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LOSAMEDCHEM

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

Part 02 | Volume 02

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L'Europe en Méditerranée
Europe in the Mediterranean

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LOSAMEDCHEM

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Feasibility study of Luka Koper

Warehouse 27A

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Executive Summary

The present document has been developed within the project "LOSAMEDCHEM – How could the logistics and safety of the transport of chemicals be improved in the Mediterranean area", which has been co-financed within the transnational cooperation programme MED, 2nd call 2009.

The feasibility study has been developed by the Port of Koper and is dealing with the potential re-arrangement of an internal warehouse for storing different types of dangerous goods (DG). DG has been classified into different classes in order to have a clear picture of what the substances characteristics are. As the characteristics of every DG is different, their influence on other DG's when stored jointly could be also a potential cause of accident.

The project deals with the transport of DG and therefore the beginning of the document is analysing the Slovenian national infrastructure network (road, rail, pipelines) giving some insights on the status of it. It also gives an overview of the quantities of DG's transported in last years.

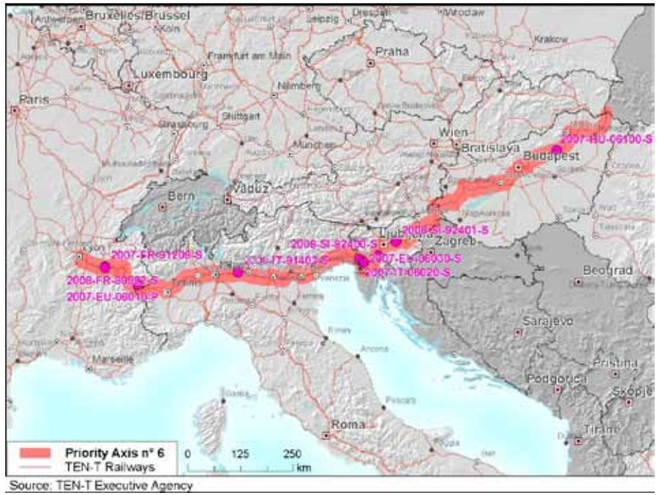
The study continues with the classification of different potential DG into classes in order to be easier to store in the warehouse. The classification also defines the necessary characteristics of joint and separate warehousing. In the tables the different measures that have to be taken to avoid any potential negative effects in case of accidents, are also divided and described. To cope better with the diversity of DG the warehouse is divided into different zones. The specific story of some classes of DG's in this case is also that it is advisable to have two outside containers where DG should be stored.

The final part of the study describes the needed constriction works that have to be realised in order to have a proper DG warehouse. It also deals with the internal procedures that have to be respected by a binding internal safety act. It describes the roles, responsibilities and deadlines that have to be taken when handling DG's

1. Transport infrastructure in Slovenia

During the last 15 years the volume of transport on Slovenian transport network increased considerably in passenger as well as in freight transport. In passenger transport particularly national road transport involving cars increased, followed by the air passenger traffic. In freight transport road traffic has increased the most, mainly due to increased international freight flows in directions from east to west and south-east to west countries.

The actual development of infrastructure was rather uneven, as during the last 15 years most of activities were realized in the area of road (highway) infrastructure, which was to provide an effective integration of Slovenia in international (road) transport infrastructure connections. There was actually no development and construction of rail infrastructure as the activities were limited only to minimum maintenance work.



These two modes of transport – their efficiency directly depends on the extent and condition of built infrastructure, are of crucial importance for the efficiency of national freight and passenger transport as well as international transport, freight transit in particular.

Slovenia is geographically located on the crossing of natural routes connecting west with east as well as north and northeast with southeast areas of Europe; and north Adriatic with central Europe.

The significance and prospective of the location are further emphasized by placing several important transport connections over the Slovenian territory. For Slovenia PAN EU corridors are less relevant as they don't have any financial framework behind and were "established" as corridors guidelines for countries that are non EU members. Therefore PAN EU corridor V and corridor X, which actually cross the city of Ljubljana, have been a guideline until the country became a full member of the EU 27.

Definitely most important on the national level is the Priority Project (PP) 6, which is part of the TEN-T network starting in Lyon crossing Italy, Slovenia, and Hungary till the Ukrainian border. In 2011 the Executive Aagency TEN-T has revised the TEN-T policy in this matter. Until the end of 2013 the new TEN-T policy should be outlined with an improved methodology that would improve the overall EU transport's network.

Figure 1: TEN-T Priority Project 6 map

Objective development of transport infrastructure is of crucial importance for planning and realization of traffic flows, on national as well as on international level, and particularly for transit flows. These activities should be consistent with the principles of sustainable development and transport.

2. The Slovenian Transport and Logistics Network

2.1. Road Infrastructure Characteristics

The total length of the Slovenian road network is 38,900 km. In table 1 there are the actual lengths of road network in Slovenia.

Road category	Length in km
Highways	657
Express ways	90
Main roads	819
Regional roads	5,117
Local roads	13,598
Public roads	18.626

Table 1: Characteristics of Slovenian road network in 2009

Source: Direkcija Republike Slovenije za ceste

The current status of the motorway system in Slovenia is presented below

Figure 2: Slovenian motorway system in 2009

Source: DARS

[2] *http://www.dc.gov.si/fileadmin/dc.gov.si/pageuploads/pdf_datoteke/Seznam_cest/Javne_ceste_2009.pdf*

[3] *http://www.dars.si/Dokumenti/3_cestninski_sistem/AC%20sistem%202012.pdf*

The volumes of traffic and traffic loads are shown in figure

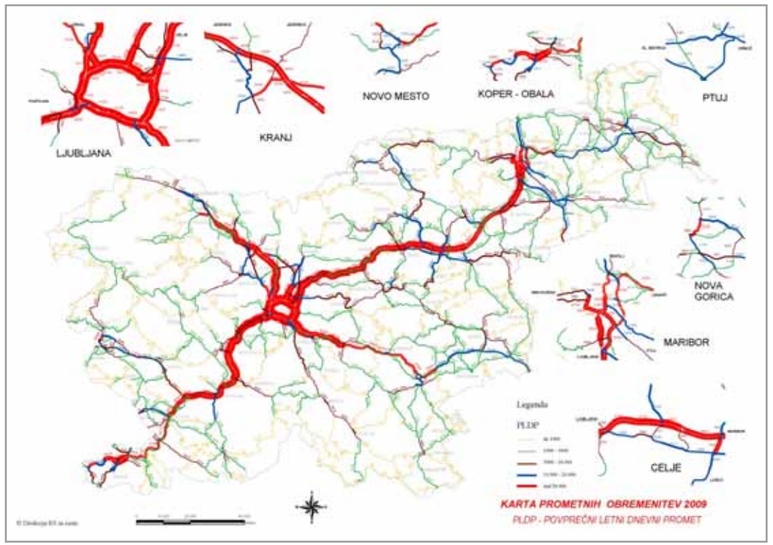


Figure 3: Volume of traffic on Slovenian road network

Source: Direkcija Republike Slovenije za ceste

From year 2006 the share of passenger cars in total kilometers driven has been constantly decreasing (from 81 % in 2006 to 78.3 % in 2007 and 77.3 % in 2008), due to the higher rate of increase in goods vehicle traffic (heavy goods vehicles as well as trucks and trailers), which reached a share of 21.8 % of total highway and expressway traffic in Slovenia in 2008.

2.2. Characteristics of Rail Infrastructure and its Utilization

In 2009, there was 1,228 km of railway tracks on the public railway infrastructure network in Slovenia of which approx. 898 km is single track and approx. 331 km double track lines.

The Slovenian public railway network consists of main lines and regional lines. Main lines represent a part or parts of several international railway connections.

Figure 4 Railway network in Slovenia

The maximum allowed vehicle and load dimensions, on all railway lines enable rail transport in line with the international loading (clearance) gauge, loading gauge SŽ1 and loading gauge for combined transport GA and GB (lines suitable for combined transport are also properly coded).

Most of the railway lines in Slovenia open for transit traffic, fulfill the criteria of the D3 line category (axle load – 22.5 t/axle; longitudinal load – 7.2 t/m), which is also declared to be the normal category for public network lines in Slovenia.

Figure 5 Number of tracks on the Slovenian railway network

Note: Red line – double track; Black line – single track

Figure 6: Axle load limitations on Slovenian railway network

Note: Red line (22,5 t/axle); Yellow line (20,0 t/axle) Blue line (18 t/axle); Grey line (16 t/axle)

According to the speed railway lines can be classified, as lines for high speed or conventional lines. All railway lines in Slovenia are classified as conventional lines.

The electrification system of the Slovenian railway lines is 3 kV DC, except at the junction points with railway infrastructure of foreign countries:

- 25 kV AC, frequency 50 Hz (Croatia),
- 15 kV AC, frequency 16 2/3 Hz (Austria).

Figure 7: Electrification of the Slovenian railway network

Technical characteristics of the main lines are presented in the table 2 below.

No.	Railway route/section	Line code	No. of tracks	Section length	Traction system	Max. axle load	Line capacity	
							Capacity (train paths/24 hours)	Capacity employment rate (%)
1.	Dobova- Ljubljana							
	Dobova d.m.-Dobova	E70; Corridor X	2	2.3	25 kV	D3 (225 kN; 72 kN/m)	Ljubljana-Dobova=292; Lj-Zidani most=300	Lj-Dobova=27; Lj-Zidani most=51
	Dobova - Zagorje	E70; Corridor X	2	65.6	3kV	D3 (225 kN; 72 kN/m)	Ljubljana-Dobova=292; Lj-Zidani most=300	Lj-Dobova=27; Lj-Zidani most=51
	Zagorje -Ljubljana	E69, E70; Corridor X	2	46.6	3kV	D3 (225 kN; 72 kN/m)	Ljubljana-Dobova=292; Lj-Zidani most=300	Lj-Dobova=27; Lj-Zidani most=51
2.	Ljubljana izklj.-Jesenice d.m.							
	Ljubljana-Lj. Šiška	E65; Corridor X	1	1.6	3kV	D3 (225 kN; 72 kN/m)	76	81
	Ljubljana šiška-Lj. Vižmarje	E65; Corridor X	1	4.8	3kV	D3 (225 kN; 72 kN/m)	76	81
	Ljubljana šiška-Jesenice	E65; Corridor X	1	58.1	3kV	D3 (225 kN; 72 kN/m)	76	81
	Jesenice-Jesenice d.m.	E65; Corridor X	2	7.1	15 kV	D3 (225 kN; 72 kN/m)	76	81
3.	Zidani most izklj.-Šentilj d.m.							
	Zidani most-Šentjur	E67, E 69; Corridor X	2	3.,6	3 kV	C3 (200 kN; 72 kN/m)	Maribor-Šentilj=62; Zidani most-Maribor=185	Maribor-Šentilj=69; Zidani most=65
	Šentjur-Maribor Tezno	E67, E 69; Corridor X	2	53.2	3 kV	D4 (225 kN; 80 kN/m)	Maribor-Šentilj=62; Zidani most-Maribor=185	Maribor-Šentilj=69; Zidani most=65
	Maribor Tezno-Šentilj	E67; Corridor X	1	19.6	3 kV	C3 (200 kN; 72 kN/m)	Maribor-Šentilj=62; Zidani most-Maribor=185	Maribor-Šentilj=69; Zidani most=65
4.	Pragersko izklj.-Središče d.m.							
	Pragersko-Središče d.m.	E69; Corridor V	1	51.9	diesel	C3 (200 kN; 72 kN/m)	55	89
5.	Ormož izklj.-Hodoš d.m.							
	Ormož-Murska Sobota	Corridor V	1	38.5	diesel	C3 (200 kN; 72 kN/m)	34	88
	Murska Sobota-Hodoš d.m.	Corridor V	1	30.7	diesel	D4 (225 kN; 80 kN/m)	34	88
6.	Ljubljana izklj.-Sežana d.m.							
	Murska Sobota-Hodoš d.m.	E 65, E 69,E 70;Corridor V	2	116.8	3 kV	D3 (225 kN; 72 kN/m)	135	62
7.	Pivka izklj.-Ilirska Bistrica d.m.							
	Pivka-Ilirska Bistrica d.m.	E 65	1	24.5	3 kV	C2 (200 kN; 64 kN/m)	63	54
8.	Divača izklj.-Koper							
	Divača-Prešnica cep.	E 69, Corridor V	1	16.5	3 kV	D3 (225 kN; 72 kN/m)	66	88
	Prešnica cep-Koper	E 69,Corridor V	1	31.5	3 kV	D3 (225 kN; 72 kN/m)	66	88

Table 2: Characteristics of the Slovenian railway network – main lines

Source: Slovenske železnice

Table 2 shows the employment rate of singular lines; therefore bottlenecks can be derived from it.

Important shunting stations which must be mentioned are:

- Shunting stations: Ljubljana Zalog, Maribor Tezno, Celje tovorna and Koper tovorna.
- Stations where container terminals are located: Celje tovorna, Luka Koper, Ljubljana Container terminal and Maribor Tezno (tracks at these stations are not part of the public railway infrastructure).
- Stations suitable for loading and unloading of cars: Koper, Jesenice, Maribor, Most na Soči, Podbrdo, Bohinjska Bistrica.
- Stations opened for combined transport ("piggy-back"): Ljubljana Moste and Maribor Tezno (tracks at these stations are not part of the public railway infrastructure).

Figure 8: Utilization of railway lines in 2009

Source: Slovenske Železnice d.o.o.

2.3. Intermodal Infrastructure Characteristics

Intermodal infrastructure in Slovenia consists of a network of intermodal terminals specialized for a certain type of intermodal transport, regarding the handling techniques and the intermodal loading units handled.

For the combined transport of road vehicles (accompanied and unaccompanied) two terminals are available – in Ljubljana (Moste) and Maribor (Tezno). Both terminals are owned and operated by Slovenian Railways.

Intermodal (container) terminals are located in Ljubljana, Maribor, Celje and in the Port of Koper. Container terminal in the Port of Koper is the biggest intermodal terminal in Slovenia.

Types of goods are defined by the Goods Nomenclature for Transport Statistics (NST/R) till 2008. In 2008 this classification was replaced by a new goods classification NST, 2007. The following 10 groups of goods are defined for the purpose of analyses.

	International transport - goods loaded in Slovenia			International transport - goods unloaded in Slovenia			Transit		
	2005	2006	2007	2005	2006	2007	2005	2006	2007
Type of goods - TOTAL	5,029	4,892	5,558	4,825	5,230	4,648	3,110	3,311	3,750
Cereals	7	6	1	145	287	130	92	136	333
Potatoes, other fresh or frozen vegetables and fresh fruit	0	0	0	0	0	0	0	0	0
Live animals, sugar beet	0	0	0	69	36	0	0	0	0
Wood and cork	110	124	202	685	808	697	562	614	935
Textiles and waste, other raw animal and vegetable materials	0	0	0	0	0	0	3	2	2
Foodstuffs and animal fodder	31	48	34	81	46	30	214	233	190
Oil seeds and oleaginous fruits and fats	2	1	0	21	14	10	4	4	7
Solid mineral fuels	**383**	**268**	**429**	**68**	**63**	**114**	**17**	**17**	**21**
Crude petroleum	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Petroleum products	**108**	**113**	**188**	**177**	**184**	**88**	**157**	**184**	**192**
Iron ore, iron and steel waste and blast furnace dust	2,166	1,968	2,078	369	399	342	614	558	451
Non-ferrous ores and waste	32	37	27	0	0	0	0	1	0
Metal products	57	27	140	623	774	820	490	466	430
Cement, lime, manufactured building materials	15	19	16	34	32	65	53	51	50
Crude and manufactured minerals	203	174	160	305	306	323	33	27	28
Natural and chemical fertilisers	**0**	**0**	**1**	**81**	**98**	**68**	**97**	**124**	**119**
Coal, chemicals, tar	0	0	0	1	0	0	0	2	30
Elementary chemicals, chemical products	**370**	**368**	**371**	**139**	**88**	**81**	**170**	**158**	**70**
Paper pulp and waste paper	25	16	11	217	187	179	52	24	26
Vehicles and transport equipment, machinery, apparatus, engines or not assembled, and parts thereof	181	186	230	196	209	183	88	78	107
Manufactures of metal	0	0	0	0	0	0	2	1	0
Glass, glassware, ceramic products	33	36	40	17	6	8	44	50	43
Leather, textiles, clothing, other manufactured articles	74	75	98	142	152	129	78	130	158
Other non-mentioned product	1,232	1,425	1,534	1,455	1,540	1,379	339	452	558

Table 3: Railway goods transport by type of goods (NST/R) and type of transport (in 1000 tons

Source: SURS

In table 7 chemical products are highlighted in bold.

Slovenian Railways (SŽ d.o.o.) own and operate three combined transport terminals in Slovenia, located in Ljubljana, Maribor and Celje.

Combined/intermodal transport today represents more than 20 % of the freight (more than 3.8 mil. tons per year) transported by the Slovenian Railways. Roughly two thirds of freight is transported in containers, while the rest is transported by other means of intermodal transport.

Most of the freight is handled by the Slovenian Railways at the Ljubljana Container terminal. Much less freight is handled at the terminals in Maribor and Celje. In recent years the Ljubljana terminal recorded a throughput of more than 90,000 TEU per year, which is actually a small volume compared to the throughput of the container terminal in the Port of Koper; that was more than 589.000 TEU in 2011.

The recorded throughputs of the three combined transport terminals in the last years are as follows (see also Figure below):

a) 2007: CT Ljubljana: 64,427 TEU, CT Maribor: 7,587 TEU, CT Celje: 4,994 TEU,

b) 2008: CT Ljubljana: 97,639 TEU, CT Maribor: 9,632 TEU, CT Celje: 6,290 TEU,

c) 2009: CT Ljubljana: 80,337 TEU, CT Maribor: 12,163 TEU, CT Celje: 8,174 TEU

d) 2010: CT Ljubljana: 81,301 TEU, CT Maribor: 12,175 TEU, CT Celje

e) 2011: CT Ljubljana : 72,037 TEU, CT Maribor: 12,736 TEU, CT Celje

3. Traffic in the Port of Koper

3.1. Freight Flows and its characteristics

The only Slovenian port of Koper is operated by the company Luka Koper d.d. It operates 12 specialized terminals which are equipped for handling almost all type of goods.

The freight handled can be classified into five groups, characterized by cargo (way of manipulation and transportation) as follows: dry bulk cargo, break bulk cargo, liquid cargo, cars and containers.

Traffic throughput grew in the port at a yearly rate of 5.9 % until 2009, where the growth was 8%. The highest growing rates had cargos like containers and cars, while other cargos grew at a smaller rate.

In the years 2010 and 2011 approximately two thirds of cargo handled in the Port of Koper was transit cargo, while one third was for the national market. However the structure of cargo flows changed somewhat during these two years.

In 2011 container traffic achieved record values, as the highest number of container units (TEU) transshipped was as many as 589,314. The year to year growth of container transshipment amounted to almost 24%, and the port thus kept its leading position in comparison to the neighboring northern Adriatic ports. This was especially positive given the fact that containers represent a very desirable type of freight in ports.

In year 2009 a minimum decrease of the container transshipment happened. Fortunately only a 3% drop was averted which was definitely positively leveraged by the construction of the new operative shore with hinterland surfaces and the acquisition of four new post-panamax container cranes, which provided the conditions necessary to establish the new direct shipping links to the Far East. The new railway connections of the port with the hinterland markets and the new shipping links with the eastern Mediterranean were also of great significance.

[4] *http://en.wikipedia.org/wiki/TEU*

The structure of the throughput of Luka Koper is shown in the next table 4.

	2010	2011
General cargos(break bulk)	1,445,630	1,383,355
Containers	4,302,542	5,334,817
Vehicles	533,300	640,407
Liquid cargoes	2,727,014	2,922,890
Dry and bulky cargos	6,363,557	6,769,845
TOTAL	**15,372,044**	**17,051,314**

Table 4: Throughput by product groups in tonnes

3.2. Analysis of Slovenian Transport Network Bottlenecks

From 1991 only reconstructions and modernization of tracks were carried out on the Slovenian public railway infrastructure, which mostly maintained the status quo and transportability, while there were no major updates and new constructions (the only exception was the building of a new rail link between Slovenia and Hungary).

A presentation and assessment of the situation in the Slovenian transport infrastructure is given within the Operational Program of Environmental and Transport Infrastructure Development for the 2007-2013 Period , a 2008 document, which aim was to ensure conditions for growth by providing sustainable mobility, for improvement of the environment's quality and for the construction of adequate infrastructure.

3.3. Public railway infrastructure situation

Due to insufficient funding the railway network is in its worst condition ever. Until now only 25% of the National Program of the Slovenian railway Infrastructure Development was adopted.

The railway tracks in Slovenia suffer from evident:

- damages and defects on tracks, catenaries, signaling and safety devices, points and which results in the introduction of lower speeds.

[5] *The Operational Programme of the Environmental and Transport Infrastructure Development for the 2007-2013 Period is an implementation document of the Republic of Slovenia for the period extending from 2007 to 2013, which determines legal obligations and the rights to implement the EU's cohesion policy in Slovenia. It is Slovenia's and the EU's joint programme document adopted after harmonisation with the European Commission, with the partners implementing and financing it together.*

Such conditions of the railway infrastructure have resulted in:

- Axle and speed load restrictions: Inadequate maintenance and slow modernization of the railway infrastructure, with increased route loads due to the extending scope of transport

- Decrease of the railway transport scope: Due to the poor infrastructure condition, the already less competitive railway transport services are moving even further away from the requirements and needs of their users;

- By-passing Slovenian lines: Due to the inadequate allowed axle loads certain freights are already being directed to transport routes passing Slovenia (which, of course, means losing freight) or box cars in certain directions of main routes are loaded by 15 % less than admissible in view of their load capacity (e.g., Zidani Most-Šentilj and Pragersko-Murska Sobota);

- Speed constraints: With the existing condition of the infrastructure, transport safety can only be ensured by restricting speed which results in increased railway transport delays and lower average commercial speeds

- Influence on the intermodal transport: Poor condition of the public railway infrastructure also influences the running of intermodal transport; the freights transported are also restricted by admissible axle load.

- Increased train delays: Within the public railway infrastructure network in Slovenia, the situation in freight transport presents the greatest problem.

A first analysis of the Slovenian public railway network shows that the infrastructure has to be modernized as soon as possible to ensure safe, reliable and modern transport conditions to all users.

3.4. Identified Infrastructural Bottlenecks

The Network Statement of the Republic of Slovenia for 2010 issued by the Slovenske železnice company distinguishes between permanent and temporary bottlenecks. Permanent bottlenecks are present on routes with prevailing long-term guaranteed freight potential and linked to infrastructure modernization. Temporary bottlenecks are connected with current freight potential and linked to operational solutions.

Bottlenecks have been located on the following track sections:

- Ljubljana – Jesenice
- Pragersko – Ormož
- Maribor – Prevalje
- Ljubljana – Kamnik
- Jesenice – Nova Gorica
- Divača – Koper
- Novo mesto – Metlika
- Ljutomer – Hodoš.

Permanent bottlenecks are mostly present on the following track sections:

• Divača – Koper

• Ljubljana – Jesenice and

• Pragersko – Ormož – Ljutomer – Hodoš.

From the aspect of international railway links, especially in the northern direction Adriatic –Baltic, important bottlenecks appear on the following routes (key characteristics are presented in the Table below):

• Koper – Ljubljana – Slovenian/Austrian border (Villach)

• (Zagreb/HR) – Zidani Most - Maribor – Slovenian/Austrian border (Graz)

• Zidani Most – Ljubljana.

Section	Bottlenecks	Negative Consequences
Ljubljana – Divača	passenger train max speed = 100 km/h	lower train speed
		expected year of saturation = 2012
Divača – Koper	single track	lower train speed
	max gradient 25 ‰	expected year of saturation = 2012
	min radius 250 m	
A/SLO border – Zidani Most	max axle load = 20 tons	train load capacity underutilization
	single track between A/SLO border –Maribor (16 km)	
Zidani Most – Ljubljana	max speed on Ljubljana – Zidani Most section = 120 km/h	lower train speed
		expected year of saturation = 2012

Table 9: Railway bottlenecks and negative consequences on major international connections

Source: Updated data from AB Landbridge Project

The improvements planned for the technical characteristics of the railway infrastructure are:

- provision of admissible axle load of the minimum D3 category (225 kN/axle and 72 kN/m) across the entire network of the main routes in Slovenia,

- construction of the new Divača – Koper railway link

- increase of the highest allowed route speed along main routes coinciding with corridors V and X to 160 km/h, with admissible and substantiated deviations

- further modernization of the signaling-safety and telecommunications devices along corridor V.

With the above mentioned steps the modernization should bring:

- increase in route transport electricity
- increased level of transport safety
- more effective transport management
- lowered operating expenses
- introduction of interoperability.

3.5. Road Network Bottlenecks situation

In previous years, the Republic of Slovenia mostly made investments in the construction of a motorway network, while investments in the national road network were practically non-existent or were implemented in a substantially lesser volume. Based on this, bottlenecks related to the road infrastructure can be divided into two groups:

From the year 1998 traffic by road increased substantially which caused various problems on the network and as a consequence bottlenecks were forming.

