical companies point of view, has highlighted substantially 2 application possibilities for UIRNet platform.

8.1.1. UIRNet platform implementation at CIM S.p.a.

The project UIRNet can be defined as an "integrator" for ICT systems. The main actor on local scale for a UIRNet implementation is CIM. A UIRNet integration with WOLT could be developed for the management of the booking arrival time at the gates and for the transfer of electronic travel documentation. The result of integration could result in a greater predictability of arrivals and consequently a better fluidity in the management of the internal handling. Interviews carried out at CIM (Crosstec S.r.l.) showed a predictable easy interoperability between systems UIRNet and WOLT. At present time, however, it is not possible to make specific assumptions about costs for a system since UIRNet has not yet been officially presented. In any case, only an "intangible" integration cost is predictable, mainly related to programming activities.

It is foreseeable that integration activities would be carried out by Crosstec S.r.l. internal staff. For integration projects, some professional figures are usually commissioned: a project manager with the responsibility to manage the working progress, a senior programmer as supervisor of one or more junior programmers in charge of carrying out the most operational activities.

Having to estimate the integration cost between the two systems and lacking information about Crosstec S.r.l. internal professional figures (and related costs), an hypothesis based on completely outsourced project cost (professionals from external company) has been made. The hourly estimated cost (all-inclusive cost for the retrieval of external staff) of these professional figures varies from 50 € (junior programmer) to 120 € (project manager). The timetable (Fig. 29) conceivable for a complete integration between the two systems is approximately 6 months (the first one is intended for a in-depth analysis of the UIRNet system, the second and third for operating activities and the last two months are dedicated mainly to a "on field" task verification and debugging of the work completed in step 2). The total estimated cost stands at about 24.000 €.

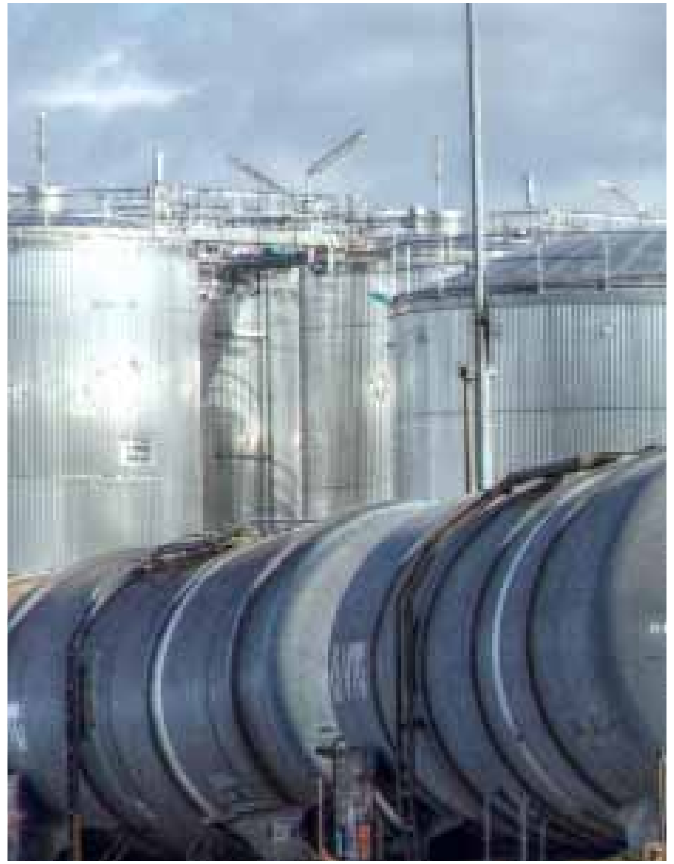
Fig. 29: Timetable and budget for UIRNet integration at CIM

Professional skill	Hourly Cost	Step 1 Month 1 (hrs)	Step 2 Month 2-4 (hrs)	Step 3 Month 4-6 (hrs)	Total (hrs)	Total (€)
Project Manager	120 €	20	20	10	50	6.000
Senior Programmer	70 €	80	40	20	140	9.800
Junior Programmer	50 €	10	120	40	140	8.500
Total					330	24.300

Source: self elaboration

Positive results in terms of added value offered by UIRNet to the CIM handling management system cannot be evaluated regardless of the UIRNet diffusion among the truck drivers. It is in fact necessary, as well as the static integration at freight village, a diffuse subscription and appreciation of UIRNet platform at any logistic level. This is a fundamental issue for any challenge for the platform to become the national standard. It has to be said that currently in Italy only about 20% of the commercial vehicles have a satellite tracking system, which is the primary requirement for the platform usability. The extreme pulverization of the Italian trucking sector makes even more complex the diffusion of the system, given the multitude of individualities to deal with.

The attention that haulers could reserve to the platform will be dependent, in addition to the actual added value, also by the on board adaptation costs. These consist mainly of the integration cost of UIRNet with the already existing tracking and tracing system or (more frequently) lacking a GPS tracking system, in the cost of buying it. This is estimated between 500 € and 1000 €/each (including installation) for mid-range products. Part of this cost, however, it could be recovered as insurance bills against theft and get lower when the vehicle is equipped with a satellite tracking system.



Interviews were carried out with UIRNet S.p.a. staff, in order to evaluate the positioning strategies of the product on the market and the following significant points have emerged:

- a massive marketing operation has to be done at all the stakeholder levels. In particular, it is crucial to gain the cooperation of the several driver associations in order to support the platform adoption within the members. Currently the scarce presence of GPS tracking systems on commercial vehicles in Italy is a strong limitation to the affirmation of the system. For this reason UIRNet is studying at a free allocation possibility of about a thousand of GPS kits. From this point of view, the interest in UIRNet shown by the local Confartigianato (workers association also including driver associations) during the Regional Stakeholders Meeting on 8th May 2012 held in Novara, is remarkable.
- the widespread reluctance of the transport sector to provide and share personal data in a common platform such as UIRNet is a real important threat. It has in fact observe a strong will in keeping private information, while it is clear that the sharing of information flows is the basis for the real usefulness of the platform. The management of sensitive data should therefore be carefully managed and a robust privacy policy should be explained to all the logistic operators.

8.1.2. UIRNet implementation for local chemical companies

Regarding the possibility of UIRNet integration with local chemical companies appears the possible interaction with SARPOM refinery of San Martino di Trecate. During the above mentioned Regional Stakeholders Meeting it has been shown that the refinery has some problems in load management of the road tankers. Currently the loading average volume stands at about 300 road tankers/day with an average time for loading operations of about 45 minutes. The unpredictability of road tankers arrivals creates situations of congestion at the loading bays with waiting times up to 2-3 hours. SARPOM seems therefore quite interested on a hypothesis of UIRNet system integration for a better management of arrivals at the loading bays. In this case, it is foreseen a strong need for a massive membership to UIRNet platform by the tanker driver coming to the refinery. On the driver side, it is also likely that the interest in UIRNet can be very significant if the system will prove a strong potential for the reduction of waiting times.

References

AISCAT (2011), ***AISCAT Informazioni***, n. 3-4/2010, Roma.

Alptransit San Gottardo (2011), ***Alptransit in Ticino***, Edizione 02/11, Bellinzona.

Alptransit San Gottardo (2012), ***Nuove vie di transito attraverso il cuore della Svizzera***, 04/12, Lucerna.

Autorità Portuale di Genova (2011), ***Il Porto di ieri,di oggi, di domani***, Genova.

BLS Alptransit AG Kommunikation, ***Loetschberg tunnel di base***, maggio 2000, Thun.

Campagna A., ***ICT e logistica dell'autotrasporto***, Università La Sapienza, 2010.

Censis, Unione Interporti Riuniti (2009), ***Il disegno dell'interportualità italiana***, Franco Angeli, Roma, 2009.

CIM (2011), ***Piano Strategico di Sviluppo Industriale 2011-2015-2019***, CIM S.p.a., ottobre 2011.

Comune di Verbania (Ente Capofila) (2008), ***Programma Territoriale Integrato - VCO Qualità in movimento***, Programma Operativo, Verbania.

Dallari F., Curi S. (2011), ***Il sistema logistico in Lombardia: trasformazioni in atto e scenari evolutivi***, Milano, ottobre 2011.

Energia e territorio S.p.a., Provincia di Alessandria (2007), ***La rete ferroviaria del Nord Ovest al servizio dei porti liguri***.

European Commission (2005), ***Trans-European Transport Network. TEN-T Priority Axes and Projects 2005***, Office for Official Publications of the European Communities, Luxembourg.

Ministero delle Infrastrutture e dei Trasporti (2010), ***Le Linee Politiche del Piano Nazionale della Logistica***, dicembre 2010, Roma.

Ministero delle Infrastrutture e dei Trasporti, D'Appolonia S.p.a. (2011)***, Piano della Logistica: analisi dei processi di filiera, morfologia dei flussi logistici internazionali***, agosto 2011, Genova.

Oddone P. (2012), presentazione dell'Autorità Portuale di Genova al convegno ***"Lo scenario della Logistica Chimica in Italia: Sviluppo, Sicurezza e Sostenibilità"***, Federchimica, Milano, luglio 2012.

Provincia del Verbano-Cusio-Ossola (2009), ***Piano Territoriale Provinciale***, Verbania.

Provincia di Novara (2004), ***Piano Territoriale Provinciale***, Novara.

Regione Piemonte (2010), ***Accessibilità e mobilità in Piemonte: la gestione del processo di pianificazione***, gennaio 2010, Torino.

Regione Piemonte (2010), ***Piano Regionale per la Logistica***, Torino.

Tadini M. (2008), L'offerta logistica del territorio novarese: scenario attuale e prospettive future, in ***Annali di Ricerche e Studi di Geografia***, n. 1-2, Pàtron Editore, Bologna, pp. 16-32.

Tadini M. (2010), ***Lo scenario infrastrutturale e dell'intermodalità trasportistica***, in Emanuel C. e Tadini M., a cura di, ***Progettare il cambiamento. Analisi, scenari e strategie per il quadrante territoriale del Nord-est piemontese***, Mercurio Edizioni, Vercelli.

Ufficio Federale dei Trasporti (2007), Apertura della galleria di base del Lötschberg, in ***Swisstraffic***, n. 43 – numero speciale, giugno 2007.

Ufficio Federale dei Trasporti (2012), ***Alpinfo 2010***, Berna.

UIRNet (2007), Capitolato speciale gara piattaforma UIRNet.

UIRNet (2012), Manuale Introduttivo, Piattaforma Logistica Nazionale, aprile 2012.

Web References

http://www.assocostieri.it

http://www.bav.admin.ch

http://www.cimspa.it

http://www.crosstec.it

http://www.getoil.it

http://www.gruppospinelli.com

http://www.messinaline.it

http://www.portopetroli.com

http://www.sech.it

http://www.silomar.it

http://www.uirnet.it

http://www.vte.it

Genoa
Chemical ICT platform

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Chemical ICT platform

Topic of feasibility study: implementation of a monitoring and intervention network for chemical (dangerous) traffic flows through the integration of the different ICT systems

Introduction

The introduction is important to define the topic of the feasibility study; its main goal is to clarify the general objective of this study, which in its broadest meaning, encompasses the improvements foreseen in the field of chemical logistics, but then taking into account specific problems.

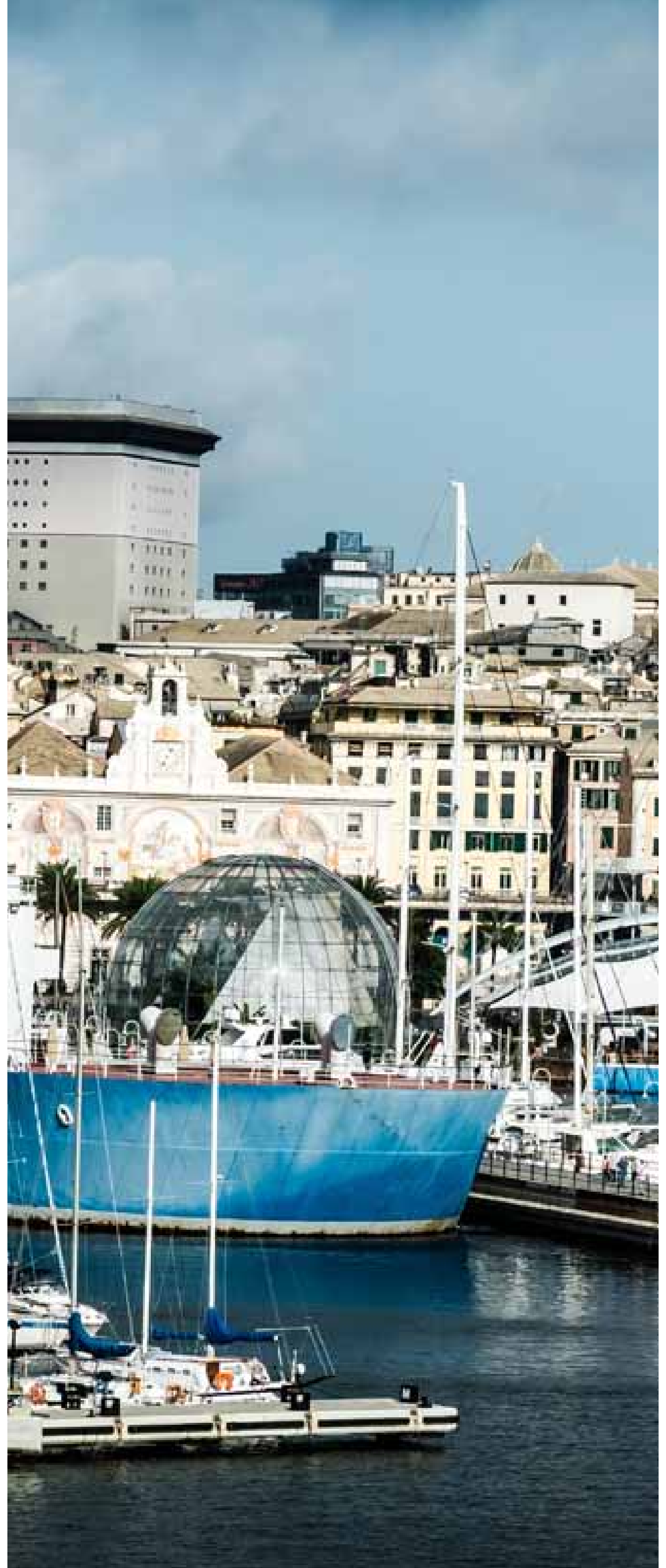
Problems generally arise from the results of the SWOT analysis that all partners have already performed, referring to their own country and chemical industry/chemical logistics.

The feasibility study deals with the implementation of a system for the monitoring and intervention related to the traffic flows of chemical (dangerous) goods on the land infrastructures network (especially road infrastructures). The infrastructural networks taken into consideration will be the ones of the national territories involved in the project, with particular reference to the area of North West Italy and to the traffics that links this area with the hinterland of the TEN-T Corridor Genova – Rotterdam.

The purpose of the proposed action is to have at a centralized level, the visibility and traceability of these flows for safety purposes and to smooth the logistics flows with the aim of improving the intermodal chain.

The flows could be recorded and monitored from the access to the land transportation network (via ports and alpine border passes) to the arrival at the final destination (and vice versa).

The project proposal would be based on the integration of the existing ICT systems already operating in the different nodes of transport, with particular reference to the Port Community System of Genoa (E-Port) and the ICT platform for the management of the Italian Logistics net (UIRNet).



The system would be capable to make the different traffic management platforms interoperable (ITS, Customs Systems, Maritime Authority and VTS systems, Operators Systems etc.) in order to obtain a full traceability of the (dangerous) chemicals cargo and to facilitate the intermodality in the nodes of the logistic chain.

As underlined in the SWOT analysis, the information and data exchange among transport players is a priority both for private and public actors and can be improved.

The possibility to have a comprehensive and in depth monitoring of chemical flows on the net allows to plan better the infrastructures utilization, to have an on-real time updated information of the position of the cargo, to exchange information about the intermodal flow, to organize ad hoc controls and monitoring campaigns, to manage interventions and crisis situations. All in the perspective of increasing the safety (and security) of chemicals logistics.

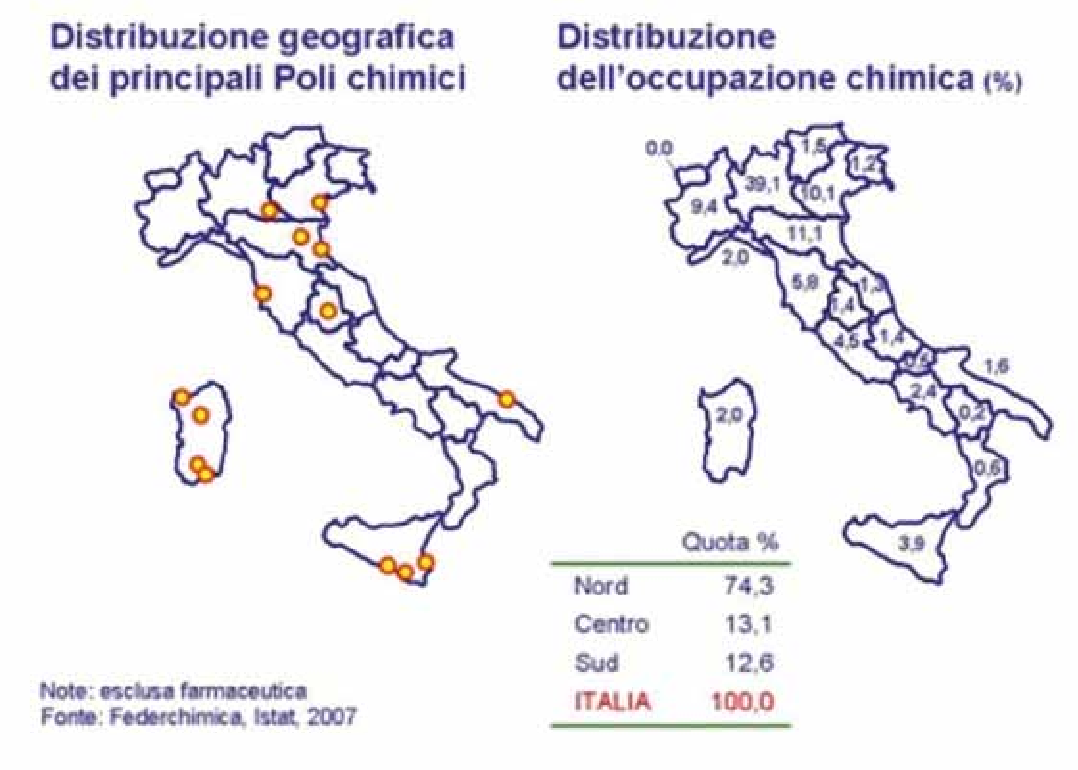
A confrontation group of public and private organizations and stakeholders, including the Port Authority and UIRNet, will support the implementation of the project proposal.

Description of current situation

Because LOSAMEDCHEM's project is mainly related to chemical goods transportation chemical, this section is devoted to:

- Description of transport volumes and relevant modalities (current volume figures, most used modalities, especially for dangerous goods, regulations in vigor, etc.) and of most critical issues.
- The transnational dimension of the traffic and the countries involved; which are the possible synergies with other LOSAMEDCHEM partners.
- Which are the pan-European corridors sustaining the bulk of traffic.
- Which is the relevance for the chemical industry and chemical logistics.
- How important is/could be the utilization of its technologies.

Italian chemical industry is one of the most dynamic and internationalized in the national economic environment. Italian chemicals exports are growing requiring an even more efficient and effective logistics chain. Northern Italy represents the main Italian pole for the production of chemical goods and consequently the infrastructural network of Northern Italy accommodates relevant flows of them.



Roads and seaports represent two of the main assets of the Italian infrastructural network and, looking at statistics, road and maritime transportation are the most relevant modes of transport for chemicals traffics.

In this context the port of Genoa and Trieste, partners of the project, are very relevant, since these ports are the main gateway and of the most important chemical district in Italy. For instance, the traffics of containe rized dangerous goods in the Genoa port increased 67% during the last five years (+14% ACGR).

The largest part of the containerized traffics, almost 85%, uses road transport to link the port and the hinterland, but intermodal transport based on railways can represent a further development opportunity to increase the geographical scope and to improve the whole safety of the chain.

These traffic flows have a broad transnational scale since they have origin/destination, via maritime transport, in a vast geographical area. They are relevant not only for the other Italian LOSAMEDCHEM Partners, but also for the other Med countries (and partners).

The TEN-T axes that are more relevant for the Genoa traffic are: PP 24 Railway axis Genova/Rotterdam, PP 21 Motorway of the Sea, PP6 Railway axis Lyon – Ukrainian border and PP1 Railway axis Berlin/Palermo.

Safety remains one of the most relevant issues dealing with flows of this kind of goods, both for public bodies and for private firms. Especially with reference to road transport the number of accidents represents a relevant concern that can be addressed and improved by the proposed action.

The impacts of the proposed action are expected to be significant for the supply chain of chemical goods. Among the different kind of impacts we can expect:

Safety and security of the chemicals flows, especially considering the relevance of dangerous goods flows in terms of:

- possibility to punctually track and trace the cargo
- data protection
- possibility of intervention in case of emergency
- accessibility of information to Public Authorities
- more utilization of rail transport.

Efficiency of the logistic chain in terms of:

- efficient use of the infrastructures and of the transport capacity
- reduction of lay-up times and queues
- rationalization of the information exchange between the logistic actors.

Quality of the transport flow

- reliability of the operations
- smoother flow through the port and land transport net
- punctuality and time savings
- integrity of the cargo
- reduction of the emissions.

The proposed action is based on the use of ICT technologies that will represent: the mean for the mapping, monitoring and tracing of the flows on the infrastructural net; the link among the different traffic management systems; the instrument for data and information circulation.

The evolving legal framework related to logistics integration is also relevant to describe the current situation in which the feasibly proposal is developed.

The following legal interventions have to be highlighted:

- Art. 46 of Law 2011/214 deals with the integrated logistics systems
- Art. 61 bis of Law 2012/27 regards the completion of the Italian Logistic Platform
- Bill on the "Framework law on inland terminals and territorial logistics platforms" (Disegno di legge A.S. n. 3257 - "Legge quadro in materia di interporti e di piattaforme logistiche territoriali").

In particular, the Art. 46 of the Law 2011/214 states that the Port Authorities can promote the realization of infrastructures linking the port to the hinterland, by establishing logistics systems in cooperation with the regions, the provinces, the municipalities interested and also with the infrastructures managers. The proposed feasibility is coherent with the perspective defined by this new law.

The Art. 61 bis of the Law 2012/27 is also particularly relevant since it designates UIRNet as the unique organization entitled by the Italian Ministry of Transport to develop and manage the platform for the national logistic net. The new article includes also the ports in the experimentation of the platform itself. This is a very crucial aspect since the present feasibility proposal has the UIRNet platform as a pivotal element in the integration of the ICT systems involved in the chemicals transport.

UIRNet began its development in the road transport field, is now working also in the intermodal and rail transport, in order to increasingly cover the complete organizational process in the different component of the national logistic platform. This point is relevant at least from two points of view: Firstly, NW Italy is the most important area for chemical production in the national territory and is the natural hinterland of the Genoa Port. Secondly the development of rail share is one of the key targets of the European transport policy and a strategic goal for the Port of Genoa. The second phase of implementation of the platform for the national logistics net is starting and will be focused also on the intermodal and rail transport, and it consequently offers an opportunity to develop the use of rail modality in the port.

Moreover, this second phase of development of UIRNet predicts an important component for the traffic of chemicals goods; the proposed feasibility can represent a draft scheme for the future implementation of the platform for the national logistics net in the field of the chemicals logistics from the perspective of the LOSAMEDCHEM Partnership. The work and the relationships deriving from the feasibility proposal and from LOSAMEDCHEM Partnership represent a starting point and a privileged strategic channel for UIRNet to implement the component for the traffic of chemicals goods.

[Description of main problem(s)]

Detailed analysis of the critical issues: bottlenecks, barriers, deficits, etc., supplying also, when possible, comparison with best practices available in Europe, not only in the Mediterranean basin.

The proposed action can allow to track the cargo and its documentation from the land haulage to the maritime last/first mile passing through port operations. Especially dangerous goods, which require a further authorization and monitoring process would benefit by such process.

The proposed action can provide the operators a comprehensive tracking and tracing of the cargo which, on the one hand, allows to supply the clients with a service highly desired by the market and, on the other hand, permits a better exploitation of the infrastructures and the vehicles capacities. For instance, the Port Authority and the terminal operators could better plan the use of port spaces and facilities while transport operators (especially the truck companies and the drivers) could optimize the voyages and the load factor of the trucks.

The Public Authorities could have the visibility of cargo flows both for the routine control and monitoring activity to intervene in case of emergency or crisis situation; this is relevant for the safety and security aspect of intermodal transport and particularly with respect to the flows of dangerous goods.

A better coordination among the different Authorities in charge of control and intervention (Police, Fire brigades, Coast Guard and Maritime Authority, Port Authorities, Civil Protection, etc.) can be achieved by the proposed action by the means of the ICT system.

The system and the control room can also provide standard procedures to the actors involved in controls, a support for planning prevention actions and protocols of interventions in case of accidents or crisis situations.

Further, the present lack of integration among the systems could cause a "grey zone" in the intermodal chain with respect to safety and security that could be better controlled under the unique umbrella of the ICT system.

Going more in detail, some crucial issues have been highlighted during the SWOT Analysis and the development of the present feasibility proposal:

• interoperability of the authorization process for the dangerous goods (land side) in the ports with the National Logistics Platform and its better integration with the operational procedure in the port and outside the port thanks to the possibility of tracking and tracing the cargo.

• optimization of the operational management at the gate and in the terminals, with particular reference to the use of the IMO parks in the port terminals.

• access to the port and inland terminal by the truck drivers and their identification, also with reference of being in the possession of the ADR driving license.

• trucks congesting or queuing at the port gates and in the road network around the port in case of emergency situation causing a limited functioning or closure of the port (such as bad weather conditions) or in case of documental deficiencies. This problem is even more serious when trucks carrying hazardous goods are involved in the congestion or queue events.

• transit of trucks carrying chemical, or even dangerous, goods in urban areas while approaching/leaving the port. Considering that the Genoa port is surrounded by the city, it's crucial that trucks approaching/leaving the terminal facilities avoid passing through some sensitive areas.

• Need of improving the use of rail transport in the port of Genoa, with particular reference to the rail connections along the Corridor 24 axis.

[Feasibility: proposal of selected projects/measures]

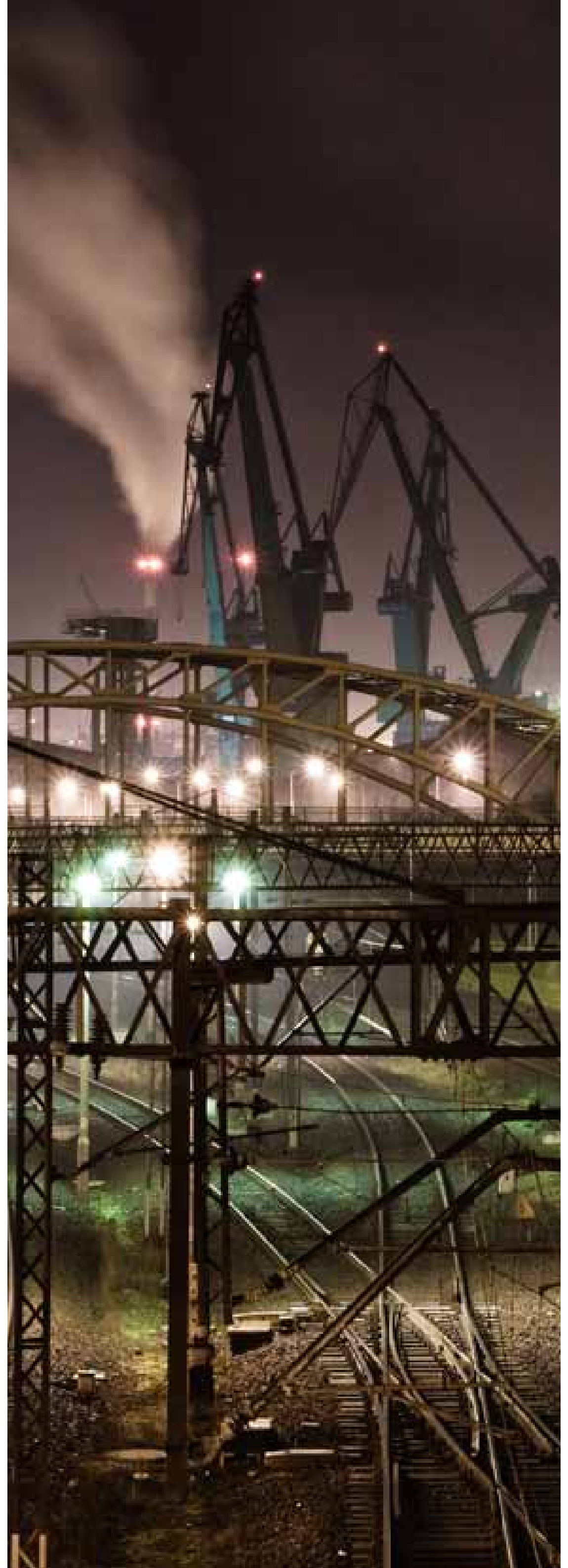
• For each problem, propose how to deal with it and solve it/improve current situation

• Analyze which are the terms (technical, economic, legal, environmental) that must be considered and revised/modified, in order to reach an improvement and get some benefits

• Individuate the most suitable actions for improving the situation and describe how the most relevant stakeholders can contribute (who will undertake these actions and therefore implement a solution or solution steps? Which are the organizations that are important for providing favorable framework conditions: e.g.: political support, administrative enhancement, legislative modifications, etc.?

• Which are the costs of investments? Where can be found the funding sources? How a finance plan could be put in place?

• Define a preliminary project time horizon and the time segments in which the proposed activities should be carried out.



The present feasibility proposal is based on a general architecture that would be based on:

• an ICT system capable of monitoring the flows on the network;

• a centralized (national based) control centre supporting the whole system and backed by public and private organizations and stakeholders.

The project foresees the implementation of an ICT System making the different traffic management systems interact and exchange data and information to obtain a monitoring of traffic flows on infrastructure network.

This ICT system, on the national territory, should mainly be based on the National Logistics Platform - UIRNet Platform, which would provide the main asset for the monitoring of road traffic (starting the monitoring from in NW Italy).

A central (national) center for the coordination would be established by UIRNet for the support of the local logistics nodes and for the overall coordination of the proposed project. The center would offer also a service of help desk/call center for the operators (private and public).

At local and regional level, the national center will interact with the local authorities and the logistics nodes with the aim at monitoring the flows and coordinating the various actors in case of intervention; both in case of routine activities (such as sample controls and check campaigns on the road net) and exceptional interventions (in case of emergency or crisis situations).

The entities involved in the development of the action would be: UIRNet, Italian Maritime Authority (Capitaneria di porto), Port Authorities, Regions, Police, Fire brigades, Operators Associations (Federchimica, Ship Agents, Forwarders, Terminal Operators, Truck Companies, etc.), Italian Customs Agency etc.

More in detail, the critical issues highlighted above will be addressed by the ICT system integration and will include some particular functions and services.

The management of the authorization process for the dangerous goods in the ports will be completely integrated in the Port Community System and will be interoperable with the National Logistic Platform. The solution is the integration between functional areas for controlling dangerous goods in the port ship and goods on land.

The telematic port system (E-Port) will dialogue with the Maritime Authority system and the national logistic Platform (UIRNet). In other words, it consists of the data and information sharing about the tracking and tracing dangerous good in order to facilitate the operative and authorization cycle of Dangerous Goods both on the port and inland.

For instance, by this integration, all the operators involved will know on real time basis and automatically via the ICT system if the ship is operational in order to embark the dangerous cargo or they can know if the truck expected to discharge a hazardous cargo is approaching the port. In the same way, in case of an import cycle, all the operators will be able to "see" if a ship disembarking dangerous goods is approaching the port and can be ready to receive, also in documental terms, the cargo.

The integration will allow to activate dedicate "alert" to inform the public and private operators about the status of the cargo and about possible problems. Some documents accompanying the hazardous cargo, as for instance the TREMCARD, can be anticipated via the ICT system.

The integration between the different systems permits not only the achievement of a significant reduction in the procedures' time completion by operators but also the optimization of the relationship among UIRNet, the port system and the Maritime Authority system.

In this way duplication of data input by the operators will be eliminated, the papers' circulation will be reduced or eliminated since the documents' exchange takes place via telematics. Moreover, the level of the safety and security of the chemicals traffics will be enhanced and the interoperability of the systems will be assured. The time required for the authorization procedure is at least halved since the operator manages the authorization procedures with the different Public Bodies involved using the same tools on a paperless environment basis. With reference to a cost perspective, the time savings can be considered into a generalized cost perspective, so generating a significant reduction of costs for the operators and for the Public Authorities.

The possibility of managing the process via telematics allows also the circulation of info on a real time basis; this in relevant for example at the port gate, where the operators at the gate can know immediately if a truck carrying dangerous goods can enter the port gate. In the same way the operators can see, thanks to the interface with UIRNet (so called "preannouncement" function), if a truck carrying dangerous good is approaching the port; in case this truck is not already authorized to discharge the hazardous good in the terminal, the operators can intervene. Moreover, when in particular cases the Port Authority requires the direct loading/unloading of the cargo (without stop in the port areas), the interface between the port community system, the Maritime Authority system and UIRNet can be strategic. For the direct loading/ unloading it is indeed necessary that:

- the ship is already at the berth and operational
- the container on board of the vehicle is related to the loading/unloading operation
- presence in the port terminal of a substitutive vehicle with the proper characteristics in case of emergency
- in particular circumstances, the evaluation of the Port Chemist can be required as by the Ordinanza 123/2004 by the Maritime Authority.

Consequently, also in case of direct chemicals loading/unloading the integration of the systems will produce benefits allowing to optimize the control and authorization process and the "appointment" between ship, terminal and truck.

The integration of the systems will also allow to optimize the use of the IMO parks in the port terminals, since all the partners and operator (the Port Authority, the Maritime Authority, the terminal operator, the forwarder, the ship agent, the truck company) involved in the logistics and authorization cycle will know in advance the time of cargo's arrival and can consequently plan the occupation of the slots in the IMO parks in the ports, avoiding the congestion events due to the space constraints of the IMO yards in the port area.

The issue of access to the port and inland terminals by the truck drivers and their identification, also with reference of being in the possession of the ADR driving license, will be addressed by creating a common and shared database for the drivers in order to allow them to enter/exit the port and inland terminals involved and to delivery/retire the cargo without problems and delays, facilitating the flow also in the perspective of the port and inland terminals operators. This database will be included in the systems integration and will be updated by the operators. So, the identification information about the driver will be matched with the documentations related to the cargo so that a slight dematerialization of the process, an increase of the speed of the operational cycle and a coherent circulation of the information can be achieved. The shared database will also contain all the information related to the ADR driving license and will be also be prearranged for the biometric identification.

Above all, considering that chemical goods are frequently hazardous cargo, the possibility of having a "certified" and centralized database on truck drivers, is very relevant in term of safety and security.

The first stage of implementation of this database will involve the port and the one intermodal terminal among the most important terminals in Italy and possibly handling a relevant share of chemicals on the total traffic. Moreover, the terminal should be on the north-south axis, to foster the intermodality on the TEN-T Corridor Genova-Rotterdam and on the MoS network of the Western Med.

Creating a "privileged lane" between Genova and this inland terminal, the use of intermodal transport is expected to increase by reducing the share of road transport in compliance to the objectives of the European policy on transports . The same model could be reproduced in other inland terminals so further strengthening the use of rail transport to/from the port. The target of pushing the use intermodal chains is also functional to improve the level of the service, the quality of the transport and also the quality of life (in terms for example of emissions and other externalities).

The problem of congestion events or queues at the port gates and in the road network around the port will also be tackled by the present proposal. It will be possible to track and trace the trucks on the road network. In particular, the interoperability and the interface between E-Port and UIRNet will allow "seeing" and knowing when the trucks approaching the port, for example the ones at 2 hours of driving distance from the port (so called "geo-fencing" functions. So in case of closure or limited functioning of the port, due for example to bad weather conditions, it will be possible to divert these trucks toward buffer areas, such as the inland platform of Rivalta Scrivia (connected to UIRNet as well), in order to avoid the worsening of the traffic situation around the port. This problem is even more serious when chemical cargo classified as hazardous are involved in the queues.

The same model will be reproduced in case of documental deficiencies. Thanks to the interface among the ICT systems, when a truck (and in the future a train) approaching the port (or a connected inland terminal) presents a deficit in the documentation accompanying the cargo, the operators involved can "see" this situation, thanks to dedicated automatic alerts, and intervene consequently to make it up. In some cases, when is impossible to remedy the deficiency during the truck (train) voyage to the port, the truck can be diverted to buffer areas external to the port so avoiding to have truck occupying the infrastructures and the limited areas in or around the port. This intervention is even more relevant when the cargo involved is a hazardous one. By this way the critical phenomenon of trucks carrying dangerous good parked in areas in or around the port wanting the proper documentation will be considerably limited and these trucks will be parked in remote areas with the proper facilities. In terms of safety and security of the transport of chemicals this can be considered an important achievement.

This interface function is already operating in the port of Genoa with a selected number of users and their fleet of trucks that use the pre-announcement for the communications (also for DG) with the port infrastructures . The perspective is to use the Eport/UIRNet integration to divert truck, in case of emergency, in buffer areas. Rivalta Scrivia (connected to UIRNet as well) will be the first area to be used in the indicated perspective.

A final field of intervention will be the possibility of identifying areas restricted to the circulation or parking of the trucks carrying dangerous cargo (the so called "geo-fencing"). UIRNet, via GPS, can determine the precise truck's location so that if the trucks enter a restricted area an alert is sent and the operators can see the trucks and intervene in the proper way. As an example, the Genoa Municipality underlined that sometimes trucks carrying hazardous goods to/from the port prefer using urban roads instead of motorways (for instance, to save the money of the motorway tool) passing through sensitive areas. The Genoa Municipality and the Port Authority, interfaced with the UIRNet System, can define precisely the areas and roads restricted to the traffic (even in particular hours) and receive an alert in case of breaches. The operators can see the trucks on their ICT system interfaced with UIRNet and the Municipality can monitor the traffic flows from the local control room and intervene on real-time basis.

The partners involved can assure the implementation conditions with respect to several profiles: authorization procedure, administrative enhancement, legislative framework, financial coverage, technical requirements and political support.

The Genoa Port Authority is already working with UIRNet (representing the Italian Ministry of Transport and Infrastructures) on the project of interfacing the two ICT systems, with a particular focus on hazardous goods. Preliminary contacts have been established with important inland terminals and intermodal operators and with the Genoa Municipality.

A final element for success and to increase the benefit of the proposed feasibility is to involve other logistics clusters to use a similar system and to interface our platform with these clusters, especially on the sea-side. By this way the magnitude of the present initiative can become more relevant and a better transnational scope of the project can be achieved. Three different development paths can be forecasted (compatible among them):

- involving one or more foreign ports among the ones belonging to areas covered by LOSAMEDCHEM project (for instance Valencia, Barcelona, Malta or Thessaloniki)
- using VTS, a system that has a wide diffusion in the Med Sea, which can guarantee links to other Mediterranean logistics clusters (i.e. Barcelona)
- interacting with MIELE project, supported by TEN-T funds to develop a pilot for an interoperable ICT platform (the "MIELE Middleware") able to interface ICT systems (i.e. single windows, port community systems) in Italy, Portugal, Spain, Cyprus and Germany (the "National Vertical Pilots").

It's also worth stressing that the proposed intervention could be very relevant for other Italian partners of LOSAMEDCHEM. Moreover, it could be of interest to the other national ports.

The time horizon to see the proposed interfacing intervention operating at full capacity can be estimated in two years, considering the integration of development time of the single components.

In terms of priority/list of interventions to be developed, the following steps can be identified:

1. Integration between E-Port and UIRNet starting from the geo-fencing function.
2. Integration between E-Port and the Maritime Authority System.
3. Development of the shared database of trucks drivers.

It's worth stressing that from the technical and financial point of view the proposed feasibility project doesn't intervene on the systems of the different private or public operators but just interface them by leaving them untouched and unchanged. So none of the partners involved should have the need to restore or change its own ICT system but just to plan and forecast a connection to the other platforms involved. Consequently, this activity can be included in the normal and already planned maintenance and evolution of the ICT systems of each partner, so limiting the technical and financial efforts. These efforts can be summarised in the detailed design of the information flows, of the data to be exchanged, of the rules governing the data exchange and in the design and implementation of the interfaces.

At the moment, the port of Genoa is already carrying out the actions characterising the present feasibility proposal for the whole port traffic (including dangerous goods). These actions will be paid with the Port Authority own resources dedicated to the evolutionary development of the Port Community System (and of its links to other ICT systems, firstly UIRNet). The following table summarises the forecasted value of the elements mostly related to LOSAMEDCHEM feasibility proposal, in terms of effort and costs for the different functional modules (only the module n. 5 is totally dedicated to dangerous goods), as described in the present feasibility proposal. It's worth stressing that the values of the table include the phase of design, implementation, testing, switch-on and training.

		Role	Effort (days/man)	Costs
1.	"Preannouncement" function in the logistics node	Project Manager	16	€ 9.600,00
		Team Leader	30	€ 13.500,00
		Analyst/Programmer	35	€ 11.900,00
		Developer	70	*€ 21.000,00*
		sub-total	151	€ 56.000,00
2.	Interface of the logistic node with UIRNet for the "preannouncement" function	Project Manager	18	€ 10.800,00
		Team Leader	30	€ 13.500,00
		Analyst/Programmer	40	€ 13.600,00
		Developer	80	*€ 24.000,00*
		sub-total	168	€ 61.900,00
3.	Alert on the status of the terminal	Project Manager	8	€ 4.800,00
		Team Leader	13	€ 5.850,00
		Analyst/Programmer	17	€ 5.780,00
		Developer	34	€ 10.200,00
		sub-total	72	€ 26.630,00
4.	Interface with the Database of the trucks drivers	Project Manager	16	€ 9.600,00
		Team Leader	21	€ 9.450,00
		Analyst/Programmer	28	€ 9.520,00
		Developer	56	*€ 16.800,00*
		sub-total	121	€ 45.370,00
5.	Integration between the Port Community System and the Maritime Authority System	Project Manager	23	€ 13.800,00
		Team Leader	38	€ 17.100,00
		Analyst/Programmer	50	€ 17.000,00
		Developer	100	*€ 30.000,00*
		sub-total	211	€ 77.900,00
		TOTAL	**723**	**€ 267.800,00**

The forecasted costs of this investment will be further detailed in the next stages of the implementation of the proposed intervention. Useful inputs in this sense will derive from the development of the next phase of LOSAMEDHCEM and in particular from the confrontation structure that will be established with the operators and authorities which are competent for implementing the present project proposal. The project LOSAMEDCHEM will assure the financial coverage for this phase while for the potential implementation of the feasibility proposal some of the partners involved could provide the financial coverage.

Further, funds from the Italian competent Ministry could soon become available for this purpose.

A final clear message, containing the main reasons for the proposed feasibility and the expected benefits must be expressed, together with the next steps which should be undertaken in order to guarantee that the project can go on.

Very important is the possibility of defining a joint transnational teamwork, where projects with similar targets could be integrated in a major project of international dimension, including many Mediterranean partners.

The strategic relevance of the intervention proposed has to be expressed once more, in order to stress how, without expensive intervention on the physical infrastructures, is possible to obtain substantial improvements in the operative conditions both on private and public perspective. The intervention proposed is inspired by this approach: using ICT solution is possible to obtain important benefits to a wide range of users in order to increase the safety and security of the logistics cycle and to optimize the use of physical infrastructures. Considering that ICT systems already in use or in a development/evolution phase will be interfaced, none of the partners will have to change its own ICT platform. However, it will be necessary just to design and implement the interfaces between them, reducing to a minimum scale the technical and financial magnitude of the intervention, while guaranteeing a broad benefit and coverage of the project.

The first steps to better define the framework of the implementation feasibility study are:

- contact and involve the other relevant partners competent for the implementation,
- create a team of experts for the development of the project,
- explore the possibility to involve foreign ports,
- design the information flows, the data to be exchanged, the procedure and rules governing this exchange,
- verify the financial magnitude of the investments and its financial coverage,
- design and implement the interfaces.

As, underlined in the previous section, the proposed project can be easily integrated with the ones carried on by some partners of LOSAMEDCHEM and/or with other project initiatives, like MIELE Action. Creating interfaces with these other ICT systems to monitor the flows of chemical goods in the Med would allow considerably increasing the magnitude of the feasibility proposal and the benefits for public and private stakeholders.

Port of Trieste
Feasibility Study on the Porto Nuovo of Trieste and its dry port

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Port Authority of Trieste

Project cofinanced by the European Regional Development Fund

1. Introduction

The amount of goods transported (both hazardous or not) in Italy in 2010 is estimated more than 216 billion tons-km, representing an increase of 4.0% compared to the previous year. Data analysis on various types of transportation demonstrates the absolute dominance of road transport, estimated for 2010 in 61.9% of tons-kilometres of the overall freight transported[1].

The percentages of other transport modes can be estimated 24.6% for maritime navigation, 13.0% for railways and pipelines, with the rail traffic representing the 8.6% of the global and finally 0.5% for air transport; a very modest share since it is mainly used for the international carriage of goods.

This period of recession has made even clearer that a country is very closely tied to logistics and that often from the ability to optimize the distribution process comes the conditions for getting the margins in production. The proposed action[2] is to move freight traffic from road to rail or to sea transport so it would optimize logistic process and it would satisfy the need for sustainable transport.

[1] *Source: Conto nazionale delle Infrastrutture e dei Trasporti, anni 2010-2011, Ministero dei Trasporti - Dipartimento per i Trasporti, la Navigazione ed i Sistemi Informativi e Statistici.*

[2] *Il Piano Nazionale della logistica 2011/2020, Ministero delle Infrastrutture e dei Trasporti - Consulta generale per l'Autotrasporto e la logistica.*

2. Scope

This study comes from a set of findings generated by the SWOT analysis, based on interviews with various stakeholders who, in various ways, are involved with dangerous goods in the port area. It is intended to evaluate the technical and economic feasibility and environmental infrastructure, solutions both tangible and intangible, as well as organizational procedural, public and private; to raise the protection of workers' health and the environment on the one hand and to safeguard the most exquisitely commercial reasons, taking into account existing regulations (see point 3).