Despite the motorway network being extended for the most part, we are still facing bottlenecks due to constant and high levels of traffic growth.

The main and regional roads have not been dimensioned and constructed for the current traffic volume that is persistently increasing, so that traffic density as well as traffic loads are rising (both resulting in road surface damage).

There are still motorway sections in construction in 2010 and present bottlenecks due to missing sections of the motorway network are shown in Table and Figure below.

Name of the motorway leg	Name of the section	Length in km	Opened for traffic
Podravje leg	Gorišnica – Ormož section	10.4	After 2013
Coastal Leg	Koper – Izola	5.2	Beginning of 2013
	Connection to the Port of Koper, phase 2	1.4	2012

Source: DARS

Figure 13: Motorway sections under construction (bottlenecks) in 2011

With the already poor condition of the roads, the key problems of the road network are:

- insufficient capacity of existing roads in the direction of future/new motorways
- expected increase of international (transit) transport towards the southeast upon further expansion of the EU to the east and further into the Balkans or after the restoration of economic flows
- reduced connections capacities to peripheral regions with central Slovenia and poor links between these areas and international highways (to the TEN network)
- expected increase of international (transit) transport in the direction southwest – northeast
- bottlenecks on roads leading through urban centers – this is related to poor safety conditions.

The elimination of bottlenecks by constructing and modernizing road links on development axes will result in:

- improved capacity on these axes as well as direct economic effects among users (lower transport costs)
- indirectly enabled improvement of economic competitiveness in these areas and consequent favorable influence on regional development
- enabled utilization of potentials offered by the area in terms of settlement, infrastructure, manufacturing and supply activities.

Construction of the new transverse development transport axis and modernization of the existing ones also means connecting regional centers in Austria, Italy, Slovenia and Croatia, and enables establishment of links of the freight and passenger road transport in all regions on this axis to the main European transport directions.

4. Pipeline network in Slovenia

Slovenia, being a small country does not have a widespread network of pipelines. In the figures below are shown the Slovenian pipelines.

Figure 14: Oil pipeline

(source: http://www.janaf.hr)

The oil pipeline is only reaching the city of Lendava where is located the only Slovenian refinery.

Figure 15: Gas pipeline of company Geoplin

(source: www.geoplin.si)

5. Classification of dangerous goods and legal framework

In Slovenia all the producers, distributers and traders of dangerous chemicals should be in line with the regulation Ur.l. RS, num. 75/2009[6] that defines the warehousing of dangerous chemicals. Some basic guidelines are described below in order to ease the processes:

- understand the regulations requests with suggestions from best practices
- reach the regulation requests
- identify the chemical class which belongs to one location have all the warehousing classes, coming from two directives (DSD/DOD) and the international transport of dangerous goods (ADR)
- with a simple model establish in which class the dangerous chemical belongs too.

The regulation also defines detailed requests and exceptions for specific technical and organizational measures for the stocking of dangerous chemicals, that are necessary for the protection of the people's health and environment and the fulfilment of buildings regarding the distribution and protection.

The regulation provisions are not used for:

- warehousing of chemicals in non-mobile containers
- warehousing of chemicals in bulk status, except mineral fertilizers from ammonium nitrate
- temporary warehousing of DC because of changing of transport mean or transport type
- warehousing of cosmetics, phyto-pharmaceutical agents, radioactive substances, ammunition and explosives

This regulation doesn't define the transport of dangerous goods.

The transport of DG is regulated in Slovenia with a law for the transport of DG from 2006 and changed and integrated in 2009[8] .

I

t is also important that there are several regulations, decrees and laws that regulate all the necessary proceedings when it comes to handling, warehousing and transporting of DG[7].

A short list is shown in the below table:

Num	Regulation name	Published
1.	Law on Transport of dangerous goods *(Zakon o prevozu nevarnega blaga (uradno prečiščeno besedilo) (ZPNB-UPB1)*	Ur.l. RS, num. 33/2006
	Law of changes and integrations on Law on Transport of DG *Zakon o spremembah in dopolnitvah Zakona o prevozu nevarnega blaga (ZPNB-B))*	Ur.l. RS, num. 41/2009
2.	Regulation for safety consultant tasks for transport of DG *Pravilnik o nalogah varnostnega svetovalca za prevoz nevarnega blaga*	Ur.l. RS, num. 88/2000
3.	Regulation on certification of expertise qualification of the security consultant *Pravilnik o potrdilu o strokovni usposobljenosti varnostnega svetovalca*	Ur.l. RS, num. 11/2001
4	Law on explosives and pyrotechnic products *Zakon o eksplozivih in pirotehničnih izdelkih (ZEPI)*	Ur.l. RS, num. 9/2003
	Regulation on conditions for the performing of controls for the loaded DG on ships and for the edit of attestations *Pravilnik o pogojih za opravljanje pregledov vkrcanega tovora nevarnega blaga na ladjah in za izdajo potrdil*	Ur.l. RS, num. 66/2003

Table 5: List of different laws and regulations in Slovenia

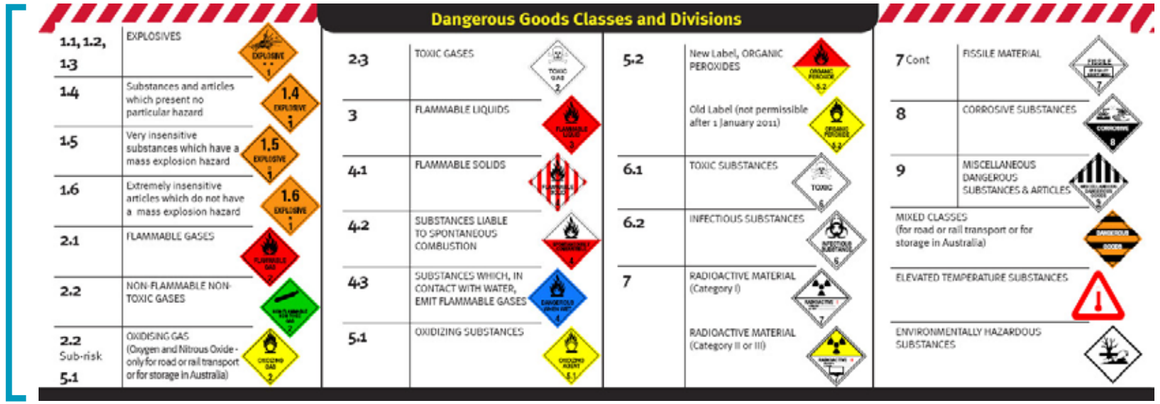


Figure 8: classification of dangerous goods

The above table 5 and figure 8 are showing the legal framework in which the transport of dangerous goods is set on a national (Slovenian) and international level.

In order to have a safe and secure warehousing activity it is important to classify the dangerous goods into classes on the basis of their specific danger characteristics. It is also important to preferentially elaborate the dangerous characteristic that needs anti-fire and explosion measures. (i.e explosives, very high inflammability, quick combustion). Products that don't enter into classification of dangerous goods because their characteristics are not relevant for joint warehousing are those that are defined as irritative, health or environment noxiousness.

5.1. The classification of DG's is shown in the below tables.

Gases Class 2A:

Item No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	2.2.	No Subsidiary Risks	1002	52	329	Air	2a
2	2.2.	No Subsidiary Risks	1006	5	1.308	Argon, compressed	2a
3	2.2.	No Subsidiary Risks	1013	18	61	Carbon dioxide	2a
4	2.2.	No Subsidiary Risks	1044	51	1.313	Fire extinguishers containing compressed or liquefied gas	2a
5	2.2.	No Subsidiary Risks	1046	6	2	Helium, compressed	2a
6	2.2.	No Subsidiary Risks	1056	204	2.382	Krypton	2a
7	2.2.	No Subsidiary Risks	1065	51	9	Neon, compressed	2a
8	2.2.	No Subsidiary Risks	1066	11	369	Nitrogen, compressed	2a
9	2.2.	No Subsidiary Risks	1956	1	1	Compressed gas, n.o.s.	2a
10	2.2.	No Subsidiary Risks	1970	13	412	Krypton, refrigerated liquid (cryogenic liquid)	2a
11	2.2.	No Subsidiary Risks	2036	22	541	Xenon, compressed	2a
12	2.2.	No Subsidiary Risks	3159	128	1.559	1,1,1,2-Tetrafluoroethane or Refrigerant gas R 134a	2a
13	2.2.	No Subsidiary Risks	3164	52	883	Articles, pressurized pneumatic or Hydraulic (containing non-flammable gas)	2a
14	2.2.	No Subsidiary Risks	3337	5	1.308	Refrigerant gas R404A	2a
			TOTAL:	**619**	**10.477**		

Into class 2A are classified gases that have temperature of 50°C the pressure higher than 300 kPa (3 bars) or are at 20°C with standard pressure 101,3 kPa totally in gaseous condition. In this class belong the products that are stated in class 2 ADR/RID including gases that are defined in other classes. In this class are not included compressed gases defined as class 2 under number 5 ADR /RID (sprays).

Aerosol sprays class 2B:

Item No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	2	No Subsidiary Risks	1950	17309	16.277	Aerosols	2b

Flammable liquid chemicals Class 3A:

In the class 3A are included liquid chemicals of whom the pressure at 50°C is max 300 kPa (3 bars) if:

- the flash point until 60°C; those are flammable liquid chemicals, that conform the measures for flash point in line with the regulation 67/548/EGS

- have the flash point between 21°C and 60°C and can be mixed with water

- are marked with standard warning messages R10, R11 and R12 in line with the regulations on chemicals

- have no flash point, but have a scale of fire and the measures are necessary for the mitigation of explosions.

Item No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	3	Can be a marine pollutant	1133	319	5.168	Adhesives	3a
2	3	Can be a marine pollutant	1139	141	852	Coating solution	3a
3	3	Can be a marine pollutant	1169	4575	111.623	Extracts, aromatic, liquid	3a
4	3	Can be a marine pollutant	1197	15354	183.490	Extracts, flavoring, liquid	3a
5	3	Can be a marine pollutant	1203	70	757	Gasoline or petrol or motor spirit	3a
6	3	Can be a marine pollutant	1224	449	12.261	Ketones	3a
7	3	Can be a marine pollutant	1263	5552	43.260	Paint	3a
8	3	Can be a marine pollutant	1266	24118	29.632	Perfumery products with flammable solvents	3a
9	3	Can be a marine pollutant	1268	488	4.970	Petroleum distillates, n.o.s.	3a
10	3	Can be a marine pollutant	1287	20	4	Rubber solution	3a
11	3	Can be a marine pollutant	1300	198	504	Turpentine substitute	3a
12	3	No Subsidiary Risks	1088	42	3.133	Acetal	3a
13	3	No Subsidiary Risks	1089	2	75	Acetaldehyde	3a
14	3	No Subsidiary Risks	1090	7	6	Acetone	3a
15	3	No Subsidiary Risks	1091	8	340	Acetone oils	3a

16	3	No Subsidiary Risks	1104	104	1.536	Amyl acetates	3a
17	3	No Subsidiary Risks	1105	30	631	Pentanols	3a
18	3	No Subsidiary Risks	1110	10	250	n-Amyl methyl ketone	3a
19	3	No Subsidiary Risks	1120	13	489	Butanols	3a
20	3	No Subsidiary Risks	1123	106	1.505	Butyl acetates	3a
21	3	No Subsidiary Risks	1129	30	2.814	Butyraldehyde	3a
22	3	No Subsidiary Risks	1130	10	133	Camphor oil	3a
23	3	No Subsidiary Risks	1157	262	2.313	Diisobutyl ketone	3a
24	3	No Subsidiary Risks	1159	40	1.515	Diisopropyl ether	3a
25	3	No Subsidiary Risks	1164	4	87	Dimethyl sulfide	3a
26	3	No Subsidiary Risks	1165	1	2	Dioxane	3a
27	3	No Subsidiary Risks	1170	10514	7.174	Ethanol	3a
28	3	No Subsidiary Risks	1173	41	1.159	Ethyl acetate	3a
29	3	No Subsidiary Risks	1180	52	1.938	Ethyl butyrate	3a
30	3	No Subsidiary Risks	1190	33	1.332	Ethyl formate	3a
31	3	No Subsidiary Risks	1191	13	227	Octyl aldehydes	3a
32	3	No Subsidiary Risks	1192	59	1.905	Ethyl lactate	3a
33	3	No Subsidiary Risks	1193	15	118	Ethyl methyl ketone	3a
34	3	No Subsidiary Risks	1195	10	450	Ethyl propionate	3a
35	3	No Subsidiary Risks	1201	31	1.149	Fusel oil	3a
36	3	No Subsidiary Risks	1202	12	503	Gas oil or diesel fuel or heating oil, light	3a
37	3	No Subsidiary Risks	1206	12	54	Heptanes	3a
38	3	No Subsidiary Risks	1207	80	1.509	Hexaldehyde	3a
39	3	No Subsidiary Risks	1208	38	1.364	Hexanes	3a
40	3	No Subsidiary Risks	1210	404	5.035	Flammable Liquid	3a
41	3	No Subsidiary Risks	1213	95	2.073	Isobutyl acetate	3a
42	3	No Subsidiary Risks	1219	5949	3.795	Isopropanol or isopropyl alcohol	3a
43	3	No Subsidiary Risks	1231	4	152	Methyl acetate	3a
44	3	No Subsidiary Risks	1233	18	454	Methylamyl acetate	3a
45	3	No Subsidiary Risks	1237	14	176	Methyl butyrate	3a
46	3	No Subsidiary Risks	1247	113	1.638	Methyl methacrylate	3a
47	3	No Subsidiary Risks	1248	20	2.500	Methyl propionate	3a

48	3	No Subsidiary Risks	1249	3	96	Methyl propyl ketone	3a
49	3	No Subsidiary Risks	1261	1	1	Nitromethane	3a
50	3	No Subsidiary Risks	1264	1	1	Paraldehyde	3a
51	3	No Subsidiary Risks	1272	30	631	Pine oil	3a
52	3	No Subsidiary Risks	1274	7	167	n-Propanol or propyl alcohol, normal	3a
53	3	No Subsidiary Risks	1275	26	110	Propionaldehyde	3a
54	3	No Subsidiary Risks	1276	2	51	n-Propyl acetate	3a
55	3	No Subsidiary Risks	1282	12	720	Pyridine	3a
56	3	No Subsidiary Risks	1294	35	631	Toluene	3a
57	3	No Subsidiary Risks	1299	174	2.288	Turpentine	3a
58	3	No Subsidiary Risks	1307	204	8.432	Xylenes	3a
59	3	No Subsidiary Risks	1648	2	7	Acetonitrile	3a
60	3	No Subsidiary Risks	1717	3	3	Acetyl chloride	3a
61	3	No Subsidiary Risks	1862	3	8	Ethyl crotonate	3a
62	3	No Subsidiary Risks	1866	4646	84.676	Resin solution, flammable	3a
63	3	No Subsidiary Risks	1915	59	238	Cyclohexanone	3a
64	3	No Subsidiary Risks	1987	437	16.068	Alcohols, n.o.s.	3a
65	3	No Subsidiary Risks	1989	179	8.662	Aldehydes	3a
66	3	No Subsidiary Risks	1993	5798	58.550	Flammable liquids, n.o.s.	3a
67	3	No Subsidiary Risks	1999	1	74	Tars	3a
68	3	No Subsidiary Risks	2045	30	962	Isobutyraldehyde	3a
69	3	No Subsidiary Risks	2046	72	607	Cymenes	3a
70	3	No Subsidiary Risks	2050	4	98	Diisobutylene, isomeric compounds	3a
71	3	No Subsidiary Risks	2052	138	2.784	Dipentene	3a
72	3	No Subsidiary Risks	2053	22	304	Methyl isobutyl carbinol	3a
73	3	No Subsidiary Risks	2058	17	57	Valeraldehyde	3a
74	3	No Subsidiary Risks	2222	24	1.200	Anisole	3a
75	3	No Subsidiary Risks	2247	6	15	n-Decane	3a
76	3	No Subsidiary Risks	2265	7	1.450	N,N-Dimethylformamide	3a
77	3	No Subsidiary Risks	2271	29	447	Ethyl amyl ketone	3a

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78	3	No Subsidiary Risks	2282	65	2.510	Hexanols	3a
79	3	No Subsidiary Risks	2310	4	3	Acetylacetone-Pentane-2,4-dione	3a
80	3	No Subsidiary Risks	2319	567	22.633	Terpene hydrocarbons, n.o.s.	3a
81	3	No Subsidiary Risks	2346	41	1.342	Butanedione	3a
82	3	No Subsidiary Risks	2368	117	1.376	alpha-Pinene	3a
83	3	No Subsidiary Risks	2377	31	2.896	1,1-Dimethoxyethane	3a
84	3	No Subsidiary Risks	2385	6	301	Ethyl isobutyrate	3a
85	3	No Subsidiary Risks	2416	1	1	Trimethyl borate	3a
86	3	No Subsidiary Risks	2528	8	46	Isobutyl isobutyrate	3a
87	3	No Subsidiary Risks	2541	5	108	Terpinolene	3a
88	3	No Subsidiary Risks	2620	84	4.112	Amyl butyrates	3a
89	3	No Subsidiary Risks	2621	17	267	Acetyl methyl carbinol	3a
90	3	No Subsidiary Risks	3056	1	3	Heptanal	3a
91	3	No Subsidiary Risks	3065	112	19	Alcoholic beverages	3a
92	3	No Subsidiary Risks	3092	266	4.662	1-Methoxy-2-propanol	3a
93	3	No Subsidiary Risks	3269	2	371	Polyester resin kit	3a
94	3	No Subsidiary Risks	3271	11	93	Ethers	3a
95	3	No Subsidiary Risks	3272	714	22.736	Esters	3a
96	3	No Subsidiary Risks	3295	581	9.859	Hydrocarbons, liquid, n.o.s.	3a
97	3	No Subsidiary Risks	3336	18	59	Mercaptans	3a
			TOTAL:	**84.103**	**704.790**		

Class 4.1 B

In this class are included the chemicals that are regulated and classified with the warning message R11 and are in case of transport of dangerous goods classified in class 4.1 ARD/RID. In this class are not included explosive substances from class 4.1 ADR/RID and are classified in 4.1A.
Chemicals that are classified in 4,1 ADR/RID and are not included and marked with the warning message R11, are treated differently (i.e. sulphur,naphthalene,)

Item No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	4.1	Can be a marine pollutant	1325	73	470	Flammable solids, organic, n.o.s.	4.1b
2	4.1	No Subsidiary Risks	1312	220	4.777	Borneol	4.1b
3	4.1	No Subsidiary Risks	1338	2	55	Phosphorus	4.1b
4	4.1	No Subsidiary Risks	2717	181	2.646	Camphor, synthetic	4.1b
5	4.1	No Subsidiary Risks	2956	139	3.980	5-tert-Butyl-2,4,6-trinitro-m-xylene or Musk xylene	4.1b
6	4.1	No Subsidiary Risks	3089	46	691	Metal powder, flammable, n.o.s.	4.1b
7	4.1	No Subsidiary Risks	3175	360	286	Solids containing flammable liquid, n.o.s.	4.1b
8	4.1	No Subsidiary Risks	3178	52	1.797	Flammable solid, inorganic, n.o.s.	4.1b
			TOTAL:	**1.073**	**14.702**		

Class 4.2: Self combustible chemicals

In class 4.2 belong chemicals that at normal temperature, in touch with air without adding energy could heat and finally burn and are on the basis of regulations of chemicals classified and marked with warning message R17 or are under ADR/RID classified in class 4.2

This class includes chemicals that are on air self-burnt and those chemicals that in cases of stagnation slowly heat up and finally burnt.

tem No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	4.2	No Subsidiary Risks	1378	28	14	Metal catalyst, wetted with a visible excess of liquid	4.2
2	4.2	No Subsidiary Risks	1384	4	648	Sodium dithionite or Sodium hydrosulfite	4.2
3	4.2	No Subsidiary Risks	2881	17	1.868	Metal catalyst, dry	4.2
4	4.2	No Subsidiary Risks	3190	2	13	Self-heating solid, inorganic, n.o.s.	4.2
5	4.2	No Subsidiary Risks	3313	1	80	Organic pigments, self-heating	4.2
			TOTAL	**52**	**2.623**		

Class 4.3: Chemicals that in contact with water create flammable gases

In this class belong chemicals that in touch with water or humid air create flammable gases in dangerous quantities. This class includes chemicals that are regulated, sorted and marked with warning message R15 and are under ADR/RID classified in 4.3

Item No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	4.3	No Subsidiary Risks	1404	13	0	Calcium hydride	4.3
2	4.3	4.2	1418	116	4.356	Magnesium, powder	4.3
3	4.1	No Subsidiary Risks	1309	26	163	Aluminium powder, coated	4.3
			TOTAL:	**155**	**4.519**		

Class 5.1A, 5.1B and 5.1C; chemicals that cause fire

In this class belong the chemicals that because of their characteristics significantly accelerate the combustion of flammable products or ignite fire when in contact with them. This class of chemicals include chemicals that are sorted under the chemical regulation, and marked with warning message R8 or R9.

Item No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	5.1	8	1463	1	25	Chromium trioxide, anhydrous	5.1
2	5.1	8	3085	40	1.119	Oxidizing solid, corrosive, n.o.s.	5.1
3	5.1	8	3149	155	165	Hydrogen peroxide and peroxyacetic acid	5.1
4	5.1	No Subsidiary Risks	1444	144	900	Ammonium persulfate	5.1
5	5.1	No Subsidiary Risks	1476	15	103	Magnesium peroxide	5.1
6	5.1	No Subsidiary Risks	1479	339	2.300	Oxidizing solid, n.o.s.	5.1
7	5.1	No Subsidiary Risks	1486	208	1.040	Potassium nitrate	5.1
8	5.1	No Subsidiary Risks	1488	13	163	Potassium nitrite	5.1
9	5.1	No Subsidiary Risks	2880	4	205	Calcium hypochlorite	5.1
10	5.1	No Subsidiary Risks	2984	11	491	Hydrogen peroxide	5.1
11	5.1	No Subsidiary Risks	3211	1	130	Perchlorates	5.1
12	5.1	No Subsidiary Risks	3215	11	491	Persulfates	5.1
			TOTAL:	**942**	**7.132**		

Class 6.1A and 6.2B: Very poisonous and poisonous chemicals

In this class are included chemicals that are vey poisonous and poisonous marked respectively with T+ and T and have the warning messages of R23, R24, R25, R26, R27,R28 and R39 or R48 and chemicals that can cause cancer (R45, R49), genetically inherited damages (R46) and/ or are poisonous for procreation and are marked with warning messages (R60 or R61).

Class 6.1A: flammable very poisonous and poisonous chemicals

In this class the following chemicals belong:

- Flammable liquid chemicals mixed with water with flash point above 60°C
- Flammable liquid chemicals not mixed with water with flash point above 100°C
- Water based substances with flammable poisonous materials
- Firm flammable materials

Item No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	3	6.1	1093	102	4.541	Flammable liquids, n.o.s.	6.1a
2	3	6.1	1131	55	36	Carbon disulfide	6.1a
3	3	6.1	1228	23	2.750	Mercaptans	6.1a
4	3	6.1	1988	46	1.271	Aldehydes	6.1a
5	3	6.1	1992	84	2.302	Flammable liquids, toxic, n.o.s.	6.1a
6	4.1	6.1	2926	14	199	Flammable solids, toxic, organic, n.o.s.	6.1a
7	6.1	3	1135	3	1	Ethylene chlorohydrin	6.1a
8	6.1	3	1199	16	137	Furaldehydes	6.1a
9	6.1	3	1545	433	2.011	Allyl isothiocyanate	6.1a
10	6.1	3	2337	1	0	Phenyl mercaptan	6.1a
11	6.1	3	2606	2	3	Methyl orthosilicate	6.1a
12	6.1	3	2611	2	10	Propylene chlorohydrin	6.1a
13	6.1	3	2929	44	1.884	Toxic liquid, flammable, organic, n.o.s.	6.1a
14	6.1	3	3080	8	415	Isocyanates	6.1a
15	6.1	3/8	1251	248	167	Methyl vinyl ketone	6.1a
16	6.1	3/8	1695	2	4	Chloroacetone	6.1a
17	6.1	3/Marine pollutant	1143	3	35	Crotonaldehyde	6.1a
18	6.1	3/P	3383	7	8	Toxic by inhalation liquid, flammable, n.o.s.	6.1a
19	8	3 / 6.1	2683	2	68	Ammonium sulfide solution	6.1a
			TOTAL:	**1.095**	**15.842**		

Class 6.1 B: Non-flammable very poisonous chemicals

In this class are classified:

- Non-flammable liquid chemicals, except those water based with flammable poisonous substances
- Non-flammable firm substances

tem No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	6.1	8	2927	264	2.663	Toxic liquid, corrosive, organic,	6.1b
2	6.1	8	3289	23	162	Toxic liquid, corrosive, inorganic, n.o.s.	6.1b
3	6.1	8	3290	196	2.033	Toxic solid, corrosive, inorganic, n.o.s.	6.1b
4	6.1	8	3455	1	0	Cresols, solid	6.1b
5	6.1	8/P	3390	1	0	Toxic by inhalation liquid, corrosive, n.o.s.	6.1b
6	6.1	No Subsidiary Risks	1551	4	362	Antimony potassium tartrate	6.1b
7	6.1	No Subsidiary Risks	1560	2	2	Arsenic trichloride	6.1b
8	6.1	No Subsidiary Risks	1561	1	3	Arsenic trioxide	6.1b
9	6.1	No Subsidiary Risks	1564	2	16	Barium compounds, n.o.s.	6.1b
10	6.1	No Subsidiary Risks	1605	4	18	Ethylene dibromide	6.1b
11	6.1	No Subsidiary Risks	1671	13	24	Phenol, solid	6.1b
12	6.1	No Subsidiary Risks	1673	12	1.301	Phenylenediamines	6.1b
13	6.1	No Subsidiary Risks	1935	547	2.297	Cyanide solutions, n.o.s.	6.1b
14	6.1	No Subsidiary Risks	2024	2	16	Mercury compounds, liquid, n.o.s.	6.1b
15	6.1	No Subsidiary Risks	2253	12	720	N,N-Dimethylaniline	6.1b
16	6.1	No Subsidiary Risks	2290	47	3.491	Isophorone diisocyanate	6.1b
17	6.1	No Subsidiary Risks	2291	276	2.337	Lead compounds, soluble, n.o.s.	6.1b
18	6.1	No Subsidiary Risks	2512	6	651	Aminophenols	6.1b
19	6.1	No Subsidiary Risks	2788	416	3.081	Organotin compounds, liquid, n.o.s.	6.1b
20	6.1	No Subsidiary Risks	2810	907	16.513	Toxic, liquids, organic, n.o.s.	6.1b
21	6.1	No Subsidiary Risks	2811	1022	14.232	Toxic solids, organic, n.o.s.	6.1b
22	6.1	No Subsidiary Risks	2876	1	8	Resorcinol	6.1b
23	6.1	No Subsidiary Risks	2937	2	28	Alpha-Methylbenzyl alcohol	6.1b
24	6.1	No Subsidiary Risks	3143	7	688	Dye, solid, toxic, n.o.s.	6.1b
25	6.1	No Subsidiary Risks	3146	1	77	Organotin compounds, solid, n.o.s.	6.1b
26	6.1	No Subsidiary Risks	3287	192	2.304	Toxic liquid, inorganic, n.o.s.	6.1b
27	6.1	No Subsidiary Risks	3288	8	649	Toxic solid, inorganic, n.o.s.	6.1b
28	6.1	No Subsidiary Risks	3293	19	364	Hydrazine, aqueous solution	6.1b
29	6.1	No Subsidiary Risks	3462	2	0	Toxins extracted from living sources, solid, n.o.s.	6.1b
30	8	6.1	1744	78	266	Bromine	6.1b
31	8	6.1	1790	4	111	Hydrofluoric acid	6.1b
32	8	6.1	2030	56	324	Hydrazine hydrate	6.1b
33	8	6.1	2922	41	3.635	Corrosive liquids, toxic, n.o.s.	6.1b
34	8	6.1	1810	24	2	Phosphorus oxychloride	6.1b
35	8	6.1	1849	5	26	Sodium sulfide	6.1b
36	8	6.1	2262	1	43	Dimethylcardamoyl chloride	6.1b
37	8	No Subsidiary Risks	2692	4	8	Boron tribromide	6.1b
38	8	No Subsidiary Risks	2809	5	188	Mercury	6.1b
39	8	No Subsidiary Risks	2829	71	2.779	Caproic acid	6.1b
			TOTAL:	**4.279**	**61.422**		

Class 8 A in 8 B: Caustic chemicals

In this class belong 8A and 8B chemicals which are on the basis of regulation on chemicals sorted as caustic (C) marked with the message R34 or R35. Products that are in ADR/RID classified in class 8.

Products that are classified under n. 8 don't explicitly belong to class 8, because their flash point can be interpreted as in class 3A and 3B. Class 8 is divided in two under-classes: non flammable caustic and non-flammable caustic chemicals.

Class 8 A: Flammable caustic chemicals

In class 8A the following chemicals belong:

- Caustic flammable chemicals that are mixed with water with a flash point from 60°C
- Caustic flammable chemicals that are mixed with water with a flash point from 100°C
- Caustic flammable firm chemicals

Item No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	3	8	1154	23	638	Diethylamine	8a
2	3	8	1158	11	11	Diisopropylamine	8a
3	3	8	1160	30	2.143	Dimethylamine solution	8a
4	3	8	1196	1	3	Ethyltrichlorosilane	8a
5	3	8	1221	4	5	Isopropylamine	8a
6	3	8	1922	105	4.499	Pyrrolidine	8a
7	3	8	2529	11	156	Isobutyric acid	8a
8	3	8	2733	5	1	Amines, flammable, corrosive, n.o.s.	8a
9	3	8	2924	435	3.845	Flammable liquid, corrosive, n.o.s.	8a
10	8	3	1604	6	297	Ethylenediamine	8a
11	8	3	2218	5	8	Acrylic acid, inhibited	8a
12	8	3	2401	4	45	Piperidine	8a
13	8	3	2734	40	2.555	Amines, liquid, corrosive, flammable	8a
14	8	3	2789	25	452	Acetic acid	8a
15	8	3	2920	186	8.493	Corrosive liquids, flammable, n.o.s.	8a
16	8	No Subsidiary Risks	1779	73	737	Formic acid	8a
17	8	No Subsidiary Risks	1838	13	4	Titanium tetrachloride	8a
18	8	No Subsidiary Risks	2579	1	0	Piperazine	8a
19	8	No Subsidiary Risks	2586	5	427	Alkyl sulfonic acids	8a
20	8	No Subsidiary Risks	2735	168	5.179	Amines, liquid, corrosive	8a
21	8	No Subsidiary Risks	2820	42	2.005	Butyric acid	8a
22	8	No Subsidiary Risks	3145	1	3	Alkylphenols, liquid, n.o.s. (including C2-C12 homologues)	8a
23	8	No Subsidiary Risks	3412	5	217	Formic acid	8a
24	8	No Subsidiary Risks	3463	2	3	Propionic acid with not less than 90% acid by mass	8a
			TOTAL	**1.201**	**31.726**		

Class 8 B: non-flammable caustic chemicals

- Caustic non-flammable liquid chemicals
- Caustic non-flammable firm chemicals

Item No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	8	No Subsidiary Risks	1719	172	4.734	Caustic alkali liquid, n.o.s.	8b
2	8	No Subsidiary Risks	1754	23	5	Chlorosulfonic acid (with or without sulfur trioxide)	8b
3	8	No Subsidiary Risks	1759	543	4.238	Corrosive solids, n.o.s.	8b
4	8	No Subsidiary Risks	1760	1702	34.225	Corrosive liquids, n.o.s.	8b
5	8	No Subsidiary Risks	1789	2	16	Hydrochloric acid	8b
6	8	No Subsidiary Risks	1805	91	1.497	Phosphoric acid	8b
7	8	No Subsidiary Risks	1813	38	768	Potassium hydroxide, solid	8b
8	8	No Subsidiary Risks	1814	3568	17.499	Potassium hydroxide, solution	8b
9	8	No Subsidiary Risks	1823	89	4.147	Sodium hydroxide, solid	8b
10	8	No Subsidiary Risks	1824	461	4.571	Sodium hydroxide solution	8b
11	8	No Subsidiary Risks	1830	2	16	Sulfuric acid with more than 51 percent acid	8b
12	8	No Subsidiary Risks	1834	1	8	Sulfuryl chloride	8b
13	8	No Subsidiary Risks	1835	8	0	Tetramethylammonium hydroxide	8b
14	8	No Subsidiary Risks	1836	18	4	Thionyl chloride	8b
15	8	No Subsidiary Risks	1902	1	0	Diisooctyl acid phosphate	8b
16	8	No Subsidiary Risks	1903	20	3	Disinfectants, liquid, corrosive, n.o.s.	8b
17	8	No Subsidiary Risks	2289	69	111	Isophoronediamine	8b
18	8	No Subsidiary Risks	2430	3	16	Alkylphenols, solid, n.o.s. (including C2-C12 homologues)	8b
19	8	No Subsidiary Risks	2491	40	747	Ethanolamine	8b
20	8	No Subsidiary Risks	2672	1	2	Ammonia solution	8b
21	8	No Subsidiary Risks	2699	58	5.399	Trifluoroacetic acid	8b
22	8	No Subsidiary Risks	2790	100	2.040	Acetic acid solution	8b
23	8	No Subsidiary Risks	2794	219	7.729	Batteries, wet, filled with acid	8b
24	8	No Subsidiary Risks	2795	1	60	Batteries, wet, filled with alkali	8b
25	8	No Subsidiary Risks	2796	54	2.100	Battery fluid, acid or Sulfuric acid with not more than 51 percent acid	8b

26	8	No Subsidiary Risks	2801	166	8.061	Dyes, liquid, corrosive, n.o.s. or Dye intermediates, liquid, corrosive, n.o.s.	8b
27	8	No Subsidiary Risks	2819	2	12	Amyl acid phosphate	8b
28	8	No Subsidiary Risks	2865	11	1.891	Hydroxylamine sulfate	8b
29	8	No Subsidiary Risks	2967	10	795	Sulfamic acid	8b
30	8	No Subsidiary Risks	3066	2	318	Paint or Paint related material	8b
31	8	No Subsidiary Risks	3253	3	19	Disodium trioxosilicate	8b
32	8	No Subsidiary Risks	3259	20	860	Amines	8b
33	8	No Subsidiary Risks	3260	10	39	Corrosive	8b
34	8	No Subsidiary Risks	3261	247	4.907	Corrosive solid, acidic, organic	8b
35	8	No Subsidiary Risks	3262	93	2.817	Corrosive solid, basic, inorganic	8b
36	8	No Subsidiary Risks	3263	22	1.368	Corrosive solid, basic, organic	8b
37	8	No Subsidiary Risks	3264	341	13.355	Corrosive liquid, acidic, inorganic	8b
38	8	No Subsidiary Risks	3265	1435	47.455	Corrosive liquid, acidic, organic	8b
39	8	No Subsidiary Risks	3266	319	5.381	Corrosive liquid, basic, inorganic	8b
40	8	No Subsidiary Risks	3267	109	7.639	Corrosive liquid, basic, organic	8b
			TOTAL	**10.074**	**184.852**		

Class12: Non-flammable products

In this class belong products that are not flammable or are so heavy to burn that don't represent danger. In this class, it can be included chemicals from 6.1 ADR/RID (packaging group III) chemicals that are marked with dangerous sign Xn, Xi or N or products that ate not dangerous for DG's or chemicals.

tem No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	9	No Subsidiary Risks	1990	2	115	Benzaldehyde	12
2	9	No Subsidiary Risks	3082	26325	652106	Environmentally hazardous substance, liquid, n.o.s.	12
3	9	No Subsidiary Risks	3334	1	7	Aviation regulated liquid, n.o.s.	12
			TOTAL	**26.328**	**652.228**		

Class 13: non-flammable firm products

In this class belong non-flammable products that heavily burn and don't represent any danger for fire. In this class, it can be included chemicals from 6.1 ADR/RID (packaging group III) chemicals that are marked with dangerous sign Xn, Xi or N or products that are not dangerous for DG's or chemicals

Item No.	IMDG class	SUBLABEL	UN No.	No. Pieces	Quantity in kg	Substance name:	Storage class
1	9	No Subsidiary Risks	1845	13	1.293	Carbon dioxide	13
2	9	No Subsidiary Risks	2211	16	745	Polymeric	13
3	9	No Subsidiary Risks	3077	16222	181211	Environmentally hazardous substance, solid, n.o.s.	13
4	9	No Subsidiary Risks	3090	32	184	Lithium batteries	13
5	9	No Subsidiary Risks	3268	1	13	Air bag inflators or Air bag modules or Seat-belt pretensioners	13
6	9	No Subsidiary Risks	3363	16	134	Dangerous goods in machinery or Dangerous goods in apparatus	13
			TOTAL	**16.300**	**183.580**		

The relevance of the classification of dangerous goods is connected with the planning of warehouses (number, capacity, security equipment) and its operations.

The basics for the creation of dangerous goods classes for the warehousing dangerous goods are:

- the system of sorting of dangerous goods which is planned to be transported, does not take into enough consideration the danger, that could arise when warehousing big quantities of goods.

- regulations about dangerous chemicals label products only according to special risks because of their characteristics and are equal related to their physical and chemical characteristcs.

The methodological approach for the classification of dangerous goods is done on the basis of the existing information that are in line with the regulation of the transport of DG's and regulation of dangerous chemicals and security documents. For products that are not classified as dangerous the available information from the producers are enough.

In the same classes are collected products with the same dangerous characteristics that require similar security measures. Every product can be classified in only one class as shown in the table below. It has to be mentioned that the method of sorting base on the following rules:

- for explosives, radioactive and infective products are valid special regulations for warehousing, that define separate stocking for every single product

- products with dangerous physical and chemical characteristics are dealt before products that are marked as poisonous

- products without and dangerous characteristics are not classified.

The sorting of DG is as follows:

• infective substances	R6.2
• radioactive substances	R7
• gases (compressed, liquefied, pressurised)	R2A & R2B
• self inflammable	R4.2
• substances that in contact with water creates gases	R4.3
• organic peroxide	R5.2
• substances that ignite fire	R5.1A, R5.2B, R5.1C
• flammable firm substances	R4.1A, R4.1B
• flammable liquid substances	R3A
• combustible liquid substances	R3B
• combustible poisonous substances	R6.1 A
• non combustible poisonous substances	R6.1 B
• flammable caustic substances	R8A
• non flammable caustic substances	R8B
• flammable substances non included in 3A and 3B	R10
• flammable firm substances	R11
• non flammable liquids	R12
• non flammable firm substances	R13

If the products with the characteristics “non flammable, caustic”, “non flammable, liquid” or “non flammable, firm” are packed in a way that the wrapping could enhance, the fire should be classified into classes 8A, 10 or 11. In this case the specific characteristics of the products should be considered. The wrapping or package that doesn’t enhance the fire is a non flammable package or is difficult to ignite and burns slowly.

6. Classification of DG according to the needs of Luka Koper – General cargo terminal

The main purpose of the feasibility study is to analyse the necessary conditions for the rearrangement of a warehouse in the Port of Koper to stock dangerous goods of various classes. In order to define all the rearrangements needed it should be clear what kind of dangerous goods would be stored in this warehouse. The warehouse is located centrally and has been used in past times to stock leather. On the below figures there is the the location of the warehouse n. 27A.

Figure 9: macro and micro location of the warehouse 27A

The need for storing dangerous goods in the port of Koper are related to the aim for a safer and more secure approach for this segment as the port is located near the city of Koper and therefore some more precautions are needed. The dangerous goods that could be potentially stored in the warehouse are the following:

Num	Description	Class	Num. Of pieces	Average weight (kg/piece)
1	Gases	2a	619	16,9
2	Aerosols	2 b	17309	0,94
3	Flammable liquid chemicals	3a	84103	8,38
4	Flammable firm chemicals	4.1 b	1073	13,7
5	Self inflammable	4.2	52	50,4
6	Chemicals – create gases when with water	4.3	155	29,15
7	Chemicals that creates flames	5.1	942	7,57
8	Flammable very poisonous and poisonous chemicals	6.1 a	1095	14,46
9	Non Flammable very poisonous and poisonous chemicals	6.1 b	4279	14,35
10	Flammable caustic chemicals	8a	1201	26,41
11	Non Flammable caustic chemicals	8b	10074	18,35
12	Non flammable products	12	26328	24,77
13	Non flammable firm products	13	16300	11,26

Table 6: list of potential chemicals

The above quantities are only indicative numbers that are subject only for this study.

The listed dangerous goods are classified in various classes and therefore special attention has been directed to the possibility of joint warehousing as they are packed in smaller boxes.

A very important issue is the warehouse where the DG's would be stored as it should fulfil some special requirements.

6.1 The warehouse 27A

The warehouse is located in the warehouses area on the terminal for general cargo. On the west side is bounded by the main road in the port, while on the east side the railway tracks are situated. The warehouse is part of more warehouses bind together, therefore the north wall is connected with the next hall, while on the south part is the transport path with under floor pools. The entrance in the warehouse is possible through the east and west side with doors 4x4m. On the south-west side are doors 6,5 x 3,6m. In the middle of the hall is the dividing wall with an open light space and doors 4x4m. The total storage capacity is 1800 m2, length 60m, width 30m. The walls and the floor are adequately prepared for handling leathers. On every entrance/exit are integrated grids that are connected with the technological sewage system and on with the septic hole of approximately 15m^3.

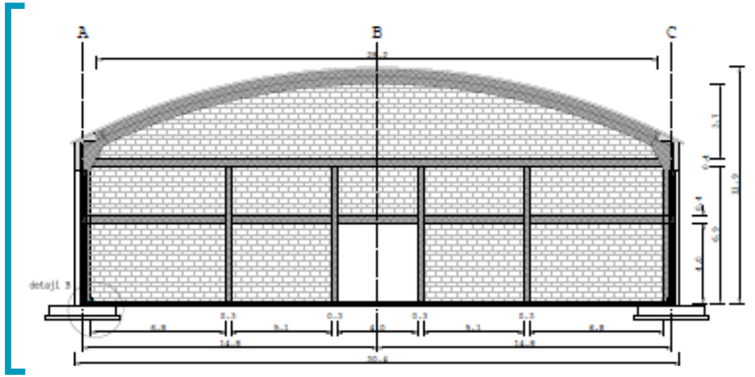


Figure 10: side view of warehouse 27a

The quantities of dangerous goods that would be stored on one time in the warehouse are only estimations based on potential flows of this kind of cargo. The quantity can vary for +/- 20 % on a monthly basis.

Assuming that the total quantity could be around 1.800 T/ per year and it would have a triple turnaround, resulting in a onetime quantity of 630 T approximately to be stored. The warehouse is thought to store dangerous goods on pallets on the floor, without shelves, as they would be packed into smaller packages for the purpose of micro distribution for national and hinterland markets.

On the bases of the warehouse dimensions the estimated pallets spots are 560 euro pallets. The max height is 1,6 m and most of the stored dangerous goods would be on one pallet. Dangerous goods in classes 12 and 13 could be stored on two pallets with the max height of 2,8m.

The warehouse should be arranged in a way to be able to accept different types of dangerous goods. Additionally it should also be thought of the outside driveways around the warehouse. The construction works that should be done are:

- 3 new fireproof doors with all safety requirements
- roof top closing of internal dividing walls
- fireproof wall on the side connected with the next warehouse
- safety pipelines, special fire extinguishers for different dangerous goods characteristics
- marking and labeling of all necessary handling zones, ex zones, emergency exits, security lightning (e.g types)
- lighting conductors where needed
- marking and labeling of outside zones for internal/ external paths
- 2 outside containers with necessary requirements
- adequate ventilation openings where needed (subject to definition of ex zones)
- complete electrical system (switches, sockets, lights) in ex types
- complete safety check of all built in materials.

The works should last not more than 5 to 6 months with an estimated cost of _____ Euros.

6.2. Rules for joint warehousing of dangerous goods

When dealing with joint storage of dangerous goods especially with high flammable and explosive characteristics a more pragmatic approach should be taken. In the next table are described the classified dangerous goods and if they can be stored next to other dangerous goods or not. It is very important that dangerous goods with highly dangerous characteristics are located, separately from others that are highly dangerous too. The table shows if joint warehousing is possible or not and if there are any limitations that have to be followed. Joint warehousing is only permitted when all the conditions are fulfilled (i.e same fire extinguisher agent for all goods, same warehouse temperature).

Additional remarks to graph 1:

Numbers from 1 to 17 in green, yellow and red in the table are representing the comments in sequence below:

1. Joint warehousing of flammable liquid chemicals with aerosols is allowed if some requirements from the regulations on technical and organizational measures for warehousing dangerous chemicals and instructions from the producers are met.

2. Aerosols sprayers can be stored with very poisonous and poisonous chemicals under the regulations defined for warehousing this kind of goods. If the goods of this kind are locked in cases that are nonflammable this regulation doesn't apply.

3. Products that are quickly flammable and could quickly ignite fire (packaging) couldn't be stored together with very poisonous and poisonous chemicals or flammable liquid chemicals.

4. Joint warehousing is permitted only if in case of an accident the products don't influence on each other. This can be achieved with diving walls.

5. Flammable caustic chemicals and flammable firm products can be stored in warehouses where there are not more than 50 gas cylinders and not more than 25 gas cylinders with flammable, very poisonous gases and oxidizing substances. The part where the cylinders are located should be divided by a 2m non flammable high wall and it should be at least 5m between the wall and the flammable chemicals.

6. Joint warehousing is allowed if the security measures for all products are in line with the class 2B.

7. Joint warehousing is allowed under the condition that the flash point of the chemicals is higher than 60°C

8. Flammable very poisonous and poisonous chemicals could be stored together with chemicals from class 4.1B in the max amount of 100T and under the following conditions: (1) quantities max 10T – no restrictions; (2) for quantities between 10 T and 100 T under the conditions that are stated in the regulation (art. 10) of technical and organizational measures for warehousing dangerous chemicals.

9. Caustic chemicals in breakable cases can't be stored together with flammable liquid chemicals. This is not applicable when they are located on a safety distance and can't influence in case of fire.

10. Joint warehousing is allowed on when considering measures described for class 5.1C, additionally producers guidelines have to be followed.

11. Joint warehousing of chemicals from class 5.1B with flammable and combustible liquid chemicals, flammable firm chemicals is allowed: (1) until 1T with no restrictions; (2) above 1T till max 20T in line with the guidelines of the art. 10 of the regulations of technical and organizational measures for warehousing dangerous chemicals. Joint warehousing of chemicals class 5.1B with flammable caustic chemicals, flammable liquid chemicals (except 3.A or 3.B) or flammable firm products (i.e. flammable greasy substance, vegetal oils, coating substances etc) is allowed: (1) altogether till 1T, no restrictions; (2) altogether above 1T till 20t in line with art. 10 of the technical and organizational measures for warehousing of dangerous chemicals.

12. Joint warehousing of chemicals class 5.2 that are heavy flammable and because of the slow burning process and don't represent a hazard for the environment is allowed.

13. Joint warehousing is allowed with those explosives and lighters that don't contain heavy metals.

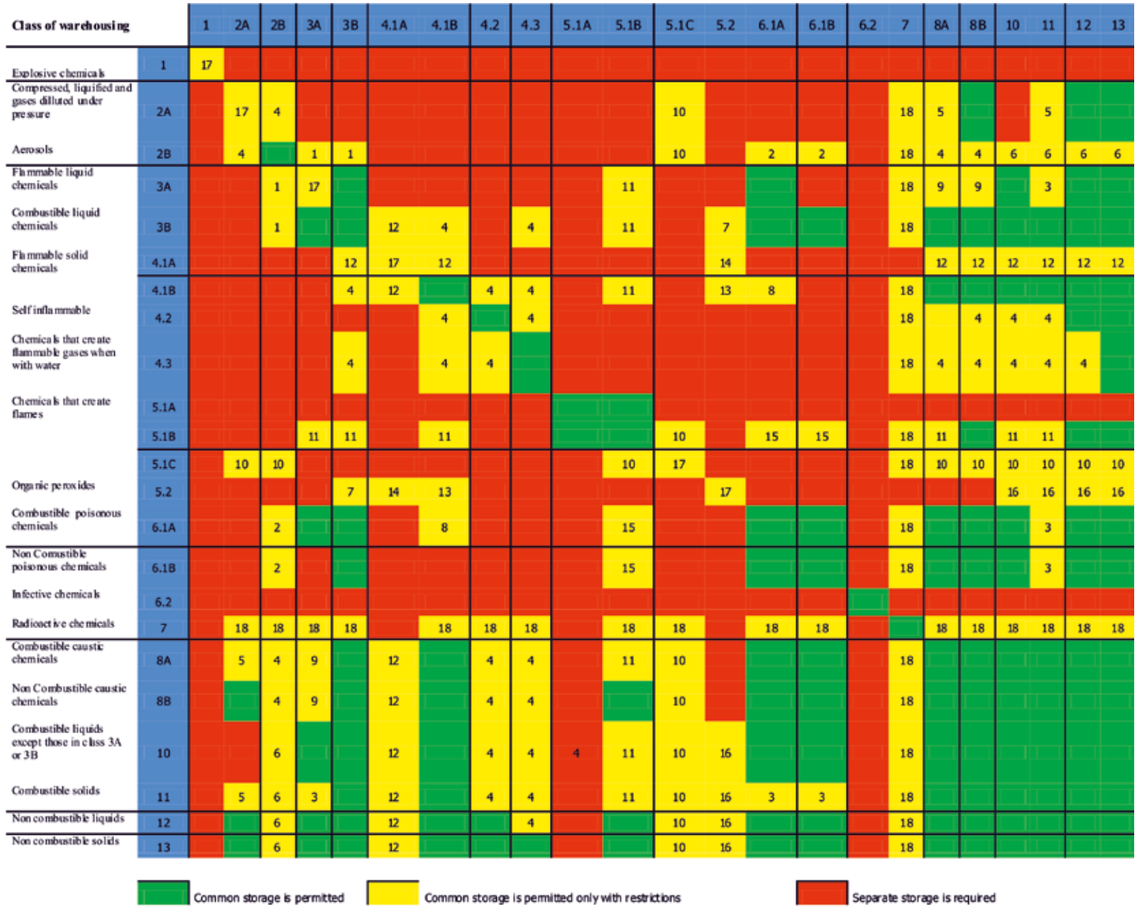
14. Chemicals that cause light can be stored together with very poisonous or poisonous chemicals under the following conditions; (1) for quantities under 1T with no restrictions; (2) above 1T and max 20 T in line with art. 10 of the technical and organizational measures for warehousing of dangerous chemicals.