The strong specificity of the port, which has been taken into account for the definition and the delimitation of the areas of intervention, can be summarized:

- Free port in accordance with the Paris Peace Treaty of 1947. The benefits are several. The first arises from the fact that goods coming by sea from non-EU Countries can freely enter, regardless of origin or destination, without being subject to customs duties within ports and they can remain there without a time limit. Duties on imported goods through the free points can be paid deferring them for up to six months, with reduced rates. In addition, on permanent depots of foreign goods can be carried out a series of operations (repacking, samples, etc.) and, following a ministerial authorization, industrial change can also be made.

Trieste is also the only city in Europe which has unique legal instruments governing the free areas. The international Peace Treaty of 1947 in fact recognizes to the port of Trieste a very large autonomy of actions on customs, tax and commercial freedom; a lot more extensive than in other zones of the European Community.

- Black Box information system: from January 1, 2011 in Italy it was entered in the force the Regulation (EC) n° 450/2008 establishing, creating a new Community Customs environment, the new Community customs code. The code gives the Customs Agency more power including all security controls of goods and, in addition to regular checks already carried out it must supervise police activities against criminal offences linked to international trade, such as the counterfeit.

The new rules require a preventive declaration of cargoes: characteristics of incoming goods must be declared to customs before unloading, and even outgoing goods should be recorded before loading.

At this point a project was created for the Customs agency which has the objective of computerizing the processing of cargo manifests for the incoming and departing goods. It was also created the CARGO application that helps the talks with the actors involved in the various processes. The project aims at increasing the efficiency of checks and reducing the time of performing customs clearance.

Since Trieste is a free port, a system to meet the requirements of the European regulation was necessary to be created, granting to maintain the facilities permitted by the status of free port. Therefore the computer system Black Box was born managed by the Port Authority, allowing operators to perform the preventive operations and the on-line monitoring of goods inside the free port of Trieste.

All the goods arriving at the free port are assigned a PF (Free Port) and a Black Box number; in this way the consignment can be traced until the moment it leaves from the free port.

Regarding the goods to be embarked the concept is similar: to the consignment it will be assigned a Black Box number and by this it will be represented and traced, by the container mark and number, if inside a container or if by means of a vehicle with its plate or its chassis number.

Authorised operators may also register even operations such as transformations (whether physical, such as mixing or grinding operations, or documentary evidence) or movements.

- Port of call with a high share of liquid goods transported (around 35 million tons per annum on ca. 50 million tons of total distributed mostly via pipeline directly to markets/refining).
- Port of call where is a high use of the railway mode (equivalent to ca. 30% of containers handled annually and ca. 15% of complete heavy vehicles loaded onto railway wagon); the transit of goods by railway, by virtue of the free port, benefits from a facilitated customs procedure.

The figures bZ elow display the floor plan of the new port of Trieste, where there are most of the trades, and the links between Trieste and other European countries, respectively.

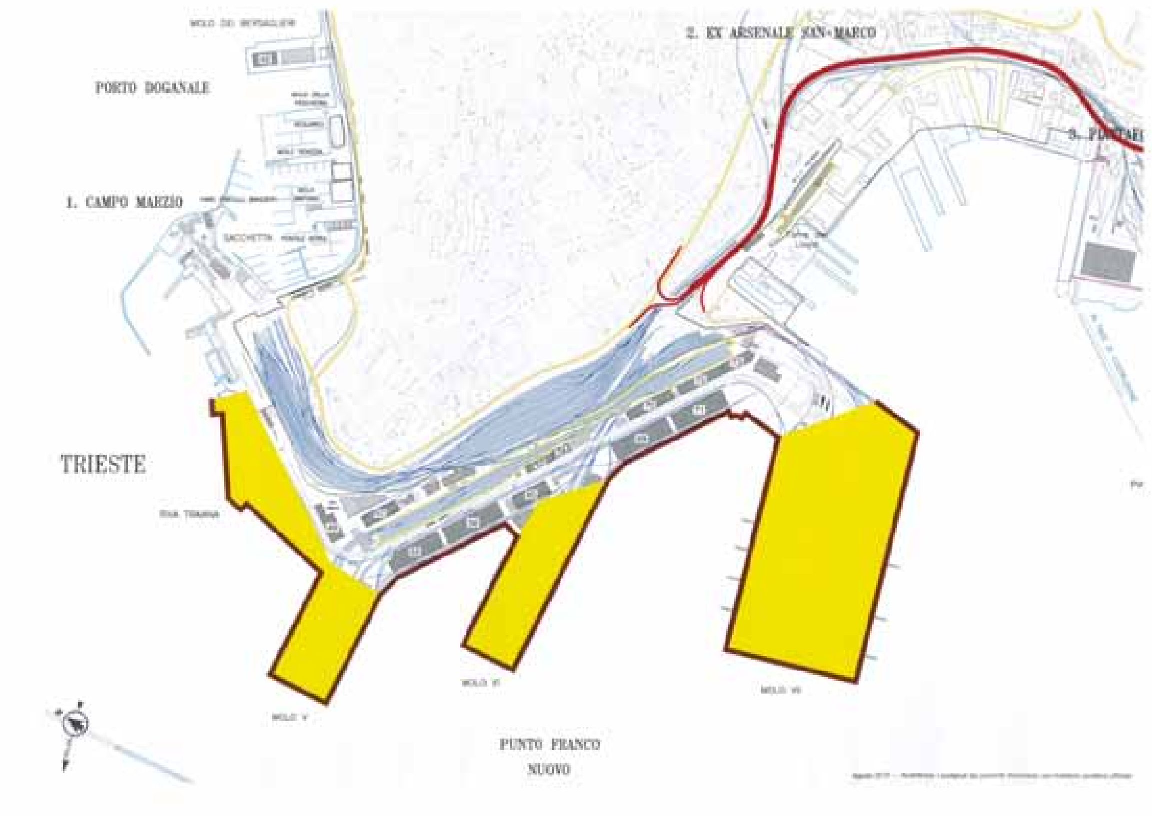
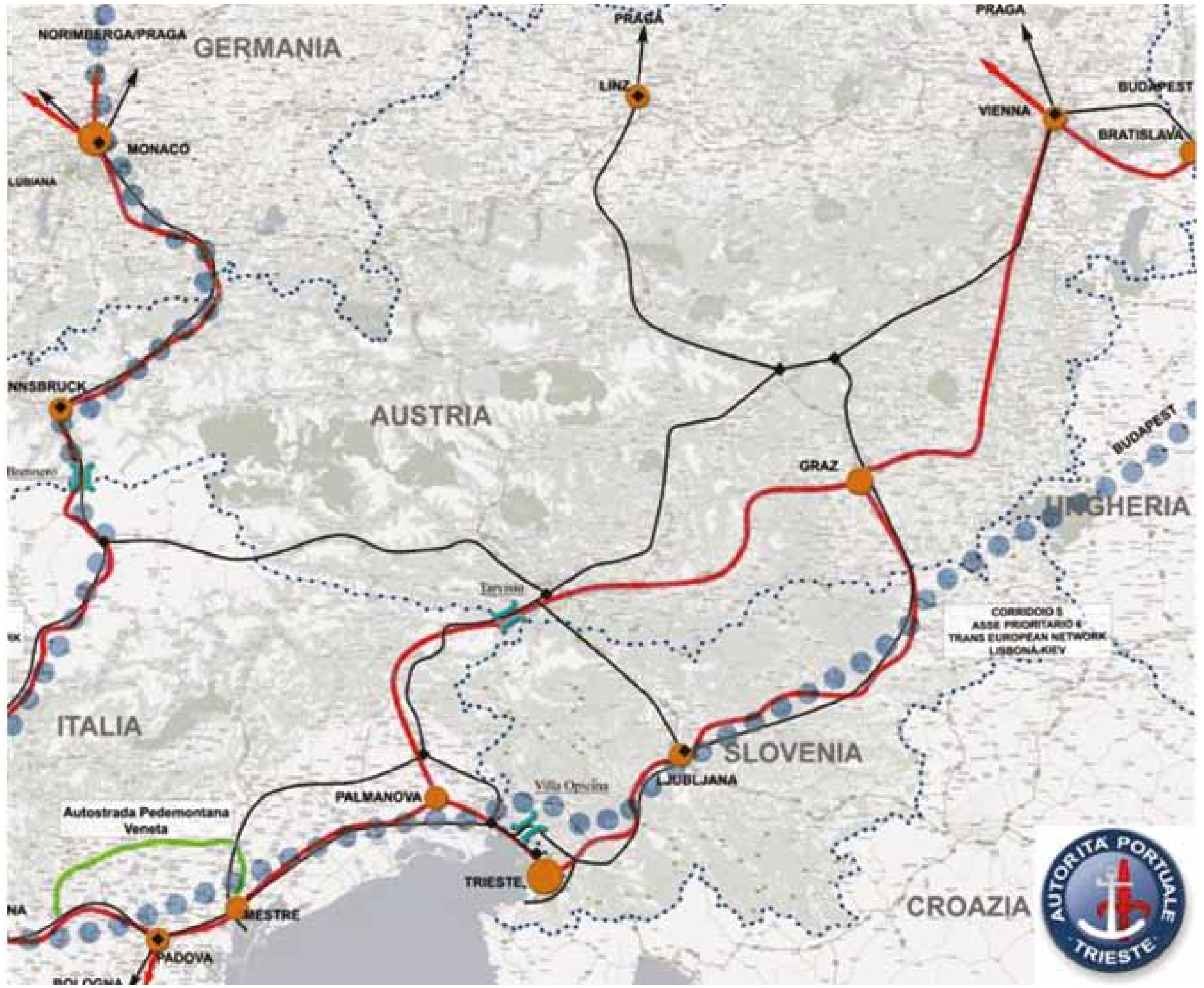


Figure parts in brown represent the interface platform/ship while portions in yellows are areas in concession to terminal operators; the red line represents the so-called Grande Viabilità Triestina joining the motorway with the port of Trieste.



3. Current Regulations

The regulation regarding dangerous goods can be summarized as follows:

- Law n. 84/1994 e s.m.i.
- IMDG code
- Set of rules ADR
- Legislative Decree 271/99 e 272/99
- Decree of the President of the Italian Republic n. 134/2005
- Legislative Decree n. 81/2008
- Law n. 27/2012
- Order Coast Guard of Trieste n. 1/2003 on the use of hot work
- Ordinance of the Trieste Port Authority n. 72/2003 on the use of hot work
- Order Harbour-master's Office of Trieste n. 536/1969
- Record 11808 of 18/06/2004 of the Coast Guard of Trieste
- Executive Decree 1340/2010
- Decree of the President of the Italian Republic n. 172/2011
- Order of the Coast Guard of Trieste n. 6/12 del 2/3/2012 to carry out supplementary fire service in the ports of Trieste's maritime compartment
- Minutes of the technical tables, both public and private and the Committee of hygiene and safety regarding the identification of structural and organisational solutions aimed at raising the level of safety in transit/storage of dangerous goods to the port of Trieste (ongoing meetings), mainly in commercial terminal active in the field of container and Ro-Ro (so-called "high risks" companies as Alder, Siot, etc. follow a dedicated legislation).

4. Project Objectives

The finalities and the project objectives are the following:

- to monitor the flow of dangerous goods both incoming and outgoing port
- to harmonise regulations and internal procedures for safer handling of dangerous goods in port
- to improve management of the flow of goods within the port
- to increase operational efficiency while maintaining an unchanged infrastructure

- to encourage and promote the sharing and transfer of know-how, technology and skills with particular reference to the security of dangerous goods traffic
- to harmonize the regulation, policy and procedures in the EU and the Mediterranean, in order to make it easier, safer and to distribute more fluid chemical goods logistics.

Even if, as clearly expressed in the "National Logistic plan 2011/2020", it is necessary to work on effective choices to improve the railway system within the ports in its criticism (railway operations affecting quite a lot the costs of rail), the objectives proposed here are aimed particularly at road transport, for which the need for constant monitoring is maximum and that today affects a lot the dangerous goods handled on the regional territory.

Instead, the promotion of intermodality remains apparently excluded from the project, and consequently the safety increases. The reduction of transport's impact through the choice of optimal combinations of transport modes, but in doing so it was tried to maximize from the beginning the benefits of adopting the proposed technologies, by avoiding to propose a project that would include all modes in the first phase of implementation. In fact, such a choice would have caused significant delays in the activation of the system. In any case, the system is designed to interface with operators of other transport modes that will be incorporated in subsequent phases of implementation, after which the network could become an important tool designed to encourage intermodality as a choice for handling dangerous goods.

4.1. Current situation

Transport safety is particularly relevant when a steady growth in traffic is registered; estimations predict further increases in the coming years, as for the port of Trieste and the Friuli Venezia Giulia region. With the growth of traffic, there is obviously an increase in the quantity of dangerous goods in transit and therefore there is a proportional increase in the correlated risk.

In this area, there are special relevance information systems for monitoring and controlling the dangerous goods transported, monitoring should be realized in an intermodal way: goods should be continuously monitored, from the departure to the destination, regardless of the means of transport.

In the regional area two traffic monitoring systems with different features are operating or are under implementation by different institutions:

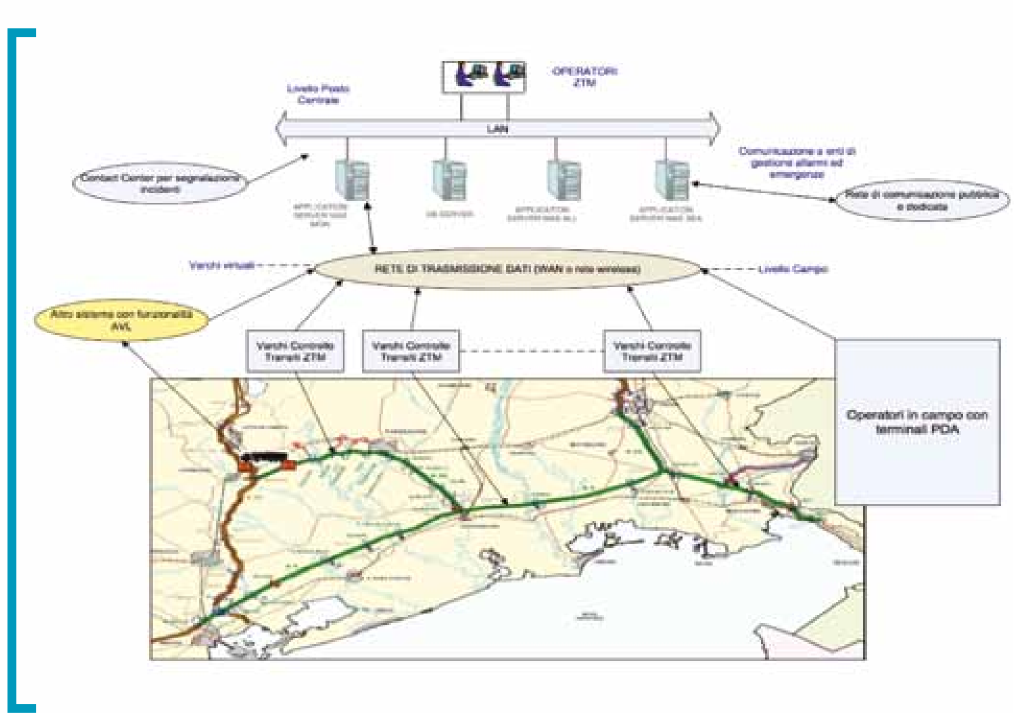
A. a system for monitoring the transport of dangerous goods on the highway

B. a system for the tracking, verifying and monitoring the transport of dangerous goods in the region.

A. The Manager of the motorways A4 Venice - Trieste, A28 and A23 has installed an internal system for monitoring the traffic of dangerous goods[3].

Monitoring of dangerous goods is one of the main functions of the control system TCC, which integrates several features. Among the various components of the system, regarding of the dangerous goods the fundamentals is:

- a network of cameras that can recognize and classify the numbers identifying the hazard class (Kemler Code) and the identification number of the goods (UN number). Cameras are placed at all tolls and barriers, service areas and some intermediate sections;
- a set of additional sensors that provide weather forecasts
- a system for simulating the dispersion of gases, complemented by a GIS base that allows estimating the effects of accidents
- a system that displays in real time, on which road section (or stop area) are the vehicles in the network, and that consequently draws a map of risk considering the towns and villages and other major points of the surrounding areas
- a control unit from which emergency actions are defined (based on data collected and processed by the various subsystems, on emergency plans and on the results from the managing of similar situation) in order to be activated in the case of incidents or other risky situation.



B. The Friuli Venezia Giulia region intends to adopt, to reach the objectives of the regional integrated logistics platform, to acquire the equipment for monitoring and managing the road transport of dangerous goods[8]. The system will consist of the appropriate technological tools to meet the current demands and open the integration with any similar systems, existing or to be developping.

[3] *Centrone G., Pesenti R., Ukovich W., (2009) - "Assessment of Risk and Accident Impacts related to Dangerous Goods Transport in a Motorway". The Third FIMA International Conference Regional Protection and Management of Environmental Risks - 2009. The Third FIMA International Conference Regional Protection and Management of Environment. Gressoney - Italy. Gennaio 2009.*

The primary objective of the system is to provide to the Friuli Venezia Giulia and to operators the entities involved in the transport of dangerous goods with an easy and intuitive tool that allows the identification and traceability of the vehicles. Particularly for those carrying dangerous goods in transit in the region and in its logistics facilities, the production of statistics and reports, a tool that could support the operators, involved the management of the transport of dangerous goods within the region.

As part of the regional logistics platform the Region aims at establishing the ICT infrastructure (hardware and software) that allows a quick and precise visualization of the number of vehicles carrying dangerous goods intercepted at each monitoring point and being present in the road sections.

The proposed system will detect the following information:

- acquisition and recording of vehicles flow (cars / trucks) with plate reading systems and detectors / sensors of traffic conditions
- detection of vehicles and recognition of those carrying dangerous goods substances n monitoring points
- identified transit of vehicles (cars / trucks): plate number, date, time, month and transit lane, location of detection (through sensors placed at strategic points)
- classification of vehicles through multi-detector technology, linked to the plate number
- precise recognition of the type of dangerous goods transported (UN number and Kemler code).

The system will also provide:

- the management of the database of all transits means of transport carrying dangerous goods (blacklists of vehicles plates and goods)
- the production of statistical reports and data analysis of the overall transits, traffic and dangerous goods flows
- availability to stakeholders to take advantage of statistical information on traffic conditions, traffic flows and handling and transportation and traffic of dangerous goods, grouped by different levels of aggregation
- access by operators to the management system via web browser with different profile and permissions.

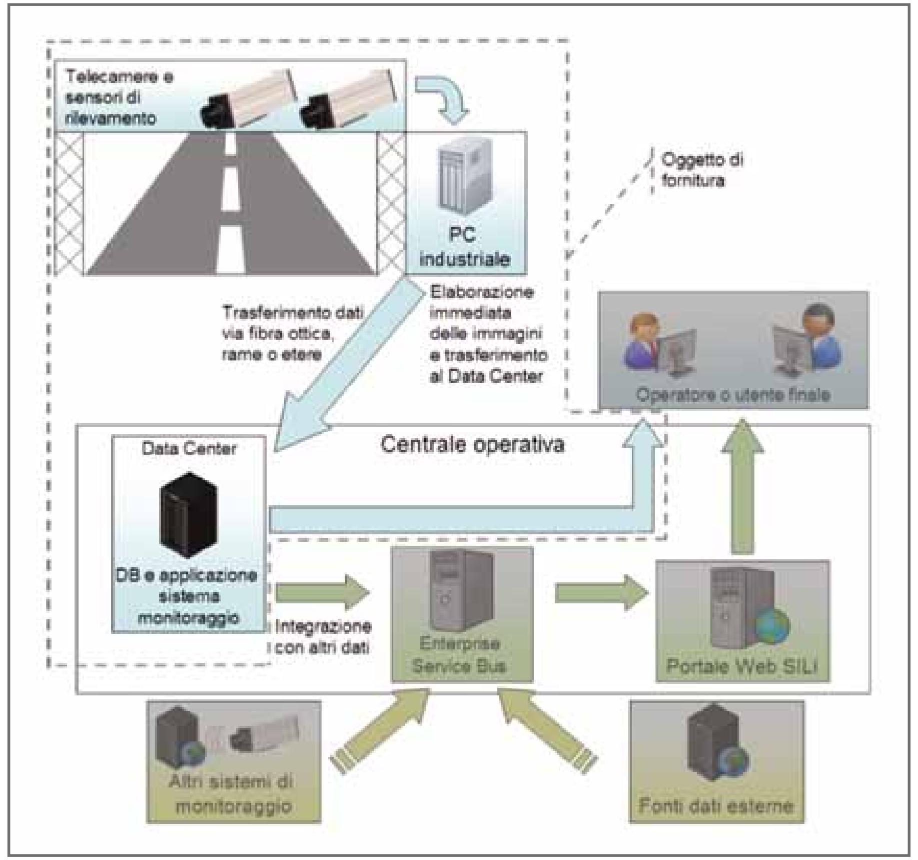
4 Insiel SpA (2012) GE 05-12 Fornitura di apparecchiature per il monitoraggio di merci pericolose - Capitolato Tecnico.

The management and monitoring system for the transport of dangerous goods will also provide:

- the compatibility of the format of the tracking devices with the requirements of traffic management, in terms of installation easiness, resistance to impacts and weathering
- the ability to remotely monitor the function and the status of the equipment for the detection of transit, the availability to all authorized logistics operators of tools, equipment and functions
- the representation of the monitored data on map.

Data collected will enable a detailed analysis of the risks related to the transport of dangerous goods (by road and by the other transport modes) and it will allow the identification of a map of risk, of the estimation of the effects of accidents and of the environmental impact and of the efficient management of any intervention.

The system described is shown schematically in the figure below:



Analysis of the information collected by the proposed system will be provided in future projects to:

- view emergency situations in real-time
- give support in activating emergency procedures by informing institutions responsible for alarms' management
- activate danger alarms (fire, smoke, weather situations critical for the road)
- manage a re-routing of vehicles to prevent accidents and minimize risky situations
- estimate the effects of the accident, given the substances involved and the location of the accident
- complete the information collected by monitoring weather conditions, equipping detection points with systems for the analysis of weather conditions (cold, snow, fog, wind)
- integrate data with geo-referenced systems
- disseminate information on variable message signs.

5. Feasibility Study Description

The achievement of several objectives is structured in different work programmes:

5.1. Monitoring flows relating to dangerous goods in/out from the port of Trieste

The access control project in the port of Trieste represents the initial search by the Friuli Venezia Giulia region to create a structure that can measure the transits of people and vehicles at the port road entrances.

The monitoring and gate security system is an integral part of the proposed "Integrated Logistic Information System" of the Region Friuli - Venezia Giulia (SILI) which will continue the development, the expansion and the implementation of the project Sec (Safe and Efficient Cargo) already started on behalf of the Region.

Implementation Tools:

5.1.1. Use of the port access portal

SEC Project (Safe and Efficient Cargo)

The ports of Trieste and Monfalcone, thanks to funding from the European Community and through a tendering procedure, were selected as areas of application. The project consists of automatic gates linked to the regional network (server farm, automated procedures).

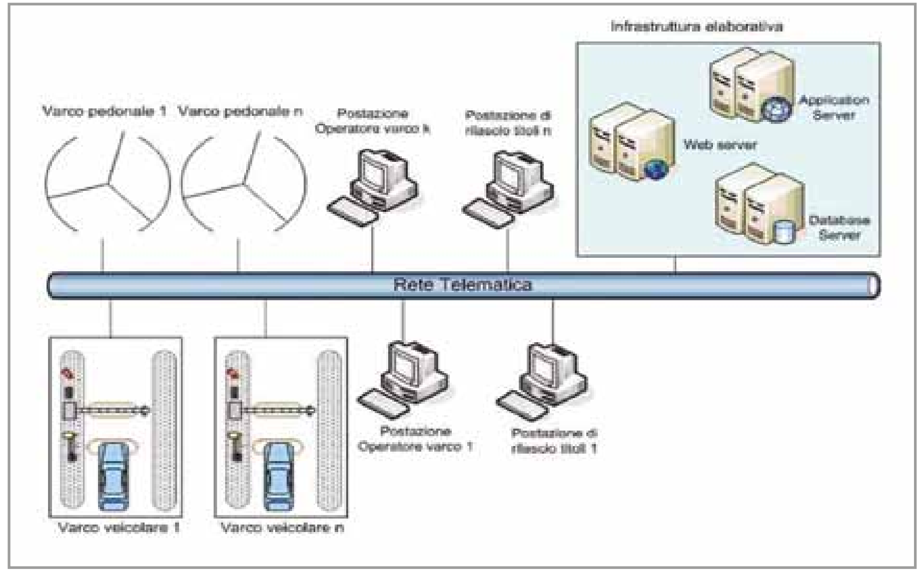
The access control system proposed is composed by:

- vehicular gates
- pedestrian gates
- workplace for the operators at the gates
- workplace for issuing the access passes
- server.

The data collected by the system can be accessed and shared by:

- safety and security office of the Trieste Port Authority
- pass issuing office of the Trieste Port Authority
- external institutions which are involved in the port's management, with customized features and characteristics.

The system will ensure continuity of service, day and night, using automatic redundancy. The described system is shown schematically in the figure below:



The immediate traceability of goods provided by the computer systems can allow to:

- know the localization of the event, the dangerous goods that being transported and to evaluate the immediate effect defining the intervention measures for avoiding or at least for encompassing the possible risks for human beings and the environment;
- program and plan the dangerous goods transports;
- check, by the operators that the itinerary would be respected
- reduce the theft risk and the unsuitable use of goods
- to evaluate the possibility of a new regulation for the goods movements, once collected data.

The software complements the hardware kit that will offer to those who want access to ports to accredit themselves through the presentation of a licence (badge) associated with the licence plate reading of their vehicle, or with a set of vehicles pre associated with a natural or legal person; where this subject is a frequenter of port areas (civil servants and private operators but also occasionally present subjects, provided that they perform at least 10 annual transits). It is estimated about 3,000 people.

This type contrasts the so-called «occasional transits», i.e. people who pass less than 10 times a year through the port of Trieste, in this case the numbers increases by 2. It is in fact for 300,000 annual transits the part intended for temporary registration ticket on an ad-hoc portal and released on Terminal warranty, printed independently or withdrawn at the two gates of the Porto Nuovo, allowing those who submit them, after reading the barcode, to be automatically credited.

5.1.2. Creation of a centre for monitoring and controlling of dangerous goods in the port integrated access control system

For dangerous goods during the registering phase for accreditation there is an additional procedure to that described above. The reasonable notice which should be performed permits the passage of materials under surveillance in a precise point of the harbour without being taken aback. At this time there is still the limit represented by the possibility of reading only the front plate.

Dangerous goods project

The project "dangerous goods" of the Friuli Venezia Giulia region provides in the contract] a passive system of license plates reading, positioned in strategic points to handle large traffic, which has the task of "counting" the number of vehicles, divided into three categories:

- cars
- motorcycles
- trucks.

All transits are collected for statistical purposes, when, besides the classical plate, it is seen for dangerous goods and then the statistical count increments that intended for the latter.

This framework does not provide a portal intended for transiting, on which accreditation is required for transit, as it is done for access control. The placement of the five devices is as follows:

• three are in the availability of ANAS (Azienda Nazionale Autonoma per le Strade) for the managed trades and it concerns exactly the State entrances of Rabuiese, Fernetti, Esso at Sgonico

• one at Gorizia - SDAG (intermodal terminal of Sant'Andrea)

• one at the intermodal terminal of Cervignano.

In the figures below, the images which were taken from the locations of the five devices are reported.

Rabuiese

Fernetti

Prosecco

Gorizia-Villesse junction

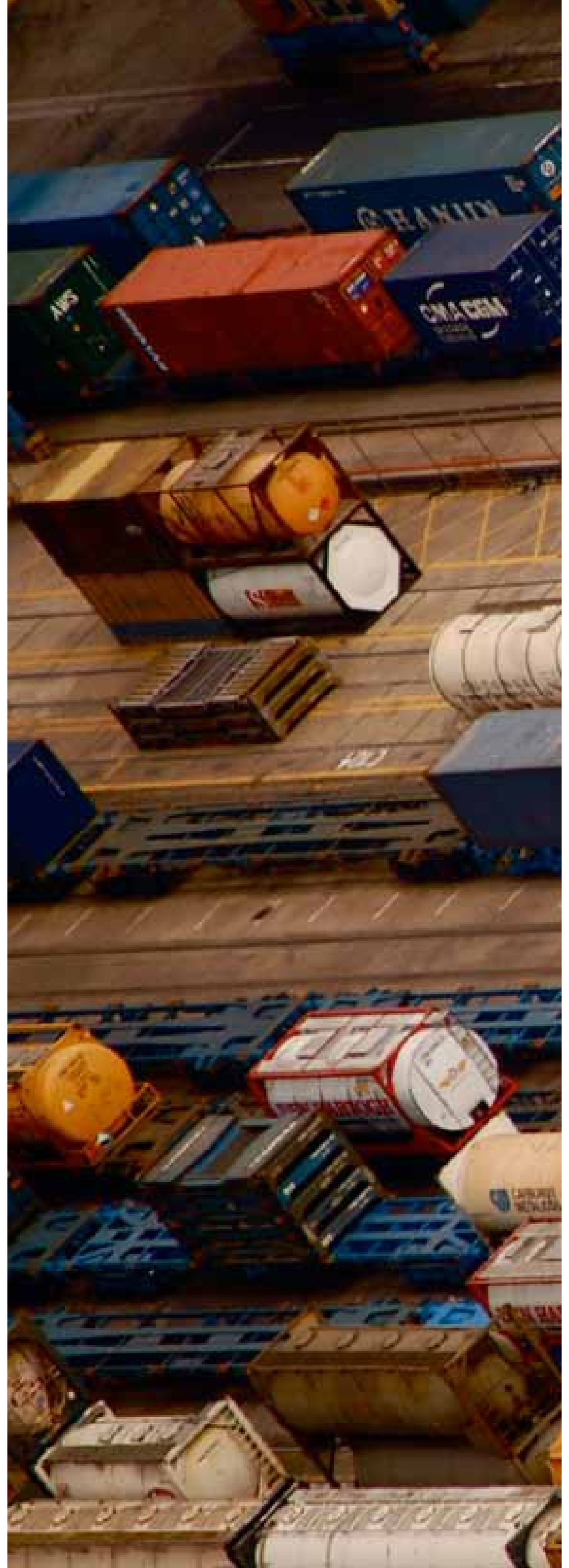
Cervignano Terminal

The phase of information acquisition is made by reading the UN number or Kemler; this action allows to immediately classifying the goods, in terms of liquid or gaseous state but also depending on the level of danger of the material being transported. There are no additional features or special alarm systems. It has only categorized their crossing and identified the typology.

5.1.3. Creation of an O / D matrix for goods

The creation of an open and effective control frame, path tracing of a vehicle carrying potentially hazardous cargo and of recognizing the type of goods transported, by reconstructing the o/d matrix (origin/destination) is of specially importance . These data will allow, once detected, the construction of an ***information database*** on the traffic flows on the major regional roads, updated and shared among the institutions.

The creation of the O / D matrix combined with the monitoring of the flows appear to be a necessary starting point for the process of planning traffic of dangerous goods in the region, aiming at encouraging the use of transport modes characterized by lower negative externalities.



The architecture of the system allows achieving the overall objectives of:

- using the gate control system recently installed at the port, described in this document in section 5.1.
- creating an O/D matrix of dangerous goods
- sharing data information with terminal operators by extending the use of systems and standard procedures

5.2. Implementation of management system for dangerous goods in port areas

5.2.1. Identification of areas and paths defined and monitored within the port

The movement of pedestrians and vehicles within the various areas of general interest of the Porto Nuovo is governed by vertical and horizontal signs, specially positioned on a site, as required by the road plan. The speed limit in these areas is fixed at 30 km / h but in particularly sensitive areas under the security aspect, the speed, according to the indications on the spot, can be further reduced.

In the areas of general interest, parking can be carried out only within the limits of the traces especially marked and highlighted by colour-code: white for the free parking stalls reserved for cars, motorcycles and tractors; yellow for parking areas that, with proper signs indicate the category of vehicles to which the areas are reserved; and blue for stalls / pay parking areas reserved for trucks, tractors, buses, trailers and trucks.

The manoeuvres of cargo handling, the design and maintenance of infrastructure and plant and the equipment have become increasingly important. This implies that the moving equipment, like vehicles, can cause injury or death and therefore, as far as possible in the operational area, people and vehicles are separated during their activities. So the pedestrian paths that do not intersect with the vehicular route and do not enter in the container stacking areas.

The traffic is regulated by traffic signs and appropriate speed limits (repeated at a suitable distance), in accordance with national legislation.

With the new port master plan and the new procedures for access control, the movement of goods, both dangerous or not and will be more properly tracked and monitored.

5.2.2. Definition of an emerZgency response procedure

Many loads have hazardous properties that can lead to events such as fires and explosions, personal injuries. Environmental damages and emergencies can occur at any time of the transport chain. On the one hand we must emphasise the fact that millions of tons which have been transported over the years have arrived at their destination without incident. On the other hand it should be noted that certain substances, if they come into contact with each other, can react violently. Hence there is a need to be ready to intervene in case of an emergency with the utmost promptness and efficiency to limit the damage, because there are many variables involved, like the hazard characteristics of the material involved, the size of the release, the proximity to incompatible materials and the weather conditions.

The Port and Maritime authority, the fire brigade, the A.S.L. (Local Health Company) and the Chemical consultants of the Port of Trieste must then define a clear operational procedure of reaction to possible emergencies of any kind and seriousness that might occur in the context of the management, handling and storage of dangerous goods in the port area. The procedure should ensure anytime the retrieval of resources in terms of people with sufficient decision-making capacity so as to define the safety intervention scene, including the isolation zone operations and possibly to evacuate it. Moreover, speed is indispensable to finding men and means to resolve the emergency as soon as possible and limit the extent of damage. Such a procedure could be made binding within an Ordinance or may be established by other forms of legislation, notwithstanding the requirement of good governance.

Operational risks may also include incorrect procedures and lack of communication and it would therefore be appropriate that periodic exercises should be provided at various terminals concerning the activity in question to maintain security levels meeting or exceeding legal obligations. It is essential for the rescue teams to interact with internal managers where incidents may occur. The exercises would also aim to pursue the increasing effectiveness of emergency contrast, allowing the continuous improvement of technical relations between the parties involved. It would also enable to understand if the education/training is enough to intervene in case of accident or if there is the need for new training modules.

5.2.3 Sharing data and information with the terminal operators by extending the use of shared systems and procedures

Sharing common procedures, especially the identification of the subjects to be involved in the management of a possible emergency, to which were assigned in advance clear and well-defined roles, can only bring benefits to the entire port system to ensure maximum preparedness in the event of an outbreak of a dangerous situation.

Information exchange on the type of goods involved in the emergency and of the methods used to deal with previous incidents can be used to review contingency plans, to adapt them to a coordinated response in case of a new incident.

All the apparatus that involves a rapid response to an accident must be flexible because of the different types of port areas that consequently lead to various types of interventions, which may differ from area to area and must be adapted to local conditions.

5.3. Management of transits with standby sites, timetable, definition of the paths and areas of embarkation/disembarkation.

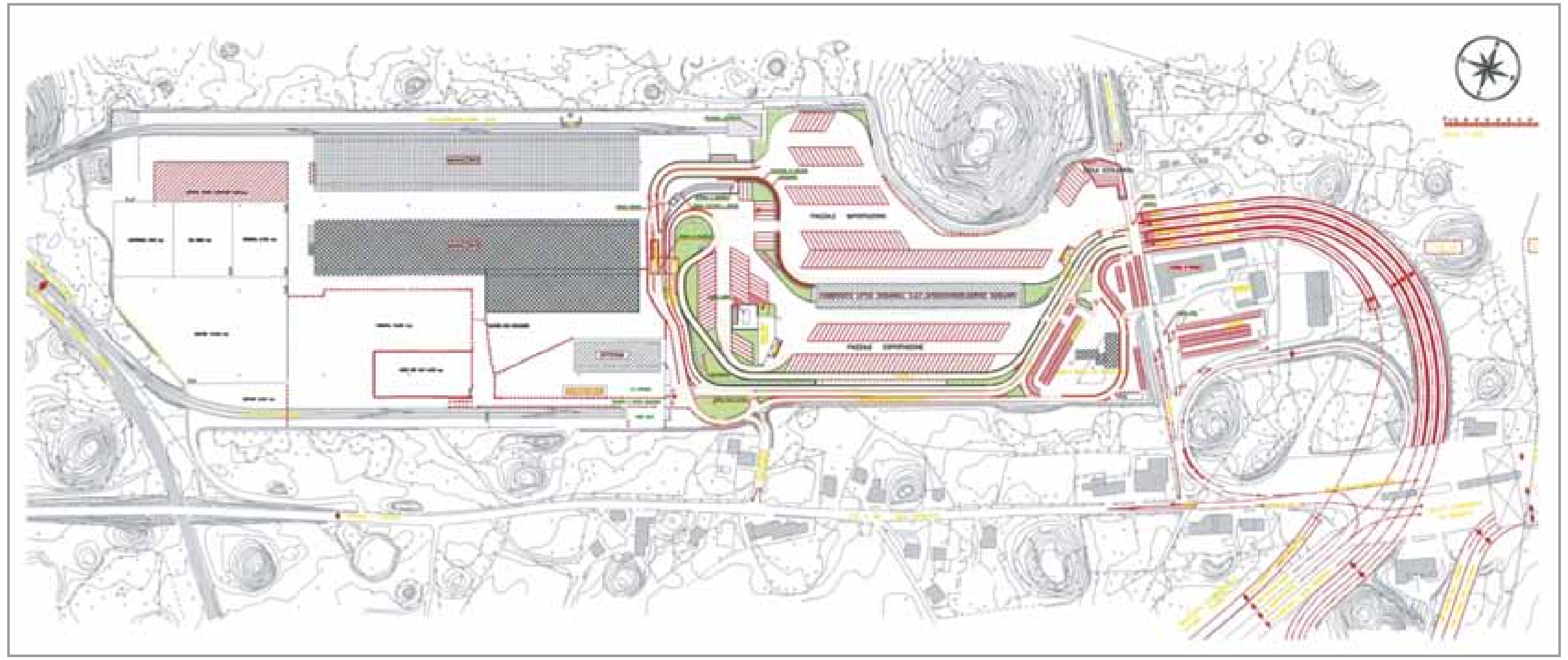
5.3.1 New procedure for boarding vehicles at the terminals of the New Free Point

With the Ordinance n. 8/2012 of the Port Authority a new phase has begun concerning the boarding procedures for vehicles intended to embark on Ro-Ro ferries to Turkey that provides a system for check-in at the Intermodal Terminal of Fernetti. This is a displacement of the entrance gate in the retro-port and the arrival in port areas only if the terminal operators have places available to receive them, and if they are intended for immediate boarding or if they have to leave the trailer but they will take another one.

By this way, the management of information concerning heavy vehicles and goods in transit is optimized with a series of managerial, economic benefits and greater environmental sustainability. With this new procedure, the Port of Trieste finally has a dry port which also acts as the entrance gate to the Port of Trieste and it is consequentially also the door of entry for sea motorways.

The terminal of Fernetti (see figure) is a structure that covers 500,000 square meters of which about 350,000 square metres are an operational area; in the latter area there are approximately 30,000 sqm of warehouse, an office building of around 5,000 sqm in which there are 40 different companies while the remaining area is occupied by a railway siding with viability and large squares, the last one for customs or not.

There is a whole range of services for complete assistance, to name a few, a petrol pump, a washing station for trucks, a specialist workshop for trucks, a tire repairer (tire service, a car electrical repair and mechanic service occupy an area of about 2000 sqm), a fuel distributor, a border veterinary health services for imports and plant pathologist office.



Moreover, a wide range of services are guaranteed for goods like repackaging and labelling, the warehouses for goods under ADR, handling of containers and heavy packages. The terminal also has a small equipped area for dangerous goods, judged suitable by fire-fighters.

5.3.2. Revision of the area intended for the stopover of the dangerous goods

The temporary stopover of dangerous goods as well as their recurring motion represents an additional risk compared to a fixed deposit. Essential differences are in the continuing diversity of types of goods transiting and remaining stationary packed in transport mode. Dedicated zones for hazardous goods must be periodically checked to see if they fully meet the changing demands of the market or if there is the need to introduce new structures or safety equipment.

The Port Authority of Trieste is geared to promote, even maintaining unchanged infrastructural resources, a strengthening of productive activities through interventions and organisational order. For this reason, the structure of areas dedicated to the stopover of goods is the process of reviewing, in order to improve them. The Port Authority is currently working on a new regulation to further regulate the presence of dangerous goods in the port area, taking into account existing ordinances concerning also viability within the port and the access to the port itself.

6. Timing Of Implementation

6.1. Monitoring flows

The project is in its final stage of implementation in the six access points to the port:

- Porto Nuovo: two distinct points exist called Varco 1 e Varco 4, statistically the most crossed access points
- Punto Franco Scalo Legnami: one official access point and a bypass connected via wireless are presents for the truck traffic toward the Ferriera di Servola
- Punto Franco Petroli: it is the only access point to the areas dedicated to the transits of hydrocarbon and its derivatives; there is little traffic but high in term of dangerous goods
- Ormeggio 57: access point to the Porto Nuovo but with an external access to the access points 1 and 4
- Porto Vecchio: this access point is affected by a mutation on its intended use and then was left for last.

In each of these access points were installed two or more lanes (gate) fully automated consisting of:

- underground coils for vehicles tracking
- double set of bars for vehicles total block
- front Cameras to read license plates, including UN and Kemler numbers, for taking pictures of vehicles and tractors
- “colonnine” for reading access titles with barcode and RFID
- turnstile for pedestrian transit check
- controlling stations for the operators to interact with the central system.

Tests for port gates number 1, 4, “Scalo Legnami” and “Punto Petroli” are about to be completed. The first operational tests were carried out at Scalo Legnami where the truck license plate (tractor only) was automatically acquired by the system.

For the simultaneous reading of tractor and trailer there is the problem of the trucks’ length, longer than the road checkpoints at port; truck license plate reading will be performed when the lorry will leave the gate. It will be possible, by reading the Kemler code and the UN number to get information about the type of transported goods. A system for statistics of incoming goods will be implemented.

It is estimated that the project regarding the dangerous goods carried out by the region Friuli Venezia Giulia is going to be completed by the end of the first semester of year 2013.

The port and the regional information systems were initially independently developed but, according to the importance of the latter, Friuli Venezia Giulia region, Insiel and Port Authority will cooperate in order to permit data exchange with the modality exposed below.

The access control system will receive with proper notice the registration for the passage of dangerous goods, vehicle data that carries them and the person driving the vehicle. At this point the system of dangerous goods takes over the data and it will be prepared to detect the passage, at one of the established points. Then it will send an alarm to those who wait for the vehicle to activate the procedures for receipt of goods, providing also the time of arrival based on its location and allowing also to check if the route is compatible with that stated.

Furthermore an increase of the check point, from five (see 5.1.2) to eight , is foreseen; the new ones are Casa Rossa- Gorizia, Coccau - Tarvisio and one at the Brennero.

The monitoring system should be established, through the creation of appropriate interfaces, with similar structures of neighbouring countries (Austria and Slovenia), particularly as a strategic transit obliged for most trades affecting the network of Friuli – Venezia Giulia.

Similarly, the system will allow interfacing with other systems for monitoring existing or under construction institutional subjects at the security forces.

In any case, they have to define appropriate technical and administrative protocols for the management of information in compliance with current regulations.

6.2. Dangerous goods management

The entry into force of the new port master plan is scheduled for the end of 2014. The Ordinance for the improvement of the system of dangerous goods is being drafted, discussed by the interested parties, and is likely to be issued as early as 2013, with effect from the next two months.

At or immediately after the issuance of the Ordinance it will be set up a technical table for the drafting of the emergency procedure, such as from point 5.1.2.

To facilitate the exchange of information (see point 5.1.3) Trieste Port Authority will keep in a special office any evidence of documentation relating to emergency incidents involving dangerous goods in order to make them available for viewing to terminal operators and other interested figures. The Port Authority will also organize outreach meetings every six months.

7. Financial Aspect

The project concerning the automation of road gates of the port of Trieste (acronyms: SEC and SILI) had been implemented thanks to an investment of four million euro (EU funds).

Afterwards, three additional modules have been designed in order to develop the system, for an overall additional cost of approximately two million euro.

This later expansion regards also the tracking of dangerous goods as better described in the present feasibility study

Project cofinanced by the European Regional Development Fund

Feasibility Study for the Improvement of Intermodality in the Broader Area of Thessaloniki

Feasibility Study for the development of an Intermodal Freight Centre in the Region of Central Macedonia

Thessaloniki Chamber Of Commerce And Industry (TCCI)

in co-operation with

Transeuropean Consultants For Transport, Development and Information Technology S.A. (Tredit S.A.)

1. Summary

From the previously conducted SWOT analysis in the framework of the project LOSAMEDCHEM, the main conclusion regarding intermodality in relation to the transport chemicals and the wider context of freight transport was the following. Although there is a comparative advantage of Thessaloniki as a national and regional transport gateway deriving from its favorable geographical location at the crossroads of a number of land and maritime transport corridors and the existence of a very functional port, Thessaloniki is significantly underexploited. The feasibility study focuses on the potential establishment of an Intermodal Freight Centre in an area within the Regional Unit of Thessaloniki since the presence and operation of such a terminal serving the whole Region of Central Macedonia is currently non-existent. The development and realization of such an initiative will significantly contribute to tackle the main problems which face the facilitation and promotion of intermodal transport in the region, improve the regional transport system and bring multiple economic, environmental and social benefits.

The under examination selected area is located at the former military camp of Gonou in the Municipality of Echedoros, which is in proximity to Thessaloniki's main industrial area. There, many chemical companies and industries are located and enjoy access to both main road and rail axes whilst being close to the port of Thessaloniki. The feasibility study specifies the transport services to be provided as well as the operational areas which will constitute the Intermodal Freight Center. It also examines the prerequisites for the successful operation of the terminal and the stakeholders that should be involved for the initiation of its development. Following relevant analysis, it is estimated that an investment of approximately 66 million euros will be required for the development of the terminal. Under an optimistic scenario prior to the end of its sixth year of operation the investment costs will have been covered and profits will be generated. Finally, the next steps are proposed to move forward towards the realization of this important project for the Region.

2. Introduction

The scope of the study is the elaboration of a feasibility study for the potential development of an Intermodal Freight Centre in the Region of Central Macedonia; with the purpose of improving freight flows management within the Region and upgrading the integrated intermodal transport flows along the

transport corridors that link the Region with the rest of the country, neighboring countries and the rest of Europe.

Therefore, the Intermodal Freight Centre could serve the Greek market, neighboring Balkan countries (FYROM, Bulgaria, Albania, Serbia) and also the central and east Europe.