15. When organic peroxide is stored with other goods it has to be checked if security distances are in line art. 10 of the technical and organizational measures for warehousing of dangerous chemicals.

16. It has to be taken into considerations of the producer for storing singular types of chemicals.

17. Radioactive materials should be stored in line with the current regulations that define the measures against the ionization radiation and nuclear security with the permission to perform radiation activities. The responsible person for security against radiation takes in every singular case the decision that is in line with confirmed security estimation of exposed workers and permission for the radiation activities.

Graph 1: rules for joint warehousing



6.3. Split warehousing

The term split warehousing means warehousing on different locations of the warehouse. One sector/ section is part of the warehouse:

- which is separated from the other areas in the building with firefighting walls and ceilings (at least EI 90)

- which is outside separated with appropriate distances (table n. ___) or with firefighting walls (at least EI 90).

Separated warehousing is necessary for the minimization of risk from possible contact between products of different warehousing classes. Warehousing of products that are located in cases but in the same space and in line with DIN 12952 normally fulfill the conditions for separated warehousing.

Distance Warehousing conditions

5 m	Between warehousing spots for flammable and non flammable products, packed in non flammable packaging size 200 L or more, with the max height 4m
5 m	Installed device for automatic detection and warning of fire and qualified staff for extinguishing
5 m	Installed device for automatic fire extinguishing
10 m	All other cases

Table 7: warehousing conditions

6.4. Separated warehousing

The term separated warehousing means storing in the same section, where products are separated by walls (non-flammable) or are not stored close to each other or are stored in non-flammable cases.

Theoretically same class products can be stored in the same section but there are some exceptions where some regulation has to be followed (i.e. graph 1)

6.5. Exceptions to the joint warehousing table

For joint warehousing, from graph 1 are valid the following exceptions:

- Special rules for warehousing of small quantities above 5 T

- Special ruler for warehousing under 5 T

In the above examples it is assumed that joint warehousing is not representing a major risk.

6.6. Exceptions for warehousing small quantities with capacities above 5 t

It is allowed to store smaller quantities of certain classes with other greater quantities of other classes' products that joint warehousing is prohibited or limited. For the purpose of clearer interpretation the quantities have been assigned with A for big quantities and B for smaller quantities. Smaller quantities signed with B are normally the values taken out from technical rules. It is considered that B products, under some rules, don't increase the danger for warehousing products A.

The rules are the following:

For A quantities of products classes 1, 2 A, 4.1 A, 4.2, 4.3, 5.1 A, 5.1 C, 5.2,6.2 and 7 there are no exceptions, which means that the table for joint warehousing is fully used.

In the case for A quantities from other classes 2 B, 3 A, 3 B, 4.1 B, 5.1 B, 6.1 A, 6.1 B, 8 A, 8 B, 10, 11, 12 and 13 it can be stored even singular products from other classes until B quantities. It has to be assured that products don't influence each other. A way that this could be done is with the security distance of 3m.

Quantities for B could be over passed if proper security measures are taken.

6.7. Exceptions for small warehouses with capacities till 5 t

Limitations and prohibitions from table____ for joint warehousing have to be followed for classes 1, 2 A, 4.1 A, 4.2, 5.1 A, 6.2 & 7. The following rules are valid for warehouses with capacities less than 5T..

In B quantities could be stored products defined in table___ . With classes 3 B, 8, 10, 11, 12 and 13 could fill the empty spaces until reaching the limit capacity.

It has to be assured that products, in case of accident, don't react with each other. Products from class 12 and 13 could serve as a security barrier.

Quantities for class 3A could be over passed only with the proper security measures in place.

Class Small qty B

Mark	Description	
1	Explosive chemicals	0
2A	Gasses	0
2B	Aerosol sprays	500 pieces
3A	Flammable liquid chemicals	100 L, flash point < 21oC* in
200 L, flash point ≥ 21 oC < 55oC		
4.1 A	Flammable firm substances	0
4.1 B		200 kg
4.2	Self ignition chemicals	0
4.3	Substances in contact with water cause gasses	200 kg
5.1 A		
Substance causing fire	0	
5.1 B		200 kg
5.1 C		100 kg
5.2	Organic peroxide	200 kg **
6.1 A	Poisonous – very poisonous substances	50 kg
6.1 B	Poisonous – very poisonous substances	200 kg
6.2	Infective substances	0
7	Radioactive substances	0

*Aerosols packed max 600 ml.

** Without appropriate equipment are allowed only smaller packed goods (max 20 l).

*** Products of general use in smaller packaging (max 200 Kg for firm organic peroxides, until 25 ml for liquid organic peroxides).

7. Definition of warehousing zones in 27A

On the basis of the before mentioned rules for joint warehousing and based on the dimensions of the warehouse 27A, the warehouse has been divided into 5 zones.

Zone 1:

Half of the warehouse – east side; area of 900 m2. The present wall has to be lifted till the roof (it serves as an anti fire wall). In the wall anti fire doors 4x4m are built. In that part of the warehouse the products classes stored would be 8a, 8b and 6.1B and partially 12.

Zone 2:

The other half of the warehouse – west side, would be divided in 3 parts; one third should be separated from the rest with fireproof walls and doors. In that part dangerous goods class 2B (south) and 2A (north side) would be stored. The whole volume of the warehouse would be defined as EX CONE 2. Forced ventilation should be provided (5x turn around and vertical).

Zone 3:

The end west side could be used for warehousing of classes 6.1A, 3A and 13 and if needed partially 12 total area of 600m2 . Ventilation of a size of 1,2 m2 near the floor have to be provided. Optionally the ventilation could be provided with the integration of 1,2m2 grid in the doors and open more holes on the south side of the hall. In that part of the warehouse an EX – ZONE 2 is foreseen till 2m height

Zone 4:

Class 4.2 chemicals are those that in contact with air could ignite (marked with R17) Due to their characteristics it is suggested to set an outside container (dim 6x 2,5m) where classes 4.1B, 4.2 and 4.3 will be stored. Ventilation should be provided with two openings of at least 300 cm2 area, situated on the door and the back side wall under the roof.

Zone 5:

Class 5.1A, 5.1B and 5.1C due to their characteristics should be stored in an outside container (dim 6x2,5 m) on the south part of the warehouse. Ventilation should be provided with two openings of at least 300 cm2area, situated on the door and the back side wall under the roof. In the chemicals' list there are also another very dangerous substances that have to be dealt with a high degree of precaution.

Figure 11: warehousing zones in 27A

8.Internal logistics procedures

In the figure below are shown (in green) the internal routes from the sea side terminals to the warehouse 27A. Most of the dangerous goods designated to the warehouse would be packed in containers and therefore be loaded on vessels berthing at the container terminal (PIER 1)

There is also the possibility of goods coming to the general cargo berth with conventional vessels, but this option is practically very minimal or remote.

The internal logistics operations in the port of Koper are subject to a certain operational document that defines all the necessary steps, procedures, documents and responsibilities when handling dangerous goods. In the table below the process is described step by step.

MAIN GATE

WAREHOUSE 27A

No	Activity	Document / Record	Responsibility	Deadline
ACCEPTANCE OF DANGEROUS GOODS				
1.	Ensure the safety data sheet (SDS) *For any new chemical is necessary to provide SDS to chemical adviser and adviser for the transport of dangerous goods*	safety data sheet (SDS)	Client, manufacturer	Before confirming acceptance
2.	Checking the level of risk *Before confirming acceptance is necessary to check if it is a dangerous chemical and the safety measures for storage and work*	safety data sheet (SDS), remarks on SDS,	chemical adviser and adviser for the transport of dangerous goods	Before confirming acceptance
3.	Review and approval of acceptance of dangerous goods *Check the facility operating permit* *Check the need to change / update the safety report and the environmental permit*	SDS, Acceptance of cargo, check legislation, safety report, environmental permit	Profit centre manager	Before confirming acceptance
4.	Preparation of documentation for the new dangerous goods and implementation of training for employees in case of arrival of new goods	Technological procedure, Instructions for safe work, safety report, environmental permit	Profit centre manager	Before arrival of goods
5	Preventive inspection of locations and equipment for manipulation	Annex Handling with Hazardous Substances	Responsible Head of the working process, Adviser for the transport of dangerous goods	Before arrival of goods
6.	Preparation of equipment to provide security and respond to emergencies	Annex Handling with Hazardous Substances, Fire policy and rescue plan, Material Safety Data Sheet, Seveso II scenarios	Head of Security office, responsible head of the working process, Adviser for the transport of dangerous goods	before arrival and during manipulation
7.	Obtaining all necessary documentation for the manipulation of dangerous goods: explosive and radioactive material, other dangerous goods.	section 4.4	Responsible person for planning	at least 48 hours before arrival of goods
8A	unloading of dangerous goods from road or rail transport (land) if the cargo or vehicle are so damaged	Annex Handling with Hazardous Substances, Technological	responsible head of the working process,	manipulation
8B	unloading of dangerous goods from ship (sea)	Annex Handling with Hazardous Substances, Technological procedures, Instructions for safe work	responsible head of the working process	manipulation
9.	Completion of handling and cleaning worksite	/	Responsible Head of working process	After manipulation

No	Activity	Document / Record	Responsibility	Deadline
STORAGE OF DANGEROUS GOODS				
1.	Marking storage areas	Material Safety Data Sheet, Instructions for safe work	profit centre manager	Continuous
2.	Provision of security measures during storage of dangerous goods	safety data sheet, fire policy	Responsible Head of the working process	Continuous
3.	Use security measures for storage of various categories of dangerous goods:	safety data sheet,fire policy, the requirements of the project documentation of warehouse, Annex Handling with Hazardous Substances	Storekeeper	Continuous
4.	Strict separation of various types of dangerous goods during storage	Safety Data Sheet, Instructions for safe work	Responsible Head of the working process	Before storage
5	Preparation of equipment to provide safety and response in case of emergency	Safety Data Sheet, Fire policy, Emergency plan, security plan of Luka Koper	profit centre manager,Head of Security office, Operational head OSH	Continuous
DISPATCH OF DANGEROUS GOODS				
1.	Check vehicle and driver before loading onto a road vehicle inspection of documents visual inspection	section 4.5 form 320-Reminder	Responsible person in the reception office, Storekeeper	Before loading
2.	Correct loading of dangerous goods, visual inspection of cargo and vehicles during and after loading, Only undamaged packaging, No cargo residues and leaking valves	OSH Training, Transport of Dangerous Goods, Fire Safety	Responsible Head of the working process, charger / loader	Continuous
3.	Periodic inspection of the process implementation		adviser for the transport of dangerous good	occasional

One of the most important aspects is the safety data sheet (SDS) that should contain all the important and necessary data about the cargo. It must be provided every time a new substance is entering the port in order to take necessary precautions in case of accident.

In the handling process the actions are the same as with all the containers and therefore special attention is only given to those with classes that are very dangerous. In these cases also the internal department for safety and security and internal fire fighters are advised to be present in case of any accidents.

The rules and procedures described above have to be followed without exceptions which are ensuring the prevention potential negative issues.

9. Potentials for improvement

Dangerous goods in international transport are mostly stored in containers as they offer many advantages, especially for safety and simplicity of handling. In a container there can be a single substance or different substances, packed singularly or bulk and divided by safety walls. Unfortunately the data of substances often provided by the shipper are incomplete or incorrect making it difficult for appropriate handling by ports, warehouses etc.

Large possibilities for improvement are in the provision of data for transported dangerous goods. Stakeholders have all different IT systems (port control, customs, port operators, agents, forwarders, carriers). Because of different types of input data in those systems there is significant potential for errors. Knowing this issue many times there are doubts whether a cargo is under classification as dangerous goods or not and if all the data of the cargo is correct. Moreover, there is no information what has been declared to authorities (entered in other IT systems) which makes the process even harder some times. On EU level it should exist a common harmonised IT system that would solve all the above mentioned problems and raise the transport of dangerous goods.

Another aspect that is very important is the potential for improvement in human resourzces know how and specifically:

- Knowledge of hazardous materials
- Experience in procedures
- National and EU legislation
- Consistency for enforcing the official procedures.

The human factor is therefore very important in handling and transporting of dangerous goods and should be one of the main concerns for improvement.

Main improvements could also be achieved with joint development work of producers and carriers of dangerous goods and play together a vital role in this process. Accidents are always possible and even with all the prevention possible, unfortunately they can happen. Therefore it should be, on EU level, adequately organised a risk management plan, actions and measures that could prevent accidents. In case of accidents there should be necessary measures for quick reaction for all the needed actors.

10. Conclusion

Transport of dangerous goods is an important segment in today's logistics, especially concerning safety and security reasons. Making solid adequate ground for the warehousing and distribution of them is very important in the global logistics of supply chains, as producers are keeping less and less stock of raw materials in their warehouse.so, this makes the single supply chain points like ports or singular nodes important distribution centres. Conventional cargo transport by road and rail is significantly less complicated than transport of dangerous goods by the same transport means thus making it more expensive. In order to prevent potential problems and accidents it has to be assured from all involved actors that all the necessary security measures are taken and followed.

In Slovenia most of the dangerous goods is transported by road to the national producers and/or exporters. The same is valid for the hinterland markets like Austria, Hungary, and Czech Republic with exceptions for some special cargoes. The Slovenian national motorway system has been finalised, offering the trucking companies very good conditions for transport, while the railway network is not in the "best shape" and has to be modernised as soon as possible. Comparing road and rail the later is more secure but it lacks of flexibility which is the main advantage of the road transport.

In the Port of Koper the acknowledgment of this fact is creating the path for secure handling and warehousing of dangerous goods, therefore creating all the necessary conditions for future related potential services. Internally a quality operational system for handling dangerous goods is defined and has to be followed to prevent potential issues.

The warehouse 27A should be re-arranged as described in the document in order to accept different types of dangerous goods in order to secure the area and in case of accidents react as quickly as possible. The need for a special warehouse for storing dangerous goods is giving space for new know-how that would be developed internally in the next periods by the people responsible including operations, safety and IT services.

The classification of dangerous goods and the rules for joint or split warehousing are important in order to have defined spaces that would be used for handling. It is very important to follow the rules, especially for those classes that couldn't be stored together, to avoid any accidents. This could also become a good practice that can be applied to other new warehouses in the future. Specifics that are related to transport of dangerous goods are common in the whole Mediterranean area and should be somehow largely harmonised and accepted to prevent any accidents. It is imperative that all the stakeholders on different levels join forces and use their strengths to improve the process in this sector.

Safer transportation and Logistics for a safer Community

This is the third stage feasibility study required as a key deliverable in the LOSAMEDCHEM project, as presented by the Maltese partners.
The study was updated in november 2012.

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Project cofinanced by the European Regional Development Fund

LOSAMEDCHEM

1.0. Foreword

The LOSAMEDCHEM (Malta) project, to date, has gone through three stages. Firstly, a comprehensive SWOT analysis for the chemical transportation sector in Malta was completed. A second stage involved the completion of a Good Practice Guidelines that would improve the sector. In this, the third Stage, a Feasibility Study has been completed for a specific idea to be developed which would significantly improve at least one, but ideally several aspects of the problems and issues identified in the earlier studies.

From very early on, in the project it was apparent that the sector in Malta suffers from two distinct problems - namely a multitude of stakeholders and entities, both public and private, with a direct interest in the sector and also from a lack of a coordinating mechanism, or mechanisms, at all stakeholder levels. At the same time, interviewed stakeholders expressed concerns at specific risk issues, some of which are quite significant to all sectors of the community in a small Island State such as Malta.

This situation presents the Local Council Association in Malta, as the LOSAMEDCHEM partner, with an opportunity to make a valid contribution towards significant improvement in this aspect of the overall problem.

This Study outlines the key ideas behind a Risk Management Collaboration Tool which will enable all stakeholders to collaborate on the common problems and issues relating to the chemical transportation supply chain in Malta. Built on the principles of common sharing; sustainability, robustness, simplicity and scaleability, the proposed tools could render chemical transportation in Malta significantly safer and with more secure on the basis collaboration.

2.0. Collaboration portal for safe chemical logistics in Malta: Business plan of the project

2.1. Study Aim

2.1.1. The aim of the feasibility study is to demonstrate how the Local Councils Association [LCA] as the project Malta partner can make a valid contribution towards the coordination aspect of chemical safety within the transportation supply chain in Malta.

2.1.2 . Building upon the analytical framework achieved from Studies 01 and 02, the feasibility study now proposes a collaboration tool that allows the LCA to achieve the following objectives at a

Strategic Level

- Establish a National context for the transportation of chemicals in Malta and Gozo
- Provide a cogent framework for collaboration between stakeholders and interested parties
- Raise awareness of chemical safety and related risk management amongst key stakeholders
- Provide an excellent tool for educational research and information sharing on this vital aspect of Community safety.

2.1.3 . The tool should also allow the LCA to actively participate and contribute as an interested stakeholder in the following objectives at an Operational Level:

- Provide a cogent framework for identifying and articulating primary potential threat
- scenarios which could result in risk to safety, security and the logistical supply chain
- Provide a cogent framework for identifying and articulating primary vulnerabilities within the transportation supply chain
- Provide a cogent framework for identifying and articulating strong points of the transportation supply chain infrastructure

Provide a cogent framework for identifying and articulating primary opportunities that may arise from an analytical evaluation of the National transportation supply chain.

2.2. Study Scope and Objectives

2.2.1. The proposed Collaboration Tool consists of a linked-portal system that is hosted online. The system consists of nine (9) linked interfaces, each being of specific value to members. Membership is intended to cascade from the LCA to Local Councils and downwards, thus providing for a self-sustaining financial model comprising Best Available Technology Not Entailing Excessive Cost [BATNEEC]. The system will be available online and should address the following aspects holistically:

- Planning
- Legal and compliance
- Participation and communication
- Education, awareness and training
- Reporting.

3.0. Summary information supplied by malta stakeholders

3.1. The MSA is identified as the National Co-ordinator for Chemical Safety.

3.2. The following entities constitute the National Co-ordinating Team:

- Agricultural Department
- Civil Protection Department
- Consumers Affairs Council
- Customs Department
- Department of Environmental Health
- Department of Health Information & Research
- Malta Chamber of Commerce, Enterprise & Industry
- Malta Environment & Planning Authority
- Malta Resources Authority
- Malta Transport Authority
- National Statistics Office
- Occupational Health & Safety Authority
- University of Malta
- WasteServ

Photo 01 – Urban Explosion - 2008

3.3. Ministries, agencies and other institutions managing chemicals and waste responsibilities of different government ministries, agencies and other institutions:

- Description of Ministerial Authorities and Mandates
- Office of the Prime Minister (OPM)
- Armed Forces of Malta (AFM)
- Staff Development Organisation (SDO)
- Management Efficiency Unit (MEU)
- Defence Matters Directorate
- Tourism
- Department for Local Government
- Malta Tourism Authority (MTA)
- Malta Environment and Planning Authority (MEPA)
- Ministry of Foreign Affairs (MFA)
- Ministry for Infrastructure, Transport and Communications (MITC)
- Malta Maritime Authority (MMA)
- Malta Transport Authority (ADT)
- Water Services Corporation (WSC)
- Enemalta Corporation
- Ministry for Resources and Rural Affairs (MRRA)
- Plant Health Department (PHD)
- Department of Agriculture
- WasteServ Malta Ltd
- Ministry of Education, Culture, Youth and Sport (MEDC)
- University of Malta (UOM)
- Malta College of Arts, Science and Technology (MCAST)
- Institute of Tourism Studies (ITS)
- Ministry for Social Policy (MSOC)
- Department for Environmental Health (DEH)
- Department of Health Information and Statistics (DHIS)
- Occupational Health and Safety Authority (OHSA)

- Ministry of Finance, the Economy and Investment (MFEI)
- Customs Division
- National Statistics Office (NSO)
- Trade Services Directorate (TSD)
- Malta Standards Authority (MSA)

3.3. Inter-ministerial Commissions and Coordinating Mechanisms:

- E-REACH Committee
- Pesticides Control Board
- Civil Protection Scientific Committee
- Integrated Pollution Prevention and Control Committee (IPPC)
- Bio-safety Co-coordinating Committee (BCC)
- Radiation Protection Board
- COMAH Competent Authority (CCA)
- Building Industry Consultative Council (BICC)

3.4. Primary Storage Facilities and relative capacities:

Locality Storage Capacity	(Tons)
Marsa Power Station	35,378
MOBC	50,835
Delimara Power Station	7,700
Corradino Tank Inventories	19,240
San Lucian Oil	50,000
Freeport Oil Tanking	531,550
B'Bugia	36,842
Has-Saptan	124,400
Hanzir Ras	49,000
Wied Dalam	4,210
Malta International Airport	987
Total Primary Storage Capacity	1,000,142

3.4. Total Number of Local Councils in Malta and

Photo 02 – LPG Filling Operation

List of Maltese local councils

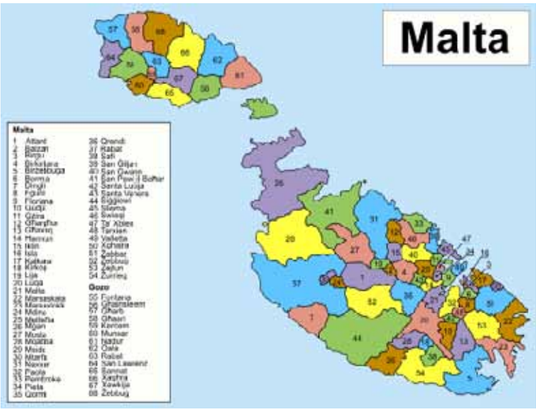


Figure 1 – Local Councils In Malta and Gozo

• Il-Kunsill Lokali tal-Belt Valletta (Città Umillisima) - South Street, Valletta (Triq in- Nofsinhar, il-Belt Valletta)

• Il-Kunsill Lokali tal-Imdina (Città Notabile) - Council Square, Mdina (Misrah il-Kunsill l-Imdina)

• Il-Kunsill Lokali tal-Birgu (Città Vittoriosa) - Couvre Porte Street, Vittoriosa (Couvre Porte, il-Birgu)

• Il-Kunsill Lokali tal-Isla (Città Senglea) - St. Joseph Street, Senglea (Triq San Guzepp, l-Isla)

• Il-Kunsill Lokali ta' Bormla (Città Cospicua) - St. Margaret Square, Cospicua (Misrah Santa Margarita, Bormla)

• Il-Kunsill Lokali ta' Hal Qormi (Città Pinto) - Victory Street, Qormi (Triq il- Vitorja, Hal Qormi)

• Il-Kunsill Lokali ta' Haz- Zebbug (Città Rohan) - Bishop Caruana Street, Zebbug, Malta (Triq l- Isqof Caruana, Haz - Zebbug)

• Il-Kunsill Lokali tas- Siggi ewi (Città Ferdinand) - St. Nicholas' Square, Siggiewi (Pjazza San Nikola, is- Siggiewi)

• Il-Kunsill Lokali ta' Haz -Zabbar (Città Hompesch) - Cawsli Street, Zabbar (Triq ic Cawsli, Haz –Zabbar)

• Il-Kunsill Lokali taz -Zejtun (Città Beland) -St. Angelo Street, Zejtun (Triq Sant' Anglu, iz -Zejtun)

• Il-Kunsill Lokali tar- Rabat, Ghawdex (Città Victoria) - Independence Square, Victoria, Gozo (Pjazza Indipendenza, ir- Rabat, Ghawdex)

• Il-Kunsill Lokali ta' H'Attard- Main Street, Attard (Triq il-Kbi ra, H'Attard)

• Il-Kunsill Lokali ta' Hal Balzan- Main Street, Balzan (Triq il- Kbira, Hal Balzan

• Il-Kunsill Lokali ta' Birkirkara- Thomas Fenech Street, B'Kara (Triq Tumas Fenech, Birkirkara)

• Il-Kunsill Lokali ta' Birzebbuga - St. Mary's Street, B'Buga (Triq Santa Marija Birzebbuga)

• Il-Kunsill Lokali ta' Had-Dingli -Sienja Lane, Dingli (Dahlet is -Sienja, Had-Dingli)

• Il-Kunsill Lokali tal-Fgura- Carmelo Street, Fgura (Triq il-Karmnu, il-Fgura)

• Il-Kunsill Lokali tal-Furjana- E.S. Tonna Square, Floriana (Pjazza E.S. Tonna, il- Furjana)

• Il-Kunsill Lokali tal-Fontana (It-Triq tal- Ghajn) - Spring Street, Fontana, Gozo (Triq il- Ghajn, il Fontana, Ghawdex)

• Il-Kunsill Lokali t'Ghajnsielem - Apiration Square, Ghajnsielem, G ozo (Pjazza d- Dehra, Ghajnsielem, Ghawdex)

• Il-Kunsill Lokali tal- Gharb- Visitation Street, Gharb, Gozo (Triq il Vizitazzjoni, l Gharb, Ghawdex) Kunsill Lokali ta' Hal Gharghur

• Il- Kunsill Lokali ta' Hal Gharghur- St. Nicholas' Street, Gharghur (Triq San Nikola, Hal Gharghur)

• Il-Kunsill Lokali tal- Ghasri- Rev. C. Caruana Street, Ghas ri, Gozo (Triq Dun K Caruana, l- Ghasri, Ghawdex)

• Il-Kunsill Lokali ta' Hal Ghaxaq -Labour Avenue, Ghaxaq (Vjal il- Labour, Hal Ghaxaq)

• Il-Kunsill Lokali tal-Gudja- R. Caruana Street, Gudja (Triq R. Caruana, il-Gudja)

• Il-Kunsill Lokali tal- Gzira - Rue D'Argens, Gzira (Triq D'Argens, il Gzira)

• Il-Kunsill Lokali tal- Hamrun- St. Joseph High Street, Hamrun (Triq il-Kbira San Guzepp, il -Hamrun)

• Il-Kunsill Lokali tal-Iklin- Romancers Path, Iklin (Trejqet ir-Rumanziera, l-Iklin)

• Il-Kunsill Lokali tal-Kalkara- Salvatur Estate, Kalkara (Binja Salvatur, il-Kalkara)

• Il-Kunsil l Lokali Ta' Kercem- Orvieto Square, Kercem, Gozo (Pjazza Orvieto, Ta' Kercem, Ghawdex)

• Il-Kunsill Lokali ta' Hal Kirkop- St. Benedict Street, Kirkop (Triq San Benedittu, Hal Kirkop)

• Il-Kunsill Lokali ta' Hal Lija- R. Mifsud Bonnici Street, Lija (Triq R. Mifsud Bonnici, Hal Lija)

• Il-Kunsill Lokali ta' Hal Luqa- St. Paul's Stree t, Luqa (Triq San Pawl, Hal Luqa)

• Il-Kunsill Lokali tal-Marsa- Balbi Street, Marsa (Triq Balbi, il-Marsa)

• Il-Kunsill Lokali ta' Marsaskala (Wied il- Ghajn) - Salini Street, M'Skala (Triq is-Salini Wied il- Ghajn)

• Il-Kunsill Lokali ta' Marsaxlokk- V. Cassar Street, M'Xlokk (Triq V. Cassar, Marsaxlokk)

• Il-Kunsill Lokali tal- Mellieha-New Mill Street, Mellieha (Triq il- Mithna- l Gdida, il- Mellieha)

• Il-Kunsill Lokali tal- Imgarr - Sir Harry Luke Street, Mgarr (Triq Sir Harry Luke, l Imgarr)

• Il-Kunsill Lokali tal-Mosta- Constitution Street, Mosta (Triq il-Kostituzzjoni, il-Mosta)

• Il-Kunsill Lokali tal-Imqabba- Parish Street, Mqabba (Triq il- Parrocca, l-Imqabba)

• Il-Kunsill Lokali tal-Imsida- Church Street, Msida (Triq il-Knisja, l-Imsida)

• Il-Kunsill Lokali tal-Imtarfa- Maltese Regiments Street, Mtarfa (Triq ir- Regimenti Maltin, l-Imtarfa)

• Il-Kunsill Lokali tal-Munxar- Profs. G. Aqulina Street, Munxar, Gozo (Triq il- Prof. G. Aquilina, il- Munxar, Ghawdex)

• Il-Kunsill Lokali tan-Nadur- North Street, Nadur, Gozo (Triq it-Tramuntana, in- Nadur, Ghawdex)

• Il-Kunsill Lokali tan-Naxxar- 21 September Avenue, Naxxar (Vjal il- Wiehed u Ghoxrin ta' Settembru, in-Naxxar)

• Il-Kunsill Lokali ta' R ahal Gdid- Sir Paul Boffa Garden, Church Street, Paola (Gnien Pawlu Boffa, Triq il- Knisja, Rahal Gdid)

• Il-Kunsill Lokali ta' Pembroke- Alamein Street, Pembroke (Triq Alamein, Pembroke)

• Il-Kunsill Lokali Tal-Pietà- K. Mifsud Street, Pietà (Triq K. Mifsud, Tal-Pietà)

• Il-Kunsill Lokali tal-Qala- Bishop M. Buttigieg Street, Qala, Gozo (Triq l-Isqof M. Buttigieg, il-Qala, Ghawdex)

• Il-Kunsill Lokali tal-Qrendi- Church Street, Qrendi (Triq il-Knisja, il-Qrendi)

• Il-Kunsill Lokali tar-Rabat- Hospital Street, Rabat (Triq l-Isptar, ir-Rabat, Malta)

• Il-Kunsill Lokali ta' Hal Safi- School Street, Safi (Triq l- Iskola, Hal Safi)

• Il-Kunsill Lokali ta' San Giljan -Forrest Street, St Julians (Triq Forrest, San Giljan)

• Il-Kunsill Lokali ta' San Gwann- R. Caruana Dingli Street, San Gwann (Triq R Caruana Dingli, San Gwann)

• Il-Kunsill Lokali ta' San Lawrenz- Our Lady of Sorrows Street, St. Lawrence, Gozo(Triq id- Duluri, San Lawrenz, Ghawdex)

• Il-Kunsill Lokali ta' San Pawl il- Bahar- St. Paul's Street, St. Paul's Bay (Triq San Pawl, San Pawl il-Bahar)

• Il-Kunsill Lokali Ta' Sannat- Sannat Road, Sannat, Gozo (Triq Sannat, Ta' Sannat Ghawdex)

• Il-Kunsill Lokali ta' San ta Lucija- Faqqani Estate, Sunflower Street, St. Lucia (Binja Tal-Faqqani, Triq il- Girasol, Santa Lucija)

• Il-Kunsill Lokali ta' Santa Venera- St. Joseph High Street, St. Venera (Triq il-Kbira San Guzepp, Santa Venera)

• Il-Kunsill Lokali ta' Tas-Sliema- Depiro Street, Sliema (Triq Depiro, Tas-Sliema)

• Il-Kunsill Lokali tas-Swieqi- St. Andrews' Road, Swieqi (Triq Sant' Andrija, is- Swieqi)

• Il-Kunsill Lokali ta' Hal Tarxien -St. Mary's Street, Tarxien (Triq Santa Marija, Hal Tarxien)

• Il-Kunsill Lokali ta' Ta' Xbiex- Mradd Street, Ta' Xbiex (Triq l-Imradd, Ta' Xbiex)

• Il-Kunsill Lokali tax- Xaghra- 8 September Avenue Xaghra, Gozo (Vjal it

• -Tmienja ta' Settembru, ix- Xaghra, Ghawdex)

• Il-Kunsill Lokali tax-Xewkija- Tingi Tower Street, Xewkija, Gozo (Triq it-Torri Tingi. ix- Xewkija, Ghawdex)

• Il-Kunsill Lokali tax- Xghajra- E. Ellul Street, Xghajra (Triq E. Ellul, ix, Xghajra)

• Il-Kunsill Lokali taz- Zebbug, Ghawdex -Church Street, Zebbug, Gozo (Triq il-Knisja, iz- Zebbug)

• Il-Kunsill Lokali taz –Zurrieq- P.P. Saydon Street, Zurrieq (Triq Pietru Pawl Saydon, iz- Zurrieq)

4.0 . How the proposed portal works

4.1. The proposed solution is a web-based portal, administered by the LCA, which is made available to multiple stakeholders who are directly, or indirectly, interested in the safety of chemicals during transportation in Malta and Gozo. Effectively, the tool will link stakeholders in a platform that allows for good collaboration between National Agencies, Competent Authorities and Designated Bodies and even Local Councils and local communities.

4.2 An additional benefit of the tool is that it will allow for research and development. The rich content, continuously updated, will enable users to conduct an online research work, thus promoting awareness, education and improvement in this vital aspect of community safety.

4.3

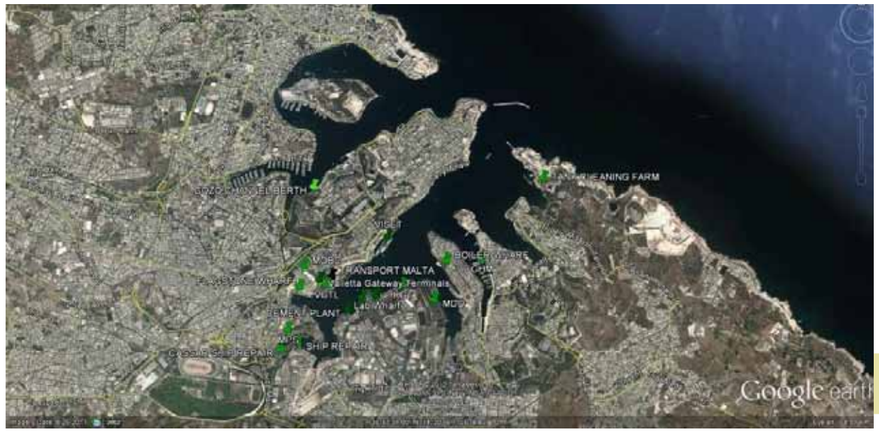
Members

- in this interface registered members are given access by means of an access controlled and secured user name and password. Once in the system, members will be able to utilize the interactive features of the tool which will allow them to:

• Seek information;
• Gain access to checklists;
• Evaluate compliance;
• Source best practice and
• Even complete chemical risk assessments if needed.

Figure 2 – User Interface - Members

4.4. Local Councils



- In this interface, registered LCs will be able to utilize all the interactive tools within the system to gain risk management information on the chemical and transportation hazards in their respective zones. Based on an ubiquitous web-based platform like Google Earth or similar applications, subscribers will be able to map their locations with relevant data in layers.

Figure 3 – Google Earth Plot showing Valletta Port Facilities

4.5. Key Stakeholders - In this interface, registered LCs will be able to utilize all the interactive tools within the system to gain risk management information on the chemical and transportation hazards in their respective zones. Based on a ubiquitous web-based platform like Google Earth or similar applications, subscribers will be able to map their locations with relevant data in layers. Very importantly, each facility will be represented with a Unique Spatial Code [USC]

4.6 Very importantly, each facility will be represented with a Unique Spatial Code [USC] which will contain all the essential information relating to compliance and emergency response arrangements. USCs will be made available to authorized parties on the basis of access control

.

4.7 Planning- In this interface, members will be able to access online to conduct risk assessments, complete safety Checklists, or even evaluate their level of statutory compliance by means of checklists specific to particular laws and regulations. Utilizing a Google earth interface, the various types of members will be able to enhance the logistical planning. Through this interface users at various levels of the tool evaluate the logistical and chemical aspects in their areas of interest, thus improving safety all round.

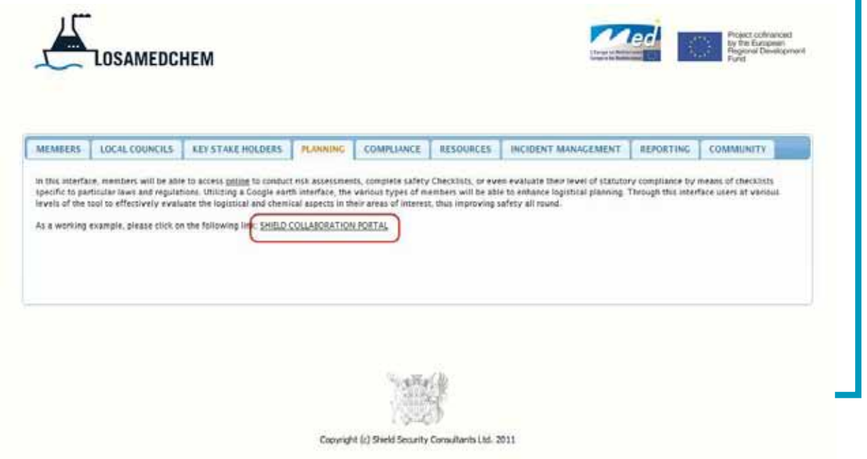


Figure 4 – User Interface - Planning

4.8

Compliance - In this interface, members will be able to evaluate compliance with legal and regulatory aspects of their respective operations. By accessing an interactive Compliance Map, users will be able to assess their performance in relation to regulatory compliance.Compliance will also work in conjunction with the UTCs in 4.6 above and facilities will be

4.9

Compliance will also work in conjunction with the UTCs in 4.6 above and facilities will be able to maintain compliance records online.

4.10

Resources - In this interface, members will gain access to best practice materials to enable them to effectively manage risk to logistical and chemical aspects. Comprising information about international standards, Codes of Practice, Guidelines other reference materials, members will be able to gain access to the right information in managing risk in logistical safety during transportation.

4.11

In this interface, specific stakeholders will be able to manage incidents. The section will contain specific contingency plans which will be activated in the event of an accident. The core idea is that this section is endorsed by MEPA, Transport Malta, OHSA, Civil Protection Department and other key stakeholders and will allow Local Councils to plan ahead for incident management taking into account safety aspects relating to their communities.

Photo 03 – Serious Chemical Fire - 2011

4.12.

Reporting- In this interface, users will be able to report accidents, incidents or even safety non-conformances to the right agency.

4.13.

Community - In this interface, users will be able to interact on safety aspects of chemical transportation and logistics safety. The interface will include blogs as well as educational material as well as (possibly) e-learning.

5.0. Financial model

5.1. Cost preliminary evaluations - 3 year plan

Ser Cost Base Euros	Year 01 – Sep 2012 to Aug 2013	
01 Further R&D co sts	CAPEX	80 000
02 Setup costs	Hosting	60 000
	Administrati n	
03 Running costs [per annum]	Maintenance	30 000
	Licences for Standards	
	Sup port	
	Total Funded Investment [Year 01]	170 000
	Year 02 – Sep 2013 to Aug 2014	
04 Year 02 -		50 000
	Year 03 – Sep 2014 to Aug 2015	
05 Year 03 -		50 000
	Total Funded Investment [Year 01 to 03]	270 000

Table 01 – Project Costs over 3 Years

5.1.1 The core idea is to generate a self-funding model.

5.1.2. Years 01 to 03 are not likely to generate profits.

5.1.3. Profits will be generated from year 3 onwards.

5.1.4. Profits to be shared proportionately between LCA, the commercial partner and a purposely set-up Community Safety Education Fund.

5.1.5. Performance accounts will be held by the Commercial Partner and are subject to independent annual audit.

5.1.6. Sponsorships by interested parties will be permitted on the basis of advertorials placed in a devoted Section within the portal. Sponsorship funds will be entered into normal accounts and subject to the same controls as in

5.1.7. Sponsors will only be permitted on the basis of a signed pact to the LOSAMEDCHEM Malta Corporate Social Responsibility Charter. This is a special purpose document which will be made available for review at the next LOSAMEDCHEM plenary meeting

.**5.1.8.** The baseline fee suggested structure is as follows: Local Councils - €195:00 [Excl. VAT] monthly, per Council;

Other Stakeholders - €250 00 Excl V T monthly, per Stakeholder

Students – Up to A-Level Studies get free access

University Students - €50 00 Excl V T per month, access provided on a per-month basis

5.2. Timeline

5.2.1. By Mar 2013 - approval by LOSAMEDCHEM and bid for funding.

6.0. Conclusions

6.1. The SWOT analysis had highlighted several key concerns in Malta, namely:

1. An urgent need for better coordination between the various stakeholders;
2. An urgent need to address the lack of stakeholder engagement;
3. A need to address the complexity surrounding multiple regulations;
4. A need to promote awareness of chemical hazards and safety in the transportation chain;
5. Other areas of concern.

6.2. Given the LC 's role within LOS MEDCHEM as a participating party, an opportunity is created to address these issues at National and Regional level.

6.3. During the course of the other Study elements, no serious initiatives contemplated by individual transporters emerged and there seems to be a general reluctance to take the lead.

6.4. The concept of a Collaboration Portal was generally well received during informal discussions with potentially interested parties.

6.5. The proposed collaboration tool would enable LCA to better engage with decision makers in designing and adopting the relevant protective, preventive and preservative strategies in securing Malta's primary transportation nodes and hubs and protect the wider Maltese community and the environment.

6.6. The model designed is sustainable, socially responsible and stands up well to Cost versus

Benefits analysis. It is equally innovative and appeals to the contemporary trends towards utilising social and interactive media for collaboration.

Glossary

AFM	Armed Forces of Malta
BATNEEC	Best Available Technology Not Entailing Excessive Costs
CPD	Civil Protection Department
ILO	International Labour Organisation
IMO	International Maritime Organisation
ISPS	International Ship and Port Facility Security Code
LCA	Local Councils Association
LOSAMEDCHEM	Logistical Safety of Chemical Transportation in the Mediterranean
MCA	Malta Communications Authority
MEPA	Malta Environmental and Planning Authority
MRA	Malta Resources Authority
MSA	Malta Standards Authority
NSO	National Statistics Office
OHSA	Occupational Health and Safety Authority
PFSA	Port Facility Security Assessment
PFSO	Port Facility Security Officer
PFSP	Port Facility Security Plan
SWOT	Strengths Weaknesses Opportunities and Threats
TM T	ransport Malta
USC	Unique Spatial Code

Feasibility Studies in the Castellón Area

Intermodal logistics center Near the Port of Castellón

Projet cofinancé par le Fonds Européen de Développement Régional
Project cofinanced by the European Regional

AUTHOR: FEPORTS

Instituto Portuario de Estudios y Cooperación de la Comunidad Valenciana

1. Introduction

Since its beginnings, the LOSAMEDCHEM project - How could the logistics and the safety of the transport of chemicals be improved in the Mediterranean area – has focused on strengthening regional cohesion between the different European chemical-producing regions in the northern Mediterranean area and between the different competent authorities involved in the transportation of chemical goods; promoting the transnational transfer of knowledge and technology with the aim of developing the optimum systems for controlling and managing freight traffic.

Along with this objective, the results of the project aim to boost intermodality and achieve higher safety standards in the activities associated with the logistics chain and transport in the chemical sector.

This project forms part of the MED Programme for Transnational Cooperation and is co-financed by the European Regional Development Fund. Its partners include various public bodies which work to boost economic activities and infrastructure and port management and study centres from Italy, Greece, Slovenia, Malta and Spain, headed by the province of Novara (Italy).

During the first phase of the project, it was carried out a SWOT analysis of the chemicals sector in each of the regions involved, with the aim of identifying their critical points and potential strengths in the immediate future. Following the results of this study, a low level of intermodality was identified in the researched area, with transport by road clearly predominating over all other modes of transport.

The above reasons led to the current phase of the project, which is to propose the design of an intermodal logistics centre in the Castellón area close to the port, thus concentrating a large percentage of the traffic in chemicals and dangerous goods in this area. The purpose is to rectify the shortfall identified by the study.

This document therefore describes the main elements that need to be included in the design and an estimation of its costs and the legal and administrative requirements that need to be complied with.

2. Feasibility study. The design of an intermodal logistics centre

The levels of industrial activity undertaken in the area of study and the absence of an intermodal logistics centre of the characteristics required have led this project to: the proposed design of an intermodal logistics centre near the Port of Castellón, which will be a key infrastructure for the industrial sector in the area, especially the chemical industry.

The following sections contain a description of the different aspects of the project, ranging from the justification for the project itself to the legal conditions to be met, together with the key technical features.

2.1. The transport of goods in the castellón area. The need for an intermodal logistics centre

The presence of industry in the province of Castellón is considerable, with significant activity in the ceramics and chemical industries. It is in this context that the Port of Castellón has been established as the gateway for the entry and the exit of goods to and from the region; with the traffic handled in 2010 being more than 12.4 million tonnes. Of these, a high percentage corresponds to chemical products and hazardous goods (more than 80%), demonstrating the vital importance of this industry to the area.

As established during the SWOT analysis, practically all the traffic related to this activity is by sea and/or road, with negligible levels of the transport of goods by rail. It is in this area where Spain has the greatest amount of work to do with regard to goods transport.

One possible reason for the scarce use of rail in goods transportion is the lack of the appropriate infrastructures in the area. Current rail services seem to be insufficient and, more specifically, are not well adapted to current needs.

The main objective of the existing Plan for the Rail Transport of Goods, part of the Generalitat Valenciana's Strategic Infrastructures Plan 2010-2020, is to increase the share of rail in the logistics market from its current level of 3% up to European levels (≈15%). The plan also seeks to improve rail access to ports, creating around 2.4 million square metres of rail facilities spread over eight logistics hubs which will handle 198,000 tonnes per day. One of these hubs will be located near the Port of Castellón.

The port has recently begun upgrading its northern connection to the general rail network managed by ADIF. Thus, the terminals in the northern expansion area of the port have access to rail transport, and they are now in operation and have a rail connection provided by the Port Authority. However, the new South Dock has no such connection, something which is essential to its future development. This is why they need a new rail facility, referred to as the southern rail connection.

Moreover, the recent inclusion by the EU of the Mediterranean Corridor in the Core European Transport Network makes the need for an intermodal logistics centre in

Castellón, included in this network and directly linked to the port, more urgent as it will enable connections to the French border and the main Mediterranean hubs.

The above leads us to the proposal for the design of an intermodal logistics hub near and directly connected to the Port of Castellón (by road and rail).

3. Center design

For reaching a proper design of such infrastructure we must take into account several aspects that will determine the future performance so as to further develop a possible proposal that meets the needs and expectations.

3.1. Design criteria

The elements to take into account for the appropriate design of an intermodal hub are as follows:

- Analysis of the current flow of goods
- Future planning
- Flexible connections to the main network (road/rail)
- Appropriate integration of the rail facilities into the terminal
- Avoidance of interference between the different modes
- Minimization of distance for goods transfer
- Integration into the surrounding area.

A final aspect to take into consideration is that the most critical factors for decision-making with regard to transport modes are specifically those related to rail, both to infrastructure and the services on offer.

3.1.1. Analysis of the current flow of goods. Opportunities for rail. Future planning

The starting point for this study was the export data for the province of Castellón, regarding to overland transport over the last five years.

Table 1. Overland exports for the province of Castellón. 2006-2010 Period. Tonnes

Transport mode	2006	2007	2008	2009	2010
Road	1,493,871.45	1,569,492.46	3,763,328.36	2,692,115.07	2,560,339.83
Rail	2,361.88	1,939.95	32,006.58	2,743.53	3,773.83
Total overland	1,496,233.33	1,571,432.41	3,795,334.95	2,694,858.60	2,564,113.66

Source: Ministry of Economy and Competitiveness. DATACOMEX. 2012

As it can be seen, road accounts for practically all overland transport for exports, with percentages above 99% in all cases. The most important destinations are France, Germany, Italy, the UK, Portugal and Poland, along with the Central European countries.

Table 2. Overland imports for the province of Castellón. 2006-2010 Period. Tonnes

Transport mode	2006	2007	2008	2009	2010
Road	629,337.95	597,241.83	844,016.25	710,607.43	1,065,377.88
Rail	772.83	2,121.58	763.83	3.99	10.80
Total overland	630,110.78	599,363.41	844,780.08	710,611.42	1,065,388.68

Source: Ministry of Economy and Competitiveness. DATACOMEX. 2012

Just as with exports, the absolute dominance of road transport for imports into the province of Castellón is clear. In this case the main countries of origin are Italy, France, Portugal, Slovenia, Germany and the UK.

As one can see, the origins and destinations of most of the foreign trade for the Castellón area coincide. This fact is of great importance for the planning and establishment of new rail freight services. This is because for such services to function, it is vital for sufficient customers to exist to ensure that the trains are not empty on their return journey, as this considerably increases costs.

Data such as the above has greatly increased the interest and efforts of government agencies, as well as a host of transport and logistics organizations and bodies, in promoting greater use of rail as a mode of goods transport. It has been identified as being one of the answers to the impending problems of congestion and pollution. This is the reason for all the policies adopted at European, national and regional levels which are aimed at increasing the share of the rail mode in the goods transport. It is in these circumstances that the Generalitat Valenciana is contemplating the possibility of improving the rail offerings to the region's industry, by studying the implementation of regular rail services.

Following the goals set out in the Strategic Plan to Promote the Transport of Goods by Rail in Spain, by the year 2020 rail is estimated to have a share of overland transport of between 8% and 10%.