From the SWOT analysis, the main conclusion regarding intermodality was that the comparative advantage of Thessaloniki as a national and regional transport gateway deriving from its favorable geographical location at the crossroads of a number of land and maritime transport corridors and the existence of a very functional port, is significantly underexploited. To a wide extent this is due to the non-existence of an intermodal freight centre in the region. Another reason is the low level of intermodal transport coordination with the consequence being the underutilization of rail transport and road transport undertaking the main share of the land transport activity with the corresponding negative externalities, such as increased air and noise pollution, heavy traffic congestion, road accidents and incidents involving dangerous goods etc.

3. Description of Current Situation

3.1. Current Transport Volumes

It is estimated that the establishment of a potential Intermodal Freight Centre at the Region of Central Macedonia would definitely attract and create freight flows to/ from all the areas of the Region. Furthermore, since currently significant competitive intermodal freight centers do exist within the wider region, its influence area is expected to cover the remaining Regions of North Greece, including partly Thrace[1]. Due to the geographic position of Thessaloniki, depending also on the operational planning of the terminal, the southern areas of the Balkan Peninsula and particularly FYROM and South Bulgaria can also be included in the terminal's influence area.

Therefore, in Tables 3.1 and 3.2 that follow it was considered necessary to present the aggregate import and export flows from the national catchment area of the potential intermodal freight centre and not only of the Region of Central Macedonia.

[1] *Catchment area including: Region of Central Macedonia, Region of West Macedonia, Regional Units of Kavala, Drama, Ksanthi from the Region of East Macedonia & Thrace.*

Table 3.1- Import volumes (in thousand tones) per origin and transport mode for 2008

	Maritime	Rail	Road	Air	Other	Total
European Union	652.769	153.927	1.494.465	6.148	3.259	2.310.568
Other European countries	1.457.886	7.508	15.931	132	126.878	1.608.334
Balkans	182.744	165.523	977.201	902	343	1.326.712
Africa	110.142	0	884	36	0	111.062
Middle East	1.030.642	1	10.805	152	0	1.041.599
NAFTA	143.526	107	2.873	475	13.208	160.188
India- Sri Lanka	122.852	0	1.181	213	0	124.246
China- Hong Kong	230.796	450	10.057	653	34	241.990
Other countries	1.993.961	13	9.446	303	17.972	2.021.695
Total	5.925.318	327.528	2.522.844	9.013	161.692	

From the above import data, it can be deducted that maritime transport is clearly the dominant mode for the imports, with road transport having less than half of its share and rail transport occupying a rather small part. The small share of rail transport can be attributed partly to the fact that a large proportion of these imports originate from other continents and sea transport is the only option. Still the rail share could be increased considerably for regions such as the Balkans and the EU where road transport is very dominant. A prime example concerns imports from Bulgaria and FYROM, where rail transport occupies approximately the 1/10 of the share of road transport despite the existence of Pan-European rail corridors (X ad IV) which directly connect Thessaloniki with these neighboring countries.

In regards to EU countries, the main import trading partners for the wider catchment area region are Italy, Germany, France and Spain. Apart from Spain, road transport is clearly the dominant mode for imports from these countries and even for Spain, road transport is competing strongly with maritime transport (approx. 80 thousands tones compared to around 100 thousand tones transported by sea).

Therefore, give the great significance of maritime transport it could be said that there is great potential for the development of intermodal (maritime-rail) transport chains or for certain cases (i.e. Italy, Spain, France) to increase the share of maritime transport in intermodal (maritime-road) chains. In this respect, the operation of the proposed intermodal freight center could facilitate and sustain the role of intermodal transportation by means of provision of higher quality intermodal and logistics services and coordination of these intermodal chains.

Table 3.2- Export volumes (in thousand tones) per destination and transport mode for 2008

	Maritime	Rail	Road	Air	Other	Total
European Union	418.316	10.476	766.092	65.198	11.495	1.271.577
Other European countries	191.201	0	0	6.856	0	198.058
Balkans	1.273.091	1.066	653.706	5.386	827	1.934.077
Africa	198.730	0	0	3	0	198.733
Middle East	175.576	0	0	141	0	175.717
NAFTA	65.837	0	0	40	0	65.877
India- Sri Lanka	11.982	0	0	0	0	11.982
China- Hong Kong	227.616	0	0	0	0	227.616
Other countries	194.291	0	0	33.116	0	227.406
Total	2.756.641	11.541	1.419.798	110.740	12.322	

From the above tabulated export data, the strong market share of maritime transport is again evident with almost double the share of road transport. However, the share of rail transport is even more disappointing than its respective share in the imports' flows. This is especially true for destinations in the Balkans, the EU and other European countries. For example, rail occupies only 1/100 of the total road market share for goods destined to Bulgaria. The main EU export trading partners are Italy, Germany, the UK, the Netherlands, Cyprus and Spain. Once again road transport is dominant for Italy and Germany with market shares of 71% and 79% respectively; even for countries-destinations where it would have been expected that its share would be minimal due to geographical reasons such as the UK and Spain, road accounts for 22% and 26% respectively.

Therefore, it can be said that there is room for massive improvements and great potential for the development of intermodal transport chains, maritime-rail. Moreover, there can be an increasing in the share of maritime transport in maritime-road chains, which the proposed intermodal freight center could serve and help sustain by means of provision of higher quality intermodal services and logistics.

3.2. Pan-European Corridors

Thessaloniki is directly linked to two Pan-European Multi-modal Transport Corridors, IV and X, which are depicted in the following Figure.

Figure 3.1.- Pan-European corridors connecting with Thessaloniki

The Multi-modal Pan-European Transport Corridor 4 (IV) connects Germany, Czech Republic, Austria, Slovakia, Hungary, Romania, Bulgaria, Greece and Turkey. The alignment of Corridor 4 links the following main cities: Dresden/Nurnberg – Prague – Vienna/Bratislava – Budapest – Arad – Bucharest – Constanta/Craiova – Sofia – Thessaloniki/Plovdiv – Istanbul with more than 4340 km railway lines, 3640 km roads, 10 airports and 8 sea and river ports.

The Multimodal Pan-European Transport Corridor 10 (X) connects Austria, Slovenia, Croatia, Serbia, FYROM and Greece. Corridor X follows the route linking the cities of: Salzburg - Ljubljana - Zagreb - Beograd - Nis - Skopje - Veles - Thessaloniki including its branches:

A: Graz - Maribor - Zagreb
B: Budapest - Novi Sad - Beograd
C: Nis - Sofia (- Istanbul via Corridor IV); and
D: Veles - Bitola - Florina (- via Egnatia to Igoumenitsa).

Thessaloniki is also directly linked to the Egnatia Motorway (Figure 3.2) which spans throughout the country on an east-west direction thus providing direct access towards Turkey on the east and towards Italy via the Adriatic-Ionian intermodal maritime-based corridor on the west. In addition the motorway's vertical axes provide access to the north towards Bulgaria, Albania and FYROM.

Figure 3.2- Egnatia Motorway

Furthermore, via the Egnatia Motorway Thessaloniki is connected to the city of Alexandroupolis and thus also secondarily linked to the Pan-European Transport Corridor IX: Helsinki - Kiev - Bucharest – Alexandroupolis.

Therefore, taking into account the gateway role of Thessaloniki's sea port being the second largest port in the country and the land connections available through the strong positioning of the city in the Pan-European Transport network, it can be deducted that by creating the right facilities and conditions there is huge potential for the development of intermodal transport in the region to accommodate maritime-land transport flows and chains that can span well beyond the Balkan area towards Central, West and East Europe.

3.3. The Chemical Industry and Chemical Logistics

The tables that follow display the import and export volumes regarding the transport of chemicals to and from Thessaloniki, their evolution in time from the year 2000 to 2010 and their percentage in relation to the total volumes that are being transported from North Greece, since it is likely that a significant proportion of the total flows of North Greece could be attracted towards Thessaloniki if the Intermodal Freight Terminal is established.

Table 3.3- Import of chemicals per transport mode (Thousands tons imported in Thessaloniki and quota in % of N. Greece)

YEAR		SEA	ROAD	RAILWAY	AIR	OTHER
2000	Ths tons	173	94	58	0,4	0,4
	% N. Greece	28,3	15,3	9,5	0,1	0,1
2001	Ths tons	156	115	64	272	3
	% N. Greece	21,2	15,6	8,7	0,0	0,4
2002	Ths tons	218	140	20	0,4	0,1
	% N. Greece	28,7	18,5	2,7	0,1	0,0
2003	Ths tons	252	193	28	0,5	0,1
	% N. Greece	30,7	23,5	3,4	0,1	0,0
2004	Ths tons	198	215	58	0,6	0,1
	% N. Greece	22,3	24,2	6,6	0,1	0,0
2005	Ths tons	210	207	68	0,4	0,4
	% N. Greece	25,9	25,5	8,4	0,0	0,0
2006	Ths tons	243	172	12	0,2	0,2
	% N. Greece	30,1	21,3	1,4	0,0	0,0
2007	Ths tons	312	167	6	0,2	0,3
	% N. Greece	36,8	19,7	0,7	0,02	0,04
2008	Ths tons	278	199	10	0,4	0,0
	% N. Greece	33,1	23,7	1,1	0,04	0,0
2009	Ths tons	264	142	11	0,2	0,4
	% N. Greece	37,7	20,4	1,6	0,02	0,1
2010	Ths tons	242	134	11	0,4	0,2
	% N. Greece	36,3	20,2	1,7	0,1	0,03

Table 3.4- Export of chemicals per transport mode (Thousands tons exported from Thessaloniki and quota in % of the country)

YEAR		SEA	ROAD	RAILWAY	AIR	OTHER
2000	Ths tons	94	72	0,05	0,2	0,02
	% N. Greece	21,7	16,7	0,01	0,1	0,01
2001	Ths tons	68	65	0,04	0,3	0,01
	% N. Greece	19,7	18,7	0,010	0,099	0,002
2002	Ths tons	50	93	2	0,5	8
	% N. Greece	11,8	22,0	0,5	0,1	2,1
2003	Ths tons	124	127	0,5	0,4	16
	% N. Greece	19,1	19,7	0,1	0,1	2,5
2004	Ths tons	102	138	0,1	0,2	4
	% N. Greece	16,3	22,0	0,0	0,0	0,6
2005	Ths tons	96	158	0,04	0,3	0,04
	% N. Greece	15,8	25,9	0,0	0,0	0,0
2006	Ths tons	48	145	3	0,1	0,4
	% N. Greece	10,5	31,4	0,6	0,0	0,1
2007	Ths tons	98	88	7	0,1	0,02
	% N. Greece	20,9	18,9	1,5	0,00	0,0

It is evident from the above tabulated data that for both imports and exports the preferable transport modes are sea and road transport. Rail transport has a slight participation particularly in exports, though in terms of imports the transported quantities of chemicals by rail are greater, probably due to the convenience related to the transportation needs for specific cargo types or their origin. However, there is evidence that a significant proportion concerns maritime-land transport chains for the transport of chemical goods and as such the role and participation share of rail transport within these chains could be considerably enhanced by the potential development of an Intermodal Freight Center in the Region of Central Macedonia.

4. Description Of Main Problems and Critical Issues

4.1. Critical Issues

The main critical issues of the freight transport system of the Region of Central Macedonia that need to be confronted and alleviated via the development of the Intermodal Freight Centre are summarized as follows:

- Lack of coordination of the current intermodal transport and logistics processes and products flows in the Region of Central Macedonia.
- Poor level of offered services regarding intermodal transport / handling of goods in the region of Central Macedonia.
- Small scale use of intermodal transport in the wider area and limited participation of SMEs in intermodal transport chains.
- Extremely fragmented transport sector in the region of Central Macedonia.
- Dominance of road transport concerning land transport modes.

5. Proposal of Selected Measures

5.1. Selection of the location for the potential establishment of an Intermodal Freight Centre

The study focuses on the potential establishment of an Intermodal Freight Centre in an area within the Prefecture of Thessaloniki. Among the first and most important considerations is the selection of the location for the establishment of this terminal. The location must provide relatively easy and fast access to rail and maritime transport nodal points (less important for air transport) and be well connected to the main national and international road axes. It should also be in proximity to the city's main industrial area and possibly other areas of commercial activity without being itself in a totally urban environment. Preferably it would involve an area which is unused and belongs to the state in order to minimise to a possible degree any acquisition costs involved.

Taking the above into consideration it is proposed that the selected area is defined and located at the former military camp of Gonou in the Municipality of Echedoros. The Municipality of Echedoros belongs to the Prefecture of Thessaloniki and was created in 1999 from the unification of the municipalities of Sindos, Ionia (Diavata, Nea Magnisia) and the community of Kalohori.

The map of Central Macedonia Region and of the Municipality of Echedoros is shown in Figure 5.1

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Figure 5.1 : Map of the Central Macedonia Region and the Municipality of Echedoros

The former military camp of Gonou is located in the western side of Thessaloniki and in particular in the Municipality of Echedoros. It covers an area of 971.271 sq.m west to the inner Ring Road of Thessaloniki, south to the Edessa – Veria national highway and north to the Pontou Street.

The most important uses of land in the wider area are the Prison of Diavata which is near to the military camp, the Vehicle Technical Control Centre (VTCC), the Refineries of EKO and the Fruit Vegetable Market of Thessaloniki. In addition, in the neighboring area numerous industrial, chemical and manufacturing companies, as well as gas and car service stations and other commercial uses of land are situated that imply wide industrial and commercial activity developed in the area. As far as road connection is concerned, all the above mentioned are served by the basic road network of the area, through local roads/ connections.

The military camp in its present condition has one entry/ exit gate. The connection with the PATHE (Patras - Athens - Thessaloniki - Evzonoi) national highway and the inner and outer Ring Road is accomplished through the junction that is near to the Central Market and the junction of Tsertseti - Polizoiti Street, which is situated approximately 2 kilometers away from the military camp. On the Ring Road and at a distance of 6 kilometres towards the airport from the junction of the Fruit Vegetable Market, there is the K18 junction connecting the Ring Road with the Egnatia national highway. At a distance of 500 meters from the entry/ exit gate of the military camp there is a direct access to the Thessaloniki – Edessa national highway connecting Thessaloniki with the northern part of the West Macedonia Region through the cities of N.Chalkidona, Giannitsa and Edessa. This particular branch of the Thessaloniki – Edessa national highway is an alternative choice to the Egnatia national highway that connects Thessaloniki with the city of Veroia.

The easy location's connection to the Egnatia and PATHE motorways allows exceptional road access to the markets of north, west, east and central Greece as well as towards neighboring Balkan countries to the north (FYROM, Bulgaria, Albania, Serbia) and Turkey to the east.

The "Macedonia" airport of Thessaloniki is located approximately 30 kilometers away from the camp of Gonou through the Ring Road which is a road with sufficient geometric and operational features so as to serve "heavy" traffic. This is the second largest airport in the country which also serves freight traffic although not in large volumes.

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As far as railway connection is concerned, the military camp of Gonou is situated next to the marshalling yard of the Hellenic Railway Organisation (HRO). Hence, the camp of Gonou could potentially be connected with any of the existing lines of the HRO railway network serving the national network (to Athens, Alexandroupoli, etc.) but also towards borders with neighboring countries (i.e. Eidomeni, Promachonas) along the PanEuropean Transport Corridors X and IV.

The military camp of Gonou is located about 5 kilometres away from the Port of Thessaloniki and is connected with it through the Fruit Vegetable Market Market junction and the new west entrance of the Port at the Gate 16. An overview depiction of the distance between the port and the selected location is provided in Figure 5.2

The area of the military camp is adjacent to the Industrial Area of Thessaloniki (Sindos) and at the same time it has direct access to the main urban areas of the wider city of Thessaloniki through Monastiriou Street and the Ring Road. The overview of the selected location of the terminal in relation to the city's main transport nodal points, transport axes and areas of industrial/ commercial activity is displayed in Figure 5.3.

Finally, it is important to note that the use of the area of the former military camp of Gonou has been officially handed over from the Hellenic Ministry of Finance to the Hellenic Railway Organisation in 2007.

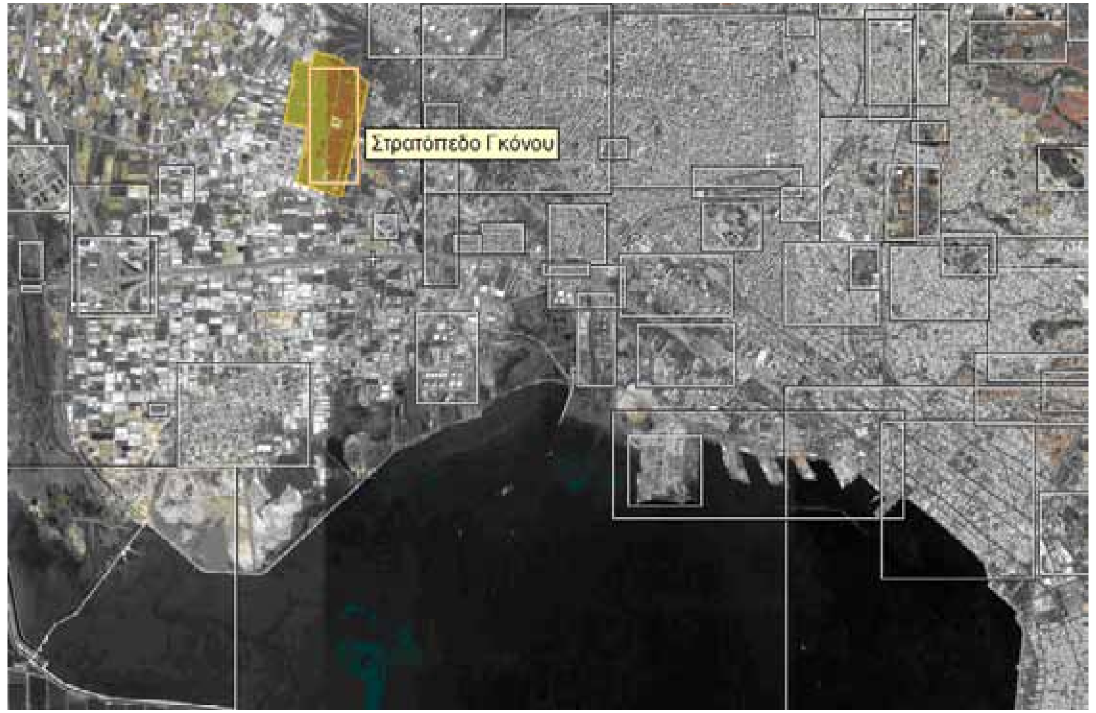


Figure 5.2- The selected location for the Intermodal Freight Center (Gonou military camp) in relation to the port of Thessaloniki

Figure 5.3- The selected location for the Intermodal Freight Center (Gonou military camp) in relation to the city's main transport nodal points, transport axes and areas of industrial/ commercial activity.

From all the above, it can be deduced that the location at the former military camp of Gonou satisfies to an acceptable degree all the main prerequisites for the development of an Intermodal Freight Centre within this location.

Road infrastructure

The road network of the area comprises of a relatively large number of major roads that serve the needs of the users on a daily basis. The roads that encompass the Gonou military camp are mainly used for the transportation of goods.

A conclusion that results from the examination of the wider area of the camp of Gonou is that the demand for transportation is high, mainly during the morning and evening hours, which is due to the uses of land that are located in the area (Industrial Area of Thessaloniki, Fruit Vegetable Market, Yard of the HRO etc).

The current situation of the road network in the area of the camp of Gonou has several problems which are mainly related to the absence of sufficient infrastructure and connections. The problem seems to be more intense at the Tertseti – Polizoiti Street, the main road that provides access and connection to the camp of Gonou. Building and operating a Freight Centre in the camp of Gonou will change the current land use and is expected to overload the existing road network with high freight flows.

Therefore, given the low flow capacity of the access road in combination with the high traffic flows of the basic road network of the wider area of the Gonou camp, arises the need to examine the possibility of improving the geometric characteristics of the access road and/or to find alternative road connection which will have relatively low traffic impact on the existing road network caused by the operation of the centre.

Railway infrastructure

In the current situation, the railway network of the military camp as well as the outer railway network is in a bad situation because of the disuse of the line. For example, some parts of the railway line are below the ground surface. An Intermodal Freight Centre is necessary to have the most sufficient railway infrastructure and for this reason significant upgrading works are required.

5.2. Detailed proposed solution

The proposed strategic objectives of the potential Intermodal Freight Centre in the Region of Central Macedonia could adopt are the following:

- Provide complete services combined with integrated transport networks
- Serve as an intermodal inter-Balkan logistics center
- Serve as a national warehousing and distribution center in the greater Balkans area
- Operate as a transit gate of the national flows using road and rail infrastructure
- Support the transit flows attracted by the Port of Thessaloniki and provide 3PL services for those flows.

Proposed offered services of the Intermodal Freight Centre

The services that the potential Intermodal Freight Centre in the Region of Central Macedonia could

provide should be the result of the analysis of the demand and the operational features of the Freight Centre. Consequently, the Intermodal Freight Centre could offer some or all of the proposed services depending on the individual needs of a specific sector, of an economic activity of the area or even of a specific good. From the above mentioned reasons it should be stressed that the following services are suggested to be considered as potential offered services that would be defined precisely only after thorough examination of the market needs.

Hence, the potential Intermodal Freight Centre could provide the following services:

- Road transport/ forwarding services and transshipment facilities (Road - Road), as well as supporting services for the vehicles and their drivers
- Intermodal transport terminal (Road – Rail), grouping and collection/distribution services for the goods, as well as supporting services for the transshipment (temporary warehousing of the transshipped goods, custom clearance, etc.)
- Rail transshipment services (Rail – Rail), grouping and collection/ distribution services of the goods, as well as supporting services of the transshipment (temporary warehousing of the transshipped goods, custom clearance, etc.). Of course, this category would include also maritime freight flows arriving at the port of Thessaloniki that would be transported via rail to the Intermodal Freight Centre i.e. Maritime-Rail-Rail.

6. Identification of the operational areas in the Freight/ Logistics Centre

6.1. Typical operational areas

For the handling of the total incoming flows and the local volume, the existence of a Space for the Transport and Forwarding Activities is necessary. This particular area should consist of buildings of different types and dimensions used for the loading and unloading, classification and temporary storage, also used by the transshipment companies.

The Intermodal Freight Centre should provide storage services for general cargo (i.e. loads that need special handling). As a result, the existence of an area for General Warehousing is also necessary. The General Warehousing areas consist of warehouses of different types and dimensions used for the sort / long term warehousing of general cargo, the configuration of shipping and the preparation for distribution. Such warehouses may also be directly connected to transshipment activities.

In case there is need for special handling of goods, the existence of an area where Special Warehousing Services are provided is also necessary. In this area special logistics services may be provided to industries (e.g. preparation of goods for sale – packaging / tagging etc.)

For the transshipment from road to rail and vice versa and from rail to rail, as well as the provision of integrated services with emphasis on the railway transport (either as origin or destination), the creation of an Intermodal Transport Terminal is necessary. The Intermodal Transport Terminal consists of the operational areas where the handling of incoming / outgoing trains, the transshipment of the intermodal unitized cargo (container /RoRo /trailers) amongst the wagons and trucks and the areas used for the temporary storage of unitized cargo, take place.

For the handling of unitized cargo which is directly related to the intermodal transport, the creation of an area where Unitized Cargo Services, such as warehousing, filling and infilling, consolidation and split of goods, cleaning and maintenance of the units etc, are provided is also necessary.

Furthermore, it should be designed a special area where Services to the Trucks coming in the Intermodal Freight Centre will be provided. In this area, apart from the standard parking for trucks, several other services, such as maintenance or fueling, may be also provided.

Within the area of the Intermodal Freight Centre, there should be a building (or buildings) where the General Services, supporting the activities and operations mentioned before, will be founded. Such services include the administration and the customs office, the telecommunications and general control centre etc. The General Services area does not presume the gathering of all the above mentioned activities in one single area, but requires their placing inside the area of the Freight Centre.

Apart from the operational areas of the Intermodal Freight Centre, areas for the development of civil infrastructure and green areas (e.g. parks) are also planned according to the spatial planning set by the Greek legislation.

The operational areas of a Freight Centre are depicted in Figure 6.1 that follows.

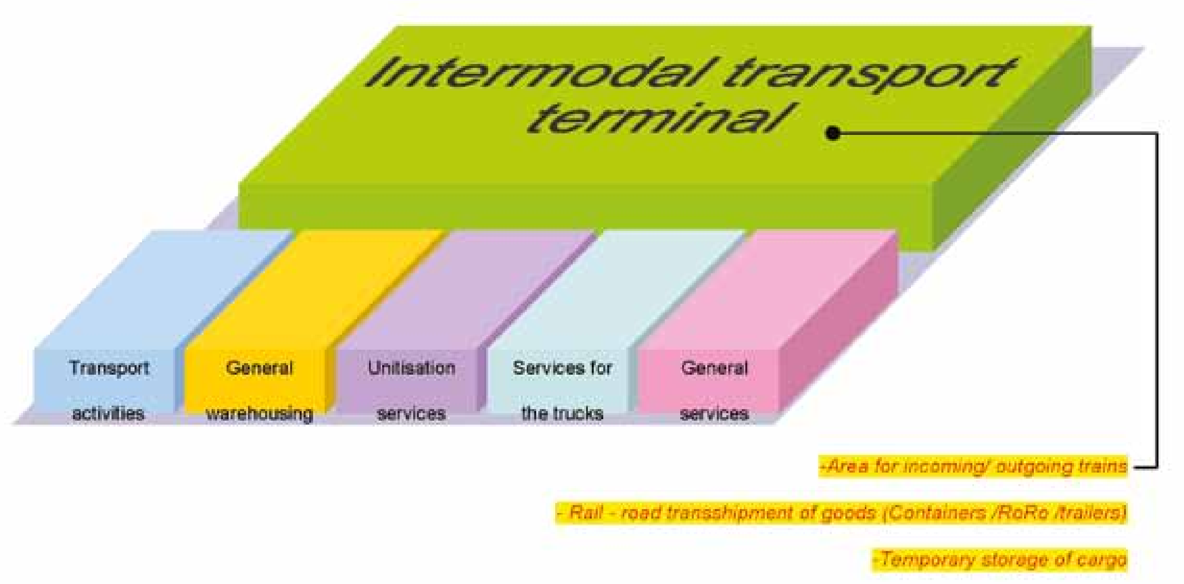


Figure 6.1: Allocation of land uses in the potential Freight Centre.

Identification of the operational areas in the Freight Centre of Central Macedonia Region

The process of the definition of the operational areas in a Freight/ Logistics Centre is directly related to the profile of the freight flows handled, the objectives and needs/ demands set by the clients or the potential investors of the Freight Centre.

Before the realization, all the necessary actions should be taken and all the contacts with the business community, the investors and the users of the Freight Centre should take place, in order for all the proposed operations and services to be identified.

Areas where transport/ forwarding activities take placeIt is also included, within the areas where transport / forwarding activities take place, areas where loading and unloading, classification and temporary storage and warehousing of goods, according to the needs of the transport and forwarding companies take place.

According to the European experience, an amount of 120 tons/day may be handled by 1 hectare of land. The related estimations are depicted in Table 6.1

Table 6.1: Forecast on the areas necessary for the development of transport and transshipment activities

Freight volume (tons/day)	[1] 2.763
Mean freight volume per hectare (tons/day)	[2] 120
Area where transport / forwarding activities take place (hectares)	[3] =[1]/[2] ⇨ 23

Areas used for general storage of goods

Warehouses of different types and dimensions are used for the long / short term warehousing of general cargo, for the composing of shipping and preparation of goods for distribution. Such warehouses may also be directly connected to forwarding activities.

The estimation of the areas necessary for general warehousing of goods is accomplished considering the assumptions displayed below:

- The 'fast moving consumable products' and the 'other' goods, representing the 22.7% and the 40.7% of the total demand, respectively, according to the categorization presented in the previous paragraph, are classified as general cargo
- About 20% of the general cargo is destined for warehousing
- About 60 tons/day may be handled by 1 hectare

The related estimations are depicted in Table 6.2

Table 6.2: Forecast on the areas necessary for general warehousing

General cargo freight volume (tons/day)	[1] x 63.4% =[4] ⇨ 2.763 x 63.4%=1.751,42
Freight volume for warehousing (tons/day)	[4] x20% = [5] ð 1.751,42 x 20% = 350,28
Mean freight volume per hectare (tons/day)	60
General storage area (hectares)	[6] =[5] / 60 ð 5,8

Special logistics areas

Within the special logistic areas several pieces of facilities of different types and dimensions to be used by specialized industrial companies, branches or products (3rd party logistics) are included. Several value added services, such as the preparation of goods for sale may be included in those activities.

The estimation of the areas necessary for special warehousing of goods is accomplished considering the assumptions presented below:

- The industrial final products, the other industrial products, the fresh and frozen goods and the agricultural products, representing the 12%, 7.5%, 11.4% and 2.5% of the total demand, respectively (33,4% in total), are classified in this category.
- About 20% of the total cargo needs specialized handling.
- About 40 tons/day may be handled by 1 hectare.

The related estimations are depicted in Table 6 - 3

Table 6-3: Estimation of special warehousing areas

Special cargo freight volumes (tons/day)	[1] x 33.4% =[7] ⇨ 2.763 x 33,4%=922,84
Freight volume for warehousing (tons/day)	[7] x20% =[8] ⇨ 922,84 x 20%= 184,57
Mean freight volume per hectare (tons/day)	40
General storage area (hectares)	[9] =[8] / 40 ⇨ 4,6

Intermodal transport services area

The international transport services area concerns services provided to unitized cargo (containers/ RoRo trailers), such as warehousing, cleaning, maintenance of units, filling, unpackaging, composing and decomposing, containerization etc.

In order for the estimation of the area required for the intermodal transport services to be provided the assumptions bulleted below are taken into consideration:

- The container is assumed to be the reference unit.
- About 15% of the total volume of loads needs provision of related services.
- For each unit (container /TEU) about 28 sqm of land are required.

The relevant estimations are depicted in Table 6.4

Table 6.4: Forecast on the area required for the development of intermodal transport

Unitized cargo (TEU/day)	[10] ⇨ 1.051
percentage of load to be handled by the Freight Centre (TEU /day)	[11] ⇨ 15 %
Handled cargo (TEU /day)	[12]=[10] x [11] ⇨158
Intermodal transport area (hectares)	[13] =158 X*10*28/10000 = 3,2

Intermodal transport terminal

The typical methodology on dimensioning the intermodal transport terminal is realized according to the rail freight flows (estimated in TEU / day). The estimations of the number and length of the trains that should be handled per day are based on the amount of cargo volumes. While estimating the demand for areas inside the terminal, the average waiting time of the trains, the operation, the amount of goods to be stored etc, should be taken into consideration.

Those areas are engaged for the realization of intermodal transport terminals, including a parking area for trains, infrastructure used for loading / unloading and transshipment from trucks to rail wagons, as well as for the temporary storage of containers.

In the current phase, the dimensioning of the terminal is achieved based on typical, gradual dimensions, produced through European projects, with the assumption that concerning 2-4 fully viable trains, about 7.8 hectares are required.

Intermodal transport terminal area (hectares)	7,8

General services area

By general services' we mean areas where several activities of the Intermodal Freight Centre are supported and promoted (such as offices, communications centre, security, customs etc). The parking areas for trucks are also included in 'general services'.

The dimensioning of the general services area (especially the parking area for trucks) is related to the number of trucks representing the incoming and outgoing road freight flows passing through the Intermodal Freight Centre.

However, the estimation of the whole area required for the development of the general services (considering buildings, offices etc) is based on the assumption that another 12000 sqm are going to be engaged in order for the buildings and the rest of the infrastructure to be installed.

Areas for infrastructure / green areas

The demand for areas related to the development of the internal infrastructure and in particular for the internal road network, depends on the spatial planning and designing of the inside area of the Intermodal Freight Centre. However, according to the findings coming from similar projects, about 10% (average) of the total operational areas is often required and is considered to be sufficient.

As far as the green areas (e.g. parks) are concerned, according to the Greek legislation, 30% of the total area should be engaged (depending on special conditions). If, for example the Intermodal Freight Centre is situated in an existing (or planned to be) industrial area or port zone, the green areas are limited (e.g. to 10%) of the total area engaged for the development of the Intermodal Freight Centre. To be on the safe side, in case of special requirements concerning the planning and designing of the Freight Centre, an amount of 30% is proposed.

Total operational areas needed

Based on the analysis carried out within the previous paragraphs, there is a demand for an area of 468000 sqm, where, concerning the Greek legislation related to infrastructure and green areas, reaches the 640000 sqm. As presented in Figure 6-2, there is need for areas used for the transport and forwarding of goods, as well as for general and specialized warehousing areas (a total of 334000 sqm).

In order to handle the expected volumes of international and national intermodal (road - rail) transport, a medium – sized (compared to the European average) intermodal (road - rail) transport terminal is required (78000 sqm). In the intermodal transport terminal a parking for trains, the potential for the operation of a loading and unloading equipment from truck to wagon and vice versa, as well as for the temporary warehousing of containers should be taken into account.

The intermodal transport services area is estimated to 32000 sqm. The services provided to unitized loads (containers/ RoRo trailers) are related to the port and the rail including storage / warehousing, cleaning, maintenance/ repair of cargo units, unpackaging, consolidation/ split of goods etc.

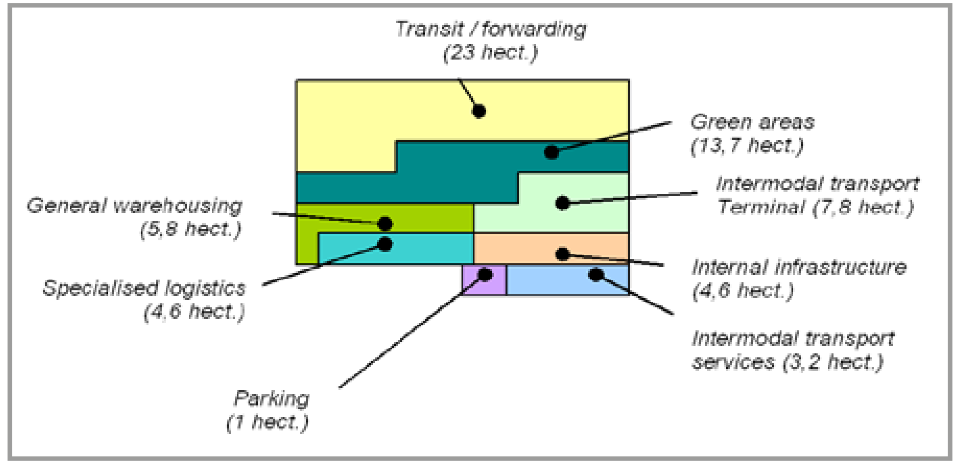


Figure 6.2- Total operational areas required

6.2. Technical considerations

For the successful operation of the Intermodal Freight Centre the fulfilment of a number of prerequisites is necessary. These prerequisites should be ensured through the property status of the Centre, itself and are the following:

- Existence of the required land area for the development of the Intermodal Freight Centre
- Ensuring the required capital for the development of the facilities and the provision of equipment that is necessary for the provision of services of the Intermodal Freight Centre
- Ensuring the required know-how for the operation of the Intermodal Freight Centre
- Ensuring the handling of the cargo volumes needed during the first stage of the Intermodal Freight Centre's development.
- Emergence of the Intermodal Freight Centre as the main nodal point in managing freight transport flows in its catchment area and ensuring the support and promotion of the Intermodal Freight Centre by bodies with adequate power and influence.

One of the most important factors for the successful development, function and operability of an Intermodal Freight Centre, as proven by the international experience, is related to the identification and the selection of the most appropriate stakeholders, as well as to the realization of the best development, function and business model, i.e. the model which defines the Intermodal Freight Centre structure, in terms of business and organizational aspects.

As far as management and operational issues are concerned, the two main bodies that could be responsible for the management of the Freight Centre in the Region of Central Macedonia involve the "Thessaloniki Port Authority" or the "Hellenic Railways Organisation" or both, supported by several private stakeholders (transport and logistic companies, industrial corporations and other types of enterprises).

The potential stakeholders can be categorized as follows, depending on the role that they could play:

A. Promotion, contribution, support of the venture

- Hellenic Railways Organisation
- Professional associations/ Chambers
- Thessaloniki Port Authority
- Administrative Region (conformity with the national transport policy)

B. Active contribution to the development of the Freight Centre

- Hellenic Railways Organisation
- Financial institution
- 3PL and freight forwarding company
- Secondarily the professional associations/ Chambers of Commerce and Industry of the region or the Administrative Region by a small percentage

C. Operators :

- Hellenic Railways Organisation
- Freight forwarding company and 3PL
- Smaller transport/ freight forwarding companies to be established in the Centre

D. Users :

- End customers of the various operators
- Commercial or manufacturing companies that will be renting facilities within the Centre for their own account.

Therefore, it can be deduced that the bodies that must be involved in the development and operation of the Intermodal Freight Centre are the Hellenic Railways Organisation, the Port Authority of Thessaloniki and a large freight forwarding or 3PL service providing company. These bodies should ensure the combination of the sea, rail and road transport modes, the adequate know-how and the required cargo volumes for its operation in accordance to the strategic placement as decided. Moreover, in order for the rest of the conditions for the success of the Intermodal Freight Centre to be ensured, the participation of a financial institution, professional associations/Chambers of Commerce and Industry of the region as well as the support from the part of the Administrative Region must also be sought.

It should also be stressed that the relevant legislation concerning the foundation and operation of Freight Centres has some practical deficiencies as it does not include the prerequisites for the development of Freight/ Logistics Centres.

6.3. Cost Analysis

The preliminary financial analysis of the Intermodal Freight Centre was implemented based on the following assumptions:

• The land will be ceded to the concessionaire, who will then develop the infrastructures for the operation of the Intermodal Freight Centre and will subsequently rent space to parties interested in using the Freight Centre

• The concessionaire will not participate in the operation of the Intermodal Freight Centre, but will only be involved in the management of the services concerning the «infrastructure». Infrastructure services are defined as operational activities concerning cleanliness, maintenance of the basic infrastructure, safety, basic information technology infrastructure

• The estimated investment cost for the implementation of the Intermodal Freight Centre is derived from the land costs (or charges based on usage since it involves concession), the estimated requirements for open spaces, infrastructures, building and warehousing facilities, equipment and transport infrastructures

• In the framework of the present analysis the investment cost is considered as being the cost of the buildings and facilities and of the general spatial configurations

• The main sources of generating income will originate from the renting of areas and facilities as well as the charges concerning cleanliness, maintenance of the main infrastructure, safety and basic information technology infrastructure.

Calculation of the investment capital

The cost of investment is presented in the following table:

Table 6.5: Investment cost

Category of investment cost	Cost (€)
Warehouses	31.190.000
Administration Building - Auxiliary Services	3.250.000
Road construction - Parking spaces	13.137.257
Spatial configurations	18.105.116
TOTAL	65.682.373

Calculation of the revenues

As mentioned previously, the foreseen income is expected to be generated through the renting of space. The renting charges of the various facilities of the Intermodal Freight Centre are estimated in accordance with the current market facts and figures. The charges for renting conventional warehousing areas is determined as being 4 Euros per sqm (square metre)/ month, while for the open storage areas as being 1,5 Euros per sqm/ month. In addition, the development of auxiliary services (restaurant, small hotel, gas station etc.) is expected to produce 7 Euros per sqm/ month. For the provision of the main services required for the operation of the Intermodal Freight Centre (cleanliness, maintenance of main infrastructure, safety, basic information technology infrastructure) a charge of 0,5 Euro per sqm/ month is estimated.

The calculation of the estimated annual revenue is presented in the following Table . In the estimation of the financial viability that follows an annual increase of 3% in rents is assumed.

Table 6.6: Estimated annual revenue

Category of revenue	Revenue (€)
Renting of open storage areas	4.005.113
Renting of conventional warehouses	4.608.000
Renting of auxiliary services	252.000
Usage charges for the facilities	4.324.557
TOTAL	13.189.670

Estimation of financial viability

For the estimation of the financial viability of the proposed project, the Net Present Value (NPV) and the Internal Rate of Return (IRR) are calculated. The capital cost is assumed as being 9% (Table 6.7.)

Table 6.7: Net Present Value and Internal Rate of Return (€)

	i	1	2	3	4	5	6	7
	9%	9%	9%	9%	9%	9%	9%	9%
Expenses	65.682.373	0	0					
Revenue	0	13.189.670	13.585.360	13.992.921	14.412.709	14.845.090	15.290.442	15.749.156
Cash flow	-65.682.373	13.189.670	13.585.360	13.992.921	14.412.709	14.845.090	15.290.442	15.749.156
(1+0,09)^i-1	1,0000	1,0900	1,1881	1,2950	1,4112	1,5386	1,6771	1,828
NPV	-65.682.373	12.100.615	11.434.526	10.805.344	10.213.087	9.648.440	9.117.192	8.615.512
NPV	-65.682.373	-53.581.758	-42.147.233	-31.341.888	-21.128.801	-11.480.361	-2.363.169	6.252.343
IRR			-43,39%	-20,36%	-6,53%	2,13%	7,81%	11,69%

The above analysis shows that if the use of all the operational areas specified is accomplished during the first year of the Freight Centre operation, then prior to the end of the sixth year of operation, the net present value turns positive and internal rate of return is 11,69%.

This approach could be considered as an optimistic scenario since it is based on the assumption the entire areas of the Intermodal Freight Centre will be utilized. However, it constitutes the basis for the thorough planning that an investor should adopt for the implementation of the Freight Centre.

The above results are in accordance with the general theory and practices existing in the field of real estate concerning warehouses, based upon which (also depending on the cost of land that is not included in the above analysis) the return is in the order of 8 to 10 years.

The analysis could be based on the development of scenarios depending on the demand for services provided by the freight centre. In order for such analysis to achieve greater meaning, a thorough market research study also determining the attractiveness of the Intermodal Freight Centre from the part of potential users, should take place.

7. Conclusive Remarks

7.1. Expected Benefits

The expected benefits that may arise from the development of an Intermodal Freight Center at the Region of Central Macedonia are summarized and listed below:

• Promotion of intermodal freight transport and increase in the quality of the services provided.

• Support towards the export activity of the region and the competitiveness of local industry and commerce

• Improved interconnection of the port of Thessaloniki with land transport corridors thus reinforcing the role of Thessaloniki as a national, regional (Balkans) and European gateway and transit nodal point

• Generation of new employment and development of new relevant commercial activity in the proximity of the terminal

• Development of economies of scale that can reduce total transport costs for individual companies and especially SMEs

• Improving the interoperability of the transport modes

• Improved distribution and managing of freight transport i.e. lowering traffic congestion in other urban areas and increasing safety by directing flows towards the intermodal freight centre

• Improving the operation of existing intermodal transport chains and facilitating the development of new ones

• Increase use of environmentally friendly transport modes i.e. greater utilization of rail transport in particular in terms of sea-rail transport chains that can attract traffic off the road and reduce externalities resulting from road transport activity i.e. less noise and air pollution, fewer accidents etc.

• Potential for deployment of advanced ICT solutions

• Facilitating the development of cooperation practices between companies and especially SMEs which will now have access to modern intermodal terminal facilities/ equipment and advanced logistics and ICT services.

7.2. Proposed next steps

The proposed next steps should involve the following:

• Elaboration of a full Master Plan and an analytical economic feasibility plan for a set time horizon.

• Definition of the organizational and business plan for the operation of the intermodal freight terminal.

• Investment plan, sources of potential funding, time plan for the construction/ development works.

• Elaboration of a Traffic study for the accessibility of the terminal, its transport connections and the impacts of the expected traffic to be generated in the proximity of the terminal.

• Elaboration of a Strategic study of environmental impact assessment.

Of course, in conjunction to the above steps concrete and continuous commitment should be shown by the Hellenic Railways Organisation to initiate the actions required for the actual development of the Intermodal Freight Centre from vision to reality. Furthermore, extensive consultation is required with all the stakeholders and parties involved both from the public and private sector, in order to initiate this important project for the economy of the Region of Central Macedonia. Different scenarios must be examined for its establishment that may also involve the formation of private-public partnerships (PPPs). Through this consultation, the organizational and business model of the terminal can be devised, planned, agreed and contracted which will form a stepping stone for the next steps of the Intermodal Freight Center's development and operation.

Feasibility Study For the Improvement of MOS and Safety of Maritime Transport in the Broader Area of Thessaloniki

Feasibility Study for the Interconnection of two different ICT systems in the ThPA container terminal

Thessaloniki Chamber Of Commerce And Industry (TCCI)

in co-operation with

Transeuropean Consultants For Transport, Development and Information Technology S.A. (Tredit S.A.)

1. Summary

The feasibility study addresses the costs and benefits from possible interconnection and exchange of information between a Terminal Operation System (TOS) and a Fleet management system in a port container terminal.

The interconnection of the systems provides improved management of the handling operations on cargo/container (including chemical cargoes), reduction of errors and the means for exception handling through the provision of timely information on abnormal events to responsible personnel, which in turn leads also to an increase in the operations' level of safety.

The feasibility takes into account the current situation in the container terminal of ThPA (Thessaloniki Port Authority) as well as the fact that it is a small-medium sized container terminal mainly operated by straddle carriers. These facts play also a crucial role for the described problem and the proposed solution.

The TOS modules that need to be integrated with the fleet management include the e-Documents handling application, the Resource Management application, the Yard Planning application, coupled with GIS capabilities and the Loading/ Unloading Control module. The solution also requires the installation of location-detection enabled PDAs on all container-handling equipment (e.g. straddle carriers).

The costs related with the deployment of the solution include mainly the costs for acquiring the relative software, configuration and integration activities and hardware needed for the operation of the system. For the container terminal of ThPA operated by 10 straddle carriers, which need to be equipped, the total approximate costs reach an amount of 620.000 euro. The total project duration is expected to approximately 18 months.

2. Introduction

The feasibility study examines the possibility of implementing ICT systems that would facilitate interconnection and exchange of information between a Terminal Operation System (TOS) and a Fleet management system in the container terminal of the port of Thessaloniki with respect to increasing safety as well as the efficiency of operations. These constitute prerequisites for the development and operation of Motorways of the Seas schemes in which port terminals perform as seamless motorways junctions linking sea transport efficiently with all other surface transport modes.

The main aims of implementing these systems concern the improved management of the handling operations on cargo/container (included chemical cargoes), the reduction of errors and the means for exception handling through the provision of timely information on abnormal events to responsible personnel, which in turn leads also to an increase in the operations' level of safety.

From the SWOT Analysis and the survey responses coming from the main interviewed actors of the Thessaloniki chemical industry, in the framework of the project LOSAMEDCHEM, it can be deducted that although the location of the port within the urban area of the city is generally convenient in terms of transport costs due to its proximity, it is also perceived as inconvenient in terms of accessibility. Therefore, its location poses issues of high requirements for enhanced safety not only for the staff involved in transport and port operations but also for the wider public.

The SWOT Analysis also revealed the respondents' concern over efficiency and capacity issues of the port operations and the terminal's distribution.

The proposed solution of implementing complementary ICT systems to facilitate the interconnection and exchange of information between a Terminal Operation System (TOS) and a Fleet management system within the port of Thessaloniki will assist towards improving the efficiency of operations within the port area whilst at the same time contribute to the enhancement of the overall safety level. Safety is a critical issue especially for the transportation of chemicals and dangerous goods and such preventive actions can prove invaluable in the long run. Protective measures reinforcing the safety level of port operations can also have a strong positive effect on the port's labor force as they also improve their working environment and reduce the risks of accidents and abnormal events taking place.

3. Description of Current Situation

3.1. Current Transport Volumes

The port of Thessaloniki, which is the second largest port in the country and the main gateway port of the wider region, handles over 16.000,000 tons of cargo per annum (out of which 7,000,000 dry cargo and 9,000,000 liquid fuel cargo), approximately 300,000 TEUs containers, 3,000 ships and 220,000 passengers.

Figure 3.1: Layout of the port of Thessaloniki

The port of Thessaloniki is equipped with modern mechanical equipment for handling all kinds of cargo, general, bulzk and containers. Within the area of the port of Thessaloniki there are 600,000 sqm of indoor and open storage areas. The Container and the Conventional Cargo Terminal are the two freight terminals within the area of the port, of 254,000 and 1,000,000 sqm total surfaces respectively. The two tables that follow present the container and conventional cargo traffic served by the port of Thessaloniki for the time period 2000-2011.

Table 3.1- Container port traffic at ThPA area in TEUs

Year	Loaded	Empty	Total	Difference
2000	174.111	52.792	226.903	6,70
2001	174.335	55.453	229.788	1,27
2002	181.909	57.607	239.516	4,23
2003	204.580	61.760	266.340	11,20
2004	238.288	85.355	323.643	21,51
2005	261.728	90.732	352.460	8,90
2006	255.002	82.594	337.596	-4,22
2007	311.638	131.000	442.638	31,11
2008	186.042	52.870	238.912	-46,03
2009	196.004	73.840	269.844	12,95
2010	209.409	63.722	273.131	1,22
2011	220.358	75.209	295.567	8,21

Currently, containers transshipment volumes are minimal while transit, which roughly account for approximately 1/6 of the total traffic is destined principally towards the neighboring landlocked of FYROM and secondarily towards southern Bulgaria.

Table 3.2- Conventional cargo traffic at ThPA

Year	Tonnes	Difference
2000	4.368.151	-
2001	3.342.138	-23,49
2002	3.142.808	-5,96
2003	3.094.033	-1,55
2004	3.526.301	13,97
2005	3.840.869	8,92
2006	3.895.984	1,43
2007	4.956.319	27,22
2008	4.445.644	-10,30
2009	3.538.140	-20,41
2010	4.402.688	24,44
2011	4.268.749	-3,04

3.2. Pan-European Corridors

Apart from serving the freight demand of the city, the region and neighboring regions, the port of Thessaloniki is also a key gateway port for transit freight flows to/from Balkan countries to the north (mainly FYROM, south Serbia and southwest Bulgaria) and has the potential to play the role of a transport hub for destinations in the Black Sea. It has a hinterland of approximately 600kms radius that expands up to Belgrade and Sofia through international rail and road corridors.

More specifically, Thessaloniki is directly linked to two Pan-European Multi-modal Transport Corridors, IV and X, which are depicted in the following Figure.

Figure 3.1.- Pan-European corridors connecting with Thessaloniki and its port

The Multi-modal Pan-European Transport Corridor 4 (IV) connects Germany, Czech Republic, Austria, Slovakia, Hungary, Romania, Bulgaria, Greece and Turkey. The alignment of Corridor 4 links the following main cities: Dresden/Nurnberg – Prague – Vienna/Bratislava – Budapest – Arad – Bucharest – Constanta/Craiova – Sofia – Thessaloniki/Plovdiv – Istanbul with more than 4340 km railway lines, 3640 km roads, 10 airports and 8 sea and river ports.

The Multimodal Pan-European Transport Corridor 10 (X) connects Austria, Slovenia, Croatia, Serbia, FYROM and Greece. Corridor X follows the route linking the cities of : Salzburg - Ljubljana - Zagreb - Beograd - Nis - Skopje - Veles - Thessaloniki including its branches:

A: Graz - Maribor - Zagreb
B: Budapest - Novi Sad - Beograd
C: Nis - Sofia (- Istanbul via Corridor IV) and
D: Veles - Bitola - Florina (- via Egnatia to Igoumenitsa).

Thessaloniki is also directly linked to the Egnatia Motorway (Figure 3.2) which spans throughout the country on an east-west direction thus providing direct access towards Turkey on the east and towards Italy via the Adriatic-Ionian intermodal maritime-based corridor on the west. In addition the motorway's vertical axes provide access to the north towards Bulgaria, Albania and FYROM.

Figure 3.2- Egnatia Motorway overview

3.2. The Chemical Industry and maritime transport

For the year 2010, 13.089 containers with chemicals were unloaded and 10.237 were loaded from Thessaloniki's port including dangerous chemicals of several categories, which are presented in detail in the following table.

Table 3.3. – Dangerous chemicals imported/ exported (number of containers) from the Port of Thessaloniki in 2010

Description of class	Import/ Unload	Export/ Load
Gases: Compressed Liquefied or Dissolved under pressure	1	
Flammable gases	50	10
Non-flammable gases	28	3
Flammable liquids	229	156
Low flash-point group of liquids (flash-point below -18C)	1	3
Flammable solids	3	
Flammable liable to spontaneous combustion	65	
Substances which in contact with water emit flammable gases	32	1
Oxidizing substances (agents) and Organic peroxides	1	
Oxidizing substances (agents) by yielding oxygen increase the risk and intensity of fire	149	7
Toxic substances	80	1
Infectious substances	1	
Corrosives	172	22
Miscellaneous dangerous substances & articles	241	10
TOTAL	1053	213

3.4. The role of ICT technologies

Information and Communication Technologies (ICT) play a strategic role as enablers of advanced services in the transport and logistics sector (also applied in the case of chemicals) since they provide:

• Enhanced and widespread capability to monitor, trace and safely handle moving goods at the required level of detail, from full shipments to individual packages or items.

• Increased efficiency of transportation networks, by improving synchronization between logistic users, operators and control authorities.

• Improved sustainability of logistic systems, by reducing their impact on local communities in terms of traffic congestion and pollution.

Track and trace possibilities of cargoes and handling vehicles has been long used and their appliance is constantly been expanded following the decrease in equipment costs and services abundance. Such solutions vary from ***Fleet management solutions*** which offer track and tracing solutions on vehicles equipped with GPS-enabled devices to Inventory management solutions providing full visibility on item level which is equipped with identification devices (e.g. RFID) and various other sensors.

When the complete transportation network is considered, the already deployed systems, for efficient collaboration amongst all stakeholders, have dramatically increased efficiency in all operations from planning to transport execution and invoicing.

At the same time, container terminals efficiency and integration into the supply chain are determinant for the effectiveness of the entire distribution system. In order for the terminals to operate effectively, terminal operators implement ICT solutions supporting processes that are related to container handling and to supply chain management. These technological solutions are known as **Terminal Operating Systems (TOS)**. TOS systems usually provide full control of intermodal terminal operations (i.e. freight terminals, freight villages, port terminals, rail terminals and so on).

A typical Terminal Operating system involves a set of interconnected, interoperable and integrated modules with some typical examples listed below:

• Entry/exit control

• Loading/ Unloading Control

• Yard inventory system

• Yard planning system

• Resource management system

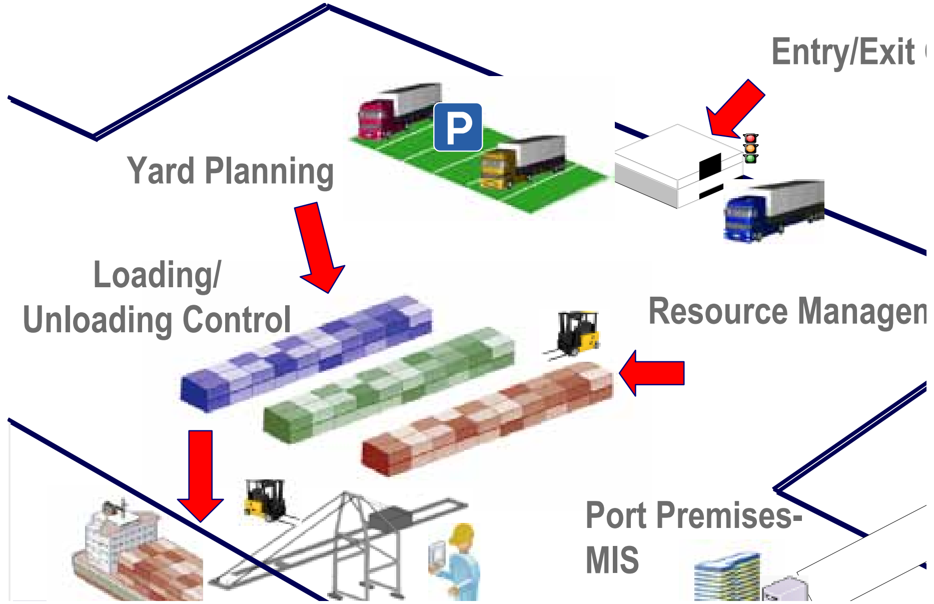
• Document submission

• Administrative support system

• Invoicing system

Positioning of the various modules of a typical TOS system within a container terminal operating environment is depicted in the Figure 3.1 below.

Figure 3.1: Container terminal operational processes overview



The container terminal of ThPA has also been invested a lot on the ICT systems for efficient operations. Currently, a TOS solution (FRETIS-IFT) is in operation and offers management possibilities for all the operations that take place in the terminal. FRETIS-IFT incorporates all the above described modules providing the possibility for a connection to the external clients as well handling all container movements within the yard.

Nowadays, with new technology continuously being developed and the needs of the terminal industry evolving due to the growth of containerization, terminal operators wish to maximize productivity and minimize costs. The productivity of a container terminal is intimately associated with the productivity of cranes, the utilization of yard and equipment, the decrease of truck turnaround time, etc.

In order to respond to these needs and enhance productivity, the terminal operation systems need to be advanced with the use of innovative technologies and become more intelligent, assisting the operators in any decision making procedures, as well as in planning and executing terminal operations faster and more efficiently. For example, when a piece of cargo arrives at the gate, the system can decide automatically about where that piece of cargo is going to be placed and which piece of cargo handling equipment will collect and take it to the location that is going to store it.

In order to achieve the goal of improving efficiency of MoS and security in logistics and transportation, interconnectivity among different ICT systems has been identified in recent years as the main driver and catalyst. Recent research activities also move to that direction of interconnecting various heterogeneous systems in a collaborative way in order to improve overall efficiency and overcome well-known obstacles and problematic areas.

4. Description of The Main Problems and Critical Issues

The goals are to automate handling and monitoring of the secure methods needed to handle sensitive / dangerous containers (chemical ones included), to reduce the likelihood of wrong handling and to guarantee that if needed a user will be immediately notified of such an alert.

TOS systems usually fulfill all the different aspects and operations needed to manage the container terminal, including the communication with external systems (e.g. incoming loading and unloading container plans) as also inter-communications between all the different subsystems used by the container terminal management process. Monitoring of all actions that take place inside the terminal is an essential functionality for a container terminal, e.g. the location of a container should always be known so as to reduce the likelihood of "losing" containers that take time to find and also to reduce dangerous materials misplacement (dangerous marked containers should be placed on specific locations for safety and security reasons).

One of the usual functionalities that are also offered by the TOS system in the container terminal of ThPA is fulfilling the above described need for knowing the location of a container. This is achieved by handling all the assigning of such movement commands inside the terminal (and sometimes outside) with the use of its appropriate equipment (e.g. straddle carrier).

These container handling orders are communicated to the operator of the specific container handling equipment (e.g. Straddle Carrier) who (after completing the work) needs to confirm upon execution of the container handling order assigned to him.

In most cases monitoring of these container movement actions - even with the use of the FRETIS-IFT TOS system in ThPA – relies on that confirmation from the operator of the container handling equipment with no means of verification. However this entails a great risk since it relies heavily on the human factor for handling dangerous cargo which can produce many problems at handling sensitive containers reducing safety and security by placing, for example, one such container at an unauthorized area.

The above situation makes it clear that we need something more than just a managing – monitoring of actions especially for dangerous cargo. The use of a fleet management system integrated with a TOS system will give ThPA this added safety and security through the knowledge of the exact location where all actions take place (container placement - picking dangerous containers). More control over the location of the equipment also means less traveling around with no purpose inside the terminal.

5. Proposal of Selected Measures

5.1. Addressing the problem – Integration of TOS with ITS solutions for position verification

The optimization of the terminal yard, including the physical handling of containers, as well as the planning and management of space and resources operating at the terminal yard (mechanical equipment, such as cranes, carriers, etc) with the use of intelligence and automation and the optimization of information flow, can improve significantly the ThPA terminal efficiency and the overall performance. In such context, there is an obvious trend towards more efficient solutions including intelligent and automated container handling.

A terminal operating system, coupled with technologies such as GPS, RFID (Radio Frequency Identification) and OCR (Optical Character Recognition) can make the operations accurate, fast and efficient.

The proposal for addressing the problem of efficiently handling chemical-related cargo is focusing on integration of FRETIS-IFT TOS system with ITS systems (such as fleet management solutions) for position verification. For example, with GPS identifying precise information on where a container is placed (which row in the stack), information is stored automatically into a database and the risk of operator error can be eliminated. With these means providing constant and real-time information of cargo movements the terminal operator can plan and manage cargo flows more effectively and increase the profitability of their operation.

Additionally, the visual information about container handling events and equipment, helps to improve processes such as fleet usage and overall productivity. It can also gather data about machine performance and then convert it into knowledge about the machine's specific maintenance needs.

The generation of visual information allows significant improvements in operational quality as it enables the operators of the control room to manage and coordinate better the container handling equipment. The aim of such a tool is to help terminal operators with the planning and coordination of their container handling machines by:

- improving the process and productivity
- preventing accidents
- training new drivers
- providing real-time monitoring of the locations of container handling equipment and container handling events
- organizing maintenance activities better,

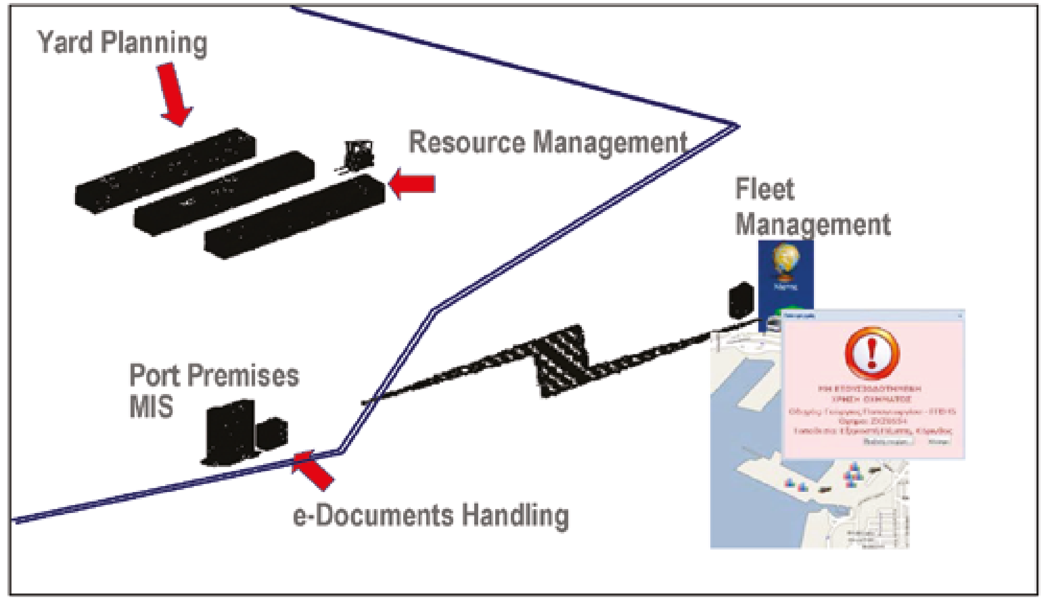


Figure 5.1- Interaction of fleet management with other port processes

Intelligence can also be added to the TOS subsystem that manages the straddle carriers (Resource management system) providing better planning and more efficient allocation of equipment to containers. In particular, during the process of unloading containers from a ship or other transport means, information of successfully unloaded containers can trigger automatically the fleet/ resource management system to assign specific straddle carriers to move the unloaded containers from the point of the yard where the unloading is realized to another point where the containers can be stored.

Information about unloaded containers that feed the fleet management system could be generated either automatically from the crane or from relevant manual input given by the user who attends the unloading procedure. Similarly, during the loading procedure the system can assign specific carriers to move containers to the crane that will finally be used for loading.

At the same time, the system -with the use of localization sensors or devices (e.g. GPS-enabled devices) - can recognize the position and also the route that the carriers have followed in previous operations within the yard, thus being able to assign them to containers on the basis of specific criteria. The logic criteria that the allocation procedure could use are the distance already covered by every straddle carrier within the yard, the shortest distance from the containers that are going to be moved, etc.

Finally, fleet management solutions can provide valuable input regarding the totally driven distance per carrier and in that way, it can contribute to a more sophisticated assignment process where orders for container movements are assigned to those straddle carriers that have less total driven distance. That would also result in less and more coordinated maintenance activities affecting at the same time the overall costs of terminal operations.

As a result, the integration of Intelligent Transport Systems (ITS) with the existing terminal operating system in the container terminal of ThPA and especially with the sub-system that performs the fleet/resources management is a prerequisite for the general optimization of the terminal processes.

5.2. Detailed proposed solution

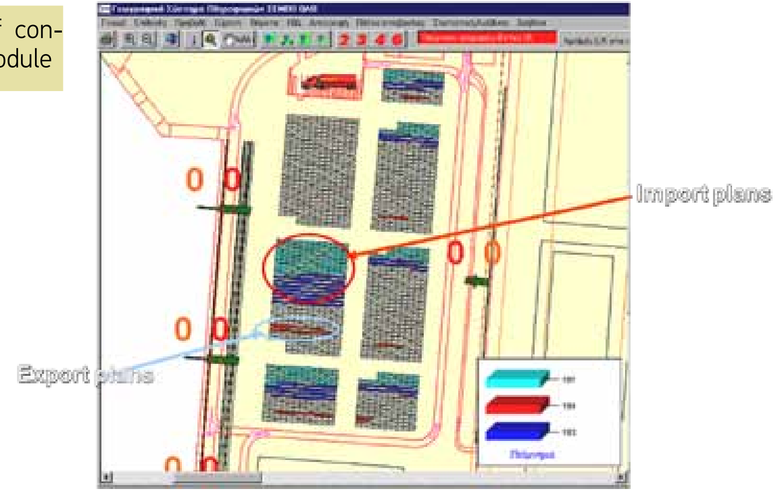
It is specifically foreseen that the TOS modules that need to be integrated with the fleet management for such operations must include:

• The e-Documents handling application: to be able to receive standardized messages (documents) in an electronic format containing information on dangerous goods and especially chemicals.

• The Resource Management application: to allow the optimization of the assignment of container handling/movement activities to straddle carrier. This module represents the core of the system allowing for intelligence and control in all container movements. The Resource Management module performs the automated organizing, delegating and monitoring of all container transfer activities within the terminal. Using a wireless local area network (WLAN), it exchanges messages and commands in real-time with the equipment operators. The Resource Management Application allows for a better utilization of the existing equipment for minimum carrier idle time. It also contributes to reductions in operating costs and improvement in performance level.

• The Yard Planning application, coupled with GIS capabilities to enable effective yard utilization and minimize the lead time associated with the stacking activities. The Yard Planning module must offer (with the help of GIS infrastructure) tools for container placement decisions. It must support a variety of planning rules and controls, to enable the execution of the port terminal operational objectives. The tool should allow the planner to define the areas in the yard where specific types of containers should be stacked based on their special characteristics (as defined and sent to the terminal through the e-Doc application) allowing for advanced control (e.g. specify the slots in the yard that chemical should be positioned).

Figure 5.2- Display of container yard planning module



• Finally the ***Loading/ Unloading Control module*** to handle the control and the electronic storage of data relating to the loading and unloading of either ships or trains. It should be able to capture the unloading activities and notify the Resource Management application (upon container unloading from ship) that the specific container is now available to be moved to an available slot in the yard (as defined through the Yard Planning module).

The solution also involves a ***Fleet Management application*** and the ***installation of location-detection enabled PDAs on all container-handling equipment*** (e.g. straddle carriers). The PDA's role will be twofold:

• Provide the possibility for the driver to receive container handling orders for the Resource Management application. Such orders could be for example, to move a specific container which has just been unloaded from the ship to the specific slot in the yard (according to the rules set by the planner in the Yard Planning tool).

• Provide the location of the PDA attached to the straddle carrier in the Fleet Management solution which in turn sends the data to Resource Management for position verification of executed against assigned order for each straddle carrier.

The Fleet Management application should be directly interfaced with the Resource Management module to receive the expected location and report on any deviations. Further to that, the Fleet Management application may also be enhanced with tools to optimize the allocation of container handling order to the closest straddle carrier and thus avoid long idle times or inefficiency in travelling long distances within the yard.

5.3. Technical considerations

Several technical considerations come along with the foreseen integration of these two systems which also arise from the foreseen use of the system.

One such example is the GPS precision: On standalone fleet management systems, accuracy of 5-10 meters is sufficient enough for "monitoring" a vehicle or any other kind of moving resource. In the foreseen integrated system, the needed GPS accuracy should be as good as possible to reduce unnecessary search for the correct container when actions need to be taken on, given the location on the map. If default GPS technology does not provide such accuracy then other methods should be used:

• Wi-Fi based location identification if Wi-Fi antennas are well-placed in the container yard.

• Differential GPS with the use of a local GPS antenna that will help improve the location given by normal GPS device.

Another problem could be warehouses where GPS signals and/or Wi-Fi do not exist. This should be handled by smart devices / servers that store the last known location and provide the information when communication is again available.

Security is another matter that needs to be taken into consideration. Information passed from one system to another must be encrypted since it holds sensitive data regarding exact positions of sensitive containers – cargo. This could be avoided by having fleet management system installed side by side with the terminal management system on the same network topology (LAN).

The Fleet management system will be used for presenting alerts (in case of wrong positioning of container) but the complete logic will remain in the TOS system. That means the alert handling is still a user-centric decision. However, in case that certain actions need to be taken by TOS then this could be automated ensuring the correct handling takes place and also reducing some workload from the user especially for repetitive simple tasks.

Finally, the integrated communication between the two systems should be fast and reliable. If the current document based communication platform is slow at passing through the alerts as they are being produced, then alternative communication ways should be investigated.

5.4. Cost Analysis

The costs related with the deployment of the solution include mainly the costs of acquiring the relative software, configuration and integration activities and of the hardware needed for the operation of the system.

Software costs include the complete set of modules which have to be updated in order to handle the location information provided by the fleet management, ta handle alerts as well as the fleet management solution and their integration activities. These estimated costs are depicted below.

Software/Activity	Approximate Costs in €
TOS Modules Updating: e-Doc Handling Resource Management Yard Planning (incl. GIS) Loading/Unloading Control	150.000
Fleet Management Application	100.000
Application on PDA devices	50.000
Integration activities	100.000
Configuration activities	200.000
TOTAL	600.000

Certain hardware needs also to be purchased and installed. These hardware costs are as follows:

Hardware	Approximate Costs in €
PDA (on-board device) (GPS enabled): For 10 straddle carriers to be equipped	3.000 per unit 30.000 in Total
Set up of a Wi-Fi infrastructure in the container terminal yard to enable communication of PDAs to back-end applications. (3G/GSM communication from PDA to back-end may also be used but this would entail monthly fees per device based also on data volumes produced and sent)	10.000
TOTAL	40.000

For the container terminal of ThPA operated by 10 straddle carriers that has to be equipped the total approximate costs reach an amount of **640.000** euro.

It is obvious from the above analysis that the costs for hardware installations may vary, based on the final number of devices to be purchased.

5.5. mplementation and deployment time-plan

The implementation of the project should be split into different activities regarding the development or purchase of relevant software and any installation activities needed on-site. The foreseen activities and their approximate duration are shown below.

Activity	Estimated Duration
Software acquisition	4 months
Software installation and configuration	8 months
Integration activities	4 months
Testing activities	2 months
Training activities	2 months
PDA on board devices installation	1 month

The timetable that follows also depicts the time of those activities presenting the overall time horizon for the project.

	Project Month																	
Activity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
Project management																		
Software acquisition																		
Software installation and configuration																		
PDA on board devices installation																		
Integration activities																		
Testing activities																		
Training activities																		

The time-plan foresees an extensive period of on-site configuration activities and integration of all systems since the operational needs and the details for each port would significantly affect the way the system should be setup.

Finally support and maintenance activities are not included as they are depended on special operational needs which cannot be predetermined.

6. Conclusive Remarks

6.1. Expected Benefits

The proposed solution for integration of various TOS modules operating in the container terminal of ThPA and an ITS-based application of fleet management may have direct impact on verification of container handling and movements within the terminal. Especially in the case of chemicals this enables enhanced security since possible deviations are captured on-time offering the possibility for timely responses and elimination of further problems that may result from an improper movement.

Misplacement of containers (and wrong information about this) is another issue that can be avoided. Even in case that this misplacement happens once per month, this leads to serious delays in container handling activities within ThPA since a further survey should be performed in order to verify the right position of the container. Several man hours need to be spent in order to verify the exact position which could of course be avoided if the location of the straddle carrier, which handled this specific container, was known to the system while this action was performed.

Furthermore, benefits that can be gained from the use of automated handling technology and intelligent and automated IT functions of TOS can be resumed as follows:

- decision making is taken away from humans -where that can be done- reducing possible human errors
- more effective planning of terminal operations
- visibility of resources and work queues
- minimization of the number of resources needed to work in the terminal
- improved equipment and entire terminal performance
- assistance and monitoring of operations in real time
- speeding up of the whole process
- enhancement of efficiency, reliability and cost control
- assistance in promoting environmentally sound operations
- provision of safety advantages.

Thus the solution offers a wide range of benefits for container handling in ThPA and especially for the efficient handling of chemicals and dangerous goods within the container terminal area.

6.2. Proposed next steps

Any future steps for the acquisition, application and implementation of these ICT systems depend solely on the willingness and financial resource planning of the Thessaloniki Port Authority; to proceed in cooperation with suitable qualified ICT development companies that can design the integration of the port ICT systems, install them and at the same time to provide the necessary training and support of the port staff that will be assigned to use them in the everyday on-the-job activities.

Feasibility Study for the Improvement of Harbours on ohe Broader Area of Thessaloniki

Feasibility Study for the Development and Integration
of a Berth Planning ICT system in the Port of Thessaloniki

Thessaloniki Chamber Of Commerce And Industry (TCCI)

in co-operation with

Transeuropean Consultants For Transport, Development
and Information Technology S.A. (Tredit S.A.)

1. Summary

The information about a ship's berthing has crucial effect to the overall planning and execution of activities within the port and as such it can be used to provide specific improvements. Berth and resource allocation involves the actions taken in order a ship that arrived in the port to be given a place in the quays and the necessary equipment and manpower to load/ unload its cargo.

This feasibility study concerns the potential development and integration of an ICT system in the Port of Thessaloniki which will incorporate modules optimizing berth allocation, process monitoring, statistics and communication between partners.

Benefits of the installation of such a system are expected to be the improvement of efficiency in ports operations, a better communication between different departments within the Port Authority and between the Port Authority and other partners involved in port processes, the availability of information and the adoption of more up-to-date technologies.

The improvements expected from the wider availability and use of the berth allocation information within the port fall within three different areas which all affect the overall processes and procedures within the port. These areas of improvement are:

• Planning processes,

• Operational/ execution processes

• Monitoring and creation of statistics.

The introduction of an advanced system that will be based on the ship berthing procedure is expected to have, as mentioned above, a number of impacts on the complete chain of port processes, from planning to execution of operations and creation of statistics through actual monitoring of the process.

The detailed functionalities of the system are therefore designed in order to create maximum values in the above areas. More specifically these functionalities are expected to include the following items:

• Communication (of the berth allocation info) between the different port actors

• Coordination with and Optimization of yard management

• Coordination with and Optimization of resource management

• Input to the Monitoring functions of workflow within the port

• Statistics generation.

The architecture of the proposed port optimization system is provided showing the positioning of the subsystems within the whole system, its interactions with potential users and the interfaces/ extensions on the existing Terminal Operating System (TOS) system of the port.

The costs related with the deployment of the solution include mainly the costs for software development, configuration and integration activities and hardware needed for the operation of the system and sum up to 600,00 Euros. The time-plan for the implementation of the system is estimated at 18 months in total.

Any future steps for the acquisition, application and implementation of this ICT system depend solely on the willingness and financial resource planning of the Thessaloniki Port Authority to proceed in cooperation with suitable qualified ICT development companies.

2. Introduction

The information about a ship's berthing has crucial effect to the overall planning and execution of activities within a port and as such it can be used to provide specific improvements. Berth and resource allocation involves the actions taken in order a ship that arrives in the port to be given a place in the quays and the necessary equipment and manpower to load/ unload its cargo.

The proposed solution of implementing an ICT berth planning system and its integration with the existing terminal management system within the port of Thessaloniki is expected to assist towards improving the efficiency of operations (integration and coordination of land-side with sea-side operations) within the port area and in parallel it also contributes to the enhancement of the overall safety level. Safety is a critical issue especially for the transportation of chemicals and dangerous goods, and any such preventive/ proactive actions facilitated by the adoption of advanced technological applications, can prove invaluable in the long run.

Thus, the proposed ICT system also addresses the respondents' concern over efficiency and capacity issues of the port operations as these were stated in the SWOT Analysis that was carried out at an earlier stage of the project LOSAMEDCHEM.

3. Description Of Current Situation

3.1. Current Transport Volumes

The port of Thessaloniki, which is the second largest port in the country and the main gateway port of the wider region, handles over 16.000,000 tons of cargo per year (out of which 7,000,000 dry cargo and 9,000,000 liquid fuel cargo), approximately 300,000 TEUs containers, 3,000 ships and 220,000 passengers.

Figure 3.1: Layout of the port of Thessaloniki

The port of Thessaloniki is equipped with modern mechanical equipment for handling all kinds of cargo, general, bulk and containers. Within the area of the port of Thessaloniki there are 600,000 sqm of indoor and open storage areas. The Container and the Conventional Cargo Terminal are the two freight terminals within the area of the port, of 254,000 and 1,000,000 sqm total surfaces respectively. The two tables that follow present the container and conventional cargo traffic served by the port of Thessaloniki for the time period 2000-2011.

Table 3.1- Container port traffic at ThPA area in TEUs

Year	Loaded	Empty	Total	Difference
2000	174.111	52.792	226.903	6,70
2001	174.335	55.453	229.788	1,27
2002	181.909	57.607	239.516	4,23
2003	204.580	61.760	266.340	11,20
2004	238.288	85.355	323.643	21,51
2005	261.728	90.732	352.460	8,90
2006	255.002	82.594	337.596	-4,22
2007	311.638	131.000	442.638	31,11
2008	186.042	52.870	238.912	-46,03
2009	196.004	73.840	269.844	12,95
2010	209.409	63.722	273.131	1,22
2011	220.358	75.209	295.567	8,21

From the above table, it can be seen that in the years 2007 and 2008 there were sharp increases and reductions in the container throughput but since 2009 there has been growth in the volumes.

Table 3.2- Conventional cargo traffic at ThPA

Year	Tons	Difference
2000	4.368.151	-
2001	3.342.138	-23,49
2002	3.142.808	-5,96
2003	3.094.033	-1,55
2004	3.526.301	13,97
2005	3.840.869	8,92
2006	3.895.984	1,43
2007	4.956.319	27,22
2008	4.445.644	-10,30
2009	3.538.140	-20,41
2010	4.402.688	24,44
2011	4.268.749	-3,04

The following table displays the total ship arrivals; the international role of the port is evident with international arrivals always being higher than the domestic ones.

Table 3.3- Ship arrivals at the port of Thessaloniki

Year	International	Domestic	Total	Gross Registered Tonnage	Net Registered Tonnage
2000	2.334	1.090	3.424	23.737.210	11.643.798
2001	2.285	1.146	3.431	22.579.459	11.052.693
2002	2.151	1.073	3.224	23.182.030	11.516.367
2003	1.898	957	2.855	23.446.207	11.408.223
2004	1.782	1.157	2.939	24.015.606	11.548.955
2005	1.775	1.235	3.010	24.913.106	12.006.043
2006	1.670	1.134	2.804	21.623.120	10.079.434
2007	1.802	1.183	2.985	25.127.873	11.891.719
2008	1.160	1.065	2.225	16.602.846	8.305.409
2009	1.327	599	1.926	18.942.912	9.263.130
2010	1.394	610	2.004	20.600.731	9.878.620
2011	1.405	583	1.988	18.363.634	8.552.605

The next table shows the data concerning ship arrivals at the port of Thessaloniki by berthing area. It can be deducted that there are high numbers of arrivals for both the container and conventional cargo terminals, much lower (and declining) for passenger vessels while anchorage for liquid fuels produces significant figures and remains relatively stable.

Table 3.4- Ship arrivals by berthing area

Year	2011			2010			Difference %
	Intl		Total	Intl		Total	
Container terminal	540	0	540	510	0	510	5,88
Conventional terminal	622	238	860	626	194	820	4,88
Passenger terminal	20	76	96	20	130	150	-36,00
Total ThPA piers	1.182	314	1.496	1.156	324	1.480	1,08
Liquid fuels anchorage	222	200	422	238	198	436	-3,21
AGET cement block	1	69	70	0	88	88	-20,45
TOTAL	1.405	583	1.988	1.394	610	2.004	-0,80

3.2. Pan-European Corridors

Apart from serving the freight demand of the city, the region and neighboring regions, the port of Thessaloniki is also a key gateway port for transit freight flows to/from Balkan countries to the north (mainly FYROM, south Serbia and southwest Bulgaria) and has the potential to play the role of a transport hub for destinations in the Black Sea. It has a hinterland of approximately 600kms radius that expands up to Belgrade and Sofia through international rail and road corridors.

More specifically, Thessaloniki is directly linked to two Pan-European Multi-modal Transport Corridors, IV and X, which are depicted in the following Figure.

Figure 3.1.- Pan-European corridors connecting with Thessaloniki and its port

The Multi-modal Pan-European Transport Corridor 4 (IV) connects Germany, Czech Republic, Austria, Slovakia, Hungary, Romania, Bulgaria, Greece and Turkey. The alignment of Corridor 4 links the following main cities: Dresden/Nurnberg – Prague – Vienna/Bratislava – Budapest – Arad – Bucharest – Constanta/Craiova – Sofia – Thessaloniki/Plovdiv – Istanbul with more than 4340 km railway lines, 3640 km roads, 10 airports and 8 sea and river ports.

The Multimodal Pan-European Transport Corridor 10 (X) connects Austria, Slovenia, Croatia, Serbia, FYROM and Greece. Corridor X follows the route linking the cities of: Salzburg - Ljubljana - Zagreb - Beograd - Nis - Skopje - Veles - Thessaloniki including its branches:

A: Graz - Maribor - Zagreb
B: Budapest - Novi Sad - Beograd
C: Nis - Sofia (Istanbul via Corridor IV) and
D: Veles - Bitola - Florina (- via Egnatia to Igoumenitsa).

Thessaloniki is also directly linked to the Egnatia Motorway (Figure 3.2) which spans throughout the country on an east-west direction thus providing direct access towards Turkey on the east and towards Italy via the Adriatic-Ionian intermodal maritime-based corridor on the west. In addition the motorway's vertical axes provide access to the north towards Bulgaria, Albania and FYROM.

Figure 3.2- Egnatia Motorway overview

3.3. The role of ICT technologies

Information and Communication Technologies (ICT) play a strategic role as enablers of advanced services in the transport and logistics sector (also applied in the case of chemicals) as they provide:

• Enhanced and widespread capability to monitor, trace and safely handle moving goods at the required level of detail, from full shipments to individual packages or items.

• Increased efficiency of transportation networks, by improving synchronization between logistic users, operators and control authorities.

• Improved sustainability of logistic systems, by reducing their impact on local communities in terms of traffic congestion and pollution.

Track and trace possibilities of cargoes and handling vehicles has been long used and their appliance is constantly been expanded following the decrease in equipment costs and services abundance. When the complete transportation network is considered, the deployed systems, for efficient collaboration amongst all stakeholders, have dramatically increased the efficiency in all operations from planning to transport execution and invoicing.

At the same time, container terminals efficiency and integration into the supply chain are determinant for the effectiveness of the entire distribution system. In order for the terminals to operate effectively, terminal operators implement ICT solutions supporting processes that are related to container handling and supply chain management. These technological solutions are known as **Terminal Operating Systems (TOS)**. TOS systems usually provide full control of intermodal terminal operations (i.e. freight terminals, freight villages, port terminals, rail terminals and so on).

A typical Terminal Operating system involves a set of interconnected, interoperable and integrated modules with some typical examples listed below:

• Entry/exit control

• Loading/ Unloading Control

• Yard inventory system

• Yard planning system

• Resource management system

• Document submission

• Administrative support system

• Invoicing system.

The positioning of the various modules of a typical TOS system within a container terminal operating environment is depicted below.

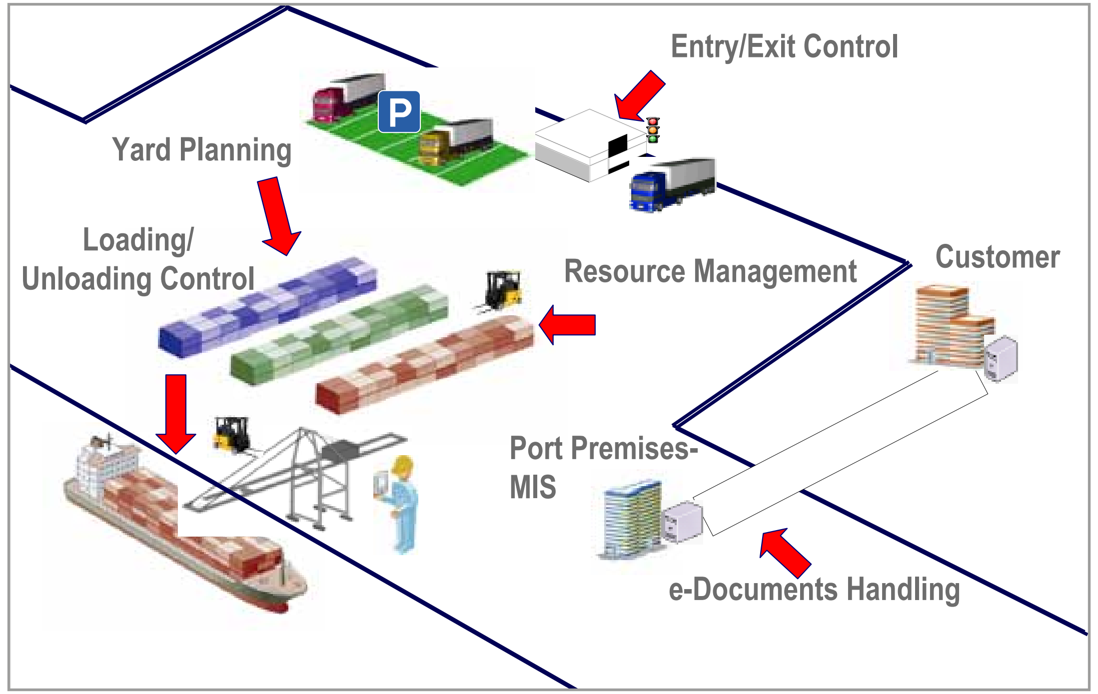


Figure 3.3: Container terminal panorama

The container terminal of ThPA has invested considerably on ICT systems to support the efficiency of its operations. Currently, a TOS solution (FRETIS-IFT) is in operation and offers management possibilities for all the operations that take place in the terminal. FRETIS-IFT incorporates all the above described modules providing the possibility for connecting to the external clients as well handling all container movements within the yard.

The introduction of an advanced system that will be based on the ship berthing procedure and its integration with the port's TOS system is expected to have a number of impacts on the complete chain of port processes; from planning to execution of operations and creation of statistics through actual monitoring of the process and thus contribute in significantly enhancing the port's infrastructure.

4. Description Of The Main Problems and Critical Issues

The increasing globalization, for example world-wide distribution of production and consumption, results in continuous increase of trade and transport. Improved port efficiency will contribute to the integration of modes and services in a single system, on condition that there is interoperability and interconnection between systems.

Taking into consideration that the size of vessels is growing faster than port infrastructure can follow, ensuring safety and efficient port approach and berthing has become an ever increasing element of port operations.

Currently, the berth allocation process in ThPA is not supported by a software application. The proposed ICT system will assist the ship's berth allocation process while enabling the actors involved in this process to exchange the information needed in real time so as to increase the availability of reaction time in view of a potentially abnormal or dangerous event taking place. Furthermore, in the case of container ships, the integration and interconnection of the system within the port's land-side Container Terminal Operation ICT system (TOS) can improve the relevant port processes in terms of efficiency and cost effectiveness, as well as the communication between internal and external involved actors.

5. Proposal of Selected Measures

5.1. Development of a Berth Planning System

5.1.1. Involved actors and their roles

Internal actors

Port operation coordination department (POC): it is the department that is responsible for the coordination of all the operations taking place in ThPA. In the port's optimization system POC is responsible for the berth allocation and the assignment of resources to a ship for loading/ unloading.

External Actors

Agent: an agent is the representative of the charterer and/ or the ship owner located at/ near the port with in-depth knowledge of port procedures. The agent is the communication link between the master, port authorities, charterer, Customs, and health office. In the port optimization system the user is the one who submits the pre-announcement and announcement notifications and the departure permission request considering a ship.

Harbour Master Office (HMO): Harbour Master Office is responsible for the safety and security in the Port. In Thessaloniki and in all Greek ports the Harbour Master Office is the Authority receiving notifications concerning the traffic in the Port, the safety and security events, but is also responsible for regulating the traffic in the Port in terms of arrival priority and departure permission. Therefore, the Harbor Master office is the office that assigns priority numbers to the ships arriving in the port and issues departure permissions when asked by an agent. The Harbor Master office is also responsible for assigning tugs and pilots to the ships.

Tug Service Company: a Tug Service Company is a company that provides tugs for manoeuvring, by towing or pushing, ships in the harbor at the berthing place assigned to them. The Tug Service Company is assigned services by the Harbor Master Office.

Pilot: the pilot is a mariner who guides the ships in the port. He is assigned services by HMO.

5.1.2. Berth plan creation ICT system

Decisions on the ship berthing position are determined by creating a "berth plan" having as input:

• the pre-announcement notifications

• the resources availability (cranes, straddle carriers, manpower etc) and

• the current traffic conditions in ThPA.

As soon as a pre-announcement is submitted to the system by the agent, the system gets the information concerning the ship identification and characteristics:

• ship name

• ship flag

• GRT (Gross Register Tonnage)

• NRT (Net Register Tonnage)

• length

• depth

• cargo

• quantity and

• estimated day of arrival.

Based on these characteristics the system creates a ship profile. The ship profile is connected with the pre-announcement file considering the arrival of the ship.

As far as the resources are concerned, the system keeps an inventory of all the resources within ThPA and their status (available, out of order and occupied). Information concerning the resources availability is inserted and updated by the Mechanical Equipment Management Department (MEM), which is responsible for coordinating the use of equipment.

Additionally, the system has stored the fixed characteristics of the port such as piers number, the quays of a pier, quays number, quays length, quays depth, cranes of a quay.

The system keeps records on previous ships having been berthed in ThPA and uses this information for deciding on berth position as well. The idea behind this is the following: it is easier for the ThPA operation to have the ships carrying the same type of cargo being berthed at the same place. This reduces the time of transferring equipment required for handling the specific cargo from one quay to another. Additionally it reduces the time and resources spent for the cleaning and maintenance of the quay.

As soon as the announcement of a ship arrival is submitted to the system and all the necessary actions preceding ship berthing are completed, the system retrieves the ship's profile and the berth-planning begins.

The POC officers receive a list of ships waiting to be berthed. ThPA berths ships in a first-come-first-served basis. This means that there are no agreements between ThPA and agents for giving priority to the berthing of a specific ship. The POC officers are trying to provide a berthing place for the first ship in the list following the procedure that is described below. If there is no available place for the first ship then the officers try to provide a berthing place for the next ship in the row. As soon as there is a change in the port (a ship has left) the POC officers restart the berth planning from the beginning of the list.

In ThPA there are two different types of terminals according to the loading unit type of the cargo; the container terminal and the conventional cargo terminal. Tanker ships do not enter ThPA premises. Therefore the first parameter taken into consideration is the type of cargo the ship carries. In case the cargo is in containers, then there is only one option as far as the pier and the quay is concerned, since the container terminal has only one quay, quay 26 in the 6^{th} pier, which can berth ships carrying containers.

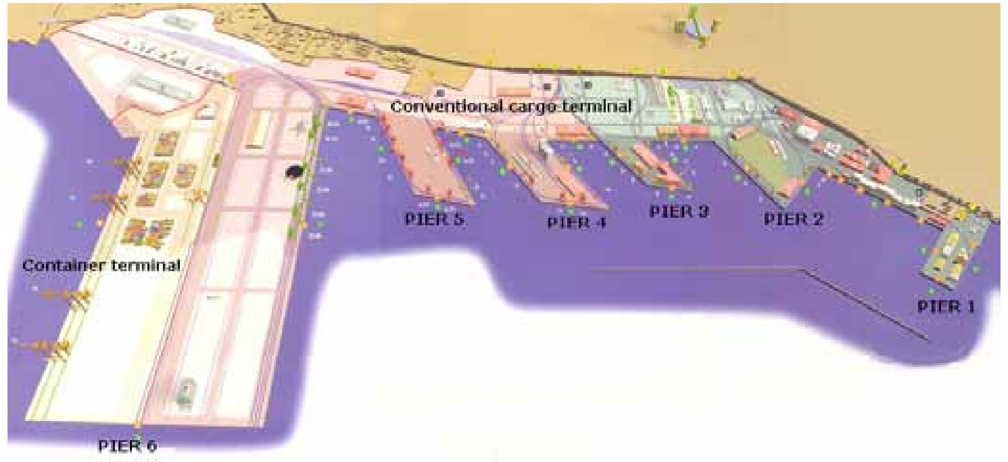


Figure 5.1- Map of the Port of Thessaloniki

The system checks the availability of quay 26 as far as berthing place and cranes availability are concerned. In case there is space and there are cranes that can serve the ship then the system suggests the place where the ship should be berthed. The final decision is up to the POC employers.