Thus, taking the above hypothesis as a starting point, it is assumed that the value of such traffic will be already occurring plus a minimum of 8%, and a maximum of 10%, of the traffic currently using roads, given that the traffic attracted will come from this mode, taking the years 2009 and 2010 as reference points.

The traffic figures to be taken into account will be those of 15 countries, many of them of Central European, which register the greatest commercial export traffic flows with the province of Castellón: France, Germany, Italy, the UK, Portugal, Poland, the Netherlands, The Czech Republic, Belgium, Romania, Sweden, Croatia, Greece and Hungary. These countries will henceforth be referred to as Group 15.

Again using information provided by the Ministerio de Economía y Competitividad, the relevant data are shown in the following table:

Table 3. Overland exports from the province of Castellón to Group 15. Years 2009-2010. Tonnes 2009 2010 Total overland Road Rail Total overland Road Rail

	2009			2010		
	Total overland	Road	Rail	Total overland	Road	Rail
Group 15	2,376,029.5 t	2,373,508.32 t	2,521.18 t	2,281,924.56 t	2,278,150.83 t	3,773.73 t

Source: Ministry of Economy and Competitiveness. DATACOMEX. 2012

After consulting a number of rail operators, the goods are considered to be transported by container. A complete train is assumed to have a maximum length of 600m (the maximum length used in Spain at the current time) made up of 30 flat trucks, holding two twenty-foot containers with an average weight of 12 tonnes each (a net load of 720 tonnes), not including the locomotive.

Using the above assumptions, the number of trains and the frequency required from the rail hub to the countries indicated above would be those shown in the table below.

Table 4. Number and frequency of future rail service for exports Hypothetical 8% share Hypothetical 10% share Goods to be transported Nº of trains/year Frequency Goods to be transported Nº of trains/ year Frequency 2009 data

	Hypothetical 8% share			Hypothetical 10% share		
	Goods to be transported	Nº of trains/ year	Frequency	Goods to be transported	Nº of trains/ year	Frequency
2009 data	192,401.85 t	267	5 per week	239,872.01 t	333	1 per day
2010 data	186,025.01 t	258	5 per week	231,588.81 t	322	1 per day

Source: FEPORTS

The next step is the analysis of the traffic for the return journey, because, as explained above, an empty train on the return journey is something to be avoided at all costs, as this would make the service considerably more expensive, bringing its viability into serious question.

Using once more data provided by the Ministerio de Economía y Competitividad, this time concerning imports, the following table was obtained:

Table 5. Overland imports to the province of Castellón from Group 15. Years 2009-2010. Tonnes 2009 2010 Total overland Road Rail Total overland Road Rail

	2009			2010		
	Total overland	Road	Rail	Total overland	Road	Rail
Group 15	691,418.26 t	691,414.28 t	3.98 t	676,818.19 t	676,808.02 t	10.17 t

Source: Ministry of Economy and Competitiveness. DATACOMEX. 2012

As it can be seen, the percentage of rail traffic is practically nil, so the capture of traffic from road transport will range between 8% and 10%. Using the rest of the hypotheses employed in the case of exports, the following table was obtained.

Table 6. Number and frequency of future rail services for imports Hypothetical 8% share Hypothetical 10% share Goods to be transported Nº of trains/year Frequency Goods to be transported Nº of trains/ year Frequency 2009 data

	Hypothetical 8% share			Hypothetical 10% share		
	Goods to be transported	Nº of trains/ year	Frequency	Goods to be transported	Nº of trains/ year	Frequency
2009 data	55,317.12 t	76	2 per week	69,145.41 t	96	2 per week
2010 data	54,154.82 t	75	2 per week	67,690.98 t	94	2 per week

Source: FEPORTS.

These calculations demonstrate that the traffic flow for the return journeys is appreciably lower than those for the outgoing journeys, but they are still encouraging when one takes into account the practically non-existent use of rail for freight at the current time.

Another factor to take into account is the significant growth in container traffic at the Port of Castellón, which has doubled over the last two years (going from just over 67,000 TEUs in 2009 to more than 130,000 in 2011). This trend looks likely to continue in future, opening up new possibilities for rail.

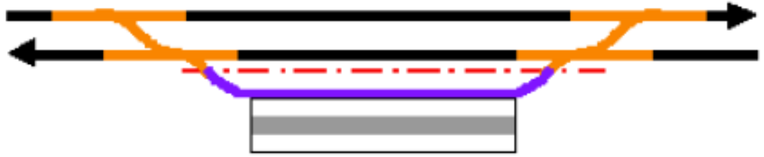
The above assumptions lead to estimate future traffic in the terminal in two daily trains.

3.1.2. Flexible connection to the main network

The connection between the main rail network and the terminal would preferably be designed in such a way as to enable the trains to access the main line in both directions. This aspect is of great importance for those nodes with feeder services, as it permits the loading and unloading of individual wagons, parts of trains or intermodal transport units en route, during the journey.

The figure below shows a possible design for a dual connection to the main network.

Figure 1. Example of a dual connection to the main rail network



Source: Network Rail.

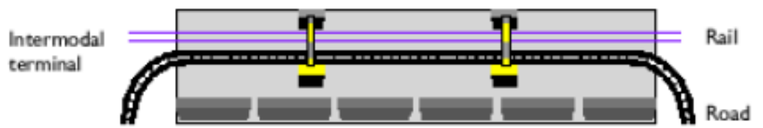
3.1.3. Appropriate integration of the rail facilities with the terminal

The correct location of the rail terminal is a key issue for the optimal functioning of an intermodal centre and its long-term use. The other areas of the centre (distribution, storage areas, depots, repair shops, etc.) must be designed around the rail facilities and not vice versa.

Longer term planning makes it advisable to allow sufficient space for rail access to the sheds built at the centre.

The following diagram shows the most usual design of an intermodal terminal.

Figure 2. Design of the integration of a rail terminal into an intermodal centre



Source: Network Rail.

3.1.4. Avoiding interference between the different modes

As the objective is to achieve maximum flexibility within the terminal regarding access to the rail facility and the other modes, it is important to avoid creating numerous points of conflict (for example, level crossings) between the different modes, since this would have negative repercussions on the functioning of the different types of traffic in the centre.

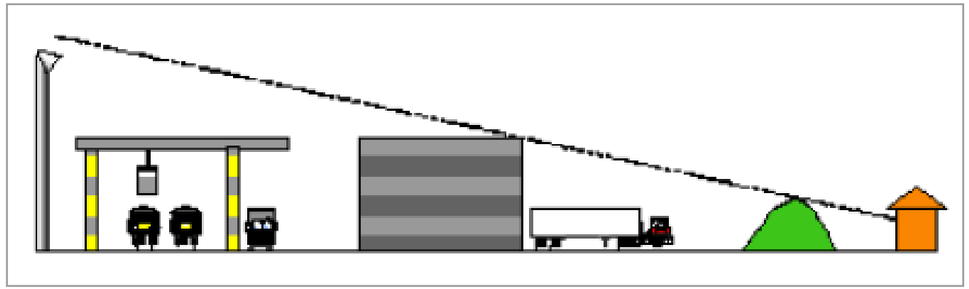
3.1.5. Minimizing the transfer distances

In centres of this kind, whose main activity is to facilitate the interchange between road and rail, the rail links must be located in such a way as to reduce the time, distance and cost of transferring the goods between the two modes. The use of concrete in the design of the platforms, including those for loading and unloading, provides flexibility as it allows both tyred and rail vehicles to use them.

3.1.6. Integration into the surrounding area

The choice of location for a centre of these characteristics must also take into account the effect it may have on the surrounding area, given that the impact on the landscape and the light and noise pollution produced by facilities of this kind is considerable. When placed near a residential area, it becomes necessary to put in place protective measures, such as barriers or screens, especially with regard to the noise produced by activity at night. Another sound option would be to locate the warehouses in the design between the rail terminal and surrounding areas, so that they act as a shield.

Table 7. Placement of the warehouses to act as a shield



Source: Network Rail.

3.2. Design proposal

The following pages describe the proposed design, taking into account the criteria mentioned above and including the following areas:

- Location
- Business park
- Industrial logistics
- Intermodal terminal
- Technical services for vehicles
- Services for users
- Parking
- Green zones
- Interior roadways

3.2.1. Location

The selection of the location for the facility is a key factor, given that the success of its operations will be largely due to the right location: one which allows quick and convenient access to the high-capacity road network in the region while at the same time being close to the main industrial and transport hubs.

The figure below shows a map of the area under consideration.

Figure 3. Map of the Castellón area

Source: Google Maps. 2012

Along with the variables mentioned above, this study also envisages the possibility of taking advantage of the existing rail infrastructure in the area by improving and expanding it. These infrastructures include:

1. Burriana-Alquerías -> Eight separate tracks, all of them electrified, five of which are of the remote-controlled interlocking type. With regard to logistics facilities, it has a yard-type warehousing of 6,923 m2.

Figure 4. Diagram of the Burriana-Alquerías rail logistics infrastructure (Castellón)

Source: Map of ADIF logistics and technical facilities. Google Earth. 2012

2. Moncófar -> The town has two yard-type storage facilities of 3,000 m2 and 500 m2 respectively. It has also an auxiliary apron of 75 m2. Moreover, it has additional services from those that would normally be available for the reception and dispatch of trains.

The following diagram shows that all the tracks are electrified with remote-controlled interlocking.

Figure 5. Diagram of Moncófar rail logistics infrastructure (Castellón)

Source: Map of ADIF logistics and technical facilities. Google Earth. 2012

3. Vila-real -> As in the previous infrastructures, all the tracks are electrified and they all have remote-controlled interlocking.

This facility has three warehouses for logistics operations: two yard-type and premises, of 800 m2, 4,000 m2 and 280 m2 respectively. It also offers additional services to the usual ones.

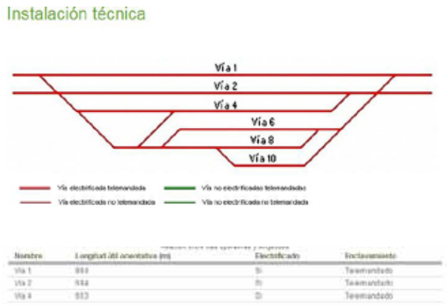


Figure 6. Diagram of Vila-real rail logistics infrastructure (Castellón)

Source: Map of ADIF logistics and technical facilities. Google Earth. 2012

However, the facilities described above have certain handicaps that make them difficult to use for developing the proposed intermodal centre:

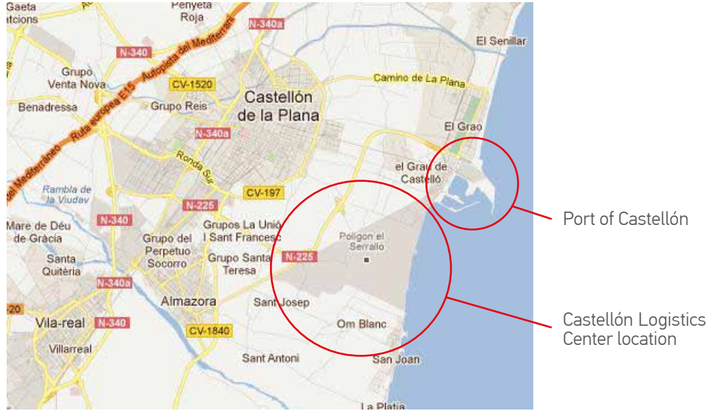
• In Burriana and Vila-real the infrastructure is very difficult to enlarge due to its location within the town centre, surrounded by buildings.

• In the case of Moncófar, although there is sufficient space for expansion, the length of the track only allows trains with a maximum length of 700 metres, while the recommendations for a centre such as the one being planned are for trains of up to 750 metres. In addition, these facilities are much further away from the Port of Castellón.

For the above reasons, the use of these particular facilities has been ruled out and the choice was made to locate the centre in a different place, as close as possible to the Port of Castellón, the established chemical industry in that area and the main hubs of the ceramic tile sector, which is a major industry in this region.

The above reasons, along with the need for easy access to the high-capacity transport network, led to the choice of the industrial estate of El Serrallo as the ideal location for the intermodal logistics centre. The map below shows its geographical location:

Figure 7. Location map of the El Serrallo industrial estate (Castellón)



Source: Google Maps – Google Earth. 2012.

Source: Google Maps – Google Earth. 2012.

This industrial estate houses the plants of various companies in the chemicals sector such as BP Oil España, Infinita Renovables, UBE Chemical, Repsol Butano and CLH. The centre is planned to be located alongside these companies.

The area to be occupied by the logistics centre is currently classified as industrial land suitable for development, as is shown in the figure below.

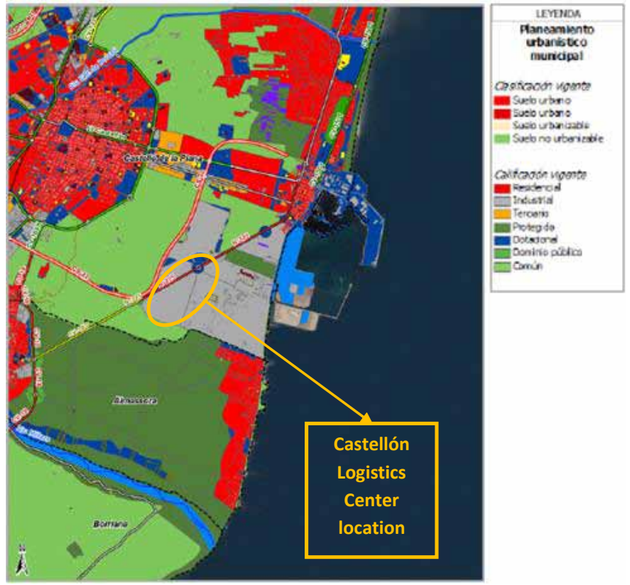


Figure 8. Urban development classification of the El Serrallo industrial estate (Castellón)

Source: Web viewer of the thematic land mapper of the Valencia Region. Ministry of Infrastructures, Territory and Environment of the Generalitat of Valencia. 2012

Figure 9. Current status of the plot

Source: Google Maps. 2012

3.2.2. Accessibility and connections

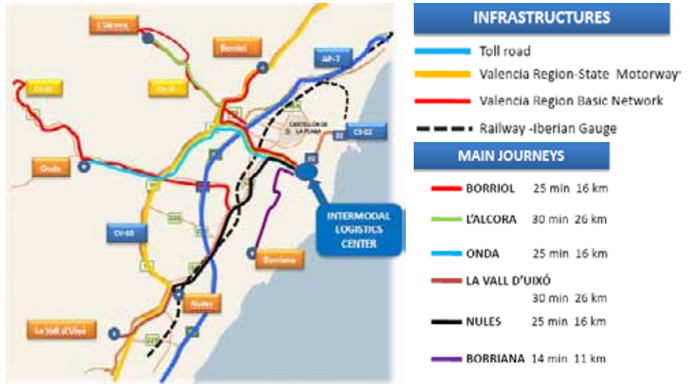
The availability of adequate accesses to the planned centre is a key aspect which will strongly influence the success of its operation. As mentioned earlier, the choice of

location had taken into consideration the proximity of high-capacity transport networks and the ease of connecting with them.

With regard to the latter criterion, the chosen location is close to the main transport routes in the province which, in turn, is connected with neighbouring regions, thus constituting the main thoroughfares.

The figure below shows the transport network in the area.

Figure 10. Transport network in the Castellón area



Source: Valencian Community: Key Logistics Region in Europe. TRANSIT Project. Ministry of Infrastructures, Territory and Environment, Generalitat of Valencia. 2011

The most important thoroughfares in this region are as follows:

• A-7/AP-7, aka Mediterranean Motorway -> Owned by the State, this motorway links the whole Mediterranean coast from the French border down to Algeciras. It is part of the European Road Network, known as Highway E-15, and is mainly made up of toll sections in this specific area, from Castellón towards the north.

• N-340, aka Mediterranean Highway -> This is the longest of the national highways, linking Cadiz with Barcelona along the whole Mediterranean coast. Together with the N-332 it offers a free alternative to the AP-7 toll motorway on the sections where they both run.

• CV-10, aka La Plana Highway ->This belongs to the highway network of the Valencian Community and is currently the busiest road, along with the N-340, as it is used to cross the province. It forms part of the A-7 highway.

• CV-16 ->Part of the highway network of the Valencian Community, links the CV-10, La Plana Highway to the inland northern areas of the province of Castellón.

• CV-18, aka Parque del Litoral Highway -> A regional highway belonging to the province of Castellón which links the CS-22, to the south of the provincial capital and to the coastal towns of Almazora, Burriana and Nules.

• CV-20 ->This is an extremely important thoroughfare in the industrial hub of the ceramics industry, which encompasses Villarreal, Onda and Alcora, known as the "Ceramics Triangle". Like the previous road, it belongs to the regional highway network of the Valencian Community.

• CS-22 ->This is one of Castellón's main urban roads and provides direct access to the Port from the N-340. It also serves as a ring road to improve access to the eastern part of the city of Castellón.

Meanwhile, the railway network in this region belongs to the line that runs from Alcázar de San Juan through Albacete, La Encina, Valencia and Castellón to Tarragona, which is a conventional electrified double-track line.

As mentioned earlier, the facilities of the Port of Castellón are 4 km away from the proposed location.

Finally, the closest operating airport is Valencia-Manises, about 80 km from the city of Castellón.

3.2.3. Business Park

The fact that there are major industrial centres in this area that generate intensive logistics activity, entails setting aside land in the centre for locating the offices and headquarters of various companies, banks, courier services, etc.

This area would be separate from the industrial logistics zone, with an estimated surface area of 40,000 m2 (4 Ha).

3.2.4. Industrial logistics zone

The organization of the movement and warehousing of materials (both raw materials and finished products), whether within or outside a company, encompasses the activities covered by the term industrial logistics. Its purpose is to supervise the efficacy of distribution and supply networks, the modes of storage and transport, the location of departments and the physical layout of premises.

Under this umbrella heading, the following areas can be distinguished:

• Loading/Unloading – Delivery/Reception

• Quarantine

• Storage/warehousing

• Packaging/Repackaging

• Cargo consolidation

Loading/Unloading – Delivery/Reception

This is the area where vehicles are loaded and unloaded. This area includes the docks and roads for transport vehicles to manoeuvre and areas for them to park.

It will be provided with specific equipment such as loading ramps to bring the docks level with the loading platforms of the vehicles and streamline processes. It is also advisable to fit roofing to protect

the area from bad weather, thus ensuring the integrity of the goods being handled and preventing any possible damage.

The estimated surface area destined for this use is 200,000 m2 (20 Ha).

Quarantine

This is the area for storing freight whose special characteristics make it a requirement for them to pass an initial analysis to ascertain their condition. This is the case for pharmaceutical and agricultural/food products.

An area of 15,000 m2 (1.5 Ha) is proposed for this activity.

Warehousing

This area is for storing freight, either permanently or temporarily (in transit). It includes areas for containerized freight as well as other goods.

It is estimated that an area of 50,000 m2 (5 Ha) would be needed for this purpose.

Packaging/Re-packaging

In some cases, the goods received need to be repackaged or repalletized in units of different sizes because of storage system's requirements, for health reasons, or for other reasons. These tasks will be carried out in an area specifically designated for this purpose, with an estimated size of 8.000 m2 (0.8 Ha).

This area is designated for grouping the cargo of different shippers destined for different consignees. An area of 20,000 m2 (2 Ha) is estimated for this purpose.

3.2.5. Intermodal Terminal

Having analysed the possible rail traffic that the centre might handle, we now turn to a description of the centre's principal characteristics. For this reason, as our point of reference is taken another such centre which is at the planning stage in Spain, the future Centro Logístico de Aranjuez (Aranjuez Logistics Centre), in the province of Madrid.

In the last quarter of 2011, the public body for rail infrastructure in Spain, Administrador de Infraestructuras Ferroviarias (ADIF), put out a public tender for the design, construction and operation of the new rail freight terminal to be called the Centro Logístico de Aranjuez. ADIF will hold 47% of the new partnership's shares, with the rest awarded to the members of the only bid submitted: a consortium of made up of AZVI (construction company and licence holder), LAMAIGNERE (international logistics operator) and ACOTRAL (logistics operator working with the supermarket Mercadona).

It is planned that this public-private partnership will be formed with 4.5 million Euros of share capital and undertakes a first stage of investment of 13.1 million Euros and a second stage of 8.5 million Euros, and will operate the Centre for 25 years. The consortium holding the licence, in partnership with ADIF, will

pay an annual fee which will increase gradually, starting at 233,158 Euros for the first year and increasing up to 1.36 million Euros in the year in which the facility opens.

The centre will cover 34 hectares (340,000m2), of which 85,000m2 will be used for the intermodal rail and road zone, with a handling capacity of 12 trains per day and up to 115,000 ITUs per year (≈172,500 TEUs).

The new facilities will possess a train yard with 3 sets of tracks for the arrival and departure of trains, each with a capacity of up to 750m, with another 3 sets of tracks for loading and unloading and a siding of sufficient length for operational purposes.

More specifically, the design includes a platform for loading, unloading and storage purposes which is 41.5 metres wide and with an initial operational length of 600 metres. A 23,400m2 container storage area is also planned for the complex, along with a storage area for empty containers of some 31,000m2, located in the area surrounding the logistics complex.

Using the above information to undertake a straightforward comparative analysis with the results from the previous section, the following can be deduced:

- The potential annual rail traffic between the province of Castellón and Europe is estimated to be in the region of 200,000 tonnes of exports and 60,000 tonnes of imports, or around 16,700 TEUs of exports (278 trains), 5000 TEUs of imports, and 11,700 empty TEUs. This comes to a total of 33,400 TEUs per year.

These 33,400 TEUs are equivalent to somewhat less than 20% of the handling capacity of the Aranjuez Logistics Centre (172,500 TEUs), and so the terminal can be scaled down to one-fifth of its size.

Following the comparison and the design criterion adopted for drawing up the preliminary project for Aranjuez, two possible designs are suggested: the first corresponds to a conventional intermodal terminal, similar to others currently operating in Spain, which corresponds to complete train services. The second corresponds to an automated terminal, similar to those in other European countries such as Italy. This kind of terminal is associated with a type of service – known as 'stop and go' – that is not yet very prevalent in Spain.

In both cases, it would be a multi-operator terminal, consisting of a single facility (sidings, warehousing area, equipment, etc.) managed by a single terminal operator which would offer its services (rail operations, loading/unloading, warehousing, etc.) to all the rail operators who require them.

3.2.5.1. Design 1: Intermodal terminal for complete train with vertical loading/unloading operations

The surface at this terminal is estimated at 70,000 m2. The table below shows the main technical characteristics that are considered suitable.

Table 8. Main technical characteristics for the design of the intermodal transport centre Length of tracks (m) Functionality Fan for Arrival/Departure (nº of tracks) Fan for Loading/Unloading (nº of tracks) Length of the storage yard (m) Width of the storage yard Total width (m) Total estimated surface area (Ha) 750 Parallel 2 2 750 40 90 7

Length of tracks (m)	Functionality	Fan for Arrival/ Departure (nº of tracks)	Fan for Loading/ Unloading (nº of tracks)	Length of the storage yard (m)	Width of the storage yard	Total width (m)	Total estimated surface area (Ha)
750	Parallel	2	2	750	40	90	7

Source: FEPORTS using "Estudio de Terminales Ferroviarias de Mercancías" by TRN Ingeniería. 2010

The following diagram shows a possible schematic plan for the design of the rail terminal:

Figure 1. Schematic design of the rail terminal

Source: FEPORTS.

Apart from the information provided in the table, and as can be seen in Figure 1, once the design in parallel of the two fans of tracks has been established (for arrival/departure and loading/unloading), it would be also necessary to build a siding up to 450 metres long for marshalling purposes. There would also be an area of 7500m2 for the storage of empty containers.

The image below shows a section of the loading/unloading area.

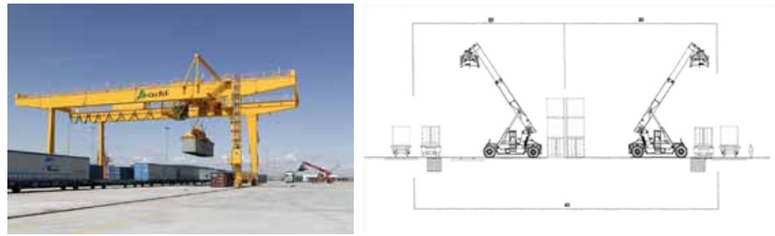


Figure 1. Loading/unloading intermodal platform section type

Source: FEPORTS.

To conclude this section, a list of the machinery necessary for the terminal to operate effectively is below:

- 1 gantry crane.
- 1 crane for empty containers.
- 2 cranes for the handling of containers.
- Auxiliary machinery (fork-lift trucks, sweepers, etc.

The described design uses technology and media commonly used in Spain, associated to developed traffic in this country. However, there is another possibility related to a new technology, which optimizes loading/unloading operations at the terminal by horizontal movements.