In case the ship carries conventional cargo then another procedure takes place. At first the system compares the quays depth with the ship depth and quays that are not deep enough are excluded from the list of quays where the ship can be berthed. The system keeps the list with the quays that are deep enough and checks what quays are available, that is they are free or they have free space that exceeds the ship length.

In case there is no quay available the system notifies the user who in turn submits to the system a message towards the captain of the ship to wait until further notice. In case there are available quays the system checks if there are available resources in the available quays. Normally the resources assigned to a ship are standard, depending on the ship length, the cargo and the quantity that the ship carries. However, where it is applicable, agents may request extra resources for a ship but there is no commitment by ThPA that their request will be accepted. Finally, the system ends up with a list of quays that can berth a ship and can serve it. If any of these quays in its previous berthing had been used to berth a ship carrying the same cargo, the system, -considering the criteria described previously- suggests this specific quay but displays the rest available quays as well. Otherwise, the system just displays the available quays.

In case the berthing of a ship is halted because there is no quay available at the moment of the arrival notification then as soon as there is a change in the quays status (e.g. a ship has left or available resources found) the system informs the POC officer that there is (are) available quay(s) for the ship waiting and suggests a quay.

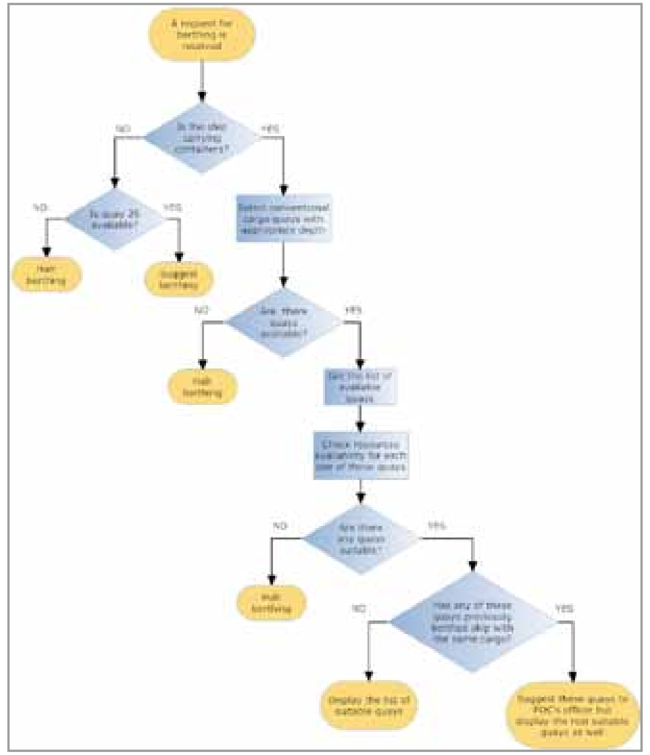


Figure 5.2- Flowchart showing the procedure for berth planning

All the above described procedure will take place as soon as the ship is ready to be berthed and without interference by the POC officers. The POC officers are only given the list of available quays and they have to make the final decision.

The system provides a view of the port with all the ships and the quays in it and the available quays are highlighted. Additionally based on the characteristics of the ship the system generates and displays a ship icon. The officers are able to select the quay they want to assign to the ship and see the outcome of this assignment visually. They can select each one of the available options before making their final decision. After making their final decision they submit the ship berthing location to the system.

5.2. Integration of the Berth Planning System with the Terminal Management System

5.2.1. Communication interface and dissemination of information between different actors within the port

The functionality of the system will develop a platform for message exchange which is expected to be of crucial importance. Being potential users of that platform, the actors involved in berth allocation process can then exchange the information needed in real time and thus increase the efficiency of services offered by Thessaloniki Port Authority (ThPA).

The tool to be developed will thus include functionality that will enable exchange of XML documents within the involved parties facilitating:

• Validation of the exchanged information against predefined formats

• Easy viewing of already exchanged information

• Possibility for creating statistics on exchanged information.

With regards to the dissemination of information among all involved actors, the possibility to use mail services (or short messaging services) will be evaluated. This could lead to better customer satisfaction through added value services.

Furthermore, by integrating this functionality of the new tool within existing systems of the port or Terminal operation (in our case within the FRETIS system that is currently operating in the port of Thessaloniki), it is expected that the overall port operation systems will be further enhanced and an added value will be created.

In the essence of single-window applications, such functionality should provide a central point for information exchange and dissemination.

5.2.2. Berth allocation

Berth allocation (as described earlier in the document) consists one of the modules developed within the new system. As part of the whole berthing procedure with its related activities within the port, the berth allocation will create the input that is needed for further optimization and coordination with yard and resource management functions.

Decisions on ship's berthing position will be determined by creating a "berth plan" having as input:

• pre-announcement notifications

• basic criteria (as resources availability, cranes usage etc) and

• known statistics and indicators for specific type of ship-cargo combination as well as crane throughput.

Moreover, the visualization of the "berth plan" will also provide the means to easily identify possible drawbacks and create alternative plans.

When "berth plan" needs to be created, one has to apply the basic criteria mentioned above with different importance and weight, since certain parameters are of high importance to the port while others to the ship and agent.

5.2.3. Coordination with, and Optimization of yard management functions (for container ships)

Yard management (and the reservation of available space within the port (or a Terminal) is a crucial part of the processes within a port. The introduction of an advanced mechanism that will use the information regarding a ship's berthing is expected to heavily improve the functionalities of the existing yard planning and management systems.

Such information about the berth, which is assigned for a ship, can have impact on the container's storage along the yard, as it will affect the decisions taken by the existing ICT tools.

For example, one relevant effect is in optimizing the placement of a container within the yard; being aware of the exact berth within the port, where a container will be discharged from the ship, the yard management system is expected to use this information as criterion when selecting the appropriate position in order to place the container within the yard.

The proposed functionality of the berth allocation tool in this respect will be to interact with the yard management module of a port's operating system, in order to optimize the berth allocation procedure i.e. allocate the ship to the best available berth in order to minimize distances to and from the yard, or facilitate – by use of other criteria – the yard management process. Such functionality is expected to:

• result in better management of available space by the queues,

• reduce the container movements within the yard/ port with significant economical benefits in fuel maintenance of equipment etc, and

• reduce the time needed for ship unloading/loading.

The functionality described above will be incorporated in the existing yard planning system of the FRETIS-IFT system (currently operating in the port of Thessaloniki) as an advanced method – option, for yard management.

5.2.4. Coordination with and Optimization of resource management

This functionality will be identical to the previous one for yard management, and for the resource management function of the port's/ Terminal's operating system.

Allocation of resources (i.e. straddle carriers, cranes, etc) can be affected by a ship's berthing information. The assignment of straddle carriers to yard areas as well as to cranes is of significant importance in order to allow for better and faster operations.

The information on ship's arrival and berthing on specific berth/ slot will be used to create the appropriate plans for the resources to be used and allocated along the container terminal area.

Apart from straddle carriers, improved management of cranes and cargo handling equipment will be also possible.

5.2.5. Monitoring of workflow within the port

An advanced monitoring function in order to provide input as necessary, and help coordinate and monitor the whole process of berth allocation vis-à-vis the whole workflow monitoring of the port's functions, is going to be part of the advanced functionality provided by the new tool/ system.

As different roles within the port take part in the completion of the various port processes, the enhanced monitoring that will be provided with the inclusion of the berth allocation information will give a more complete picture of the efficiency of the whole chain of activities (workflow) within the port.

The design of this functionality of the tool will be based on the possibility to use a centrally located database in order to hold all this information generated while in operation. This information is later to be used to extract valuable statistics as described in the following subsection.

5.2.6. Statistics creation

The berth allocation information to be stored (by monitoring the activities that take place in the frame of the berth allocation and other related procedures within the port), is going to be further exploited in order to create valuable statistics.

The proposed functionality of the new tool will consist of a number of methods for calculating and presenting statistics related to specific indicators such as:

• the berth occupation rate (percentage of time a berth is occupied)

• the average waiting time - average time to berth (from ship's arrival)

• the average time berthed (service time), as well as breakdown into actual service and idle times while ship is berthed, and

• other useful indicators.

Statistics are seen in that aspect as a tool for better planning, improvement of operations, identification of bottlenecks, and provision of the possibility to take strategic decisions within the whole port management system.

As already described in berth allocation functionality paragraph, statistics generation can be quite useful as input to berth allocation. For example, the type of ship and cargo could potentially impact the decision.

5.3. Detailed proposed solution

5.3.1. Architecture of the proposed port optimization System

Figure 5.3 presents the overall architecture that was designed to cover the functionalities that were described previously.

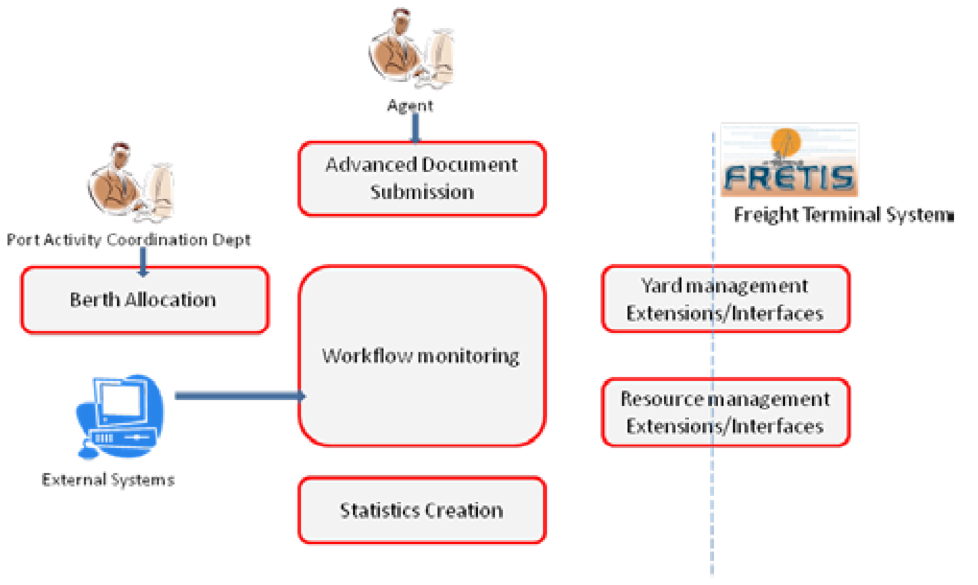


Figure 5.3- Architecture of the proposed port optimization system

The figure depicts the positioning of the subsystems within the whole system, its interactions with potential users and the interfaces/ extensions on existing FRETIS system.

Agents provide the initial information by submitting the pre-announcement notification using the document submission module.

Workflow monitoring subsystem, on the other hand, provides the overview of the process flow enabling also potentially the communication between involved parties. It is possible for the users within the Port (Harbor Master, Port Authority Activity Coordination Dept, Container Terminal etc.) to enter information in the subsystem in order to record completed activities and/or report problems during the execution of an activity.

The processes that are going to be monitored are directly involved in the berth allocation process execution and the successful completion of all related activities (recorded within the subsystem) will also take into account the information that is made available from the berth allocation application.

Information on ship's berthing position will be transmitted to the Workflow monitoring subsystem, thus enabling its usage within yard and resource management modules (integrated within FRETIS) by calling the relevant interfaces.

Finally, Statistics creation module uses all information stored within the workflow monitoring subsystem in order to create predefined reports concerning the overall performance of the process execution (in that case the berth allocation process).

As a basis for the monitoring of the execution of a process (the berth allocation process in that case with its related activities), the workflow monitoring subsystem provides both interfaces to external systems (in terms of available web services) and a user interface through which potential users can view or enter information regarding their part of the execution of the process.

This is also shown in the Figure below.

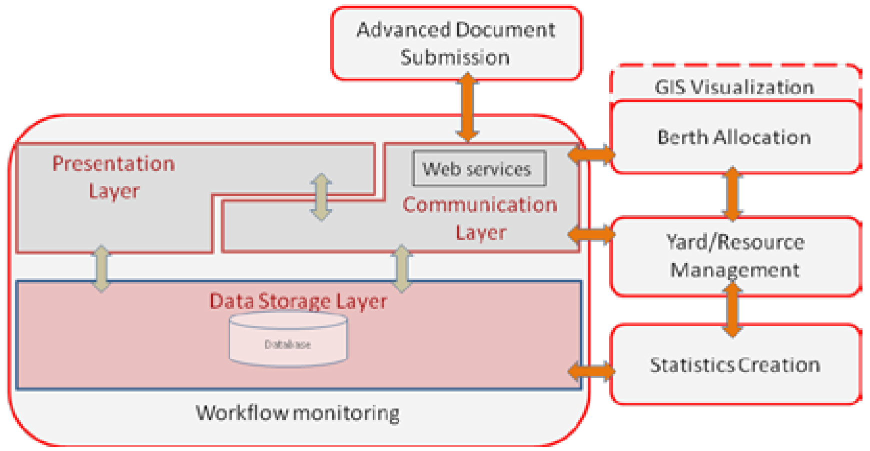


Figure 5.4- Architecture details and interfaces

The above figure presents those parts of the whole system (yard management and resource management modules have been left out) that actually have direct interaction/ interface with workflow monitoring subsystem.

The Presentation Layer defines the user interface provided to potential users:

• Harbor Master

• Port Authority Activity Coordination Dept

• Container Terminal responsible will be able to use this interface to make appropriate transactions with the system.

On the other hand, web services (Communication layer) enable external applications to provide the same information to the system. This shows the system's potential integration capabilities.

The information provided by any of the Port's roles or an external system will be stored in the data storage layer consisting the database. Historical data will be also kept and can later be used to retrieve information and create statistics.

The advanced document submission subsystem, with its enhanced functionality, will provide the means to the agents for submitting information concerning the status of a ship. This subsystem can directly use the web services provided by the Monitoring subsystem to update the execution status of certain activities of the workflow.

The Berth Allocation module will be used to create a so called "berth plan", based on known pre-announcement notifications. The user can be based on the provided GIS visualization to have a clear picture of the "berth plan". The final decision on the ship's berthing position is communicated to the workflow monitoring subsystem by calling the appropriate web interfaces.

Then, the information will also be used by enhanced yard and resource management functions of FRETIS system to provide the functionality described in the previous paragraphs.

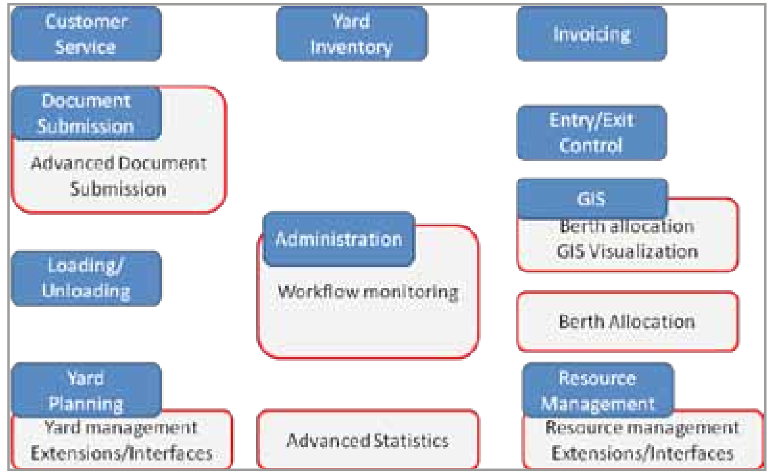
Figure 5.4 also shows the interfaces between Workflow monitoring application and Statistics creation application. Data stored within the system are further used to provide the reports and KPIs, as defined in the functionality description of the module.

5.4. Integration with the existing system (FRETIS)

The system described in the previous paragraphs will provide the appropriate interfaces for integration with the port's management information system (MIS). These integration capabilities will be shown using the FRETIS system operating in the Port of Thessaloniki.

From the integration point of view, the system is going to further enhance FRETIS capabilities in the areas shown in the picture below.

Figure 5.5- Integration/ Enhancements of functions within the existing FRETIS system



Workflow monitoring is expected to enhance the functionality provided by existing administration module by providing appropriate interfaces to external systems and workflow processing possibilities.

Berth allocation module is an extension to the current system but its GIS visualization allows the integration with existing GIS module (covering the yard area).

Statistics module will further increase system's functionality by providing valuable input to interested users. Planning and management activities can utilize this information to provide better results. Finally, the information on ship's berthing position is going to be exploited by Yard and Resource planning/ management modules (extensions of existing modules). Expected results are a better usage of yard area, a decrease of the distance traveled within the yard and a faster execution of operations.

5.5. Cost Analysis

The costs related with the deployment of the solution include mainly the costs for software development, configuration and integration activities and for the hardware needed for the system's operation.

Software costs include the complete set of modules need to be updated in order to handle the information on berth plan for each ship. These approximated costs are depicted below

Software/Activity	Approximate Costs in €
TOS Modules Updating: e-Doc Handling Resource Management Yard Planning (incl. GIS) Loading/Unloading Control	150.000
Berth Plan – GIS Visualization	100.000
Advanced Statistics	50.000
Workflow Monitoring	100.000
Communication Layer	200.000
TOTAL	600.000

5.6. Implementation and deployment time-plan

The implementation of the project should be split in different activities regarding the development or purchase of relevant software and any installation activities needed on-site. The foreseen activities and their approximate duration is shown below.

Activity	Estimated Duration
Software design and Analysis	4 months
Software Development	9 months
Software installation and configuration	1 months
Testing activities	2 months
Training activities	2 months

Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Project management																		
Software design and Analysis																		
Software Development																		
Software installation and configuration																		
Testing activities																		
Training activities																		

The time-plan foresees an extensive period of on-site configuration activities and integration of all systems since the operational needs and details for each port would significantly affect the way the system should be set up. Finally, support and maintenance activities are not included as this would be dependent on special operational needs which cannot be predetermined.

6. Conclusive Remarks

6.1. Expected Benefits

Benefits of the installation of such a system are expected to be the improvement of efficiency in ports operations, a better communication between different departments within the Port Authority and between the Port Authority and other partners involved in port processes, the availability of information and the adoption of more up-to-date technologies.

The information about a ship's berthing has crucial effect to the overall planning and to the execution of activities within the port and as such it can be used to provide specific improvements.

The improvements expected from the wider availability and use of the berth allocation information within the port fall within three different areas which all affect the overall processes and procedures within the port. These areas of improvement are:

• Planning processes

• Operational/execution processes

• Monitoring and creation of statistics.

The introduction of an advanced system that will be based on the ship berthing procedure is expected to have, as mentioned above, a number of impacts on the complete chain of port processes, from planning to execution of operations and creation of statistics through actual monitoring of the process.

6.2. Proposed next steps

Any future steps for the acquisition, application and implementation of this ICT system depend solely on the willingness and financial resource planning of the Thessaloniki Port Authority to proceed in coopera-tion with suitable qualified ICT development companies that can design the integration of the port ICT systems, install them and at the same time provide the necessary training and support to the port staff that will be assigned to use them in their everyday on-the-job activities.

Losamedchem
Feasibility study
Assessment of the Monetarised Social Risk in the Transportation of Chemicals and Fuels

Univerza v Mariboru

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University of Maribor
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1. Summary

The main goal of the feasibility study is to carry out activities to achieve goals of the LOSAMEDCHEM project, How could the logistics and the safety of the transport of chemicals be improved in the Mediterranean area?

The goal of this “Feasibility study” report for projects or action plans which will improve the logistics and safety of chemicals transport, is to draw up a methodology for evaluation of the feasibility of traffic infrastructure development or the modal shift from road to railway in the transport of chemicals and fuels. In this study we estimate broader social benefits (monetary standpoint) due to the reduction of risk of a traffic accident resulting from modality changing of chemicals and fuels transport.

Chemicals and fuels transport represents only a small portion of the entire transport within the national economy. Therefore one cannot expect that the share of chemicals and fuels transport significantly influences the traffic congestions and that is has a significant impact on the feasibility of the investment in the infrastructure. The modal shift in the chemicals and fuel transport would, however, change the overall social risk from the viewpoint of the transport itself.

Transport of chemicals and fuels represents a major risk, because accidents which would occur during the transport could influence the greater Slovenian area with its delicate ecosystems, water resource areas and the densely populated areas. Generally speaking, the overall social cost of traffic accidents consists of direct damage resulting from the accidents and of traffic accident’s remediation costs. Risks associated with the transport of chemicals and fuels can never be completely eliminated as this transport is important for the national and transnational economy. This is why the legislative bodies have, in order to minimize the likelihood of such accidents, adopted strict statutory restrictions for carriers and users. The key issue is which modality/transport chain (road/railway) in the transport of chemicals and fuels, generates a lower risk that social costs, in case they occur traffic accidents or accidents during freight handling.

According to the content Phase 2 (Transport systems), which refers to recommendations for transport improvement from the Port of Koper to hinterland, we have selected the transport corridor Port of Koper - Maribor for the chemicals transportation. We have prepared two scenarios for 2025 for the assessment of the monetarised social cost risk resulting from traffic accidents in the transportation of chemicals and fuels. Scenario 1 (modernisation of the railway) and Scenario 2 (the current state of the railway infrastructure is preserved). In Scenario 1 after the modernisation of the railways in accordance with the railways development plan, the bottlenecks on the corridor are eliminated and the increased capacity of the railways can take over from the existed roads, a maximum load of chemicals and fuels according to the potential-absorbing capacity of chemical industry and railways freight terminals. Scenario 2 presupposes maintenance of the existing situation of the railways infrastructure on which only necessary maintenance work for handling are carried out. Due to limited capacity, the growth of all chemicals and fuels cargo, according to the growth rate of chemical industry, takes place only on the road network.

The monetarised social risk in the transportation of chemicals and fuels is the sum of socio-economic costs of traffic accidents and the costs of environmental remediation of dangerous goods. In all scenarios the socio-economic costs represent the highest percentage of costs while the costs of environmental remediation are relatively low. Low environmental remediation costs are the result of a well regulated and organized area of the transport of dangerous goods, of efficient services and procedures in case of leak/exhaust of a dangerous substance.

Table 1: Annual costs of traffic accidents involving transport of chemicals and fuels by road and rail

Scenario	Modality	Socio-economic costs (€)	Costs of environmental rehabilitation (€)	Monetarised social risk (€)
Scenario 0	Road	1.473.008	52.442	1.525.450
Scenario 0	Railway	547.506	8.334	589.800
Scenario 1	Road	1.316.013	10.710	1.326.723
Scenario 1	Railway	826.116	3.628	836.342
Scenario 2	Road	1.862.492	15.155	1.877.647
Scenario 2	Railway	547.506	2.633	560.866

With the increase in transported volumes of chemicals and fuels in 2025, Scenario 2 foresees only an increase in volume of transported chemicals and fuels on the corridor Luka Koper and Maribor by road. This is due to the fact that the transport of goods by railway has already reached its performance based on infrastructure restrictions. This is also reflected in the monetarised social risk which increases 15% compared to today’s situation. Scenario 1 foresees the development of the railway infrastructure which would enable preservation or improvement of the modal distribution of the transport of chemicals and fuels in favour of the railway compared to today’s situation. In 2025 monetarised social risk of traffic accidents resulting from the chemicals and fuels transportation would be, in case of railway infrastructure development (Scenario 1), more than EUR 275,000 (12.7%) lower than in the case in which there are no development investments in the railway.

Transport of chemicals and fuels by rail proves to be more favourable in all scenarios, since the risk of social costs of traffic accidents in this modality is lower compared to the road transport. The estimation that social risk costs will be lower, represents the additional information which helps us to assess the justification of investing in a sustainable traffic system. Measures for the upgrade of the railway infrastructure from Scenario 1 change the modal distribution of freight in favour of the railway, because the railway system capacities and its competitiveness is increased.

The assessment of risk according to the modality of the rail or road represents quality information to support the final proposals for measures for safer transport of chemicals and fuels provided in the Action Plan (Phase 3). There is a number of measures to reduce risk, ranging from statutory regulations to economic de-stimulation of the higher-risk transportation mode.

The European transport policy influences the trends of transferring freight from the road to other modalities. The Marco Polo II program is one of the most important tools of the European Union to promote a modal shift in freight transport. Funding of this program helps shift freight from roads to other modalities each year. The result is equivalent to reducing 700,000 heavy goods vehicles between Paris and Berlin. This has a positive environmental, economic and social impact totalling billions of Euros per year.

It is a priority to develop conditions that stimulate the shift of the transport of chemicals and fuels from the road to rail by establishing a legal, institutional and financial framework for construction of logistics centres in Slovenia, which will have sufficient capacities to compete with the road transport in order to take over the increment of freight transport, which can be expected in the future.

2. Risk Factors in Transport Chain of Transport of Chemicals

Managing risks caused by the transport of chemicals requires the knowledge of basic risk factors and concepts such as danger, danger management, risk reduction and risk management. Environmental burden in the transport chain as the result of the existence of danger is typical of dangerous goods as it may cause great danger to the environment or people's lives or health. The possibility of occurrence of detrimental effects may be reduced by eliminating the possibility of an extraordinary event which could cause a major accident. We achieve this in practice by adopting regulations and safety standards, by exercising control over their application, by applying technical and organizational solutions or certain measures which could influence the reduction of traffic accidents' possibility and of their consequences.

The biggest risk in the transport chain are chemicals storage facilities, transport of chemicals by road, rail, plain or sea and by inland waterways. This poses the greatest risk to Karst and other ground waters, sea and other sensitive ecosystems and to people in densely populated areas.

Figures 2.1 and 2.2 present the concept of chemicals/dangerous goods transport which was, as part of the methodology for making the study, presented to the partners on the LOSAMEDCHEM project in Genoa.

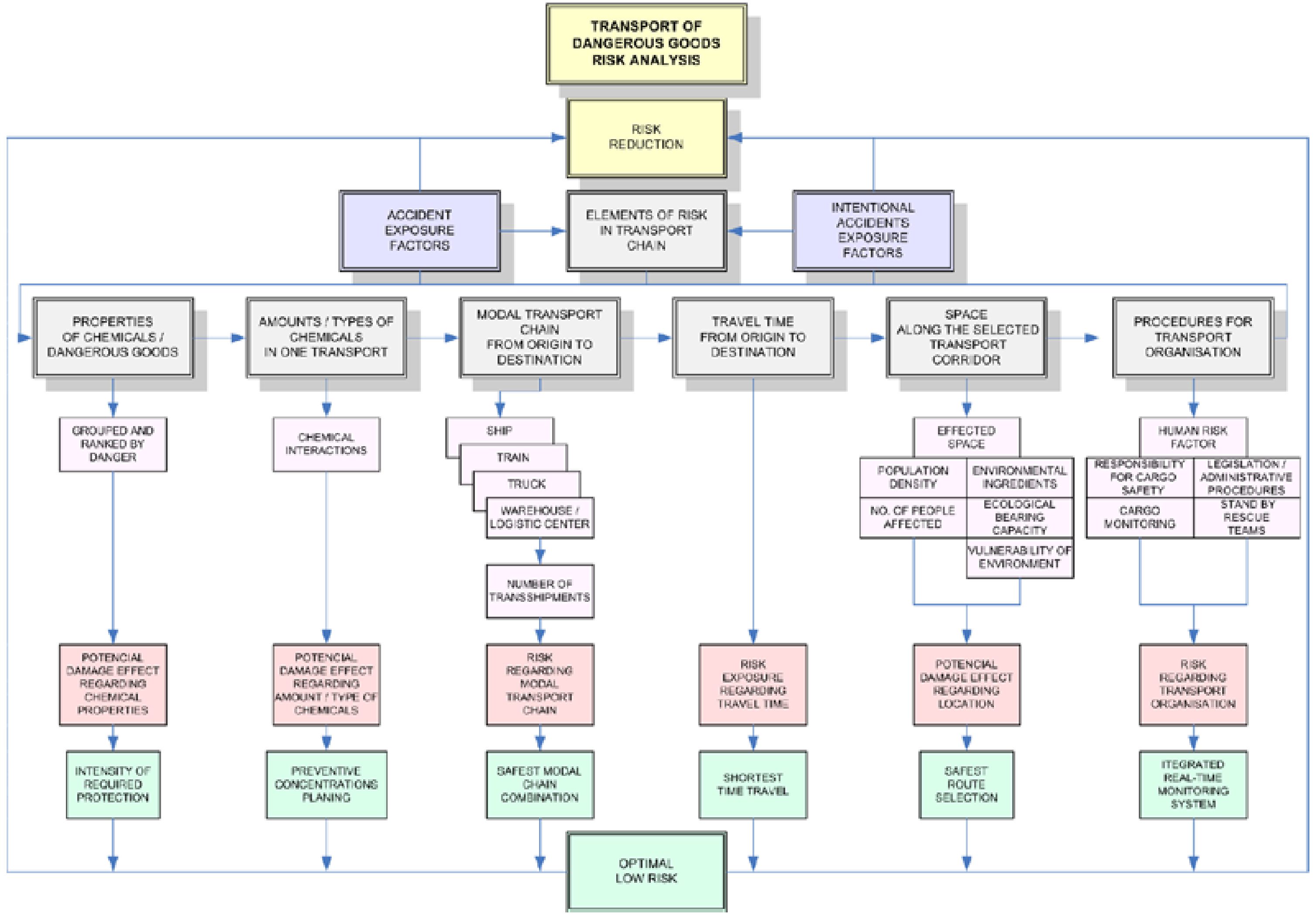

Figure 2.1: The concept of chemicals/dangerous goods transport (source: OMEGA consult

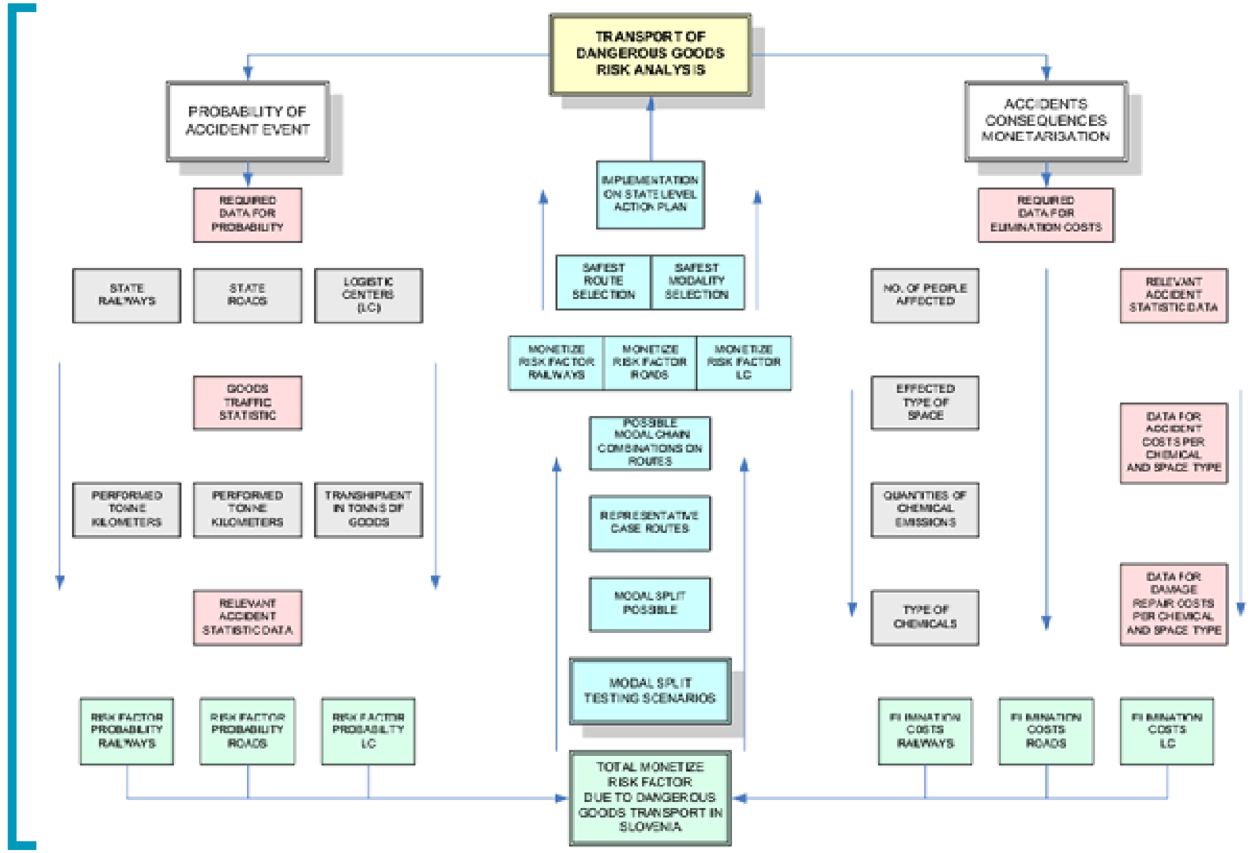

Figure 2.2: The concept of the methodology for the assessment of the risks connected with chemicals/dangerous goods transport (source: OMEGA consult

3. Transport of Chemicals

Transport of chemicals and fuels represents a major risk, because accidents which would occur during the transport could influence the greater Slovenian area with its important ecosystems, water resource areas as well as densely populated areas. Approximately four tenths of Slovenian lie in the Karst region with its characteristic quick water seepage from the surface into the underground where drinkable water resources are located and through which road and railway connections run. The sensitivity of the environment is presented more into detain in chapter 5.2.

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3.1. Types of Transported Chemicals

Detailed data on the volumes of dangerous goods transported via roads in Slovenia are not collected systematically, except for those substances for which it is required to obtain a permit by a competent authority (poisons, explosive and radioactive substances). These substances only represent a smaller percentage of the final volume of dangerous goods transported via road. Flammable liquids, mainly fuels, represent the largest percentage.

According to the Protection Against Natural and Other Disasters Act, a dangerous substance is every substance in solid, gaseous or liquid state which may, if it is released into the environment without control, directly endanger the life or health of people and animals or cause destruction or damage of property and has detrimental effects on the environment. The same act also defines an accident with a dangerous substance as an event which escaped control during carrying out an activity or handling work resources or while handling dangerous goods during production, processing, use, storage, freight handling and transport. Dangerous goods pose a special danger during transport. Therefore special protective measures must be observed, so as to ensure the safety of all those involved with transport and of people, property and environment. The term dangerous goods is also used to describe dangerous goods during transport.

The European Agreement concerning the International Carriage of dangerous goods by Road (ADR) includes the list of all dangerous goods which must be referred as hazardous. Each substance has a unique four digit number (known as UN or identification number). By this way the goods can be recognized in all countries which also makes emergency rescue easier. Each dangerous good is, with regard to the prevailing danger, placed in an individual class. Annex A to the European Agreement concerning the International Carriage of dangerous goods by Road, sets out the dangerous goods which are excluded from the international road transport and goods which may be transported under special conditions. With regard to transport it classifies the dangerous goods in limited and free classes (table 3.1) Goods, which are not stated in or classified under any group, are not dangerous under this Agreement and are accepted for transport without limitations.

Table 3.1: Classification of dangerous goods with regard to transport

Class	dangerous goods	Transport
1.	Explosive substances and objects	Restricted
2.	Gas	Restricted
3.	Flammable liquids	Free
4.1	Flammable solids	Free
4.2	Substances liable to spontaneous combustion	Restricted
4.3	Substances which release flammable gases in contact with water	Restricted
5.1	Oxidizable substances	Free
5.2	Organic peroxides	Restricted
6.1	Poisons	Free
6.2	Infectious substances	Restricted
7.	Radioactive substances	Restricted
8.	Corrosive substances	Free
9.	Various different substances and objects	Free

(Source: the European Agreement concerning the International Carriage of dangerous goods by Road - ADR)

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3.2. Transport of Chemicals In Accordance With the Applicable Law

Organization of transport is one of the risk factors in the transport chain with the transport of chemicals. In the Republic of Slovenia the organization of transport is defined into detail in the applicable law.

3.2.1. Law

The organizational structure of handling chemicals in transport is provided in relevant legal provisions.

The Chemicals Act (Official Gazette of the Republic of Slovenia 36-1752/1999, RS 11-663/2001, RS 65-3142/2003, RS 47-2236/2004, RS 61-2569/2006, RS 16-490/2008, RS 9-326/2011) together with its implementing regulations ensures that hazardous chemicals are transported in such a way that they pose as little danger to the environment and health of people as possible. All transported chemicals must include instructions for their safe use and symbols indicating danger. The law provides that for each transported chemical a safety data sheet must be issued, which is then provided to professional users and to the Chemical Office. It has to be submitted to the customs officials, when hazardous chemicals are imported. The data safety sheet is therefore mandatory for chemicals which are, in accordance with the rules on dangerous goods, classified as such.

The Chemicals Act regulates putting chemicals into transport, while the Transport of dangerous goods Act regulates exclusively the transport of dangerous goods. Not all chemicals are transported as dangerous goods, as well as not all goods, which are transported as dangerous have to be designated in accordance with the Chemicals Act. The Chemicals Act does not apply with the transport of dangerous goods. When transporting dangerous goods one does not require the safety data sheet.

In Slovenia the transport of dangerous goods is regulated with the Transport of dangerous goods Act (Official Gazette of the Republic of Slovenia 79-3756/1999, RS 96-4801/2002, RS 2-64/2004, RS 101-4400/2005, RS 41-1985/2009, RS 97-5022/2010). It applies for the transport of dangerous goods:

• in road transport,

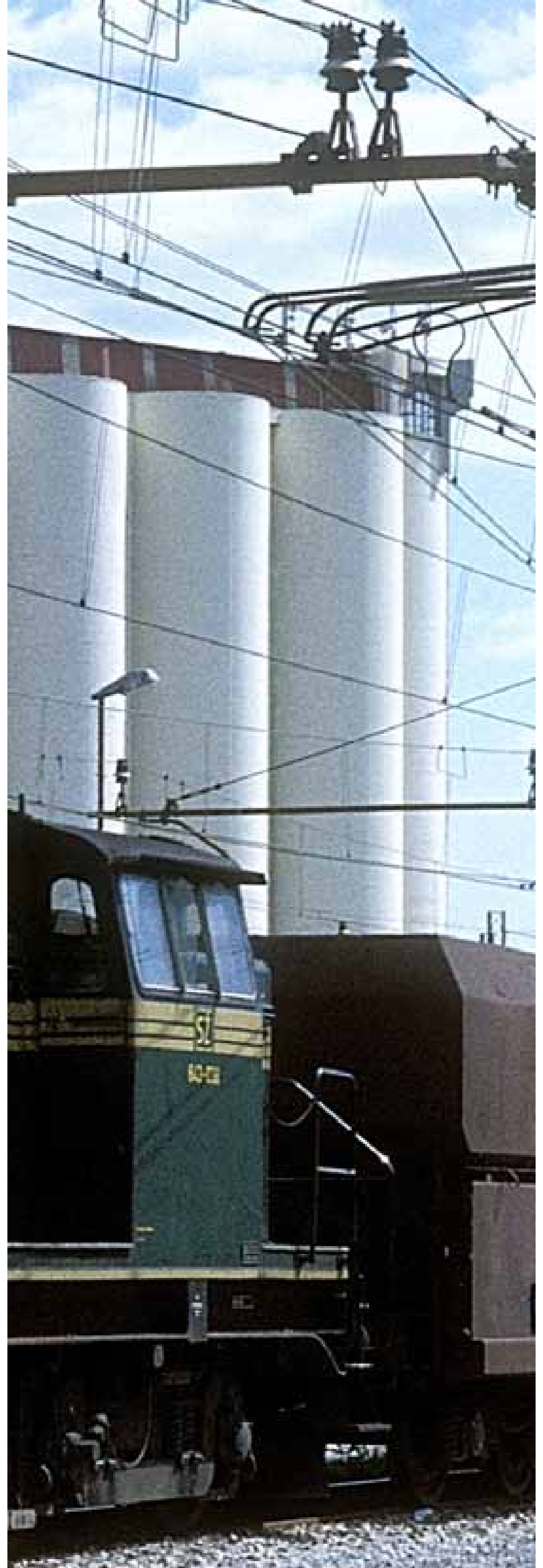
• in rail transport,

• in transport by sea and inland waters and

• in air transport.

According to the law, dangerous goods are substances, materials and objects which are divided into the following classes: explosive substances, gases, flammable liquids, flammable solid substances, spontaneously flammable substances, substances which, when coming into contact with water, release flammable gases, peroxides, organic peroxides, poisons, infectious substances, radioactive substances, corrosive substances and other dangerous goods. One requires a permit to transport explosive, radioactive and nuclear materials.

The permit for the transport of explosive materials in inland transport is issued by the administrative unit from which the delivery is dispatched and for international transport (import, export, transit) the permit is issued by the minister of internal affairs. The permit for the transport of radioactive and nuclear



materials is issued by the Slovenian Nuclear Safety Administration. However, the permit of the radioactive materials which are used in medicine or veterinary medicine is issued by the Slovenian Radiation Protection Administration.

The Transport of dangerous goods Act stipulates conditions for the transport of dangerous goods for individual transport industries, the duties of people who participate in the transport, criteria for packaging and vehicles, appointment of a safety consultant, training of people who participate in the transport, competences of the national authorities and control over the implementation of the act.

Being acquainted with the content of the Transport of dangerous goods Act is a condition for the organization of the transport and carrying out the transport of dangerous goods. Organization of the transport and carrying out of the transport are demanding tasks, and they include:

• collecting data on dangerous goods,

• participants in the transport,

• means of transport and

• acquiring relevant documents.

Organization also includes exercising control over procedures and facilities used to carry out the work. The provisions of the Transport of dangerous goods Act and of special provisions related to the modality of transport apply when carrying out procedures related to the transport of freight (the preparation procedure, carrying of the transport, completion of the transport).

International agreements, licences and other apply for the transport of dangerous goods by road:

• the European Agreement concerning the International Carriage of dangerous goods by Road (Official Gazette of the Socialist Federal Republic of Yugoslavia – MP, No. 59/72) and the Act Notifying Succession (Official Gazette of the Republic of Slovenia – MP, No. 9/92);

• the protocol which supplements Article 14, Paragraph 3 of the European Agreement concerning the International Carriage of dangerous goods by Road (Official Gazette of the Socialist Federal Republic of Yugoslavia – MP, No. 8/77) and the Act Notifying Succession (Official Gazette of the Republic of Slovenia – MP, No. 9/92);

• the protocol which supplements Article 1, item (a), Article 14, Paragraph 3 and Article 14, Paragraph 3, item b of the European Agreement concerning the International Carriage of dangerous goods by Road (Official Gazette of the Republic of Slovenia– MP, No. 7/97).

The following documents apply for the transport of dangerous goods by rail:

• Convention concerning International Carriage by Rail, (Official Gazette of the Socialist Federal Republic of Yugoslavia – MP, No. 8/84) and Act Notifying Succession (Official Gazette of the Republic of Slovenia – MP, No. 9/92), the integral part of which are the Rules on International Carriage of dangerous goods by Rail;

• the protocol on the amendment of the Convention concerning International Carriage by Rail (Official Gazette of the Republic of Slovenia - MP No. 2/04).

The following documents apply for the transport of dangerous goods by sea:

• International Convention for Safe Containers (Official Gazette of the Socialist Federal Republic of Yugoslavia – MP, No. 3/87) and Act Notifying Succession (Official Gazette of the Republic of Slovenia – MP, No. 15/92);

• International Convention for the Safety of Life at Sea, 1974 (Official Gazette of the Socialist Federal Republic of Yugoslavia – MP, No. 2/81) and Act Notifying Succession (Official Gazette of the Republic of Slovenia – MP, No. 15/92);

• International Convention for the Prevention of Pollution From Ships, 1973 (Official Gazette of the Socialist Federal Republic of Yugoslavia - MP, No. 2/85) and Act Notifying Succession (Official Gazette of the Republic of Slovenia – MP, No. 15/92) including all applicable protocols and amendments of these conventions and mandatory codes.

Each freight which contains a dangerous substance, is accompanied by documents set out by the applicable law and the European Agreement concerning the International Carriage of dangerous goods by Road. These documents show which dangerous goods are transported, who the driver, the carrier, the sender and the recipient is, how to proceed in case of an accident and whether all participants are professionally qualified. The driver must at all time have the accompanying documents with him.

3.2.1.1. Safety of transport of chemicals

Transport of chemicals must comply with strict safety provisions. Qualified personnel and well-adapted technology enable the needs of the users. The transport of dangerous goods is a change in the location of the dangerous goods, including stopovers between the transport and the time when the dangerous goods are on the vehicle, in the tank or in the container before, during and after the transport. The transport also includes intermediate storage of dangerous goods due to the change in the type of transport or means of transport (freight handling), namely under the condition that the transport document, indicating the address of the sender and recipient, is submitted at the request. In addition to this, the freight or the tanks may not be opened during the transport, due to checks carried out by competent authorities.

All people, who are in a way involved in the transport of dangerous goods, must observe and carry out the requirements of the ADR- regulations: sender, carrier, recipient, loader, person who packages the cargo, bottler, user of the tank, container/movable tank. Carrying out transport of dangerous goods is part of the activities of specialized logistics contractors.

Transport of dangerous goods is, in order to ensure greater safety, regulated by law -by national and international agreements.. The degree of danger is defined by factors, such as the vehicle, loading and unloading procedures, transport, type of dangerous goods. Moreover the international regulations governing this area in individual industries must be implemented. The danger of a substance is established based on prescribed procedures which take into consideration the chemical's properties. Chemically unstable substances classified under class 8 may be accepted for transport only if there are measures which prevent dangerous reactions of decomposition or polymerization during transport. Tanks or containers may not contain substances that would accelerate reactions. All new chemicals must be reported and other dangerous goods must be appropriately classified according to the degree of danger as well as appropriately labelled, so that each user is acquainted with the danger the substance poses to their health and the environment. All parties involved in the transport of dangerous goods must, in

accordance with their responsibilities, comply with the provisions on safety.

The quality of the transport of dangerous goods is shown by adherence to the requirements of the European Agreement concerning International Carriage of dangerous goods by road and by implementation of safety measures with the goal to reduce the possibility of an accident or of the misuse of the dangerous goods. The senders, carriers and recipients may therefore ensure complete safety of the dangerous goods during transport and therefore achieve a competitive advantage among specialised contractors carrying out this type of logistic service. The contractor which participates in loading/ transport/ storage of dangerous goods must, together with the appointed safety advisor for the transport of dangerous goods, ensure that his employees have the required expert knowledge; and that they are adhered to the regulations set out by the European Agreement concerning International Carriage of dangerous goods by road and that he must at the same time constantly check the quality of other contractors and subcontractors included in this process. If a chemical or goods is/are classified as dangerous, it means that in case of spillage damage would occur not only to the cargo, the means of transport and the immediate surroundings, but also the immediate and wider environment could also be in danger.