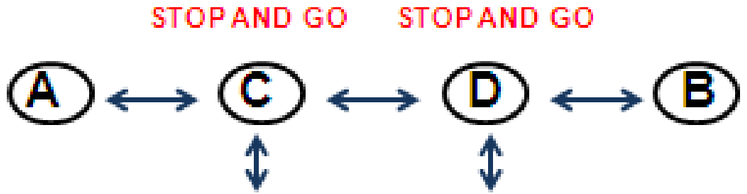
Thus, below are some characteristics that present a terminal of this type.

3.2.5.2. Design 2: Automated 'stop and go' terminal with horizontal loading/unloading

The composition of this type of terminal is associated with a freight transport system by rail that is similar to the regular passenger service, whereby the goods are loaded at one station and unloaded at another, which is known as a multi-train station.

The network is made up of different transport services – composed and fixed routes – where it is possible to load or unload freight and even change trains at intermediate points along the route. This scheme provides greater flexibility than the current complete-train services.

Figure 2. Diagram showing how the 'stop and go' service works



Source: Metrocargo. 2012.

The design of this terminal is based on the possibility of loading/unloading directly at the electrified track, without having to manoeuvre onto different tracks for the composition/decomposition of the convoy. This means that the loading and unloading of the transport units would be done horizontally.

Therefore, the factors that determine the planning of this kind of facility are:

- Location parallel to the railway tracks, and speed of operations
- High level of automation
- Adapts to any intermodal cargo unit and type of convoy
- Operation under the high voltage contact line if the train needs to be decomposed.

The table below shows the main features of the proposed automated rail terminal.

Table 1. Main features of the automated intermodal terminal Length of tracks (m) Fan for loading/unloading (no. tracks) Platform for loading/unloading (no.) Modules (no.) Width of the loading/unloading area (m) Total width (m) Total estimated surface area (Ha) 750 1 2 2 21.5 63 4.8

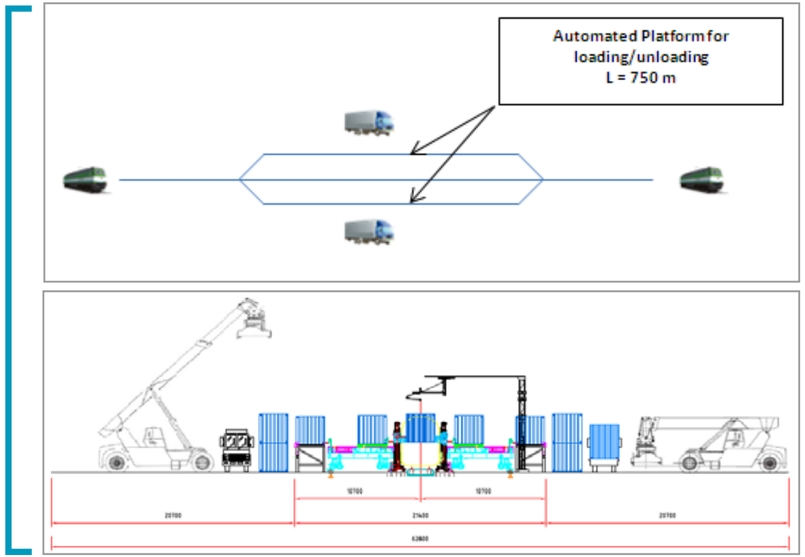
Length of tracks (m)	Fan for loading/ unloading (no. tracks)	Platform for loading/ unloading (no.)	Modules (no.)	Width of the loading/ unloading area (m)	Total width (m)	Total estimated surface area (Ha)
750	1	2	2	21.5	63	4.8

Source: FEPORTS.

As in the case of the conventional terminal, an area of 7,500 m2 is planned for depositing the empty containers.

The following figure shows a possible diagram of the planned intermodal terminal, taking into account the previous considerations.

Figure 3. Diagram of the design of the automated intermodal terminal



Source: FEPORTS based on information from Metrocargo. 2012. Figures in mm.

The automated platforms shown in the above diagram are made up of different modules, each of them comprising:

- 4 towers -> With independent movement, constituting the elevation system. These can identify and raise the cargo unit of the railway wagon in front of them.

Their synchronized movement allows for precise handling by identifying the positions of the corners of the cargo units (containers and swap-bodies).

Each tower is equipped with an independent PLC panel (Programmable Logic Controller), a wireless communications system, motor drivers, hoisting and transfer activation systems, and control and security systems.

- 1 transfer tank -> This comprises two semi-trailers that move parallel to the railway track. Each of them has a device for mobile trans-shipment which moves perpendicularly to the track.

Like the towers, they are equipped with electrical power control, PLC distribution and coordination, and a communications system.

The position of the semi-trailers can be adjusted depending on the size of the freight units that need to be handled.

• 1 warehouse dock -> The docks of the warehouse structures are made from steel and are large enough to house all sizes of freight units. They are equipped with fixed devices for centring freight and position sensors.

The number of docks will depend on the operations expected to take place in the terminal.

All the above elements can support freight units of up to 40 tonnes in weight.

The picture below shows a mock-up of a typical platform of these characteristics.

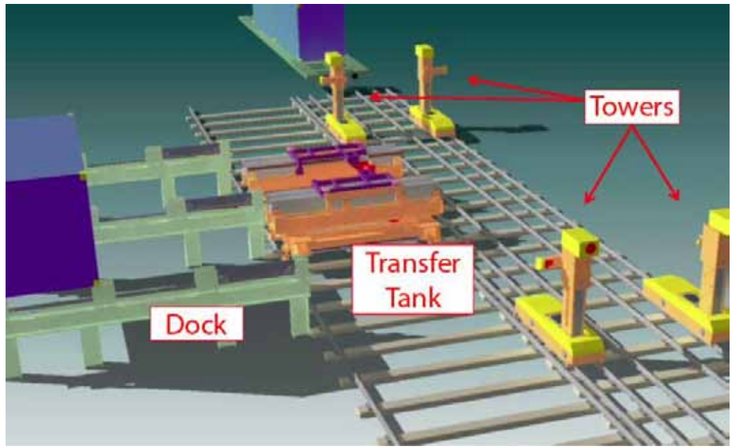


Figure 4. Mock-up of an automated platform with horizontal loading/unloading

Source: Metrocargo, 2012

In addition, this type of terminal has auxiliary systems whose purpose is to ensure the optimum operation of the platforms during loading and unloading operations:

• Control room -> The system is controlled in a single facility where all the management, control and supervision systems are housed. Its purpose is to provide the operating personnel with information and it is equipped with an intuitive graphic interface.

• Programming -> This refers to secondary-level control and is responsible for dispatching and the programming of activities with the aim of keeping handling time to a minimum.

• Automation -> The coordination PLC acts as an interface between the programming system and the loading/unloading modules of the trains, sending out commands for action.

• Convoy reconnaissance portal -> This searches for the freight unit and identifies the ISO code by means of an optical character recognition system (OCR). The information on the composition of the train is sent to the control room, where it is processed.

• Active security system -> Using advanced software, this allows the whole operations area to be controlled to ensure the total safety of personnel, blocking operations in the event of any danger.

3.2.6. Technical services area

This area is for the maintenance and repair of cargo units (containers, swap-bodies, etc.) and transport vehicles (trucks, etc.).

The area for cargo units will be equipped as follows:

• Mechanical workshop for repairing, welding and painting.

• Facility for washing and disinfecting containers and swap-bodies.

• The area for vehicles will be equipped with:

• Mechanical repair workshop

• Washing facility for industrial vehicles

• Washing centre for the internal and external washing of tanker trucks.

• Service stations

The total surface area designated for these activities is 30,000 m2 (3 Ha).

3.2.7. General services area

This area will house the services for different users and clients of the centre, including the following areas:

• Restaurants, hotels and other hospitality premises

• Rest areas for drivers

• Training centre

• Primary school

An area of 15,000 m2 (1.5 Ha) will be set aside for this purpose

3.2.8. Parking area

Another large area of the centre will be set aside for the parking of both regular cars and heavy goods vehicles.

Regional legislation in this respect makes it mandatory to have a parking space for heavy goods vehicles for every 1,500 m2 of industrial land for development (both public and private). In this specific case, 150 parking spaces of different sizes are planned, concentrated on a plot close to the general services area. Of these, 25 will be earmarked for vehicles that carry dangerous goods. This facility will be equipped with a 24-hour, 365-day security system of cameras and a microphonic cable intrusion detection sensor.

In view of the above, a total area of 25,000 m2 (2.5 Ha) will be set aside for this facility.

3.2.9. Green zone

In accordance with the current legislation of the Valencian Community on urban development, Urban Development Law 16/2005, of 30 December 2005, of the Generalitat of Valencia (LUV) states in Article 67 it is necessary to be provided a green zone of more than 10% of the total surface area. Therefore an area of 62,000 m2 (6.2 Ha) will be set aside for this purpose.

3.2.10. Internal roads

Finally, an area will be set aside for the internal roads in the centre. The internal road system is understood to refer to the series of public elements and spaces reserved for the movement and transport of people and freight. An area of 60,000 m2 (6 Ha) is designated for this purpose.

3.2.11. Total surface area of the facility

Following the above descriptions for the different uses and activities of the centre and the surface area designated for each, the following table summarises the main characteristics of each area.

Table 2. Distribution of the surface area of the logistics centre by use. Use Surface (m2) 1 – Business area 40,000

Use	Surface (m2)
1 – Business area	40,000
2 – Industrial logistics area	293,000
Loading/Unloading – Delivery/Reception	200,000
Quarantine	15,000
Storage	50,000
Packaging/Repackaging	8,000
Cargo consolidation	20,000
3 – Intermodal terminal: complete train/stop and go*	77,500 / 55,500
4 - Technical services area	30,000
5 - General services area	15,000
6 - Parking area	25,000
7 - Green zone	62,000
8 - Internal roads	60,000
TOTAL	**602,500 / 580,500***

*Source: FEPORTS. * In designing the terminal, two different options are proposed: the first for a traditional complete-train terminal; and the second for a 'stop and go' terminal with horizontal loading/unloading for a multi-station train.*

The figure on the next page shows a map with the estimated surface area of the terminal in colour.

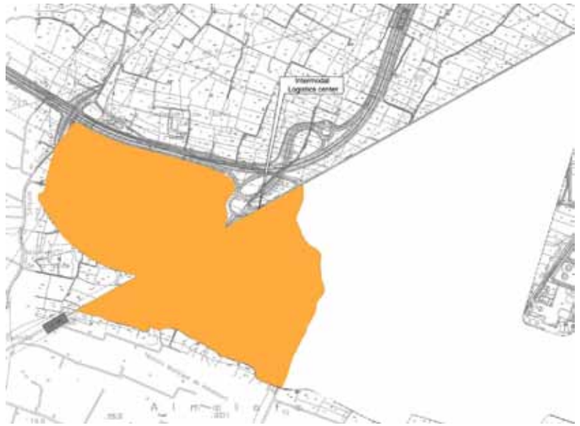


Figure 5. Map of the proposed intermodal logistics centre.

Source: FEPORTS.

4. Administrative procedure

Currently, infrastructure of this type is developed by means of the creation of public-private partnerships, in which several companies participate (such as for the future Centro Logístico de Aranjuez).

Public-private partnerships are used as a means of co-operation between governmental bodies and the private sector for the development and modernization of key public infrastructure and services. It enables enhanced economic and social performance of infrastructures, improved distribution of profits; and the funding costs are shared in an appropriate manner during the useful life of the infrastructure.

In this way, the governmental body awards (by means of a limited tender) the design, construction and operation of the centre to a consortium for a period of 25-30 years, after which it becomes the property of the governmental body.

The public body, ADIF, has a stake which ranges between 25%-49% in the initial share capital, with the rest being held by the private consortium.

The public body which provides the land for the construction of the centre, will receive a fee from the new partnership, linked to its level of activity.

It is estimated that the whole process of the design, limited tender, construction and launch of the service at the centre will take a maximum of 3 years.

5. Economic and financial analysis

Having described the technical characteristics, we will now make an economic and financial analysis of the execution and start-up of the centre, taking into account the necessary investments, the potential revenue and finally the estimation of the project's feasibility.

5.1. Initial investment

The new logistics centre near the Port of Castellón, which is intended as a specialized intermodal centre, will require an investment divided between the following concepts:

• Purchase of the land **->** considering a unitary market price of 36 €/m2, the following investment will be required:

-> In the case of the proposal for a traditional railway terminal (a larger surface area), the area designated for developing the logistics centre would cost 21,690,000 €. This amount includes the expropriation of land and the other administrative formalities. It should also be pointed out that the amount corresponding to the area of the intermodal terminal (77,500 m2) will be provided by ADIF (Spanish Administrator of Railway Infrastructures), which amounts to 2,790,000 €. Thus the private consortium responsible for operating the centre would require to invest 18,900,000 €;

-> In the case of a 'stop and go' rail terminal (smaller in size), the cost of buying the land is estimated at 20,898,000 €. As in the previous case, this amount includes the process of expropriating the land and other necessary administrative processes. Once again, the amount corresponding to the area of the intermodal terminal (55,500 m2) will be provided by ADIF (Spanish Administrator of Railway Infrastructures), amounting to 1,998,000 €. Thus the private consortium responsible for operating the centre would need to spend 18,900,000 €, as in the previous case.

• Urban development of the land **->** this includes reconversions, roads and the provision of services. The estimated unit price of this urban development is 41 € per m2, which comes to a total of:

-> 24,702,500 € in the case of a traditional terminal, or

-> 23,800,500€ in the case of a 'stop and go' terminal

• Intermodal terminal **->** as indicated throughout this study, a differentiation has been made between the following designs:

-> Traditional terminal for complete trains **->** with an estimated investment of 10,000,000 €, and

-> Terminal for multi-station stop and go trains with horizontal loading/unloading ☒ in this case, the bulk of the investment comes to 6,000,000 €.

• Machinery for the terminal **->** this includes the cost of buying the machinery for the operations to be carried out at the terminal:

-> Traditional terminal: One gantry crane (3,500,000 €), two pneumatic cranes for handling containers (reach-stackers) and one crane for handling empty containers (reach-stacker), plus all the other material for terminal operations. The total comes to 5,000,000 €.

-> 'Stop and go' terminal: Two reach-stacker cranes for handling full containers and another reach-stacker for empty containers. This cost would come to 1,500,000 €.

• Other **->** the costs of the different administrative processes required, estimated at 0.1% of the initial investment, which would come to:

-> 58,603 € in the case of a traditional terminal, or

-> 50,201 € in the case of a 'stop and go' terminal

The table below shows a summary of the above figures.

Table 3. Investment needed to develop the centre Concept Investment (€) Complete train Terminal Stop and go Terminal

Concept	Investment (€)	
	Complete train Terminal	**Stop and go Terminal**
Land Acquisition	18,900,000	18,900,000
Urbanization	24,702,500	24,702,500
Intermodal Terminal	10,000,000	10,000,000
Intermodal Terminal Equipment	5,000,000	5,000,000
Other	58,603	58,603
TOTAL	**58,661,103**	**58,661,103**

Source: FEPORTS.

5.2. Anticipated revenue

Once the centre has been developed, revenue is anticipated from the following sources: the use of the intermodal railway terminal's facilities by different operators; the sale and rental of plots of land; and the adjudication of concessions to run certain activities in the rest of the area.

Having studied various Spanish logistics centres and the real estate market in the area in question, the following prices have been established for commercializing the land:

• 150 € and m2 in the case of sales the land for sale is estimated at 80% of the total area designated for business activities (business park, logistics area and service area). Thus income from these sales is estimated at 45,360,000 €, as shown in the following table.

Table 4. Maximum revenue from the sale of land

Concept	Investment (€)
Total area for sale (302,400 m²)	45,360,000)

Source: FEPORTS.

• 8 € per m2 per year for rentals **->** the remaining 20% of the land set aside for business activities would be leased. The annual income generated from this would amount to 604,800 €.

• 15-year concession of the parking area for heavy goods vehicles having consulted various centres of this type that are currently in operation, a fee of 1,500 € per month is estimated, giving a total of 18,000 € per year.

The table below sums up the revenue generated by rentals and concessions.

Table 5. Maximum annual income from rentals and concessions

Concept	Investment (€)
Total area for rent (75,600 m2)	604,800
Concession of the HGV parking area	18,000
TOTAL	**606,600**

Source: FEPORTS.

• Rates for using the facilities of the intermodal terminal:

• Fee for Parking and Use of Station Platforms -> if the terminal is regarded as Type 2, according to ADIF's Network Statement, this would give the following results:

Table 6. Fee for Parking and Use of Platform Stations Fraction between 15 to 45 min or for each 5 min additional Fraction between 45 to 120 min or for each 5 min additional From 120 min or for each5 min additional €/train 1.08 1.63 2.16

	Fraction between 15 to 45 min or for each 5 min additional	Fraction between 45 to 120 min or for each 5 min additional	From 120 min or for each5 min additional
€/train	1.08	1.63	2.16

Source: ADIF Network Statement. 2012.

In case of a complete-train terminal, with traffic of two trains per day and an average stopover of six hours each, this would produce an annual revenue of 76,877 €.

However, in case of a 'stop and go' terminal, the average stopover of the train is 1.5 hours (90 min). In case of two trains per day, the revenue from this charge would amount to 1,190 €.

• Fee for the Provision of Services that Require Authorization for the Use of Public Domain Railways as this is urbanized land, the ADIF Network Declaration of 2012 establishes a fee of 0.65 € per m2 per month.

- For the complete-train terminal, taking into account an area in the public domain for handling freight of 67,500 m2 (30,000 m2 of cargo platform, 30,000 m2 of warehousing and 7,500 m2 for empty containers), the monthly revenue would come to 43,875 €, i.e. 526,500 € per year.

- For the 'stop and go' terminal, with a total area of 55,500 m2 (48,000 m2 of loading/unloading platform and warehousing and 7,500 m2 for empty containers), the monthly revenue would come to 36,075 €, with 432,900 € per year.

• Additional services -> the different additional services as published in the ADIF Network Statement for 2012 are given below:

• Operations associated with the reception or dispatch of trains (SC-1): 36.55 € per service.

Bearing in mind that traffic of two trains per day is expected, i.e. two services in each case (one of access and the other dispatch), we estimate 1,460 services per year, providing annual revenue of 53,363 €.

• Shunting manoeuvres (SC-4B/5B):

- Complete-train terminal: Type B, for operators who wish to operate with full trains; in the event that they might want to aggregate or disaggregate trains in any particular facility, they would pay individually for each train and/or shunting manoeuvre.

With vehicle – 115.20 € per train

Without vehicle – 24 € per train

Estimating each type at 50%, and in view of traffic of one train per day, this would provide annual revenue of 25,404 €.

- 'Stop and go' terminal: Type A, for operators who want to do an unlimited number of aggregation/disaggregation procedures of wagons in the facility.

With vehicle – 278 € per train

Without vehicle – 91.45 € per train

Estimating each type at 50% and in view of traffic of two trains per day (the formation of trains in this case entails both loading and unloading), this would provide annual revenue of 134,849 €.

• Handling intermodal transport units (ITU): the following table shows the rates established by ADIF for 2012.

Table 7. Rates for handling Intermodal Transport Units (ITU) Between 0 to 2 days in transit Between 3 to 7 days in transit Excess of 7 days in transit * Additional handling for more than 7 days in transit €/ ITU 21.00 38.00 6.00 21.00

	Between 0 to 2 days in transit	Between 3 to 7 days in transit	Excess of 7 days in transit *	Additional handling for more than 7 days in transit
€/ITU	21.00	38.00	6.00	21.00

*Source: ADIF Network Statement 2012. *Amount to be paid per ITU and extra day after the seventh day.*

It is assumed that 30% of the ITUs moved per year would be warehoused for an average of 3 days, thus producing annual revenue of 332,880 € per year.

• Traction current supply:

Freight train – 2,369 € per GTK

Single locomotive – 2,369 € per GTK

Management (per MWh) – 1.12 € MWh

Estimating the GTK (Gross Tonne Kilometres) at 12 million per year and taking the equivalence of 24.2 Wh per GTK, the result is the following: 28,428 €, plus 325 € in management fees, making a total of 28,753 € per year.

• Fuel supply:

Fuel – 1,370 €/l (regional average)

Management fee – 0.021 €/l

Pumping fee – 0.0194 €/l

- Complete-train terminal: assuming the hypothesis of filling the tank of trains starting from the terminal, and taking into account the traffic estimates in section 3.1.1 of two trains per day, it is estimated that seven trains would leave the terminal each week. Considering a total of 3,000 litres of fuel per convoy, this would come to a total of 1,095,000 litres per year. This supply would have an approximate value of 1,544,388 €.

- 'Stop and go' terminal: the fuel supply in this case would be much lower, given that the convoy would be making various stops along its route. The assumption of filling one quarter of the tank in 30% of trains per year would result in 328,500 litres and hence an annual value of approximately 463,317 €.

The following table shows a summary of the annual revenue anticipated from terminal operations.

Table 8. Annual revenue anticipated from the provision of services by the intermodal terminal

Concept	Investment (€)	
	Complete train Terminal	Stop and go Terminal
1 – Parking and use of platforms	7,877	1,190
2 – Public rail	526,500	432,900
3 – Additional services	1,984,788	1,018,162
Access/Despatch	53,363	53,363
Shunting manoeuvers	25,404	139,849
Handling of ITUs	332,880	332,880
Traction supply	28,753	28,753
Fuel supply	1,544,388.	463,317
TOTAL	**2,588,165**	**1,452,252**

Source: FEPORTS.

5.3. Other benefits to be included in the economic evaluation. Internalization of external costs

This section details the savings that can be expected to be included in the economic feasibility analysis: variations in the cost of accidents and impacts on the environment.

The external effects associated with the implementation of an infrastructure like the one being proposed, should be taken into account when making a cost-and-benefit analysis to decide upon investments. In this case, the implementation would entail a reorganization and adjustment of the demand for transport. This adjustment would be translated in general terms to a transfer of freight from other modes of transport to the new infrastructure, as mentioned earlier.

The European Commission has published a Green Paper entitled "Towards Fair and Efficient Pricing in Transport" (1995) to make railways more profitable, which features the external costs associated with road and rail transport.

In 2004, the INFRAS institute and IWW at the Karlsruhe University in Switzerland published an updated version of the study External Costs of Transport in Europe which contains data for 2000. The results for road and rail transport systems are shown in the following table.

Table 9. External transport costs of freight traffic by road and rail Concept Freight traffic (€/1,000 GTK) Road (heavy-duty vehicles) Train

Concept	Investment (€)	
	Road (heavy-duty vehicles)	Train
Accidents	4.8	0.0
Noise	4.9	3.2
Air pollution	38.3	8.3
Climate change	12.8	3.2
Nature and landscape	2.0	0.3
Urban effects	1.1	0.5
Additional costs	7.4	2.4
TOTAL	**71.3**	**17.9**

Source: External Costs of Transport in Europe. Updated version 2004. INFRAS/IWW.

It should be noted that these kinds of figures are taken into account when evaluating the execution of linear transport infrastructures, not on-off ones. Meanwhile, although the development of the centre would entail the transfer of freight from road to rail, it would also be associated with the generation of heavy goods traffic on adjacent roads, which would lead to an increase in external costs.

Below there are the hypotheses used to calculate the savings obtained from reducing external costs.

• Traffic transferred from road to rail is estimated at 305,000 tonnes per year (section 3.1.1).

• 70% of rail traffic either originates in or is being sent abroad, with an average journey of 1,800 km; the other 30% takes place within Spain, with an average journey of 350 km.

• The number of heavy goods vehicles that would access the centre every day is estimated at 503 (see Annex I). Each of them is estimated to be carrying a load of 12 tonnes and making an average journey of 100 km.

Thus the savings from the transfer of freight transport from road to rail are estimated as follows:

(71.3-17.9) €/(1,000 tkm) x [305,000 t/year x (0.7 x 1,800+0.3*350)km]= 22,231,755 €/year

Meanwhile, the traffic of heavy goods vehicles generated by the development of the centre would entail an increase to external costs as shown below:

Overall, the net savings would be.

71.3 €/(1,000 tkm) x [(503 hgv/day x 12 t/hgv x 365 days/year) x 100 km]= 15,708,388.20 €/year

5.4. Maintenance and service costs

This section calculates the maintenance and service costs that would be entailed by the intermodal centre every year. For calculating this, various logistics depots that are already in operation were consulted. The results were as follows:

Fees for the Public-Private Collaboration Agreement **->** The consortium responsible for operating the centre will need to pay the public body an annual fee associated with the following activities:

• A fixed fee for occupancy of the Intermodal Zone (RFZI): estimated at 250,000 € per year. This would be payable from the beginning of works.

• A variable fee for Intermodal Activity (RVZI): 1.5% of the annual revenue generated by this activity. This would be payable from the date the centre starts operating.

In the case of the complete-train terminal, this amount is estimated at 38,823 €, and in the case of the 'stop and go' terminal, at 21,784 €.

• A variable fee for Logistics Activities (RVZAL): 16% of the annual revenue generated by these activities, which is associated with the sale, rental and concession of logistics land. As in the previous case, this would be payable from the date the centre goes into service.