Conditions and requirements for the transport are therefore set out by the law, while the law does not explicitly define requirements for the transport and handling of dangerous goods within the company. The European Agreement concerning International Carriage of dangerous goods by road therefore sets out the requirements which the sender, when handing over the goods for public transport, and the recipient, when taking over the goods from public transport, must comply with. However, the setting up of the requirements for handling of dangerous goods within the company is at the companies' sole discretion.

3.2.1.2. Organization of the transport

Different components of the cargo, which consists of dangerous goods, must be appropriately loaded onto the vehicle or container and protected with the appropriate devices which prevent excessive movement according to the walls of the vehicle or container. The freight may be protected by using a strap for attaching the freight onto the side walls, sliding ribbed panels and adjustable brackets, air bags and anti-slip locking devices. Adequate protection described in the first sentence may also be achieved if each layer of the entire freight space is completely filled with packages.

Transport organization is a long and extensive procedure which is divided into the preparatory stage, carrying out the transport and the transport completion stage. All provisions must be complied with during each stage.

During the preparatory stage

Each transport of dangerous goods must be accompanied by the prescribed documents which must be located in a visible place in the vehicle. Namely:

• transport document and

• instructions in case of an accident.

These documents are very important for rescue after an accident, because the transport document indicates the type of freight that is transported; the instructions also state the measures to be taken in order to successfully carry out the rescue.

Every vehicle carrying dangerous goods must have these documents:

• certificate of the roadworthiness of the vehicle and

• supplementary insurance.

Documents for drivers, carrying out the transport of dangerous goods:

• certificate on the qualification of the driver and

• identification Figure document.

The organizer of the transportation or the sender must provide an appropriate vehicle for transport and prepare and submit all the appropriate transport documents. Everyone who participates in the transport must hold appropriate professional qualifications.

Documents of the vehicle which transports the dangerous goods include the certificate of the road-worthiness of a vehicle and supplementary insurance. Transport by road may only be carried out by a vehicle which is equipped with the transport of dangerous goods. This means that the vehicle must, in addition to standard equipment and technical roadworthiness, also bear labels according to the international regulation governing the transport of such goods. The vehicle must be labelled as defined in the European Agreement concerning International Carriage of dangerous goods by road regarding to the transport of dangerous goods; each driver must have the accompanying transport documents and the written instructions on measures to be taken in case of an accident. The impact of the transport is the greatest in case of an accident, because spillages may cause an enormous damage to the ecosystem and to people. The driver must complete the necessary training and acquire the ADR certificate (to be renewed every 5 years). Each member of the vehicle must have an identification Figure document with him at all times. Additional safety measures or a safety sheet apply/applies for dangerous goods, such as explosive substances, noxious gases and petrol. Vehicles which transport such goods must have certain equipment for the prevention of the theft of the vehicle or cargo. The freight dispatching procedure includes the loading of the goods, a check of the goods vehicle, a check of the driver's documents proving that he is qualified to carry out the transport, a handover of the dispatch documents by the carrier, signing of the dispatch order with which the driver confirms the takeover of the goods and documents for the transport of a dangerous substance.

Regulations governing the transport of dangerous goods mainly refer to packaging and labelling of dangerous goods, as well as to the means of transport which carries out the transport.

During the transport

The transport begins when the freight is loaded and the driver stores the accompanying documents. The transport is carried out according to the designated route plan. If the plan does not predict stopovers, the transport is carried out continuously. If the plan predicts stopovers, the vehicle must be supervised. In case the transport cannot be carried out according to the planned route the organizer or the sender must be informed. The sender and the organizer must be constantly in contact with the driver and monitor the course of the entire transportation and procedures carried out before, during and after the transport.

Completion of the transport

The recipient takes over the transport and the documents from the driver and monitors the unloading. In addition to handing over the freight and the documents the driver monitors the unloading, cleans the vehicle, conceals the labels indicating the transport of dangerous goods and removes the vehicle from the unloading location. If the freight is not handed over to the recipient listed in the documents, it must be returned to the sender or to the organizer.

3.2.1.3. Summary of documents required for the transport of chemicals

Document on the transport of dangerous goods

• data on the type of the dangerous substance (chemical, technical and commercial)

• the label according to the European Agreement concerning International Carriage of dangerous goods by Road, class, successive number, indication of danger

• data on volume (gross and net weight, number of items, volume)

• information about the sender

• information about the recipient

• sender's statement regarding the hand over, safety instructions

• signature and stamp of the sender and recipient.

Special safety instructions:

• the type of danger which exists during the transport and measures to be taken to minimize the danger

• how to act and help if people come into contact with the substance

• how to act in case of fire;

• separately stated substances and equipment the use of which is forbidden

• measures to be taken in case of damage to the packaging, leakage or escaping

• state the designation of the dangerous substance, class or number, no. indicating the danger and UN number if it exists.

Certificate of the roadworthiness of the vehicle for the transport of dangerous goods:

• the vehicle must acquire the certificate for the transport of certain substances (form B3 in line with the European Agreement concerning International Carriage of dangerous goods by road)

• list of the dangerous goods, which may be transported with the vehicle

• valid for 1 year

• technical inspection of the vehicle is also a condition.

Certificate of the training for the transport of dangerous goods:

- the driver must undergo basic training
- the driver must be acquainted with dangers during transport, loading and unloading
- with general regulations
- with the protection of the environment
- with labelling
- with equipment
- with the characteristics of the vehicle
- with procedures in case of an accident

The certificate must be renewed every 5 years.

- Special permits for the transport of dangerous goods:
- they are required for the dangerous goods of classes ADR 1, 6.1, 7;
- must contain instructions on: conduct during driving, driving times, the required escort, the designated route.

3.2.1.4. Control of the transport of chemicals

In Slovenia the transport of dangerous goods is controlled by the police, the customs administration and inspection services on the roads and on borders, and they may also request the help of individual professionals. On the request of the authority, competent to carry out the control, the driver must hand over the documents and equipment for inspection. He must also enable the inspection of goods and the extraction of such amount of the sample of the dangerous goods; analysis may be conducted. The authority, which carries out the control, must fill out the minutes and hand over one copy of the minutes to the driver after the control is completed.

4. Characteristics of Transport of Chemicals and Fuels According to Modality

Compared to 2000, the transport of freight by road has been increased by 30% and by sea by 85% in 2009. The rail traffic was reduced by 4% expressed in tons, and increased by 2% expressed in tkm1. During the period in question the air transport was reduced by 9%. It generally applies that rail transport is safer but railway capacities on key Slovenian lines are already full. In recent years the Slovenian motorway network has been newly constructed on all key corridors and can now compete with the railway.

According to estimations the transportation of crude oil and petroleum products represents from 75% to 80% of all transports of dangerous goods by road in Slovenia. However, not all areas of Slovenia are equally burdened. Most oil, required for supply in Slovenia, comes from the ports in Koper and Rijeka. This consequently means that the most burdened transport connections are those coming from these two ports to the inland (stretches Koper-Kozina, Starod-Kozina and Jelšane-Postojna).

Transportation of dangerous goods by sea mainly consists of tankers carrying petroleum products, liquid chemicals, and also other dangerous goods. So some preparations should be done since the transportation may cause major damage due to the fact that the goods are poisonous or due to their unfavourable physical-chemical characteristics. The shallow, closed and ecologically extremely sensitive Gulf of Trieste is much endangered due to dense maritime transport coming into the Slovenian port in Koper and the Italian port in Trieste. Spillage of petroleum products and other dangerous chemicals could have severe and long-lasting effects on the ecosystem.

Figure 4.1 represents the structure of all goods transported into the Republic of Slovenia between 2001 and 2010 by the modality of transport.

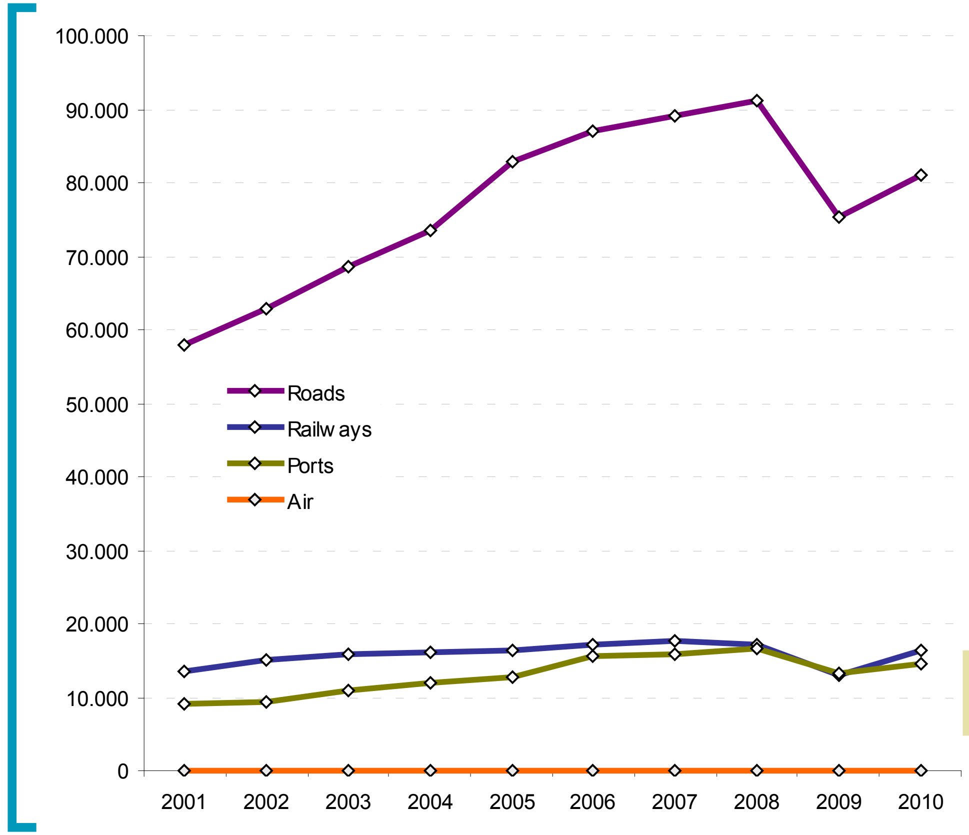


Figure 4.1: The amounts of goods transported expressed in 1,000 t by modalities (roads, railways, by sea, airports)

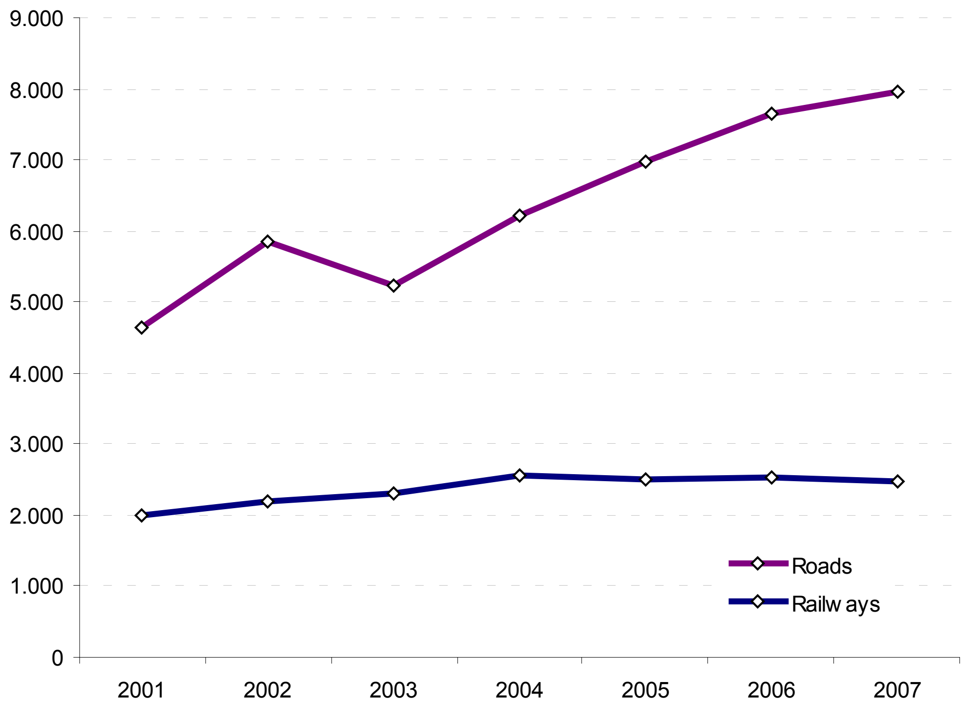
(Source: Statistical Office of the Republic of Slovenia, 2012)

[1] *Tonne kilometres (tkm) are the sums of products of the amount of goods and distances through which the goods were transported (Statistical Office of the Republic of Slovenia, 2004).*

Figure 4.2 represents the structure of all chemicals transported into the Republic of Slovenia from 2001 to 2007 by the modality of transport.

Figure 4.2: The amounts of chemicals transported expressed in 1,000 t by the road or railway

(Source: Statistical Office of the Republic of Slovenia, 2012)



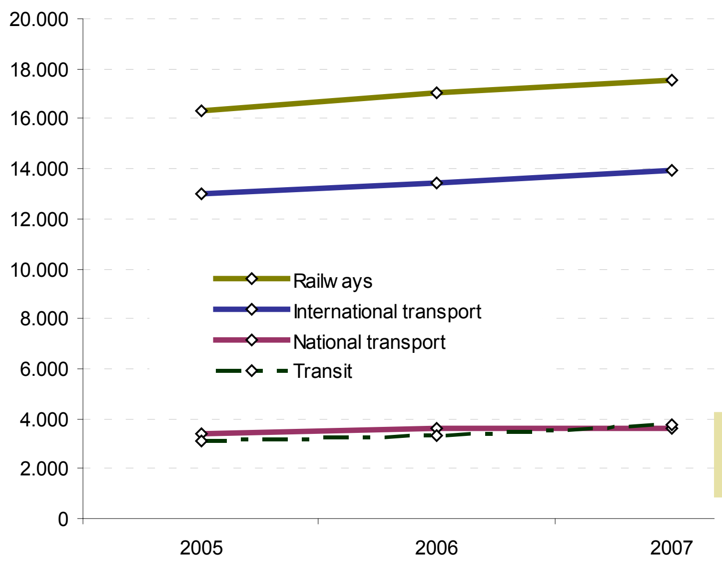
The Figure indicates:

- that all the increase in the transport of chemicals between 2004 and 2007 was transported by road;
- that the ratio of the transported chemicals between the modalities of road / railway is significantly lower than that of the entire transported goods shown in the Figure 4.1;
- the graph shows that the railway capacities for the transport of chemicals have been full since 2004.

4.1. Transport of Chemicals and Fuels by Railway

Rail transport is an extremely important link in the logistics chain of fuel supply to the economy, households as well as for the renewal of national stocks. The main advantages of the rail transport are possibility of mass transports, ensuring safety and environmentally safe transport. There has not been a rail accident during the last ten years, where a major leakage would occur. Slovenian railways have implemented an information system which enables constant control over train compositions and provides information on carriages carrying dangerous chemicals. Rail transport services take the majority of freight in the international and transit transport, including port transit; this also applies to the field of classic multimodal transports and transport of dangerous goods. Rail transport has a number of advantages: it is relatively cheap, fast, punctual and safe, independent from the weather conditions throughout the year, and it is especially able to take on enormous quantities of goods which is especially convenient for the industries nowadays. Three quarters of dangerous chemicals which are transported by rail are petroleum products, 15% are gases, 5% are corrosive substances and 5% are other chemicals.

The following dangerous goods are transported by rail: paints, varnishes, pesticides, ammunition, pyrotechnics, bottled gas, and nitric acid in containers, methanol in bottles, hunting ammunition, cotton, and ferrosilicon. Liquid freight includes: orthoxylene, jet fuel, phosphoric acid and fuel oil.



Dangerous goods come into the port of Koper by ships. They are then transported to the inland by rail. In the coastal region the transport of dangerous goods is carried out on lines which run through catchments or very close to them. Some stretches of railway lines Koper-Prešnica and Kozina-Pula are very critical. The stretches are regulated in such a way that the run-off of the possible spillage could be prevented and it would, in case of an accident, go directly to the Karst sub-terrain.

Figure 4.3 shows the structure of all goods transported to the Republic of Slovenia by rail from 2005 to 2007 from the perspective of the destination-origin. International transport represents transport with the destination or origin of which is abroad, while international transit represents transport with the destination and origin abroad.

Figure 4.3: The amounts of goods transported by rail expressed in 1,000 t classified by origin

(Source: Statistical Office of the Republic of Slovenia, 2012)

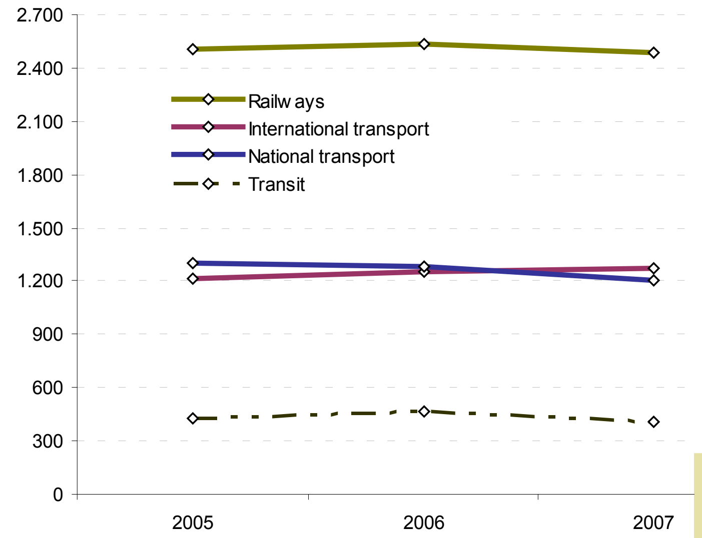


Figure 4.4 shows the structure of all chemicals transported to the Republic of Slovenia by rail from 2005 to 2007 from the perspective of the destination-origin. The ratio between the national and international transport is in case of transported chemicals is rather equated.

Figure 4.4: The amounts of transported chemicals by rail expressed in 1,000 t classified by origin

(Source: Statistical Office of the Republic of Slovenia, 2012)

The rail transport service consists of:

• planning of the transport (national and international transport solution which offer a high degree of safety and reliability, as well as efficient planning of the movement of goods);

• transport of consignments on the required route (individual consignments are transported by regular trains; the timetable for the transport of entire trains is created according to the needs and requirements);

• safety and loading consulting (the national transport of dangerous goods and fuels is carried out according to the law and regulations and the international transport is carried out according to the Regulations Concerning the International Transport of dangerous goods by Rail).

Dangerous goods and fuel are mainly transported in special carriages which must comply with the requirements on safety and a manner of loading depending on the type of goods. Own or leased carriages may be used for transport, or the railway may provide carriages through its network of private owners.

Therefore, the Slovenian railway infrastructure is already capable of undertaking the transport of dangerous goods and there are no restrictions which would prevent the transport of such goods on any line. The main disadvantages of this type of transport is the limitation of the railway network itself as it is not as widely spread as the road network and its capacities are full. Some stretches of railway lines Koper-Prešnica and Kozina-Pula (RH) are very critical. In addition to this, some parts of the railway network are difficult to be accessed with intervention vehicles which is a problem in case of an accident.

Rail transport (from the economic point of view) is more appropriate for longer distances. Transport policy measures can divert the freight transport from roads to railways more efficiently. By construction of the envisaged infrastructure investments Slovenia will unburden the already existing road loads, take the surplus of transport demand with rail transport and provide conditions for a greater percentage of combined transport which is one of the main guidelines of the common EU transport policy.

4.2. Transport of Chemicals and Fuels by Road

Transport of dangerous goods by road is the dominant type of transport. Organizing transport of dangerous goods by road is a demanding task because it poses a great danger to all road users. Transport of such goods poses a great danger to the environment, because routes also go through catchments or near them. For example, the majority of petroleum products supplied to our country come from the port of Koper, which means that the roads leading from the port to the inland are too burdened. Koper-Ljubljana, Koper-Buzet (RH), Portorož-Buje (RH) are the most critical routes. This happens also outside of the coastal municipalities in Kozina-Rupa. The majority of Slovenian motorways were constructed with oil separators, namely only chemicals which are lighter than water. However, if poorly or not properly maintained these separators enable direct drainage into the ground instead of retaining the substance.

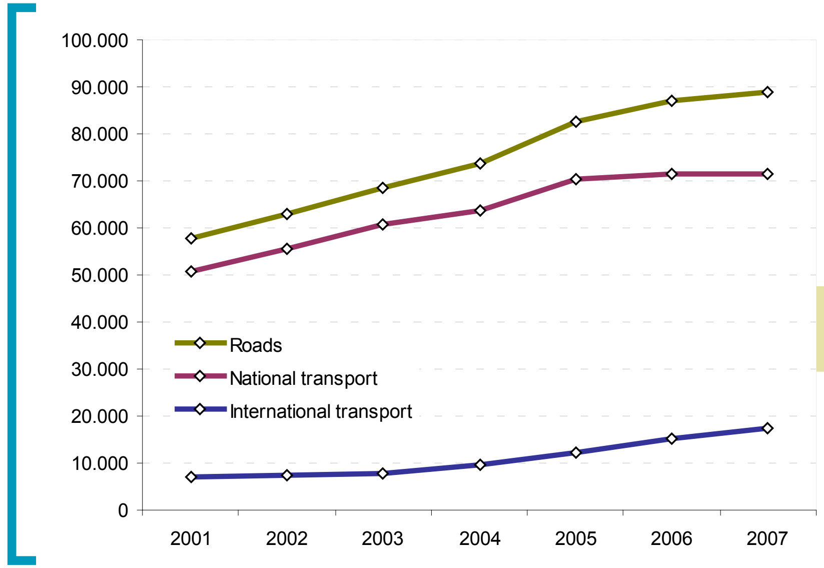


Figure 4.5 shows the structure of all goods transported to the Republic of Slovenia by road from 2001 to 2007 from the destination-origin perspective. International transportation's origin is abroad, while the national transportation's origin and destination is in the Republic of Slovenia. Compared to railways the percentage of national freight transport represents the majority of all transport in the structure.

Figure 4.5: The amounts of goods transported by road expressed in 1,000 t classified by origin

(Source: Statistical Office of the Republic of Slovenia, 2012)

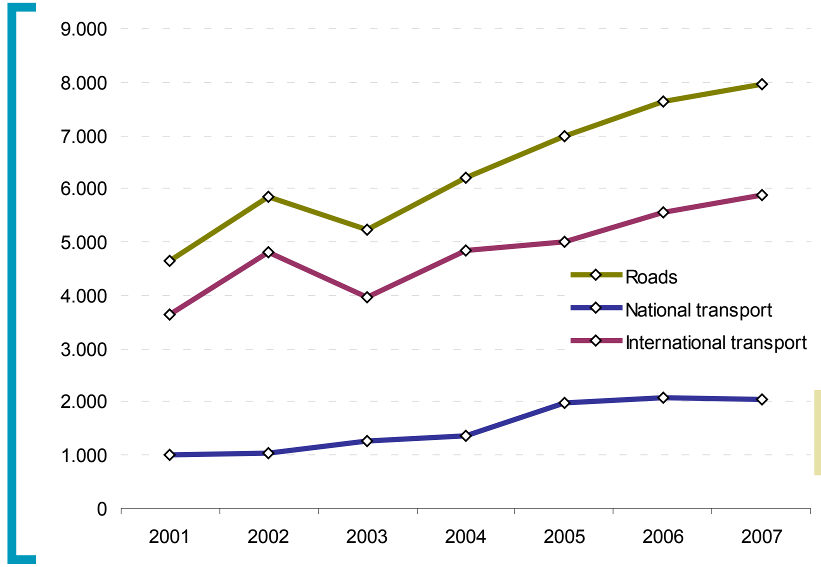


Figure 4.6 shows the structure of all chemicals and fuels transported to the Republic of Slovenia by road from 2001 to 2007 from the destination-origin perspective.

Figure 4.6: The amounts of chemicals transported by road expressed in 1,000 t classified by origin

(Source: Statistical Office of the Republic of Slovenia, 2012)

Figure 4.7 shows how burdened was the existing road network in 2010 from the perspective of transported quantities expressed in millions of tons. The Figure clearly indicates the main goods distribution corridors in the Republic of Slovenia. The majority of chemical goods transported by roads in the Republic of Slovenia are transported through these transport corridors.

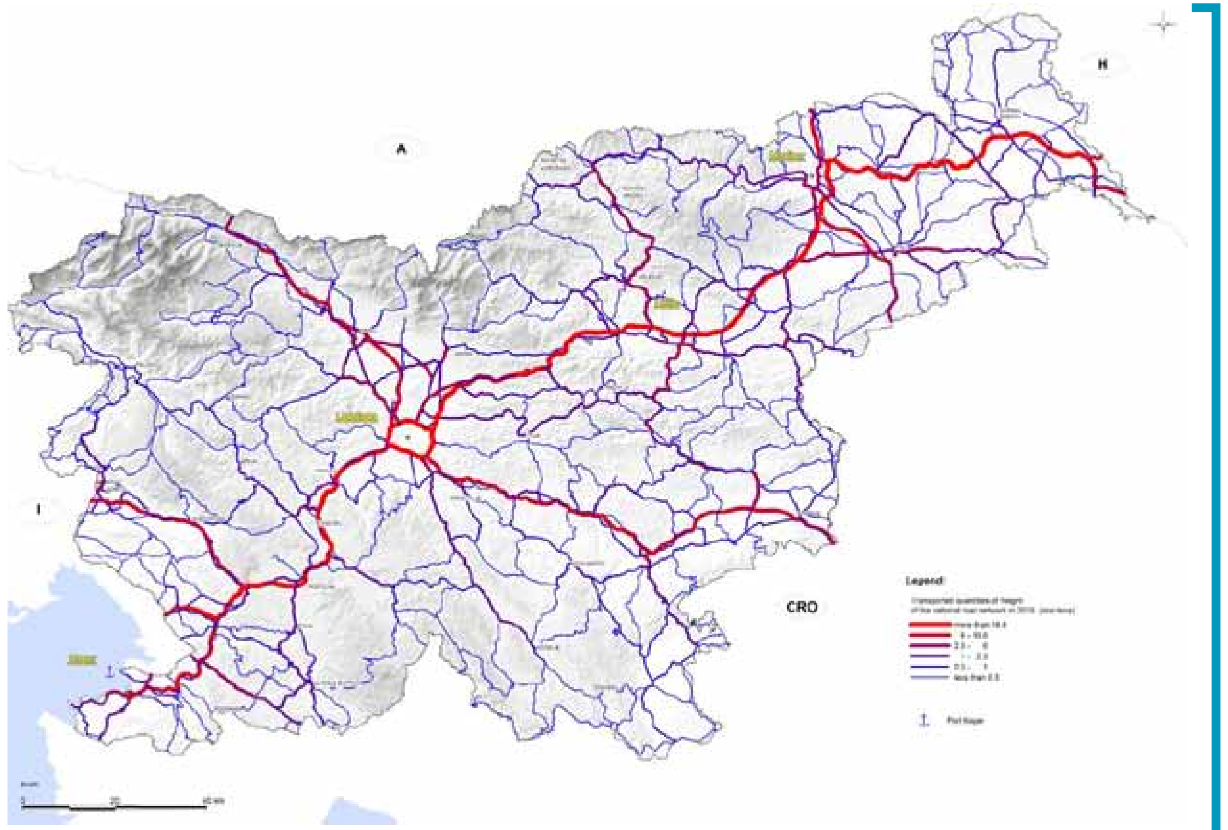


Figure 4.7: Transported quantities of freight expressed in mi tons by stretches of the national road network in 2010

(Source: Slovenian Roads Agency, Statistical Office of the Republic of Slovenia, our own calculation)

5. Transport of Chemicals According to the Environment

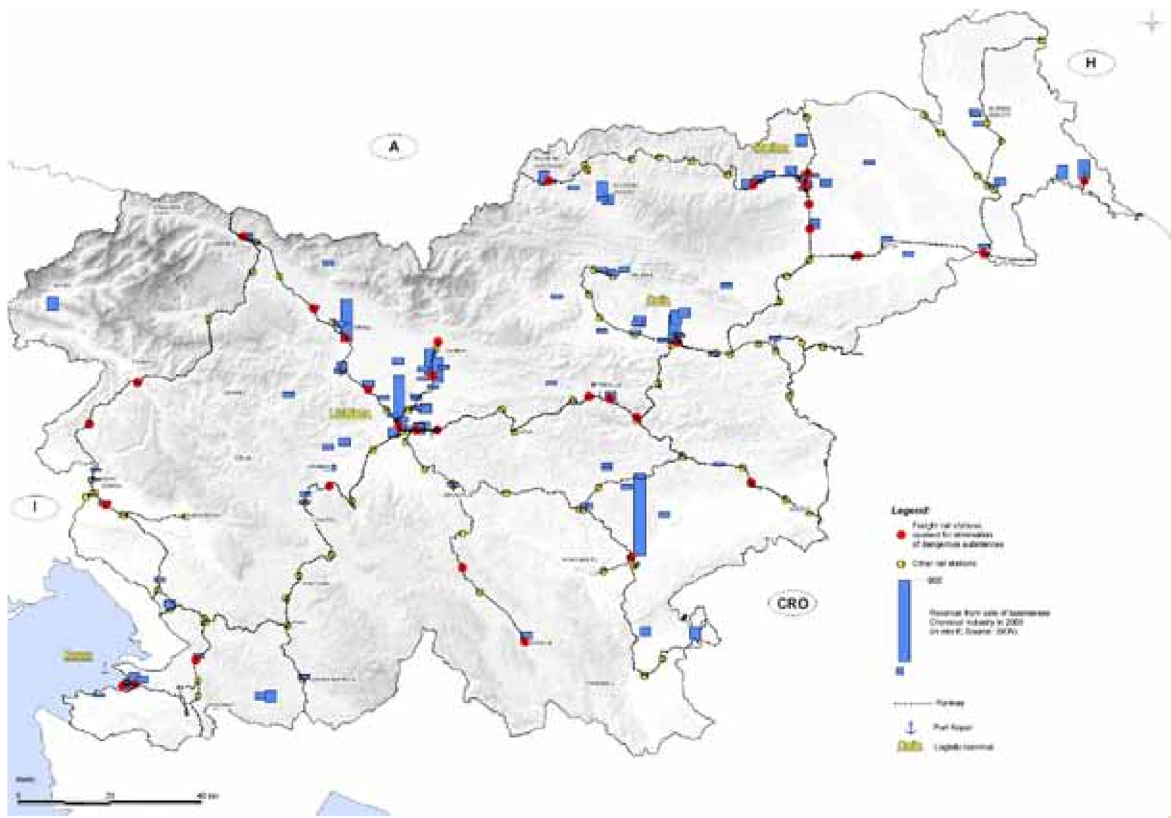
Spatial distribution of chemical facilities and rail terminals which are equipped for handling chemicals and fuels, defines the traffic currents in transport of chemicals and fuels. We created an index of environmental sensitivity. We chose a stretch of the V. corridor between the Port of Koper and Maribor for our pilot calculation of social cost risk in case of a traffic accident involving chemicals and fuels. We calculated the exposure of the environment to the leakage in case of a traffic accident during the transport of chemicals and fuels for this corridor.

5.1. Locations of Major Chemical Facilities and Chemical Rail Terminals

Figure 5.1 shows the distribution of the chemical industry according to the standard classification of activities excluding companies which sell motor fuels in the Republic of Slovenia together with the rail freight logistic network. The distribution is presented according to the size of companies by sales revenues in 2009. Sales revenues are based on data collection of credit ratings of iBON 2010 companies (InfoBON, 2010).

The Figure shows that in 2009 the biggest concentration of chemical facilities in Slovenia was in Novo mesto, Ljubljana, Kranj, Domžale, Kamnik, Maribor and Ruše, Ljutomer, Lendava, Murska Sobota, Slovenj Gradec and Metlika.

In 2008 the Ministry of the Environment and Spatial Planning pursuant to the Resolution on National Environmental Action Plan 2005-2012 (Official Gazette of the Republic of Slovenia No. 2/2006) and in accordance with the Decree on the prevention of major accidents and mitigation of their consequences (Official Gazette of the Republic of Slovenia No. 71/2008) and European Union Directives governing this field drew up the Programme for the mitigation of environmental risks due to major accidents involving dangerous goods. As part of this Programme tables 5.1, 5.2 and Figure 5.1 show the list of facilities which represent a major or minor environmental risk in the Republic of Slovenia. Figure 5.1 in addition to facilities and major and minor risk to the environment, also shows freight rail stations from which freight containing dangerous goods are dispatched.



The list of freight rail stations available for handling of dangerous goods is shown in table 5.3. Each such station has different freight capacities and may handle only certain dangerous goods. Four freight rail stations also have the role of larger intermodal centres (equipped for handling intermodal transport units are marked blue in table 5.3), which enables efficient logistic freight handling due to international independence of the freight and the means of transport. This intermodal centres are: Port of Koper, Ljubljana KT (container terminal), Celje tovorna and Maribor Tezno.

Figure 5.1: Distribution of chemical industry and railway logistic support in the Republic of Slovenia in 2009

Table 5.1: A list of facilities which pose an increased danger to the environment in the Republic of Slovenia – May 2008 (Source: Ministry of the Environment and Spatial Planning, 2008

ID	ACTIVITY OF THE FACILITY	FACILITY
1	Chlor-alkali electrolysis	TKI – HRASTNIK, d.d.
2	Aluminium production	TALUM, tovarna aluminija
3	Production of paints	HELIOS, TBLUS, d.d.
4	Production of explosives	KIK KAMNIK, d.d.
5	Production of chemical products	BELINKA PERKEMIJA, d.o.o.
6	Production of chemical products	MELAMIN, d.d.
7	Production of chemical products	FENOLIT d.d.
8	Production of chemical products	NAFTA LENDAVA
9	Production of chemical products	ATOTECH PODNART
10	Production of soft polyurethane foam	PLAMA PUR, d.d.
11	Production of glass	STEKLARNA HRASTNIK VITRUM
12	Production of glass	STEKLARNA ROGAŠKA, d.d.
13	Storage and distribution of LPG	ENOS – ENERGETIKA, d.o.o.
14	Storage and distribution of LPG	BUTAN PLIN, d.d.
15	Storage and distribution of LPG	INTERINA, d.o.o.
16	Storage and distribution of LPG 1	ISTRABENZ PLINI, d.o.o.
17	Storage and distribution of LPG 2	ISTRABENZ PLINI, d.o.o.
18	Storage and distribution of LPG	PETROL ENERGETIKA, d.o.o.
19	Storage and distribution of LPG	PLINARNA MARIBOR, d.d.
20	Storage and handling of petroleum products 1	PETROL SKLADIŠČENJE, d.o.o.
21	Storage and handling of petroleum products 2	PETROL SKLADIŠČENJE, d.o.o.
22	Storage and handling of petroleum products	INSTALACIJA, d.o.o.
23	Storage and handling of petroleum products	The Agency the Republic of Slovenia for Commodity Reserves
24	Storage and handling of dangerous goods	LUKA KOPER d.d.

Table 5.2: A list of facilities which pose a minor danger to the environment in the Republic of Slovenia – May 2008 (Source: Ministry of the Environment and Spatial Planning, 2008)

ID	ACTIVITY OF THE FACILITY	FACILITY
1	Production of floor and wall ceramic tiles	1. GORENJE NOTRANJA OPREMA, d.d.
2	Filling spray bottles	2. IMN, d.o.o.
3	Production of paints	3. COLOR, d.d.
4	Production of other organic chemicals	4. KEMIPLAS
5	Production of electricity	5. TERMOELEKTRARNA BRESTANICA, d.o.o.
6	Production of electricity	6. TERMOELEKTRARNA ŠOŠTANJ, d.o.o.
7	Production of electricity	7. TE-TOL LJUBLJANA, d.o.o.
8	Production of electricity	8. TERMOELEKTRARNA TRBOVLJE, d.o.o.
9	Manufacturing high-quality steel products	9. SŽ ACRONI, d.o.o.
10	Production of chemical products	10. TKK, d.d.
11	Production of chemical products	11. Cinkarna Celje, d.d.
12	Production of cosmetic products / pharmaceutical substances	12. LEK, d.d.
13	Manufacturing of parts for the automobile industry and products used in construction	13. Sava Tires, d.o.o.
14	Manufacturing of parts for the automobile industry and products used in construction	14. SAVATECH, d.o.o.
15	Manufacturing of parts for the automobile industry and products used in construction	15. JOHNSON CONTROLS NTU, d.o.o.
16	Manufacturing of parts for the automobile industry and products used in construction	16. JUTEKS, d.d.
17	Manufacturing of parts for the automobile industry and products used in construction	17. ISKRA TELA, d.d.
18	Production of disinfectants, pesticides and agrochemical products	18. TKI PINUS RAČE, d.d.
19	Manufacturing glass fibres	19. COMET umetni brusi in nekovine, d.d.
20	Manufacturing glass fibres	20. SWATY, d.d.
21	Production and storage of technical gases	21. LINDE PLIN, d.o.o
22	Production and storage of technical gases	22. SPG-SOL PLIN GORENJSKA, d.o.o.
23	Storage	23. ORKA, d.o.o.
24	Storage and handling of oil and petroleum products 1	24. PETROL SKLADIŠČENJE, d.o.o.
25	Storage and handling of oil and petroleum products 2	25. PETROL SKLADIŠČENJE, d.o.o.
26	Storage and distribution of LPG 1	26. BUTAN PLIN, d.d.
27	Storage and distribution of LPG 2	27. BUTAN PLIN, d.d.

ID	ACTIVITY OF THE FACILITY	FACILITY
28	Storage and distribution of LPG	28. INTERINA, d.o.o.
29	Storage and distribution of LPG 1	29. ISTRABENZ PLINI, d.o.o.
30	Storage and distribution of LPG	30. PETROL PLIN, d.o.o.
31	Storage and distribution of LPG 2	31. ISTRABENZ PLINI, d.o.o.
32	Storage and distribution of LPG	32. PAM, d.o.o.
33	Storage of explosive substances	33. SCT Univerzalgrad, d.o.o.
34	Storage of explosive substances	34. LECANA, d.o.o.
35	Storage of explosive substances	35. PROEKS, d.o.o.

Table 5.3: The list of freight rail stations available for handling of dangerous goods (Source: Slovenian Railways, 2011)

ID	NAME OF THE FREIGHT STATION	CODE	OTHER CHARACTERISTICS OF FREIGHT STATIONS
1	Koper luka (port)	44351-5	A list of customs station offices. Station for handling of international transport units Station opened solely for consignments of the users and co-users of the Port of Koper industrial tracks (see also List of co-users of industrial tracks in the Port of Koper). The sender who is dispatching the consignment for the Port of Koper station must write on the consignment note (under item 30) the code or name of the Port of Koper hand over location.
2	Koper tovorna	44361-4	A list of customs station offices. The station has a storage house.
3	Hrpelje-Kozina	442010	The station has a storage house.
4	Verd	44005-7	The station has a storage house.
5	Ljubljana KT	42213-9	A list of customs station offices. The station has a storage house. Station for handling of international transport units The station is opened for accompanying road-rail transport system.
6	Ljubljana Moste	422220	A list of customs station offices. The station has a storage house. The station has a customs storage house.
7	Ljubljana Zalog	422030	Redistribution (transit) is carried out at the station.
8	Trbovlje	42201-4	
9	Hrastnik	42200-6	The station has a storage house.
10	Zidani most	43103-1	The station has a storage house.
11	Celje tovorna	43353-2	A list of customs station offices. The station has a storage house. The station has a customs storage house. Station for handling of international transport units
12	Kidričevo	42400-2	Station is opened with a special prior arrangement. The station has a storage house.
13	Jesenice	42307-9	A list of customs station offices. The station has a storage house.

ID	NAME OF THE FREIGHT STATION	CODE	OTHER CHARACTERISTICS OF FREIGHT STATIONS
14	Kranj	42304-6	The station has a storage house.
15	Medvode	42301-2	
16	Ljubljana Šiška	42004-2	Deviations and restrictions stated in a separate table The station has a storage house. The station is only opened for consignments: a) by managing authorities or co-users of the industrial tracks b) for the needs of the railway.
17	Krško	43400-1	The station has a storage house.
18	Maribor	43304-5	The station has a storage house.
19	Maribor Tezno	43303-7	A list of customs station offices. Redistribution (transit) is carried out at the station. Station for handling of international transport units The station is opened for monitored road-rail transport system.
20	Hoče	43301-1	Station is opened with a special prior arrangement.
21	Rače	44707-8	
22	Most na Soči	44704-5	Station is opened with a special prior arrangement.
23	Anhovo	44602-1	Deviations and restrictions stated in a separate table. The station has a storage house. Only for consignments of the following users: a) SALONIT Anhovo d.d.; b) FRANTSCHACH Industrijske vreče, d.o.o.; c) ESAL d.o.o.; d) PLASTIK d.d., Kanal ob Soči: e) for consignments used by the railway.
24	Volčja Draga	42356-6	Station is opened with a special prior arrangement.
25	Kamnik Graben	42353-3	Station is opened with a special prior arrangement.
26	Jarše-Mengeš	42600-7	
27	Novo Mesto	42856-5	A list of customs station offices. The station has a storage house. The station has a customs storage house.
28	Kočevje	42853-2	
29	Ortnek	43404-3	Station is opened with a special prior arrangement.
30	Ruše	43656-8	Station is opened with a special prior arrangement.
31	Lendava	44351-5	A list of customs station offices. The station has a storage house.

5.2. Index of the Environmental Sensitivity

The sensitivity and vulnerability of the environment, with its natural and social characteristics, to the effects of accidents involving dangerous goods are one of the most important risk factors in the transport modal chain of chemicals and other dangerous goods transportation. Due to this fact the extent of the consequences of accidents with the same quantities of released dangerous goods are different in different locations.

For the purpose of this study we analysed the Slovenian environment in terms of environmental sensitivity to accidents involving dangerous goods. We divided the environment of the Republic of Slovenia into more than 8,000 hexagons; we introduced the environmental sensitivity index and determined sensitivity classes for each of the hexagons.

Environmental sensitivity index is calculated from the methodology which was developed to be used in the oil industry. With the development of geographic information systems (GIS), the opportunity for spatial analysis of data and environmental sensitivity mapping occurred (Environmental Sensitivity Index Guidelines, 2002; Bae, 2006). An environmental sensitivity model for the American state of North Carolina was produced (Inyang, 2003). They produced a spatial sensitivity map with the help of GIS tools. They focused on demographic factors, presence of water bodies and presence of protected areas.

The basic formula for the calculation of the index for each spatial hexagon is:

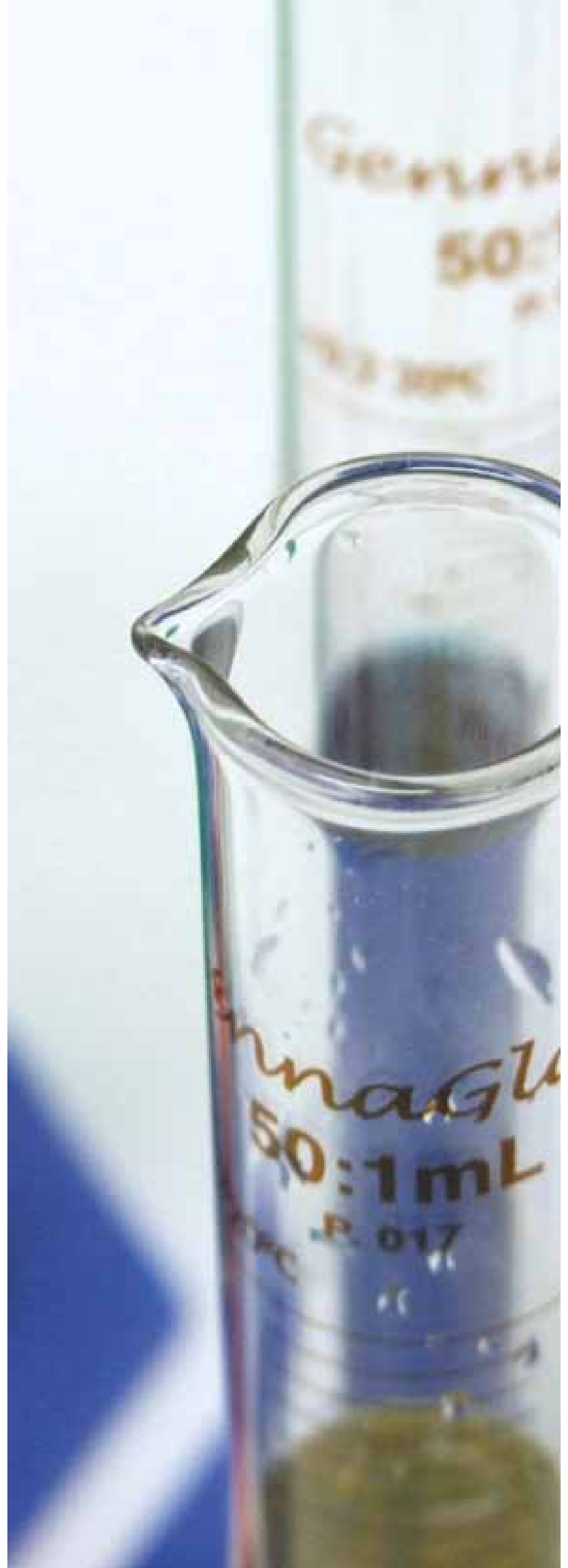
(1) $$G_N = \sum_{i=a}^{i=j} F_i W_i = F_a W_a + F_b W_b + \cdots + F_j W_j$$

The calculation for “the affected area” for larger numbers of hexagons:

(2) $$G_T = \sum_{N=1}^{N=n} G_N = G_1 + G_2 + \cdots + G_n$$

where:

- GN......index/ environmental sensitivity indicators (ESI-environmental sensitivity index) for the hexagon GN;
- Fi........ sensitivity factor for indicator i
- Wi...... weight of the indicator i
- j......... the number of used indicators
- GT......common ESI index in the affected area
- n........ number of hexagons which cover the affected area.



From the perspective of the exposure of the environment to dangerous goods we took into consideration, when calculation the environmental sensitivity index, the most relevant indicators (G1, G2, G3, G4, G5), namely:

1) Inhabitants-residing (ir)

2) Inhabitants-meeting (im) (areas with positions of employment, education, medical care, tourism, shops)

3) Water (w) (rivers, standing waters, underground water, protected underground water areas)

4) Karst aquifers (Karst)

5) Protected areas -NATURA 2000 (pa).

The calculation for an individual indicator (example: inhabitants) is the following:

$G_{inh.}$ = No. of inhab.$_i$ / No. of inhab. $_{total}$ * Weight$_p$ * A_{max} / Ai

- G_{inh}..................value of an environmental sensitivity indicator -inhabitants for an individual hexagon
- No. of inhab. $_i$..........number of inhabitants in an individual hexagon
- No. of inhab. $_{total}$....number of inhabitants in all hexagons (the population of Slovenia)
- Weight$_p$ ....the applied weight of inhabitants in the common ESI indicator (0.25)
- A_{max}.................maximal surface area of the hexagon (amounts to 2.59 km2)
- Ai........................surface area covered by all hexagons (in our case the surface area of Slovenia).

The table 5.4 shows weights of the environmental components (indicators) applied when calculating the index of environmental sensitivity to dangerous goods. Weights were determined based on consequences an accident involving chemicals and fuels may have on the relevant environment components.

Table 5.4: Weights of environmental components used for the calculation of the environmental sensitivity index for dangerous goods

INDICATOR G_N (Environmental Sensitivity Index) = $G_{ir}+G_{im}+G_w+G_{karst}+G_{pa}$			
Used weight of indicators	Used environmental components	Used environmental components within the indicator	Used weight within the indicator
0.25	Inhabitants residing (G_{ir})	Inhabitants residing	1
0.17	Inhabitants meeting (G_{im})	positions of employment	0.2
		education	0.2
		medical care	0.2
		tourism	0.2
		shopping malls	0.2
0.33	Waters (G_w)	rivers	0.4
		standing waters	0.1
		underground water	0.05
		protected underground water areas	0.45
0.17	Karst aquifers (G_{karst})	Karst aquifers	1
0.08	Protected areas Natura 2000 (G_{pa})	protected areas Natura 2000	1

We have acquired the data on used environmental components for each individual spatial hexagon from geographic data layers and databases that were at our disposal and from official sources as well as from our own calculation:

Data on inhabitants - spatial network 100 m × 100 m (Statistical Office of the Republic of Slovenia, 2012);

IPIS – database on companies, activities and employees (The Agency of the Republic of Slovenia for Public Legal Records and Related Services, 2011);

Geographic data layers on waters, aquifers and Natura 2000 (Slovenian Environment Agency, 2012).

Figure 5.2 shows the final map of the sensitivity of the environment based on the calculated environmental sensitivity index in the Republic of Slovenia together with main locations of chemical facilities, storage houses, rail chemical terminals and gas stations.

The Figure shows that the greatest sensitivity of the environment / area to an accident involving chemicals is in densely populated areas.

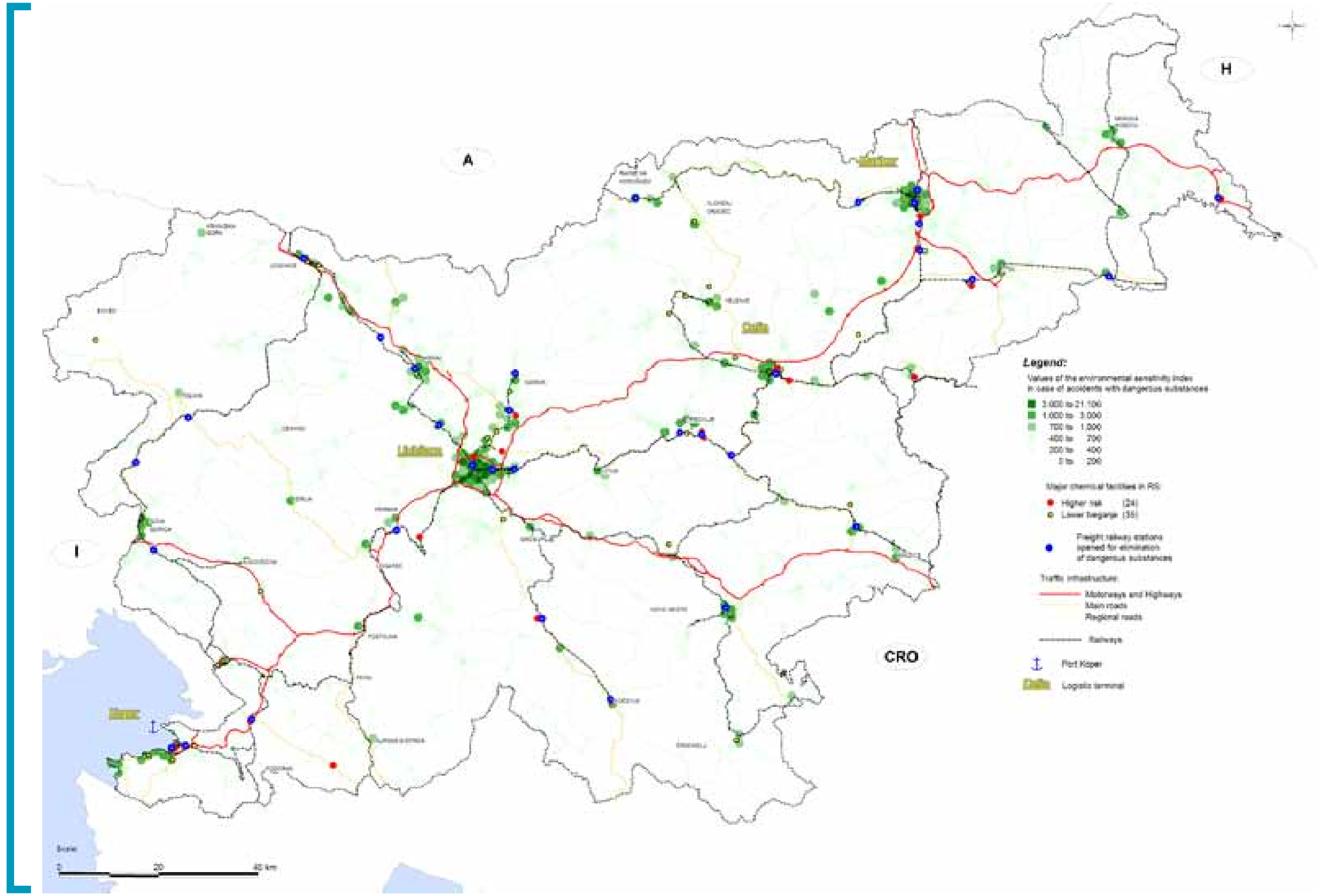


Figure 5.2: Calculated values of the environmental sensitivity index in case of an accident involving chemicals (Source: OMEGA consult, 2012)

1.1. Exposure of Environment on Selected Traffic Corridor Koper-Maribor

In accordance with the content Phase 2 (Transport systems), which refers to recommendations for transport improvement from the Port of Koper to hinterland, we have selected the transport corridor Port of Koper-Maribor for the chemicals transport. We have prepared two scenarios for the assessment of the monetarised social cost risk resulting from traffic accidents in the transportation of chemicals and fuels on the selected corridor, namely:

• Scenario 1 - after the modernization of the railway in accordance with the Plan for the railway infrastructure development (conditions Z1) bottlenecks will be eliminated until 2025. The increased railway capacities will be able to take on the maximum possible amounts of dangerous goods from roads with regard to potential absorption capacities of the chemical industry and rail freight terminals:

• Scenario 2 - the current condition of the railway infrastructure is preserved. Only the necessary maintenance works required for operations are carried oot, but due to the fact that these capacities are full the entire surplus of the chemicals and fuels transport according to the estimated economic growth is transported exclusively by road.

Port of Koper-Maribor traffic corridor was chosen as the representative route, namely because:

the corridor has a parallel rail and motorway connections;

• the route is part of the traffic corridor V and also partly of the traffic corridor X;

• more than one third of the transport in the Republic of Slovenia is carried out through this corridor;

• intermodal centres Port of Koper, Ljubljana, Celje and Maribor, as the last one on this corridor in Slovenia, are located on this corridor;

• the final larger storage house of dangerous chemicals (storage of gas) and final freight railway stations for elimination of dangerous goods are located in Maribor;

• there is sufficient data available to make a credible risk estimation for a traffic accident involving dangerous goods on the corridor in question;

• in accordance with the Plan for the railway infrastructure development (conditions Z1) until 2025 bottlenecks will be eliminated from this corridor and the railway capacities will increase (construction of the second track on the Koper-Divača line, construction of the Ljubljana railway hub and other reconstructions).

Figure 5.3 shows the selected corridor in space according to Scenario 0 (present state) together with the calculated environmental sensitivity index.

Figure 5.4 shows the selected corridor in space according to Scenario 1. According to this scenario, the spatial change of the rail corridor occurs on the line Koper-Divača and in the Ljubljana area. With this scenario we have, in the Ljubljana area, applied a safer (in terms of potential risk which poses to environmental components) course of the freight by-pass route pass Ljubljana, related with the course of one of the versions of the Ljubljana by-pass line included in the Plan for the railway infrastructure development.

If the chemicals and fuels are transported by rail or by road a different procedure applies. We have already defined different types of environment exposed to risk by choosing the modality and thus the extent of the total cost of the consequences in case of an accident.

Chapter 7.3 defines differences and predispositions for the comparison of both scenarios more into detail.

Figure 5.1: Value of the environmental index of the traffic corridor Port of Koper - Maribor according to Scenario 0

(Source: OMEGA consult)

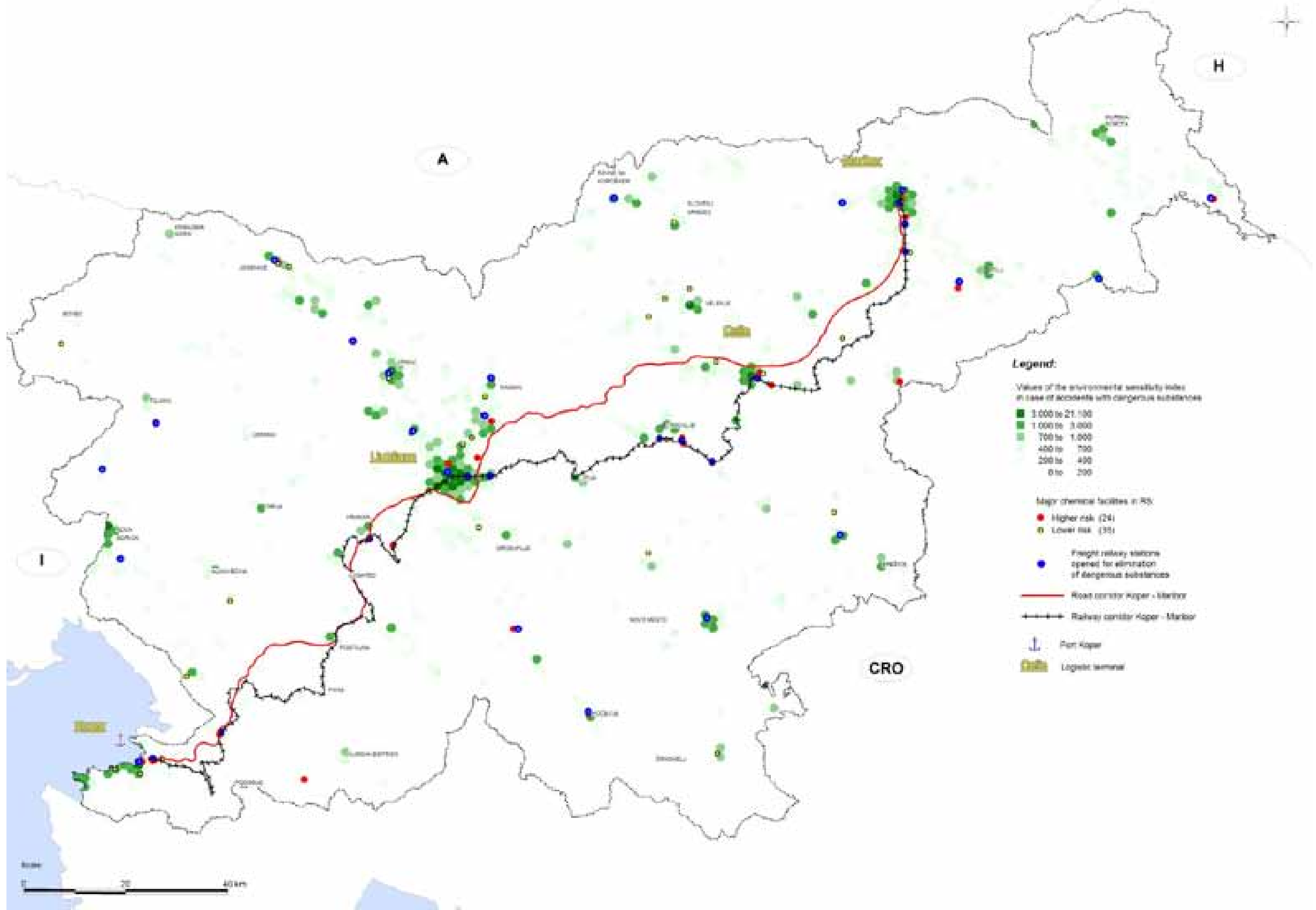
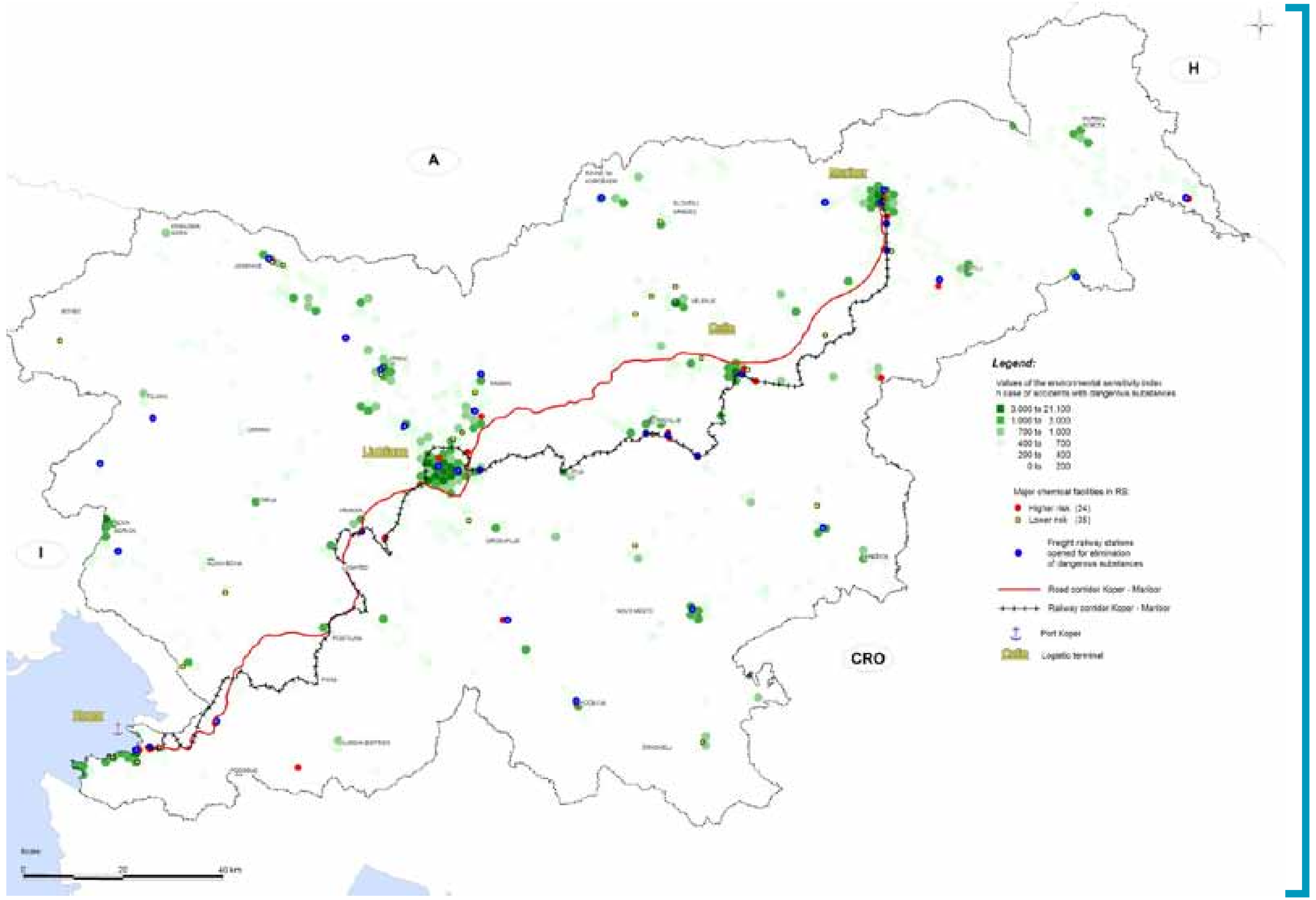


Figure 5.2: Value of the environmental index of the traffic corridor Port of Koper - Maribor according to Scenario 1

(Source: OMEGA consult



Figures 5.6, 5.7 and 5.8 show the environmental index values by locations (distances on a stretch) with regard to the change in the course of the route in space and the sensitivity of the environment. The values of the environmental index indicated in the Figures are calculated to the same time unit of exposure and can be compared.

The following can be concluded from the Figures:

• the environmental index increases most in areas where there is a great concentration of inhabitants

• the environmental index of the railway route is, in case of this corridor, far greater than that of the motorway

• the railway environmental index is in the area of cities a few times higher than in case of motorway (the railway runs through densely populates areas)

• after the altered route of the railway line in space as proposed by the Scenario 2, the value of the environmental index is significantly decreased, especially in Ljubljana (by-pass freight railway).

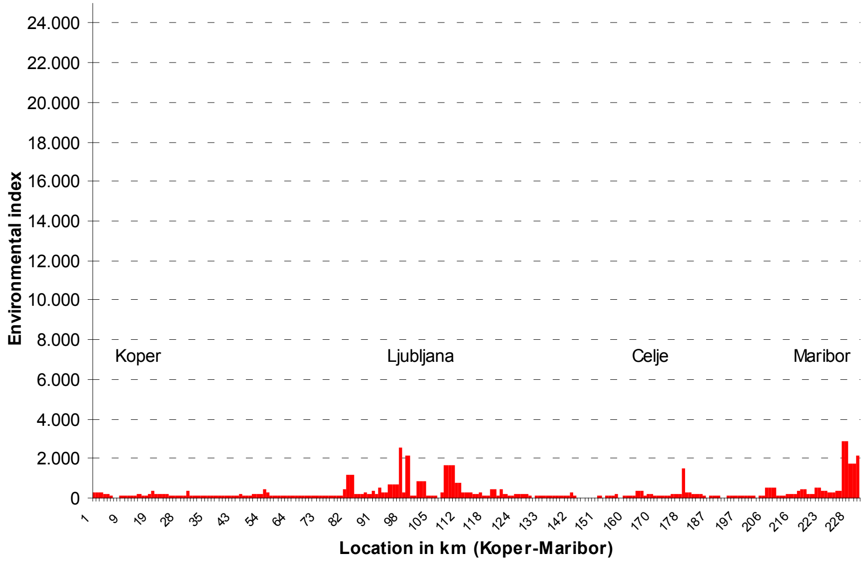


Figure 5.5: Environmental index values on the Port of Koper-Maribor road route

(Source: OMEGA consult, 2012)

We find, according to the above, that in terms of the course of the route in space, a motorway route on the Port of Koper-Maribor corridor would be much more favourable for the environment. This is mainly due to the fact that Koper-Maribor motorway was recently enhanced and spatially designed so that it passes nearby cities, while the railway route was designed over 100 years ago and runs immediately through larger city centres.

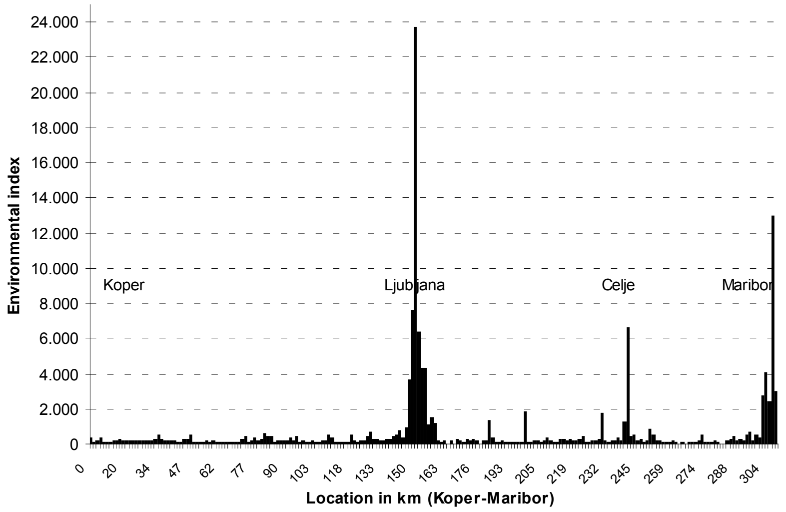


Figure 5.6: Environmental index values on the Port of Koper-M aribor rail route

(Source: OMEGA consult, 2012)

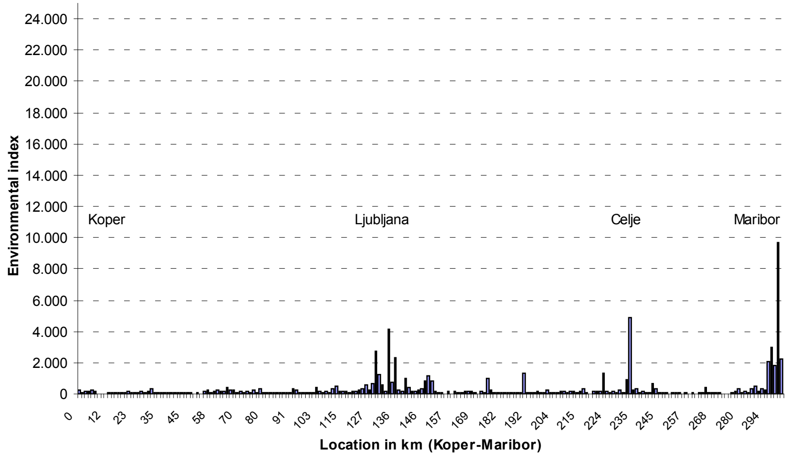


Figure 5.7: Environmental index values on the Port of Koper-Maribor rail route with the diverted course according to Scenario 1

(Source: OMEGA consult, 2012)

2. Traffic Accidents in Transport of Dangerous Goods According to the Modality of Transport

This chapter analyses the available databases which include all relevant accidents that may help determine the safety of transport and the estimation of the risk of accidents during rail (train) and road (goods vehicle) transport. Namely, the majority of accidents in the transport chain which involve chemicals does not depend on the type of the chemical by mainly on the safety of the transport. The applicable law defines provisions and procedures which ensure safety in the chemicals and fuels transport; here we mainly refer to dangerous goods. These legal provisions provide an appropriate level of protection, to ensure that the transport of dangerous goods is safe. On one hand they minimize the possibility of an accident occurrence involving dangerous goods in all links of the transport chain (e.g. accident involving a dangerous substance during a traffic accident, during freight handling, storage); and if the accident occurs, the consequences can be minimized by complying with these legal provisions.

Sources of data on traffic accidents are:

• the data of the police on road-traffic accidents since 1994 (Police, 2012),

• data on rail traffic and rail traffic accidents provided by EUROSTAT (EUROSTAT, 2012) and

• data on accidents involving dangerous goods provided by the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief (2012a).

We may estimate the amount of risk of an accident in the transport of chemicals by road and rail, based on the analysis of the acquired data. We have calculated the risk of the occurrence of a traffic accident on the road and railway based on the historic data. The transport of chemicals and fuels is part of the transport of goods and is carried out with either a goods vehicle by road or with a freight train by rail. The risk of the occurrence of a traffic accident in the transport of chemicals and fuels equals the general risk of a traffic accident during the transport of goods. As such it is expressed in the number of events (traffic accidents during the transport of goods) by the number of transports carried out.

Traffic accidents have a number of negative consequences which are from the social perspective described as monetarised social cost. Traffic accidents which involve the transport of dangerous goods to the costs of environmental remediation are also included. The main purpose of calculating the costs of the traffic accidents consequences is to evaluate the reduction of risk of social costs, which the reduction in the risk of the occurrence of a traffic accident would bring; especially the kind involving dangerous goods.

2.1. Accidents of Goods Vehicles on Roads

We mentioned all accidents on the Slovenian road network, which included a goods vehicle, which date were obtained from the Police database on traffic accidents. We compared the number of accidents on the national road network, which included a goods vehicle, with the road work carried out on national roads, measured in vehicle kilometres[1] by each type of road category (DC-all national roads, LC-local and municipality roads, DC are: AC-motorways, H-express roads, G1-main roads of order I ,G2-main roads of the order II, R1-regional roads of the order I, R2-regional roads of order II, R3-regional roads of order III and RT-regional tourist roads.

Figure 6.1 shows the number of accidents involving a goods vehicle on LC and DC from 2000 to 2010 and the kilometres carried out on the DC network from 2000 until 2010. The graph shows the upward trend of kilometres on national roads, with the exception of 2009, when they appear the effects of the global crisis. The number of accidents is constantly decreasing, with certain fluctuations. The safety of transport by goods vehicles is therefore increasing. The number of reported accidents on LC is 2.5 times higher than on national roads. However, unfortunately we do not have any data regarding the kilometre carried out on LC.

The following Figures from 6.2 to 6.9 present the reported accidents and kilometres by road categories. The data indicates that safety is improving in all roads categories. Since 2004 there has been a negative trend on the number of traffic accidents (the number is decreasing), while the kilometres on the road network is increasing. According to the quantity of kilometres, AC are the safest, followed by other categories of roads according to their significance, with exception of RT which have proven to be safer for goods vehicles than other regional roads.

[1] *The vehicle kilometre unit (vkm) represents the movement of the motorised vehicle in the distance of one kilometre (Statistical Office of the Republic of Slovenia, 2004,.*

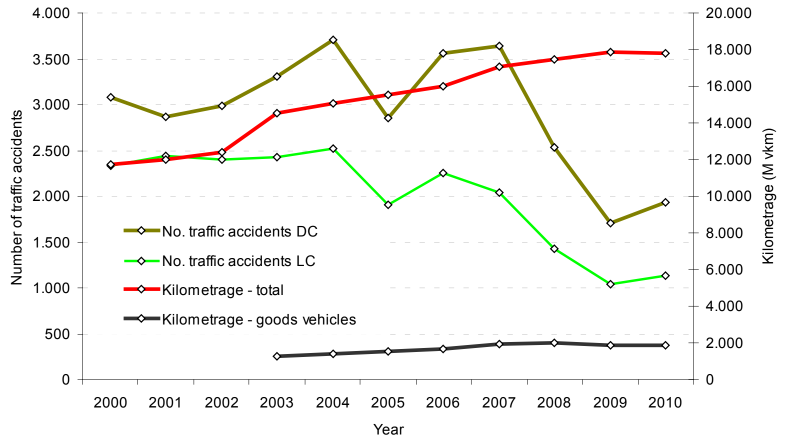


Figure 6.1: Data on the number of traffic accidents involving a goods vehicle with and kilometrage goods vehicles on the national road network in the Republic of Slovenia (DC)

(Source Police, 2012; Slovenian Roads Agency, 2011)

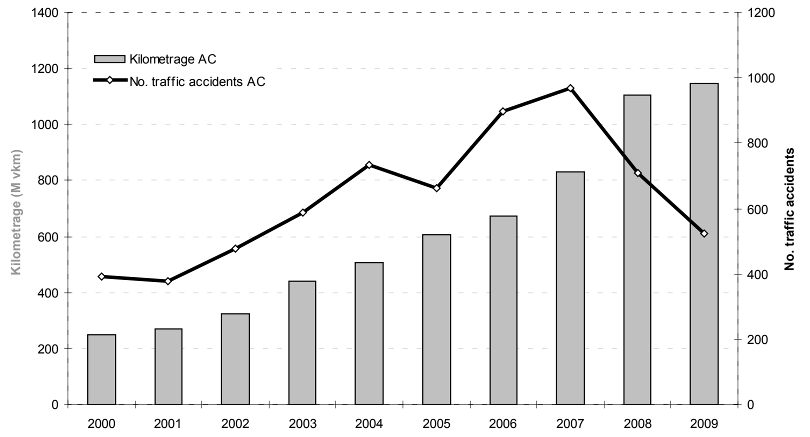


Figure 6.2: Data on the number of traffic accidents involving a goods vehicle and kilometrage goods vehicles on motorways (AC) in the Republic of Slovenia

(Source: Police, 2012; Slovenian Roads Agency, 2011)

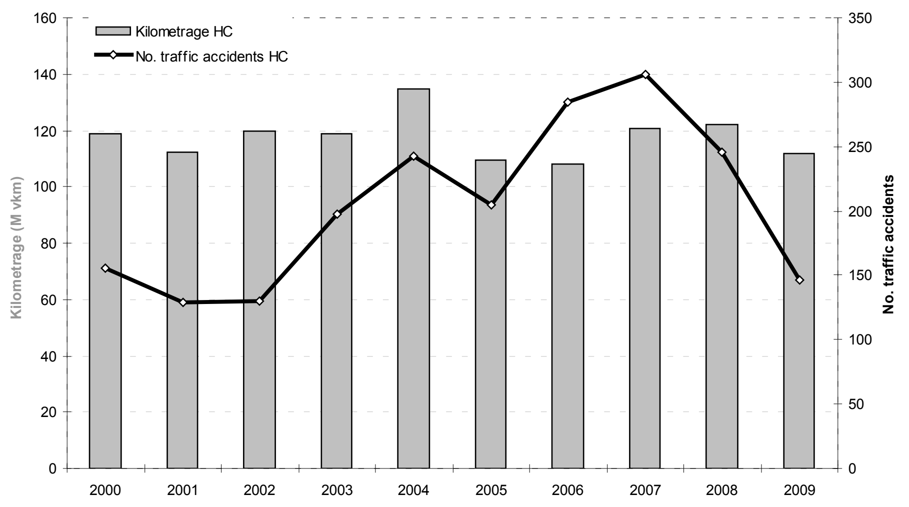


Figure 6.3: Data on the number of traffic accidents involving a goods vehicle and kilometrage goods vehicles on express roads (HC) in the Republic of Slovenia

(Source: Police, 2012; Slovenian Roads Agency, 2011)

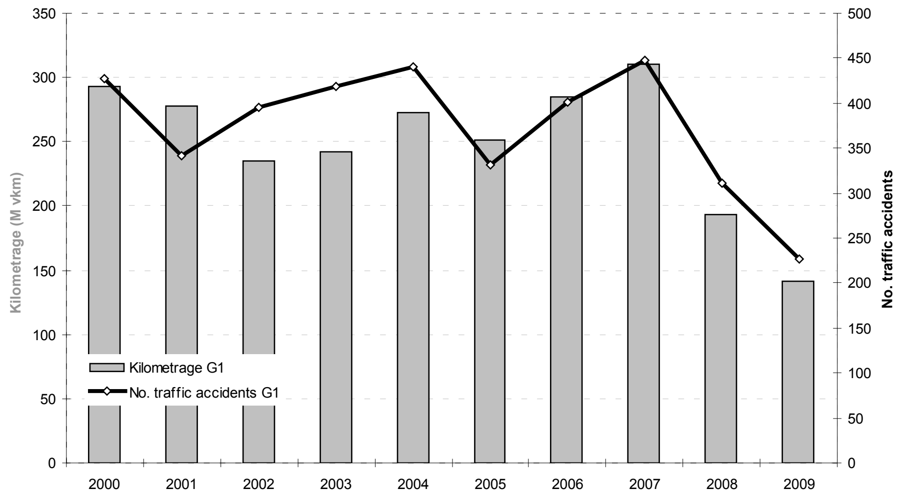


Figure 6.4: Data on the number of traffic accidents involving a goods vehicle and kilometrage goods vehicles on express roads (HC) in the Republic of Slovenia

(Source: Police, 2012; Slovenian Roads Agency, 2011)

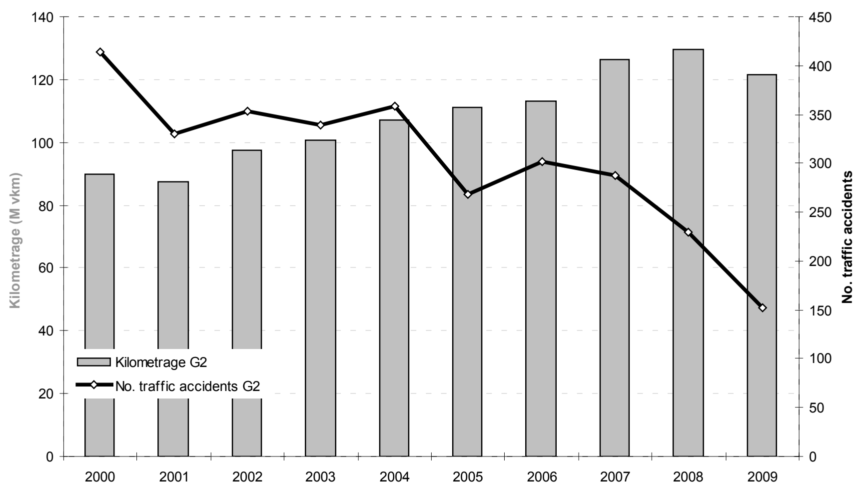


Figure 6.5: Data on the number of traffic accidents involving a goods vehicle and kilometrage goods vehicles on main roads (G2) in the Republic of Slovenia

(Source: Police, 2012; Slovenian Roads Agency, 2011)

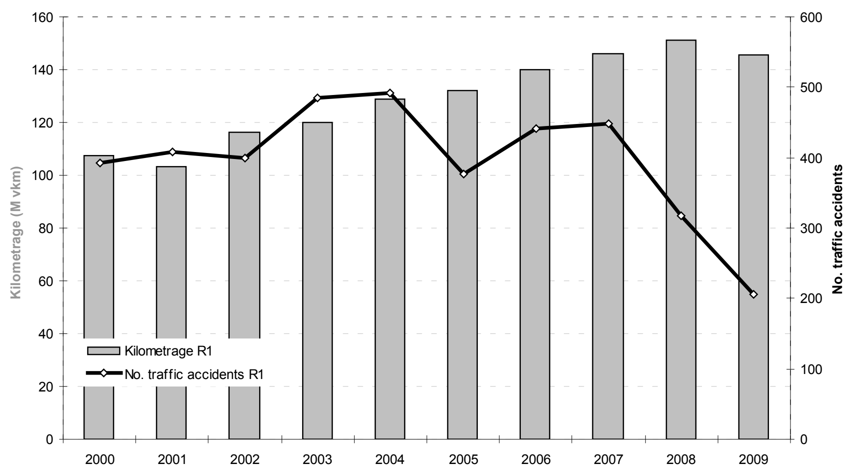


Figure 6.6: Data on the number of traffic accidents involving a goods vehicle and kilometrage goods vehicles on regional roads (R1) in the Republic of Slovenia

(Source: Police, 2012; Slovenian Roads Agency, 2011)

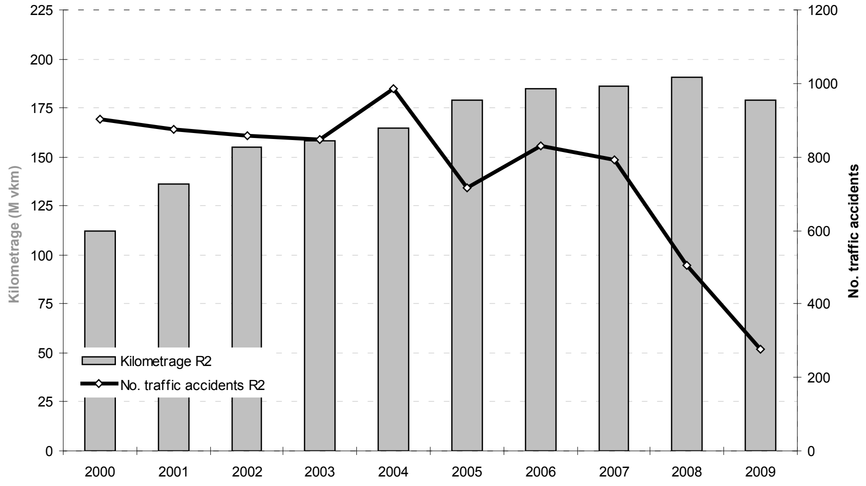


Figure 6.7: Data on the number of traffic accidents involving a goods vehicle and kilometrage goods vehicles on regional roads (R2) in the Republic of Slovenia

(Source: Police, 2012; Slovenian Roads Agency, 2011)

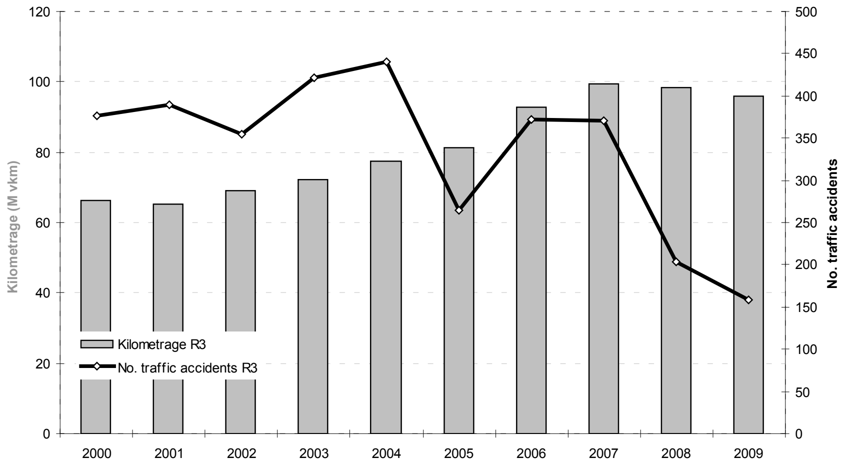


Figure 6.8: Data on the number of traffic accidents involving a goods vehicle and kilometrage goods vehicles on regional roads (R3) in the Republic of Slovenia (

Source: Police, 2012; Slovenian Roads Agency, 2011)

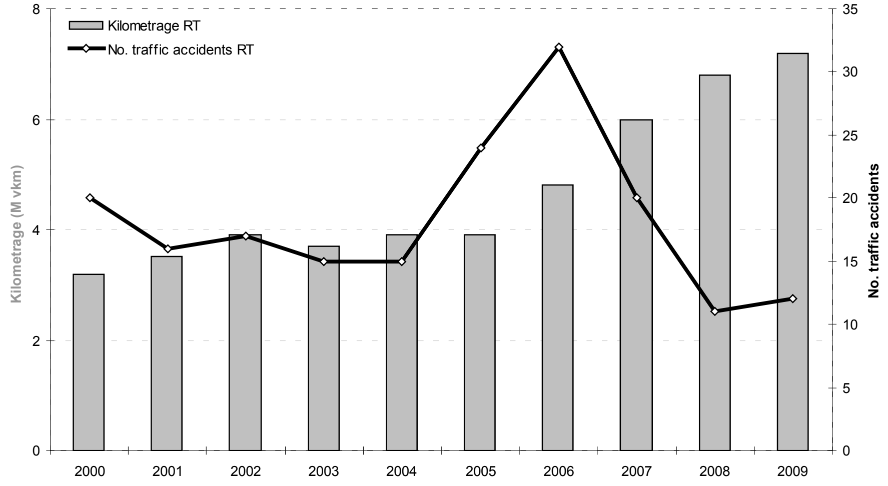


Figure 6.9: Data on the number of traffic accidents involving a goods vehicle and kilometrage goods vehicles on tourist roads (RT) in the Republic of Slovenia

(Source: Police, 2012; Slovenian Roads Agency, 2011)

Figure 6.11 shows micro locations of accidents involving goods vehicles on the DC network in the Republic of Slovenia during the period in question.

2.1.1 Calculation of risk of a traffic accident of a goods vehicle on the road

The risk of a traffic accident of a goods vehicle on the road is described by the data on traffic accidents of goods vehicles in Slovenia which are recorded in the traffic accident database kept by the Police (Police, 2012) and by the data on transport work carried out (expressed in tonne kilometres (tkm)) on the roads, which is published by the Statistical Office of the Republic of Slovenia. The risk of a traffic accident during the transport of freight by roadζ is calculated, based on the above mentioned data for the period 2004 to 2011 (Figure 6.10).

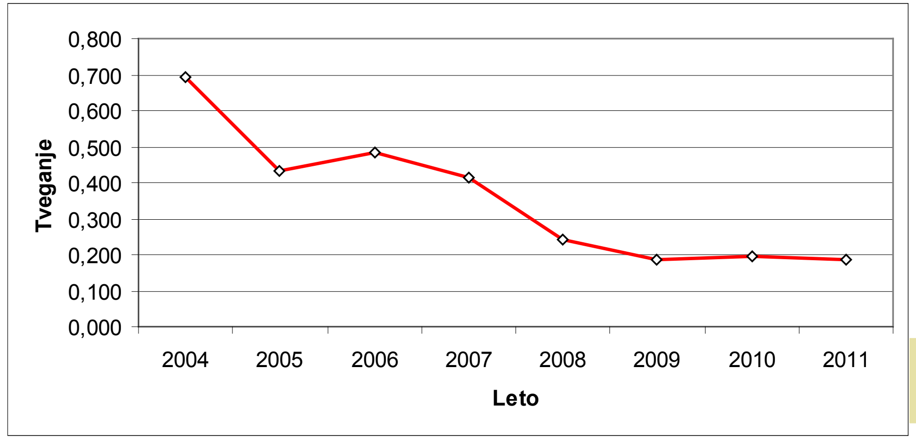


Figure 6.10: Risk of a traffic accident during the transport of freight by road in Slovenia 2004-2011

We founnd that during the period in question the risk was decreasing and in 2011 amounted to 0.188 accidents per million tonne kilometres. We estimate, taking into consideration the trend of the decrease of risk (and general improvement of traffic safety), that the risk will, in the period of the scenario (2025), amount to 0.1 accidents per million of tonne kilometres.

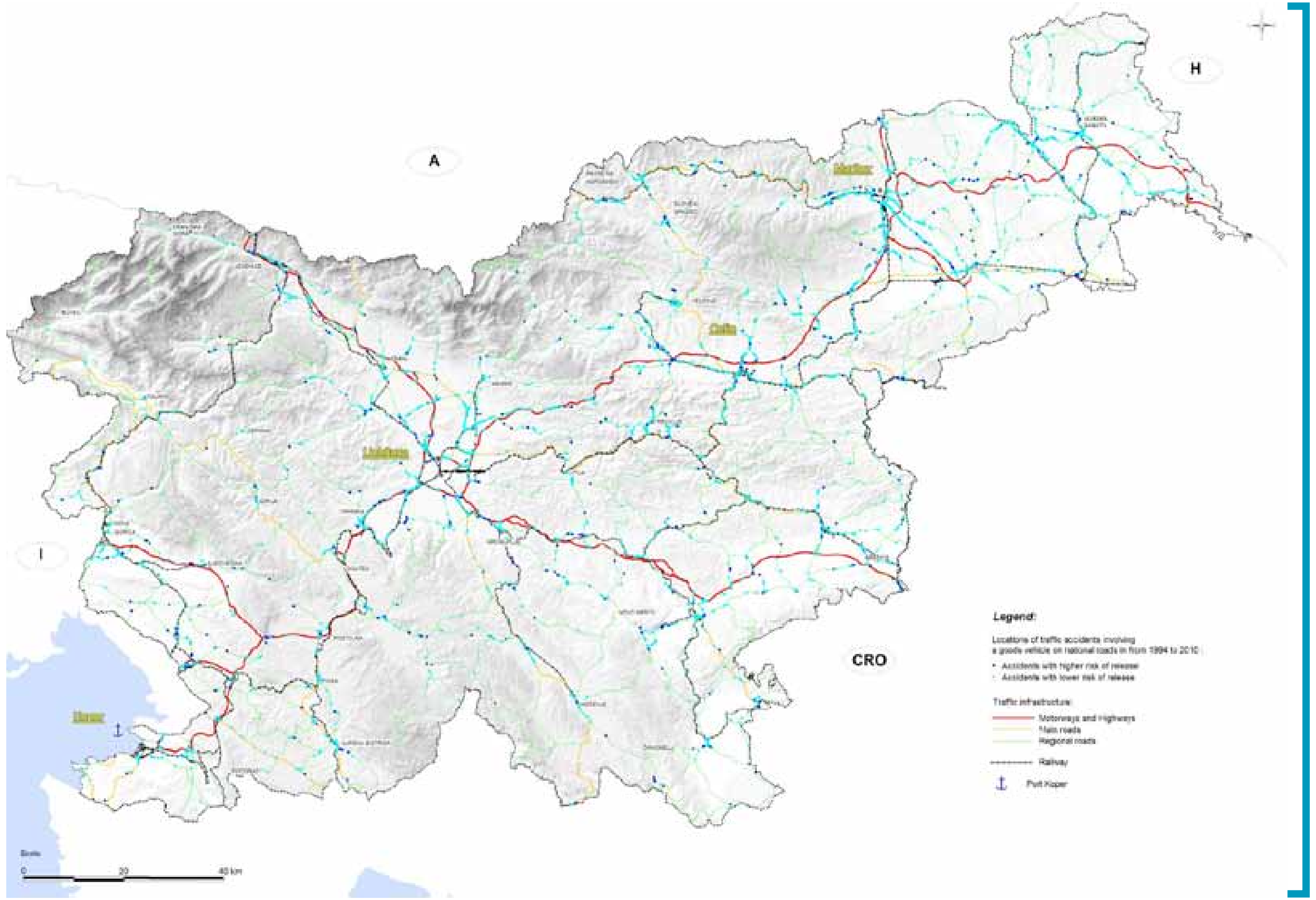


Figure 6.11: Locations of traffic accidents involving a goods vehicle on national roads in the Republic of Slovenia from 1994 to 2010

2.2. Rail Traffic Accidents

We acquired the data on rail traffic accidents from the EUROSTAT database (EUROSTAT, 2012). The collected data refers to individual EU member countries and observer states for the period 2000 to 2011 or to data that each country had provided, according to the type of train accident. Figure 6.11 shows data for Slovenia.

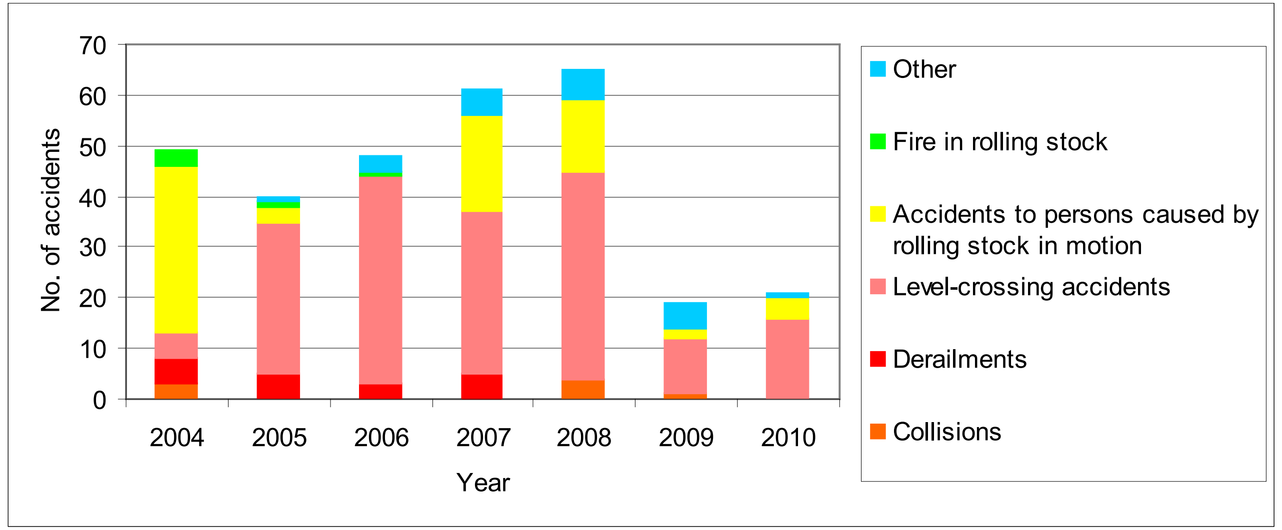


Figure 6.12: Structure of rail accidents by types of accidents in Slovenia from 2004 to 2012

(Source: EUROSTAT)

2.2.1.Calculation of risk of a rail traffic accident

The risk of a rail traffic accident is the probability for the event occurrence with the current amount of transport. An event is a traffic accident causing damage to the freight (dangerous substance leakage). Such rail accidents represent the following types of accidents: collisions, derailing and fire on the vehicle. The scope of rail transport is described and published by EUROSTAT. The data collected refer to individual EU member countries and observer states for the period 2000 to 2011 or to the data that each country had provided. Rail traffic accident risk is presented in the following table.

Table 6.1: Risk of a rail traffic accident (Source: EUROSTAT, 2012, own calculation)

Country	Risk	Number of accidents	Transport work (million of tkm)
Slovenia	0.00136	31	22.841
EU-27	0.00210	6.746	3212080
MED countries	0.00154	401	259.800

In Slovenia the risk of a traffic accident with damage to the freight is **0.00136 of accidents per million of tonne kilometres.** In countries where railways are more developed, such as the Netherlands, France, Switzerland, the risk is **approximately 0.001 accidents per million of tonne kilometres.** We will use this risk to estimate the social cost in future scenarios.

It is rare that the entire composition is damaged during a freight train accident. The web page of the Rail Accident Investigation Branch (RAIB, 2012) publishes the data on individual rail accidents, course of an individual accident; carriages, injured people and damaged infrastructure.

Based on the collected data on the described rail accidents in Great Britain, we can observe that on average 13.7% of the train composition carriages are damaged in a rail accident.

2.3. Traffic Accidents Involving Dangerous Goods

Daily information bulletins on accidents involving dangerous goods prepared by the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief (2012a), in which the records of accidents as well as a description of the characteristics of each accident are kept, is the source of data on accidents involving dangerous goods. The Figure graphs 6.13 through 6.18 show the statistics of accidents involving dangerous goods from September 2006 to April 2012.

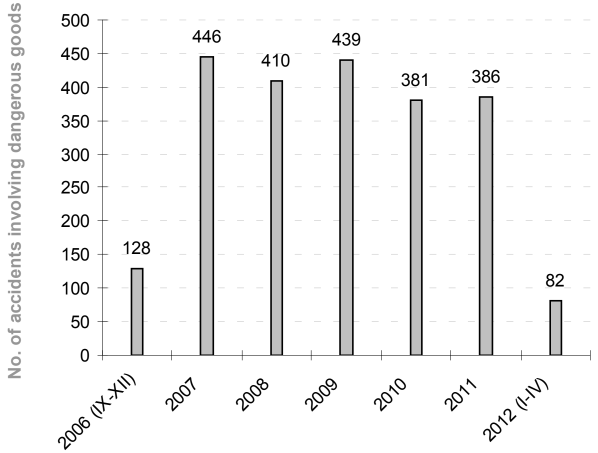


Figure 6.13: Number of accidents involving dangerous goods in the Republic of Slovenia from September 2006 to April 2012

(Source: Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012a)

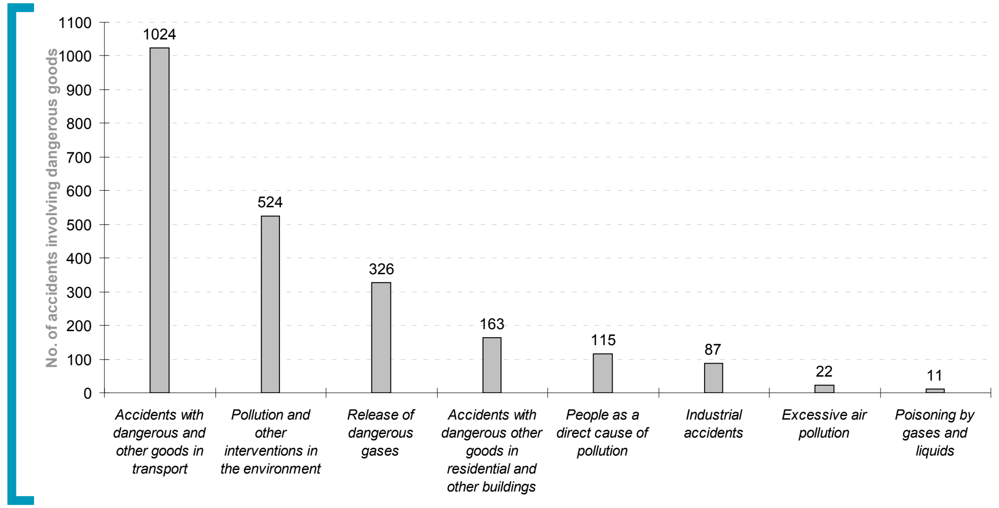


Figure 6.14: Structure of accidents involving dangerous goods in the Republic of Slovenia from September 2006 to April 2012

(Source: Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012a)

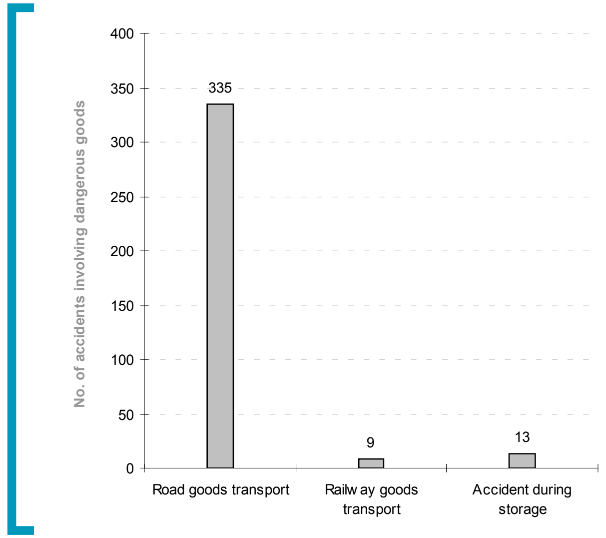
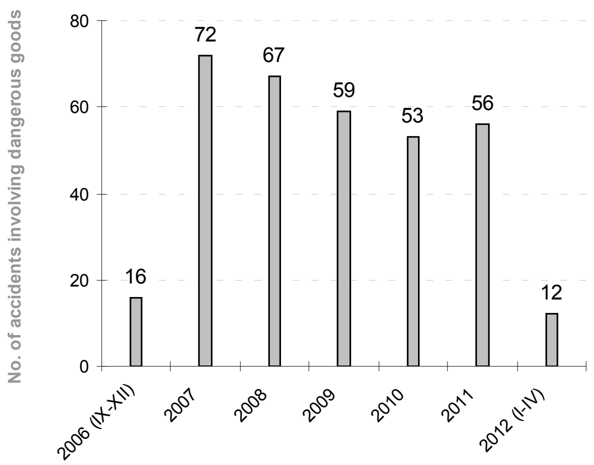


Figure 6.15: Structure of accidents involving dangerous goods in the Republic of Slovenia according to the accident description and the modality of the logistics chain from September 2006 to April 2012

(Source: Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012a)

Figure 6.16: Number of accidents involving dangerous goods in the Republic of Slovenia involving a goods vehicle from September 2006 to April 2012

(Source: Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012a)



From 2009 to 2011 (the period is selected based on the available data on the accident remediation, chapter 6.4.1) there were 168 traffic accidents in Slovenia where dangerous substance leakage of the freight occurred, which is average 56 per year. Data on traffic accidents involving goods vehicles which were carrying dangerous goods but where the leakage did not occur, are not available and must therefore be estimated. The estimation was done based on the information on the transported chemicals and fuels in Slovenia and based on the existent risk of a traffic accident. Based on this, we estimate that from 2009 to 2011 there w ere average 293 traffic accidents during the chemicals and fuel transport per year.

Percentage of goods vehicles where dangerous substance leakage during a road traffic accident occurred is 0.19.

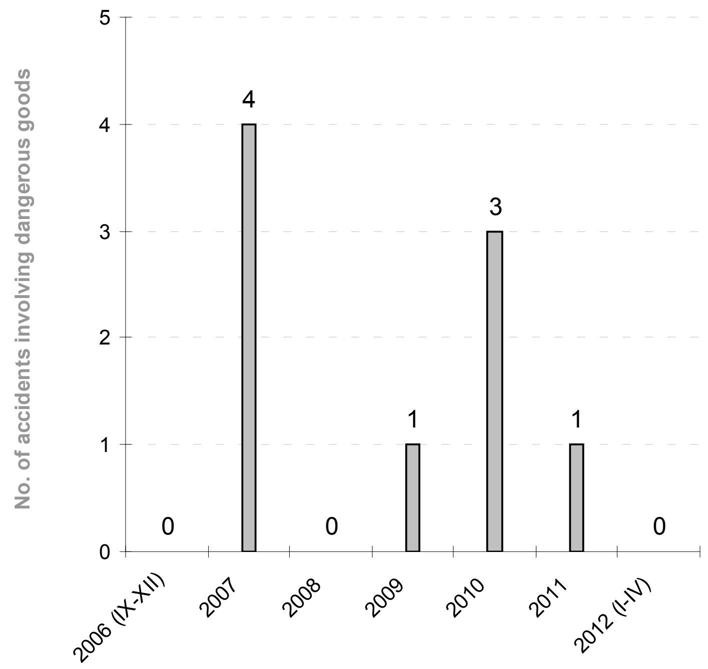


Figure 6.17: Number of accidents involving dangerous goods in the Republic of Slovenia involving a freight train from September 2006 to April 2012

(Source: Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012a)

We acquired the data on rail traffic accidents involving dangerous goods from the EUROSTAT database (EUROSTAT, 2012). The data collected refer to individual EU member countries and observer states for the period 2000 to 2011 or to data that each country had provided. The database includes traffic accidents of freight trains where a dangerous substance leakage occurred as well as those where it did not. There was a total of 528 rail traffic accidents involving dangerous goods; leakage occurred in 267 cases.

Percentage of rail transport from 2000 to 2011 where a dangerous substance leakage occurred during a traffic accident is 0.505.

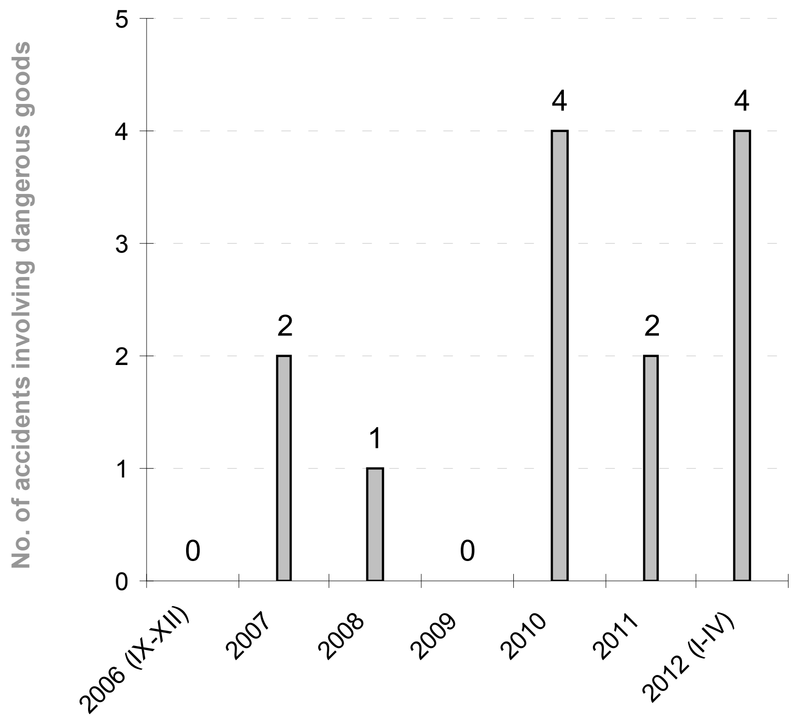


Figure 6.18: Number of relevant accidents involving chemicals which occurred during storage in the Republic of Slovenia from September 2006 to April 2012

(Source: Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012a)

1.1. Costs of Traffic Accidents in the Transport of Chemicals and Fuels

Consequences of traffic accidents represent an enormous burden for the society. It is measured as monetarised costs resulting from the accidents. With the chemicals and fuels transport (especially with the transport of dangerous goods) these costs are comprised from socio-economic costs and environment remediation costs due to a dangerous substance leakage. Socio-economic costs include the costs of people involved in the accident and material costs of the accident itself.

In traffic accidents involving the chemicals and fuels transport, we divide the traffic accidents and their appertaining costs into two different categories. The first category involves the transport of chemicals and fuels with no leakage during the accident. In these accidents we take into consideration the socio-economic costs. The other categories are traffic accidents where there is a dangerous substance or fuel leakage. In these accidents we must take into consideration not only the socio-economic costs but also the environmental remediation costs due to leakage of a dangerous substance.

1.1.1. Remediation costs after traffic accidents involving dangerous goods

This chapter provides the monetarised remediation costs of accidents involving dangerous goods during the last 3 years (2009-2011), reported by the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief (2012b).

During this period they are 91 such accidents, based on calls made to the emergency notification centre. The number of interventions by years, individual months and the total amount of costs due to accidents involving dangerous goods by individual months are shown in table 6.2.

Table 2.1: Total costs of interventions in accidents involving dangerous goods from 2009 to 2011

(*Source:* Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012b)

	2009		2010		2011	
Month	no. of interventions	Amount excluding VAT (in €)	no. of interventions	Amount excluding VAT (in €)	no. of interventions	Amount excluding VAT (in €)
January	0	0	0	0	2	1,237
February	1	180	1	73	1	60
March	2	1,472	6	6,396	0	0
April	1	330	2	1,578	3	3,540
May	4	4,197	4	26,994	0	0
June	2	429	2	4,514	2	275
July	6	31,528	1	87	0	0
August	2	1,807	2	143	0	0
September	2	223	22	66,226	3	6,396
October	0	0	2	2,235	1	182
November	1	1,549	8	3,918	1	569
December	3	1,850	3	3,046	1	114
TOTAL	**24**	**43,564**	**53**	**115,209**	**14**	**12,372**

Table 6.3 shows the remediation of dangerous goods in kg by the types of dangerous goods in theob-served period.

Table 2.2: Remediation of dangerous goods in kg by type of dangerous goods in the period from 2009 to 2011
Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012b)

European Waste Code	Waste description	Mass (kg) 2009	Mass (kg) 2010	Mass (kg) 2011
06 01 06	Other acids	0	1	0
07 02 13	Waste plastic	0	0	107
08 01 11	Waste paints and varnishes containing organic solvents or other dangerous goods	2,067	0	0
08 04 09	Waste adhesives and sealants containing organic solvents or other dangerous goods	95	0	0
12 01 09	Machining emulsions and solutions free of halogens	0	212	0
13 02 05	Mineral-based non-chlorinated engine, gear and lubricating oils	345	379	430
13 05 07	Oily water from oil/water separators	70.800	232.054	1,275
13 07 01	Fuel oil and diesel	0	363	0
13 07 03	Other fuels (including mixtures)	0	4,140	0
13 08 99	Wastes not otherwise specified	8,289	10,358	0
14 06 03	Other solvents and solvent mixtures	2,594	191	0
14 06 05	Sludges or solid wastes containing other solvents	229	0	0
15 01 10	Packaging containing residues of or contaminated by dangerous goods	0	178	0
15 02 02	Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous goods	5,351	9,644	1,433
16 01 07	Oil filters	0	37	0
16 05 07	Discarded inorganic chemicals consisting of or containing dangerous goods	0	155	0
16 05 08	Discarded organic chemicals consisting of or containing dangerous goods	1	0	0
16 06 01	Lead batteries	0	0	24
17 03 01	Bituminous mixtures containing coal tar	444	0	0
17 05 03	Soil and stones containing dangerous goods	16,507	74,149	18,459
20 01 21	Fluorescent tubes and other mercury-containing waste	1	0	0
	TOTAL	**106,723**	**331,861**	**21,728**

Remediated dangerous goods include leaked dangerous goods due to traffic accident and other quantities which were exposed to the leakage of the dangerous substance (soil, water, cleaning products, filters). During the observed period 11.727 tons of dangerous goods leaked in traffic accidents with the average amounts to 3.9 t/a (tons per year).

In order to estimate the costs of the remediation of rail traffic accidents involving transport of chemicals, we must calculate the average percentage of leaked dangerous substance per traffic accident. The basis for the calculation of the amount of dangerous substance involved in a traffic accident is the data on transported dangerous goods in Slovenia; that is to say the percentage of involved goods vehicles and carriages in which a leakage occurred. Based on this, we can calculate the percentage of the leaked dangerous substance per traffic accident during which a dangerous substance leaks into the environment.

The average percentage of the dangerous substance which leaks into the environment during an accident in the transport of dangerous goods is 0.03.

Table 6.4 shows the specific remediation costs by type of dangerous substance during the observed period.

Table 2.3: Cost of services rendered during interventions depending on the type of dangerous goods in the period from 2009 to 2011 in € excluding VAT (Source: Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012b) Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012b)

European Waste Code	Waste description	Price € / kg	2009 (€)	2010 (€)	2011 (€)	TOTAL (€)
06 01 06	Other acids	0.37	0	0	0	0
07 02 13	Waste plastic	0.22	0	0	24	24
08 01 11	Waste paints and varnishes containing organic solvents or other dangerous goods	0.66	1,364	0	0	1,364
08 04 09	Waste adhesives and sealants containing organic solvents or other dangerous goods	0.42	40	0	0	40
12 01 09	Machining emulsions and solutions free of halogens	0.42	0	89	0	89
13 02 05	Mineral-based non-chlorinated engine, gear and lubricating oils	0.08	28	30	34	92
13 05 07	Oily water from oil/water separators	0.24	16,992	55,693	306	72.991
13 07 01	Fuel oil and diesel	0.42	0	152	0	152
13 07 03	Other fuels (including mixtures)	0.24	0	994	0	994
13 08 99	Wastes not otherwise specified	0.24	1.989	2.486	0	4.475
14 06 03	Other solvents and solvent mixtures	0.42	1.089	80	0	1.170
14 06 05	Sludges or solid wastes containing other solvents	0.44	101	0	0	101
15 01 10	Packaging containing residues of or contaminated by dangerous goods	0.56	0	100	0	100
15 02 02	Absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous goods	0.42	2.247	4.050	602	6.900
16 01 07	Oil filters	0.42	0	16	0	16
16 05 07	Discarded inorganic chemicals consisting of or containing dangerous goods	1.20	0	186	0	186
16 05 08	Discarded organic chemicals consisting of or containing dangerous goods	1.20	1	0	0	1
16 06 01	Lead batteries	0.00	0	0	0	0
17 03 01	Bituminous mixtures containing coal tar	0.44	195	0	0	195
17 05 03	Soil and stones containing dangerous goods	0.47	7,758	34.850	8.676	51.284
20 01 21	Fluorescent tubes and other mercury-containing waste	0.00	0	0	0	0
	TOTAL waste		31,806	98,727	9,642	140,174
	TOTAL services		11,758	16,483	2.731	30,972
	TOTAL cost		**43,564**	**115,209**	**12,372**	**171,146**

1.1.2. Socio-economic cost of consequences of traffic accidents

Traffic accidents have a number of negative consequences, because they cause the loss of resources, human lives and well-being. All these consequences are included when estimating the cost. Some costs may refer to people involved in traffic accidents (e.g. medical cost, non-medical remediation, lost production and human cost), and other may refer to the event itself or the traffic accident (e.g. material damage, administrative and other costs).

Socio-economic cost of the traffic accidents are summed up in accordance with the Handbook on estimation of external costs in the transportation sector (Maibach et al., 2008). The average traffic accident costs according to the type of vehicle are stated in EUR 1998. Because of the comparison we calculated all values from the base year to 2011 with the index of the growth of GDP/capita in an individual country by taking into consideration the purchasing power parity (PPP).

Average cost of a traffic accident involving a goods vehicle amounts to 0.024 €/vkm. Average cost of a traffic accident involving a freight train amounts to 0.52 €/vkm.

2. Social Benefits of Improving Transport Infrastructure in Terms of Transport of Chemicals and Fuels

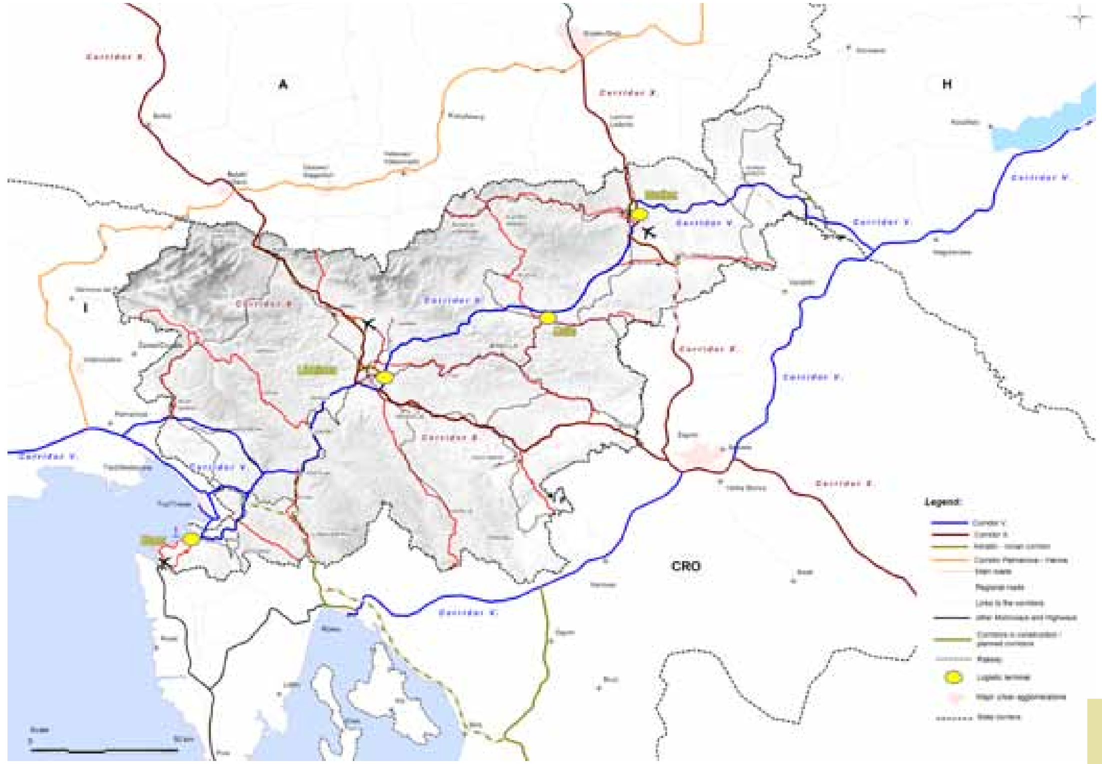
The insofar development of the transport infrastructure in Slovenia was directed mainly into the construction of the motorway network. Development and upgrade of the railway network did not receive the required attention which is why the amount of transport by rail has, on certain occasions, almost reached its maximum capacities. The result of such development is an unsustainable transport system which is evident from the fact that the amount of transport by road increases while the amount of transport by rail stagnates. Sustainable transport system is the goal of the European Union policy and is written in the White Paper. In order to achieve the set goals, we must invest into the development and upgrade of the railway transport system and intermodal terminals which will enable the required change of modality of transport for the benefit of railways.

Chemicals and fuels transport represents only a small portion of the entire transport within national economy. Therefore one cannot expect the share of chemicals and fuels transport to significantly influence traffic congestions and to have a significant impact on the feasibility of the investment in the infrastructure. The modal shift in the transport of chemicals and fuels would, however, alter the overall social risk which would occur during such transport.

This study is based on the calculation of the risk estimation of the potential social cost which would result from a traffic accident involving chemicals or fuels. By decreasing the social cost risk connected with an accident during the chemicals and fuels transport, it represents an immediate additional benefit of investing into a certain type of transport infrastructure. The following risk estimation was calculated for the selected transport corridor from Port of Koper to Maribor, where there is also the last intermodal terminal in Slovenia on the corridor V.

2.1. Transport Infrastructure in Slovenia

Slovenia is one of the few countries which have a junction of significant road and railway lines: the European transport corridor V and the European transport corridor X. Both corridors contribute to Slovenia's modern transport connection with Italy, Austria, Hungary and Croatia. It is very important for Slovenia not only the possibility of development of logistics centres and intermodal hubs at the European level (Koper, Ljubljana, Maribor) but also the increased role of the Ljubljana airport. These centres will play a major role as generators of development and connection with neighbouring and other European countries.



The motorway network is the backbone of Slovenia's road transport infrastructure. It enables the connection with the international motorway network (E-roads and European corridors V and X). The distance of the entire national road system was approximately 6,710 km in 2010; 750 km of this were express roads.

Slovenian public railway network consists of the main line and the regional line. There was 1,228 km of railway lines on the public railway network infrastructure in Slovenia in 2009. Approximately 898 km of these were single-track and 330 km were double-track lines.

International maritime transport also takes place in the Slovenian territorial waters, namely in the cargo Port of Koper. Koper cargo Port is a modern port which is connected to the inland by road and railway. It enables international trade flows, due to its geographic-transport location by the corridor V.

Figure 2.1: Transport infrastructure and connection with international transport corridors

Restrictions regarding the interoperability of neighbouring countries' railway systems represent a bottleneck in transnational connections. Technical characteristics which result in such restrictions are of a different voltage on the electrified part of the railway network or non-electrified parts of networks, lower allowed axle loads and last but not least lower speed limits. In 2010 Slovenia's railway network was full of permanent and temporary bottlenecks.

Permanent bottlenecks are mainly present on the following networks:

- Divača-Koper;
- Ljubljana-Jesenice;
- Pragersko-Ormož-Ljutomer-Hodoš.

With international railway connections, especially on the Adriatic - Baltic Sea destination, significant bottlenecks are located on the following lines:

- Koper-Ljubljana-Slovenian/Austrian border crossing (Klagenfurt, Austria);
- (Zagreb, Croatia)-Zidani Most-Maribor-Slovenian/Austrian border crossing (Graz, Austria);
- Zidani most-Ljubljana.

Bottlenecks also emerge on the road network (motorway network) because it is not yet completed. The not yet completed motorway network:

- Gorišnica-Ormož;
- connection to the Port of Koper;
- Koper-Lucija;
- Peračica-Podtabor.

2.2. Scenario for the Development of Transport Infrastructure

In accordance with the content Phase 2 (Transport systems), which refers to the proposals for improvement of the transport from the Port of Koper to inland, the risk estimation was calculated for the transport of chemicals on the selected Slovenian corridor which depends on the selected transport modality to/from the Port of Koper to/from inland.

Scenario 1 - after the modernization of the railway according to the Plan for the railway infrastructure development, bottlenecks will be eliminated. The increased railway capacities will be able to take on the maximum possible amounts of dangerous goods from roads with regard to potential absorption capacities of the chemical industry and rail freight terminals.

Scenario 2 - the current condition of the railway infrastructure is preserved, only the necessary maintenance works required for functioning are carried out, but due to the fact that these capacities are full, the entire surplus of the transport of chemicals and fuels according to the estimated economic growth of the chemical industry is carried out exclusively by road.

2025 was set as the target year for both scenarios.

In Scenario 1 we took into consideration the development plans of the Slovenian Railways in accordance with conditions "Z1"[1] (by the above stated company) which represent investments for ensuring sufficient capacities of the main railway lines. The following measures are to be taken as part of this scenario:

Construction of a new railway line Divača-Koper.

1. Newly constructed Ljubljana railway hub.[2]

2. Upgrading of the line and stations on the Zidani Most - Ljubljana expand by setting up of the long-distance rail traffic and by increasing the line speed on the Litija-Ljubljana road.

3. Upgrading of stations, signalling safety devices and setting up long-distance rail traffic on the Zidani Most-Pragersko road.

4. Upgrading the Pragersko-Šentilj stretch by upgrading the stations and signalling safety devices and setting up long-distance rail traffic.

5. Upgrading the Ljubljana-Sežana line by upgrading the stations and signalling safety devices, providing conditions for setting up long-distance rail traffic and construction of additional substations.

6. Upgrading the Ljubljana-Borovnica stretch so that it allows speeds up to 160 km/h.

With the road infrastructure we took into account the implementation of the electronic toll collection for goods vehicles and the removal of existing toll stations on the motorway route. The main investments into the motorway network on the discussed road corridor were, unlike on the rail infrastructure, already carried out as part of the construction of the Slovenian motorway network on the Pan-European road corridors V and X. The routes of both scenarios were shown in Figures 5.4 and 5.5.

2.3. Social Cost Risk in the Transport of Chemicals and Fuels

The methodology for the calculation of social cost risk in the transport of chemicals and fuels was based on the risk analysis of the potential social cost which may occur in a traffic accident involving chemicals or fuels. Generally speaking, the overall social cost of traffic accidents consists of direct damage resulting from the accident and of traffic accident's remediation costs. Risks associated with the transport of chemicals and fuels can never be completely eliminated as this transport is important for the national and transnational economy.

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[1] *Analysis of possibilities and needs for the development of public railway structure in the Republic of Slovenia, 2011.*

[2] *With this scenario we have, in the Ljubljana area, applied a safer (in terms of potential risk it poses to the environmental components) course of the freight by-pass route pass Ljubljana, in accordance with the course of one of the versions of the Ljubljana by-pass line included in the Plan for the railway infrastructure development.*

This is why the legislative bodies have, in order to minimize the likelihood of such accidents, adopted strict statutory restrictions for carriers and users. The key issue is which modality/transport chain (road/railway) in the transport of chemicals and fuels generates a lower risk than social costs, in case traffic accidents or accidents during freight handling incur.

Monetarised social risk with the transport of chemicals and fuels for the selected mode of transport (railway or road) may be, in accordance with the previously explained methodological concept, expressed as:

$$M_r = C_a + C_s$$

socio-economic cost of a traffic accident:

$$C_a = T_v \times C_{au}$$

Costs of dangerous substance remediation in a traffic accident:

$$C_s = T_g \times R_{ns} \times K_c \times C_{su} \times I_{ot}$$

M_r	-	Monetarised social risk in the transport of chemicals and fuels
T_g	-	Transport work of chemicals and fuels (million tkm)
T_v	-	Kilometrage of chemicals and fuels (million vkm)
R_{ns}	-	Risk of an accident
K_c	-	Percentage of dangerous substance leakage
C_{au}	-	Socio-economic cost of a traffic accident per unit
C_{su}	-	Dangerous substance remediation cost in a traffic accident per unit
I_{ot}	-	Index of the exposure of the environment of the route (road or railway)

We required the following variables to calculate the monetarised cost of risk with the transport of chemicals and fuels:

• the amount of transported chemicals and fuels by rail and by road on the observed corridor;

• increase in the amount of transported chemicals and fuels by rail and by road on the observed corridor until 2025;

• risk of a traffic accident in the transport of chemicals and fuels with a freight train by rail;

• risk of a traffic accident in the transport of chemicals and fuels with a goods vehicle by road;

• percentage of chemicals and fuels leaked in a freight train accident;

• percentage of chemicals and fuels leaked in a goods vehicle accident;

• average costs of dangerous goods remediation according to the quantity;

• average socio-economic costs of train and goods vehicle accidents;

• risk of a traffic accident in the transport of chemicals and fuels by rail in the target year 2025;

• risk of a traffic accident in the transport of chemicals and fuels with a goods vehicle by road in the target year 2025;

• average transport times in the transport of chemicals and fuels by road on the observed corridor;

• index of the exposure of the environment during the transport of chemicals and fuels on the road route of the observed corridor;

• index of the exposure of the environment during the transport of chemicals and fuels on the rail route of the observed corridor;

[1] We calculated the amount of transported chemicals and fuels by rail and by road based on:

• an estimation of transport work of all transports of freight2;

• the percentage of transported chemicals and fuels taken over with regard to the entire freight transported into the Republic of Slovenia3.

[2] We acquired the data of the increase in the amount of transported chemicals and fuels by rail and by road on the observed corridor until 2025 from the study titled "Comparison of possible effects resulting from the selection of different transport systems from the viewpoint of sustainable development of transport in countries participating in the SEETAC project" (OMEGA consult, 2012). We applied the scenario A from this study which takes into consideration the accelerated economic growth of the EU candidates countries from SE Europe and thus a greater increase in transport in these countries. According to this scenario the increase in the freight transport amounts to 18.4%.

[2] Calculated from the data on the average load of vehicles and the number of vehicles (freight train/ goods vehicles) on the stretches and based on distances of individual stretches (Source: Statistical Office of the Republic of Slovenia, Slovenian Railways, Transport 2011, GJI - The Surveying and Mapping Authority of the Republic of Slovenia).
3 Under the assumption that the percentage on the observed transport corridor is the same as in the Republic of Slovenia (Source: Statistical Office of the Republic of Slovenia).

[3] In Slovenia the risk of a traffic accident in the transport of chemicals and fuels by rail with a freight train, where damage to the freight would occur, is 0.00136 accidents per million tonne kilometres (Source: EUROSTAT, 2012).

[4] In Slovenia the risk of a traffic accident in the transport of chemicals and fuels by road with a goods vehicle, where damage to the freight would occur, is 0.188 accidents per million tonne kilometres (Source: Police, 2012)

[5] We calculated the average amount of chemicals or fuels leaked during an accident of a freight train based on:

• the calculation of the amounts of chemicals and fuels transported by rail (see [1]).

• the risk of a traffic accident in the transport of chemicals and fuels by rail with a freight train (see [3]).

• the percentage of rail transport, where a dangerous substance leakage occurred during a traffic accident, is 0.505 (Source: EUROSTAT, 2012).

• the average percentage of carriages of the train composition which were damaged in the traffic accident on the railway amounts to 13.7% (Source: RAIB, 2012)

• the average percentage of the leaked dangerous substance, where leakage into the environment occurred, which amounts to 0.03 (chapter 6.4.1).

[6] We calculated the average amount of chemicals or fuels leaked during an accident of a goods vehicle based on:

• the calculation of the amounts of chemicals and fuels transported by road (see [1])

• the risk of a traffic accident in the transport of chemicals and fuels by road with a goods vehicle (see [4])

• the percentage of transport of goods by road where a dangerous substance leakage occurred during a traffic accident, is 0.19.

• the average percentage of the leaked dangerous substance during a traffic accident, where leakage into the environment occurred, amounts to 0.03 (chapter 6.4.1).

[7] We acquired the average dangerous substance remediation costs in a traffic accident, according to the amount, from the available data on remediated amounts of dangerous goods according to types of dangerous goods in traffic accidents (train and road) and leaked dangerous goods remediation costs according to types and quantities for the period 2009 to 2011 (Source: Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012b)

[8] The average cost of a traffic accident of a goods vehicle amounts to 0.024 €/vkm, the average cost of a freight train accident amounts to 0.52 €/vkm (Source: Maibach, 2008).

[9] The risk of a traffic accident in the transport of chemicals and fuels by rail with a freight train was estimated for the target year 2025 based on the risk in more developed countries, which is approximately 0.001 accidents per million tkm.

[10] The risk of a traffic accident in the transport of chemicals and fuels by road with a goods vehicle was estimated for the target year 2025 based on the downward trend of the risk of an accident, projected to the target year 2025. We estimate, taking into consideration the trend of the decrease of risk (and general improvement of traffic safety), that the risk will, in the period of the scenario (2025), amount to 0.1 accidents per million tkm.

[11] The average time of transport of chemicals and fuels by rail and by road is set based on the Slovenian Railway timetable and the data provided by road transport operators.

[12] The index of exposure of the environment during the transport of chemicals and fuels by the road route of the observed corridor was set in accordance with the described methodology for the calculation of the environmental sensitivity index for each spatial hexagon through which the road route runs (chapter 5). We then weighted the values on hexagons with an average driving time of the goods vehicle through an individual hexagon on the route which is how we got the index of the exposure of the environment. We summed the so calculated hexagons on the route and got the index of environmental exposure of the route.

We had to further standardise the index of environmental exposure of both routes in accordance with the average monetarised costs of environment remediation in order to adequately compare the road and railway route (Source: Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012b) Data on average costs of environment remediation in the Republic of Slovenia, due to leakage of dangerous goods during traffic accidents from 2009 to 2011, include the sensitivity of the environment and space. These traffic accidents occurred on the actual transport infrastructure of the Republic of Slovenia which runs through various environmental-spatial elements. In accordance with this, we calculated the average index of environmental sensitivity for the railway and road networks in Slovenia. With road network we took into consideration all national, local and urban collector roads. We standardised the average environmental sensitivity indexes of both routes according to the average environmental sensitivity index of the transport infrastructure hexagons. The normalised ratio between the road and rail routes is in Scenario 0 (current state) 1: 5.075, and in Scenario 1 is 1: 2.818.

[13] In terms of the used methodology, the index of environmental exposure during the transport of chemicals and fuels by the rail route of the observed corridor was calculated in the same way as it was in the case of the road route (see [12]).

2.4. Estimation of the Reduction in Social Cost in the Transport of Chemicals and Fuels

We prepared an estimation of social and environmental costs during the transport of chemicals and fuels (table 7.1) for the relevant development scenarios. We hereinafter calculated the reduction of social cost risk in a monetarised form (table 7.2), which would occur due to the modal shift with the transport of chemicals and fuels as the result of the development of the transport infrastructure. Scenario 0 represents the current state in 2011.

Table 2.1: Components of annual costs of traffic accidents involving chemicals and fuels by scenarios and modalities

Scenario	Route	Socio-economic costs (in €) [C_a]	Environmental remediation costs (in €) [C_e]	Monetarised social risk (in €) [M_r]
Scenario 0	Road	1,473,008	52,442	1,525,450
Scenario 0	Railway	547,506	8,334	589,800
Scenario 1	Road	1,316,013	10,710	1,326,723
Scenario 1	Railway	826,116	3,628	836,342
Scenario 2	Road	1,862,492	15,155	1,877,647
Scenario 2	Railway	547.506	2,633	560,866

Table 2.2: Monetarised annual social risk of traffic accidents involving chemicals and fuels by scenarios

Scenario	Monetarised social risk (in €) [Mr]
Scenario 0	2,115,250
Scenario 1	2,163,065
Scenario 2	2,438,513

In all scenarios the socio-economic costs represent the highest percentage of costs while the costs of environmental remediation are relatively low. Low environmental remediation costs are the result of a well regulated and organized area of the transport of dangerous goods and of efficient services and procedures in case of leak/exhaust of a dangerous substance. All scenarios have proven that rail transport is more favourable, because risks of a traffic accident are lower in this transport modality than they are on the road.

With the increase in transported volumes of chemicals and fuels in 2025, Scenario 2 predicts only an increase in the volume of transported chemicals and fuels by road, since the transport of goods by railway has already reached its infrastructure restrictions. This is also reflected in the monetarised social risk which increases by 15% compared to today's situation. Scenario 1 foresees the development of the railway infrastructure which would enable preservation or improvement of the modal distribution of the transport of chemicals and fuels in favour of the railway compared to today's situation.

In 2025 monetarised social risk of traffic accidents resulting from the transport of chemicals and fuels would be, in case of railway infrastructure development (Scenario 1), more than EUR 275,000 (12.7%) lower than in the case there are no development investments in the railway line on the Port of Koper - Maribor corridor.

The estimation, in which social risk costs will be lower, represents the additional information which helps us to assess the justification of investing in a sustainable traffic system. Measures for the upgrade of the railway infrastructure from Scenario 2 change the modal distribution of freight in favour of the railway, because they increase the railway system capacities and its competitiveness.

3. Conclusion

The monetarised social risk in the transportation of chemicals and fuels is a sum of socio-economic costs of traffic accidents and the costs of environmental remediation of dangerous goods. In all scenarios the socio-economic costs represent the highest percentage of costs while the costs of environmental remediation are relatively low. Low environmental remediation costs are the result of a well regulated and organized area of the transport of dangerous goods and of efficient services and procedures in case of leak/exhaust of a dangerous substance.

Scenario 1 foresees the development of the railway infrastructure which would enable preservation or improvement of the modal distribution of the transport of chemicals and fuels in favour of the railway compared to today's situation. In 2025 monetarised social risk of traffic accidents resulting from the transport of chemicals and fuels would be, in case of railway infrastructure development (Scenario 1), more than EUR 275,000 (12.7%) lower than in the case there are no development investments in the railway line on the Port of Koper-Maribor motorway.

With the increase in transported volumes of chemicals and fuels in 2025, Scenario 2 predicts only an increase in volume of transported chemicals and fuels on the corridor Luka Koper and Maribor by road, since the transport of goods by railway has already reached its performance-based infrastructure restrictions. This is also reflected in the monetarised social risk which increases by 15% compared to today's situation.

All scenarios have proven that rail transport is more favourable, because the risks of a traffic accident are lower in this transport modality than they are on the road. It should be noticed, however, that the road route on the Port of Koper- Maribor motorway is much more favourable in terms of the environment. This is mainly due to the fact that Koper - Maribor motorway was recently enhanced and spatially designed so that it passes all larger nearby cities, while the railway route was designed over 100 years ago and runs immediately through larger city centres. After the altered route of the railway line in space as proposed by the Scenario 1, the value of the environmental index is significantly decreased, especially in Ljubljana (by-pass freight railway).

The estimation that social risk costs will be lower represents additional information which helps us to assess the justification of investing in a sustainable traffic system. Measures for the upgrade of the railway infrastructure from Scenario 1 change the modal distribution of freight in favour of the railway, because they increase the railway system capacities and its competitiveness.

We calculated the risk assessment for the transport of chemicals at the chosen Port of Koper-Maribor transport corridor (where there are road as well as railway connections) for the current state in 2011, Scenario 1 and Scenario 2. We find that the rail transport of chemicals and fuels (and also transport in general) is safer. Rail transport represents lower risk of social costs.

The estimation of risk according to the modality of the rail or road represents quality information to support the final proposals for measures for safer transport of chemicals and fuels provided in the Action Plan (Phase 3). There are a number of measures to reduce risk, ranging from statutory regulations to economic de-stimulation of the higher-risk transportation mode.

The European transport policy actively influences the trends of transferring freight from the road to other modalities. The Marco Polo II program is one of the most important tools of the European Union to promote a modal shift in freight transport. Funding of this program helps shift freight from roads to other modalities each year. The result is equivalent to reducing 700,000 heavy goods vehicles between Paris and Berlin. This has a positive environmental, economic and social impact totalling billions of Euros per year.

It is necessary to develop conditions that will stimulate the shift of the transport of chemicals and fuels from the road to rail by establishing a legal, institutional and financial framework for construction of logistics centres in Slovenia which will be competitive and have sufficient capacities.

4. References

• Statistical Office of the Republic of Slovenia, 2011) Database on companies, activities and employees, Agency of the Republic of Slovenia for Public Records and related services.

• Analysis of possibilities and needs for the development of public railway structure in the Republic of Slovenia, 2011.

• Slovenian Environment Agency (2012). Geographic data layers on waters, aquifers and Natura 2000, Slovenian Environment Agency.

• Bae, S., Inyang, H.I. (2006). Overview of what the Visual Grid can do for visualization in our area. A Quantitative Methodology for Indexing Environmental Sensitivity and Pollution Potential for NC. Global Institute for Energy and Environmental Systems. UNC Charlotte.

• COM(2001) 370 final, (2001). White Paper – European Transport Policy for 2010: Time to Decide. European Commission, Luxemburg.

• Slovenian Roads Agency (2011). Transport 2010, Slovenian Roads Agency.

• Environmental Sensitivity Index Guidelines, Version 3.0. (2002). National Oceanic and Atmospheric Administration; Seattle, Washington, 2002.

• EUROSTAT (2012). Data on rail traffic and rail traffic accidents, 2012, http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database .

• InfoBON, (2010). iBON 2010.

• Inyang H.I., Fisher G.F., Mbamalu G.E., (2003). A quantitative methodology for indexing environmental sensitivity and pollution potential; GIEES, University of North Carolina, Charlotte, North Carolina.

• M. Maibach, C. Schreyer, D. Sutter, H.P. van Essen, B.H. Boon, R. Smokers, A. Schroten, c. Doll, B. Pawlovska, M. Bak, (2008). Handbook on estimation of external costs in the transport sector. Produced within the study Internalisation Measures and Policies for All external Cost of Transport (IMPACT). Version 1.1. Delft.

• MOP, (2008), List of facilities in the Republic of Slovenia which pose a major risk to the environment – May 2008 and List of facilities in the Republic of Slovenia which pose a minor risk to the environment – May 2008, Ministry of the Environment and Spatial Planning.

• OMEGA consult (2012). Comparison of possible effects of different selected transport systems from the viewpoint of sustainable development of transport in countries participating in the SEETAC project, OMEGA consult, d.o.o., Ljubljana.

• Police, (2012). Data on road-traffic accidents from 1994 to 2011, Police.

• RAIB, (2012). Rail Accident Investigation Branch, data on rail accidents. last accessed 11 June: http://www.raib.gov.uk.

• Slovenian Railways, (2011). The list of freight rail stations available for handling of dangerous goods, Slovenian Railways.

• Statistical Office of the Republic of Slovenia (2012). Transport statistics, Statistical Office of the Republic of Slovenia.

• Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, (2012a). Daily information bulletin, data on accidents involving dangerous goods, the Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012.

• Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, (2012b). Remediation costs for accidents involving dangerous goods from 2009 to 2011, Administration of the Republic of Slovenia for Civil Protection and Disaster Relief, 2012.


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