The table below shows the amounts of the fees mentioned above.

Table 10. Annual fees payable to the public body (ADIF).

Concept	Fees (€)	
	Complete Train Terminal	**Stop and go Terminal**
Intermodal Area Occupancy	250,000	250,000
Intermodal Activity	38,823	21,784
Logistics Activity*	7,357,248	7,357,248
Sale of land	7,257,600	7,257,600
Rent of land	96,768	96,768
Concession of HGV area	2,880	2,880
TOTAL*	**7,646,071**	**7,629,032**

*Source: FEPORTS. * The fees for the sale and rental of land have been calculated on the assumption that this would take place during the first year of operation, which, when analysing the feasibility of the project, would be spread over the concession period.*

• Maintenance of installations **->** This would be necessary for the optimum operation of logistics activities and is estimated at 0.50% of the initial investment per year.

• Miscellaneous services **->** This includes utilities such as electricity, water and gas and waste collection. This is estimated at around 1% per year of the initial investment in starting up the centre.

• Fuel consumption **->** The annual cost of supplying diesel fuel to the terminal is estimated at 1,250,000 € in the case of a complete-train terminal and 371,000 in the case of a 'stop and go' terminal.

• Labour **->** A workforce of 20 people is considered necessary (including the staff of the intermodal terminal), with a gross salary of 30,000 € per year.

• Annual depreciation of the facility **->** The assumption is for depreciation over 25 years, the duration of the operating concession (zero residual value).

5.5. Feasibility analysis

Following the economic evaluation described above, the feasibility analysis of the project was made, calculating the Net Present Value (NPV) and the Internal Rate of Return (IRR). This calculation is based on the following assumptions: Concept Fees (€) Complete Train Terminal Stop and go Terminal

• As mentioned throughout the study, two different scenarios are under analysis: the first concerns a complete-train terminal, and the second a 'stop and go' terminal with horizontal loading/unloading.

• The construction and start-up would be done over a three-year period, the first corresponding to 10% of the total investment, the second to 60%, and the third to the remaining 30%.

• The sale and rental of land is estimated to be completed within five years, as follows:

- Year 1 **->** 20%
- Year 2 **->** 25%
- Year 3 **->** 40%
- Year 4 **->** 10%
- Year 5 **->** 5%

• The concession for operating the heavy goods vehicle parking area will be formalized during the first year of operation of the centre.

• Annual inflation is estimated at 3%.

• Two different scenarios will be established in terms of NPV profitability: 4.5% and 6%.

• Two different analyses will be made: the first without considering external costs, and the second including them.

5.5.1. Scenario 1: Complete-train terminal with vertical loading/unloading

The results of the feasibility analysis are given below:

Without considering external costs

Table 11. Profitability indicators in euros

NPV to 4.5 %	NPV to 6 %	IRR
-28,791,820.96	-31,820,221.16	-13.85 %

Source: FEPORTS.

NPV to 4.5 % NPV to 6 % IRR

- 28,791,820.96
- 31,820,221.16
- 13.85 %

As we can see, the profitability of the centre is negative over the period under consideration. In this respect, the following factors should be pointed out:

The infrastructure designed has an evidently social objective above and beyond an economic one. For this reason a public-private collaboration is planned, to the point where, in the case of the Valencian Community, the Public Administration is responsible for managing these kinds of centres.

The rates taken for operating the intermodal terminal are those currently applied by ADIF (Spanish Administrator of Railway Infrastructures), the public body. It would seem obvious that the rates applied by a private entity would be geared more towards making a profit and hence would be higher, thus resulting in higher profits from the activities in the centre.

Including external costs

Table 12. Profitability indicators in euros

NPV to 4.5 %	NPV to 6 %	IRR
9,325,782.89	1,524,387.14	16.89 %

Source: FEPORTS.

The figures in the above table demonstrate the importance of these kinds of infrastructures for social benefit, because by taking them into account in the economic evaluation, the profitability increases considerably.

The tables on the following pages show the calculations of the different profit factors of the project in greater detail. NPV to 4.5 % NPV to 6 % IRR

Table 13. Scenario 1: Complete-train terminal with vertical loading/unloading – Calculation of profitability WITHOUT CONSIDERING EXTERNAL COSTS. In Euros.

Inflation	Period	Infrastructure investment	Public-Private Contract shares	Faclility maintenance	Miscellaneous services	Fuel	Staff	Depreciation	Land safe	Land rent	Granting HGVs Area	Intermodal Terminal services	Total
	2,012	-5,866,110.30	-250,000.00										-6,116,110.30
	2,013	-35,196,661.80	-250,000.00										-35,446,661.80
	2,014	-17,598,330.90	-250,000.00										-17,848,330.90
1.03	2,015		-1,762,576.08	-293,305.52	-586,611.03	-1,250,000.00	-600,000.00	-600,000.00	9,072,000.00	120,960.00	18,000.00	2,588,165.00	8,469,208.46
1.03	2,016		-2,194,203.31	-302,104.68	-604,209.36	-1,287,500.00	-618,000.00	-600,000.00	11,680,200.00	155,736.00	18,540.00	2,665,809.95	11,108,471.91
1.03	2,017		-3,430,366.76	-311,167.82	-622,335.64	-1,326,125.00	-636,540.00	-600,000.00	19,248,969.60	256,652.93	19,096.20	2,745,784.25	18,774,334.51
1.03	2,018		-1,122,382.82	-320,502.86	-641,005.71	-1,365,908.75	-655,636.20	-600,000.00	4,956,609.67	66,088.13	19,669.09	2,828,157.78	4,287,471.15
1.03	2,019		-742,184.00	-330,117.94	-660,235.88	-1,406,886.01	-675,305.29	-600,000.00	2,552,653.98	34,035.39	20,259.16	2,913,002.51	1,847,405.91
1.03	2,020		-338,163.12	-340,021.48	-680,042.96	-1,449,092.59	-695,564.44	-600,000.00	0.00	0.00	20,866.93	3,000,392.58	-743,461.96
1.03	2,021		-348,308.01	-350,222.12	-700,444.25	-1,492,565.37	-716,431.38	-600,000.00	0.00	0.00	21,492.94	3,090,404.36	-747,765.82
1.03	2,022		-358,757.25	-360,728.79	-721,457.57	-1,537,342.33	-737,924.32	-600,000.00	0.00	0.00	22,137.73	3,183,116.49	-752,198.79

Source: FEPORTS

Table 14. Scenario 1: Complete-train terminal with vertical loading/unloading – Calculation of profitability INCLUDING EXTERNAL COSTS. In Euros.

Inflation	Period	Infrastructure investment	Public-Private Contract shares	Faclility maintenance	Miscellaneous services	Fuel	Staff	Depreciation	Land sale	Land rent	Granting HGVs Area	Intermodal Terminal services	External costs savings	Total
	2,012	-5,866,110.30	-250,000.00											-6,116,110.30
	2,013	-35,196,661.80	-250,000.00											-35,446,661.80
	2,014	-17,598,330.90	-250,000.00											-17,848,330.90
1.03	2,015		-1,762,576.08	-293,305.52	-586,611.03	-1,250,000.00	-600,000.00	-600,000.00	9,072,000.00	120,960.00	18,000.00	2,588,165.00	6,523,366.80	14,992,575.26
1.03	2,016		-2,194,203.31	-302,104.68	-604,209.36	-1,287,500.00	-618,000.00	-600,000.00	11,680,200.00	155,736.00	18,540.00	2,665,809.95	6,719,067.80	17,827,539.71
1.03	2,017		-3,430,366.76	-311,167.82	-622,335.64	-1,326,125.00	-636,540.00	-600,000.00	19,248,969.60	256,652.93	19,096.20	2,745,784.25	6,920,639.84	25,694,974.35
1.03	2,018		-1,122,382.82	-320,502.86	-641,005.71	-1,365,908.75	-655,636.20	-600,000.00	4,956,609.67	66,088.13	19,669.09	2,828,157.78	7,128,259.03	11,415,730.18
1.03	2,019		-742,184.00	-330,117.94	-660,235.88	-1,406,886.01	-675,305.29	-600,000.00	2,552,653.98	34,035.39	20,259.16	2,913,002.51	7,342,106.80	9,189,512.72
1.03	2,020		-338,163.12	-340,021.48	-680,042.96	-1,449,092.59	-695,564.44	-600,000.00	0.00	0.00	20,866.93	3,000,392.58	7,562,370.01	6,818,908.05
1.03	2,021		-348,308.01	-350,222.12	-700,444.25	-1,492,565.37	-716,431.38	-600,000.00	0.00	0.00	21,492.94	3,090,404.36	7,789,241.11	7,041,475.29
1.03	2,022		-358,757.25	-360,728.79	-721,457.57	-1,537,342.33	-737,924.32	-600,000.00	0.00	0.00	22,137.73	3,183,116.49	8,022,918.34	7,270,719.55

Source: FEPORTS.

5.5.2. Scenario 2: 'Stop and go' terminal with horizontal loading/unloading

The results of the feasibility analysis are shown below:

Without considering external costs

Table 15. Profitability indicators, in euros

NPV to 4.5 %	NPV to 6 %	IRR
-20,294,760.82	-23,330,950.71	-7.75 %

Source: FEPORTS.

As in Scenario 1, the profitability of the centre is negative over the period under analysis. Once again, the conditions that should bear in mind in relation to this project are:

- The proposed infrastructure has a clearly social purpose above and beyond the economic one.
- The rates used for operating the intermodal terminal are those currently applied by ADIF (Spanish Administrator of Railway Infrastructures), the public body, which are lower than those that would be applied by a private organization whose sole purpose is the financial profit.

Including external costs

Profitability indicators, in euros

Table 16. Profitability indicators, in euros

NPV to 4.5 %	NPV to 6 %	IRR
17,822,843.04	10,013,657.60	23.10 %

Source: FEPORTS.

Once again, the figures shown in the above table highlight the importance of the social benefit to this kind of infrastructure, significantly increasing its profitability.

The tables on the following pages show the different profit factors of the project in greater detail.

Table 17. Scenario 2: 'Stop and go' terminal with horizontal loading/unloading – Calculation of profitability WITHOUT EXTERNAL COSTS. In Euros

Inflation	Period	Infrastructure investment	Public-Private Contract shares	Faclility maintenance	Miscellaneous services	Fuel	Staff	Depreciation	Land safe	Land rent	Granting HGVs Area	Intermodal Terminal services	Total
	2,012	-5,025,070.10	-250,000.00										-5,275,070.10
	2,013	-30,150,420.60	-250,000.00										-30,400,420.60
	2,014	-15,075,210.30	-250,000.00										-15,325,210.30
1.03	2,015		-1,745,537.38	-293,305.52	-586,611.03	-371,000.00	-600,000.00	-300,000.00	9,072,000.00	120,960.00	18,000.00	1,452,252.00	8,512,295.46
1.03	2,016		-2,176,653.45	-302,104.68	-604,209.36	-382,130.00	-618,000.00	-300,000.00	11,680,200.00	155,736.00	18,540.00	1,495,819.56	11,143,851.52
1.03	2,017		-3,412,290.41	-311,167.82	-622,335.64	-393,593.90	-636,540.00	-300,000.00	19,248,969.60	256,652.93	19,096.20	1,540,694.15	18,801,775.51
1.03	2,018		-1,103,764.18	-320,502.86	-641,005.71	-405,401.72	-655,636.20	-300,000.00	4,956,609.67	66,088.13	19,669.09	1,586,914.97	4,306,735.37
1.03	2,019		-723,006.80	-330,117.94	-660,235.88	-417,563.77	-675,305.29	-300,000.00	2,552,653.98	34,035.39	20,259.16	1,634,522.42	1,858,248.07
1.03	2,020		-318,410.60	-340,021.48	-680,042.96	-430,090.68	-695,564.44	-300,000.00	0.00	0.00	20,866.93	1,683,558.09	-741,294.54
1.03	2,021		-327,962.92	-350,222.12	-700,444.25	-442,993.40	-716,431.38	-300,000.00	0.00	0.00	21,492.94	1,734,064.84	-754,533.37
1.03	2,022		-337,801.80	-360,728.79	-721,457.57	-456,283.20	-737,924.32	-300,000.00	0.00	0.00	22,137.73	1,786,086.78	-768,169.38

Source: FEPORTS.

Table 18. Scenario 2: 'Stop and go' terminal with horizontal loading/unloading – Calculation of profitability INCLUDING EXTERNAL COSTS. In Euros

Inflation	Period	Infrastructure investment	Public-Private Contract shares	Faclility maintenance	Miscellaneous services	Fuel	Staff	Depreciation	Land sale	Land rent	Granting HGVs Area	Intermodal Terminal services	External costs savings	Total
	2,012	-5,025,070.10	-250,000.00											-5,275,070.10
	2,013	-30,150,420.60	-250,000.00											-30,400,420.60
	2,014	-15,075,210.30	-250,000.00											-15,325,210.30
1.03	2,015		-1,745,537.38	-293,305.52	-586,611.03	-371,000.00	-600,000.00	-300,000.00	9,072,000.00	120,960.00	18,000.00	1,452,252.00	6,523,366.80	15,035,662.26
1.03	2,016		-2,176,653.45	-302,104.68	-604,209.36	-382,130.00	-618,000.00	-300,000.00	11,680,200.00	155,736.00	18,540.00	1,495,819.56	6,719,067.80	17,862,919.32
1.03	2,017		-3,412,290.41	-311,167.82	-622,335.64	-393,593.90	-636,540.00	-300,000.00	19,248,969.60	256,652.93	19,096.20	1,540,694.15	6,920,639.84	25,722,415.35
1.03	2,018		-1,103,764.18	-320,502.86	-641,005.71	-405,401.72	-655,636.20	-300,000.00	4,956,609.67	66,088.13	19,669.09	1,586,914.97	7,128,259.03	11,434,994.41
1.03	2,019		-723,006.80	-330,117.94	-660,235.88	-417,563.77	-675,305.29	-300,000.00	2,552,653.98	34,035.39	20,259.16	1,634,522.42	7,342,106.80	9,200,354.87
1.03	2,020		-318,410.60	-340,021.48	-680,042.96	-430,090.68	-695,564.44	-300,000.00	0.00	0.00	20,866.93	1,683,558.09	7,562,370.01	6,821,075.47
1.03	2,021		-327,962.92	-350,222.12	-700,444.25	-442,993.40	-716,431.38	-300,000.00	0.00	0.00	21,492.94	1,734,064.84	7,789,241.11	7,034,707.73
1.03	2,022		-337,801.80	-360,728.79	-721,457.57	-456,283.20	-737,924.32	-300,000.00	0.00	0.00	22,137.73	1,786,086.78	8,022,918.34	7,254,748.97

Source: FEPORTS.

6. Mobility plans for new facilities of particular importance

The implementation of uses, services and residential units with particular importance, in relation to their capacity to generate or attract demand for mobility should be preceded by the formulation of a specific mobility plan, as in this case.

Mobility plans relating to these facilities should evaluate the demand associated with the new implementation. They should also indicate the solutions in terms of addressing them in relation to the principle of a pedestrian/cycle connection with the closest urban centres and the adequate provision of public transport in relation to motorized modes of transport as a whole.

To study the location of the logistics centre, we examined the stops or stations of the basic elements of the public transport system of the Valencian Community and the municipality in question, these being understood as fulfilling three requirements simultaneously:

- Acceptable frequency, at least one service every 15 minutes.
- Sufficient capacity to handle at least 50% of the demand for transport associated with the new location.
- A system of connections that guarantees a reasonable journey time to and from the service area of the proposed facility as a whole.

The mobility plan should also provide the appropriate solutions for connecting to the public transport system, either by changing or extending existing services or by creating feeder services, dissuasive parking and other similar measures. The plan's proposals should include the infrastructural needs associated with these actions and an evaluation of their costs as well as the inherent recompense for providing a public service, if needed. In both cases they would be payable by the developer of the new facility.

In addition to the above, and taking into consideration the fact that there will be distances of more than one kilometre between some of the activity hubs of the centre, services will need to be set up for internal transport to ensure convenient mobility and access for people who do not have their own vehicle.

Finally, it should be noted that it is the responsibility of the competent transport authority to approve the planned mobility plans, which should be issued before the granting of the licence or approval of the project or planning instrument that authorises the development of the facility. This procedure should be resolved in a maximum of two months, subject to a report from the relevant town or city council.

7. Environmental impact assessment

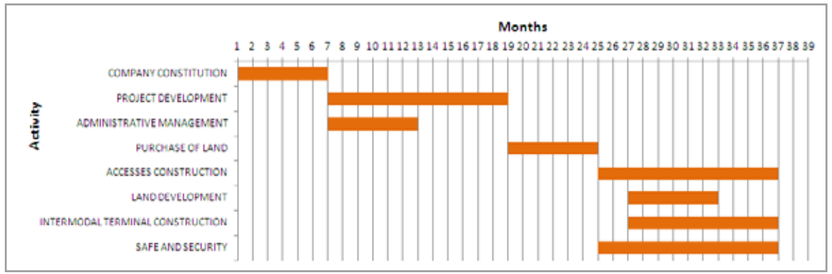
The development of the intermodal logistics centre will be subject to the issue of a favourable Environmental Impact Statement which is conditional upon compliance with the following conditions:

- In accordance with article 11 of Law 4/1998 of 11 June 1998 of Valencian Cultural Heritage, a favourable report must be obtained from the General Directorate of Language Policy and Cultural Heritage of Valencia, proving compliance with the provisions in the abovementioned mandatory and binding report.
- Before the definitive approval of the project, a favourable report must be obtained from the Júcar Water Authority or the authorized collaborating organization (justifying the source). This concerns the availability of water resources in sufficient quantity and quality for the forecast consumption arising from the development of the facility, as established in article 19.2 of Law 4/2004, of 30 June 2004, on Regional Planning and Environmental Protection.
- Likewise, a favourable report must be submitted to the relevant Authority prior to the definitive approval of the project from the Hydraulic Resources Division of the General Directorate of Public Works of the Ministry of Infrastructures, Transport and the Environment, stating compliance with the relevant provisions.
- All the industrial activities that will be taken place in the logistics centre, detailed in the Annexes of the Regulation enforcing Law 2/89 on Environmental Impacts must obtain the relevant favourable Environmental Impact Statement which is essential to obtain the corresponding works and business licences. Likewise, the City Council will supervise the legality of all the activities set up in its municipality to check that they have the relevant authorizations and comply with the conditions imposed, where applicable, by the relevant Environmental Impact Statement.
- The City Council will require the companies responsible, after the completion of works, to submit the relevant certificates for the reception of Inert Solid Waste by the landfills or companies authorized to handle this type of waste, in accordance with the instructions on waste selection in the Report by the Regional Environmental Service of the Regional Land and Housing Directorate of Castellón.

8. Development and start-up Plan

The last point in this study sets out the development and execution plan of the Centre which is shown as a timeline with the major tasks to be undertaken.

Figure 6. Plan of the start-up of the Intermodal Centre



Source: FEPORTS.

The above table shows the actions that will need the longest timescale, these being drawing up the plans and the construction of the access roads and the intermodal terminal. The total time period estimated for putting the centre into service is 36 months.

Annex I – Traffic Study

Based on the information on heavy goods vehicle traffic on nearby roads with access to the logistics centre where the facility will be located, an estimation of the number of tankers using these roads can be made. To make this calculation, we had used the traffic survey conducted at another centre, the CTIA in Bailén (Jaen), so as to extrapolate in a similar way the number of trips generated/attracted by the planned logistics centre.

Firstly, considering the location of the centre, we had analysed the traffic volumes recorded in the vicinity. To do so, the following graph shows the traffic monitoring stations on the access roads to the centre, identified on the Traffic Map 2008 of the General Directorate of Traffic.

Figure 7. Location of the Intermodal Logistics Centre and nearby traffic monitoring stations

Source: Google Maps 2012. Traffic Map 2008. General Directorate of Traffic.

The above figure highlights the following traffic monitoring stations close to the logistics centre:

- Station CS-68-2 **->** A secondary station located on the CS-22 highway at KP 3.09, hence belonging to the Provincial Council of Castellón.
- Station E-89-0 **->** A permanent station located at KP 6.19 on the CS-22 highway which belongs to the Provincial Council of Castellón. It has only data relating to 2008.
- Station CS-67-2 **->** A secondary station belonging to the Ministry of Public Works, located at KP 49.2 on the N-225 highway.

Taking into consideration the above stations, and based on the data provided by the traffic maps of the Ministry of Infrastructures, Territory and Environment, we have also taken into account the following monitoring station:

- Station CV-183-010 **->** Monitoring station located on the CV-183 highway, part of the Highway Network of the Valencian Community.

Shown below is a table summarising the ADT (Average Daily Traffic) figures for the 2006-2008 period for each station and the percentage of heavy goods vehicles in each year.

Table 9. ADT and percentage of heavy goods vehicles recorded by traffic monitoring stations close to the intermodal logistics centre.

STATION	2006	2007	2008
E-89-0	18,497 (7.62%)	18,095 (15.41%)	18,064 (13.98%)
CS-68-2	-	-	18.346 (19.1%)
CS-67-2	4,361 (7.56%)	4,483 (9.17%)	4,067 (9.17%)
CV-183-010	5,300 (4%)	6,346 (7%)	6,314 (4%)

Source: Traffic Map 2008. General Directorate of Traffic. Ministry of Infrastructures, Territory and Environment of the Valencia Region.

Taking as a basis the percentages of heavy goods vehicles recorded at each station over the 2006-2008 period, an average percentage of heavy goods vehicles can be established for consideration in future years at each station, obtaining an average of the recorded figures. The results obtained are as follows:

- Station E-89-0 -> p = 12.3%
- Station CS-68-2 -> p = 19.1%
- Station CS-67-2 -> p = 8.6%
- Station CV-183-010 -> p = 5%

The methodology for making a traffic forecast in newly-developed areas is based on forecasting the future traffic as the sum of two components:

- The traffic that can be expected if no new urban development is undertaken; the simple natural evolution of traffic in the area for global or general reasons (changes in motorization rates, income indicators, the cost of fuel, etc.), and
- The additional traffic generated by the new urban development; in this case the intermodal logistics centre.

Natural evolution of traffic volumes

In the first case, based on the data from the previous table, a traffic hypothesis for the coming years was made.

Analysing the stations on the CS-22 highway, it can be seen that the first one, E-89-0, recorded a slight drop in traffic during the first year it was in service (-2.2%). Next year remains more or less constant (-0.1%). In the case of the second station, CS-68-2, as shown above, records are only available for one year: 2008.

Station CS-67-2, on the N-225, recorded a traffic increase of 2.8% between 2006 and 2007, which dropped by 9.3% the following year (2008).

Finally, the last of the stations mentioned above recorded an increase, of nearly 20%, between 2006 and 2007 before dropping by 0.5% the following year.

According to the Analysis of access conditions to general points of interest in the Valencian Community conducted by FEPORTS in 2008, for most of the access roads to the Port of Castellón an increase in traffic of around 3% was forecast between 2010 and 2020.

In view of the above, it should be noted that the data used for this study had not yet taken into consideration the opening of the access highway CS-22. So the figures do not exactly match the current situation although they can be used as a reference. We can thus assume an increase in traffic over the coming years of 3% per year up to 2015, and then 2% up to 2020.

Thus the forecast ADTs up to the target year of the access infrastructures of the stations in question are shown in the following table.

Table 10. ADTs forecast for the traffic monitoring stations close to the centre

STATION	2012	2015	2022
E-89-0	20,331	22,216	25,520
CS-68-2	20,649	27,750	31876
CS-67-2	4,577	6,152	7,066
CV-183-010	7,106	9,550	10,971

Source: FEPORTS.

Traffic generated by the development of the intermodal logistics terminal

To analyse the impact on traffic generated by the development of the planned intermodal logistics terminal, we resorted to studies on this subject conducted in the English-speaking world, specifically North America. The Federal Highway Administration (FHA), the Institute of Transportation Engineers (ITE) and the states of California, Florida and Oregon, amongst others, have published manuals of the methodology to be used. It is worth emphasising, and the manuals themselves make a point of this, that these methodologies are essentially empirical and use as starting data those that are usually available at the planning stage (distribution of land according to different activities and population densities).

Thus the methodology used to study the traffic generated by the new urban development planned in the area would be that proposed firstly by the Trip Generation Manual of the city of San Diego; and secondly that of the Institute of Transportation Engineers (ITE). Taking into account the areas planned for the different usages of the logistics centre, an empirical calculation has been made of the number of trips associated with the centre's activities.

1. Trip Generation Manual of the San Diego Municipal Code

In accordance with the Section 3.2.11 of this study, the planned uses are shown in the following table.

Table 11. Urban distribution of the Intermodal Logistics Centre in Castellón

Use	Surface (m2)
1 – Business area	40,000
2 – Industrial logistics area	293,000
Loading/Unloading – Delivery/Reception	200,000
Quarantine	15,000
Storage	50,000
Packaging/Re-packaging	8,000
Cargo consolidation	20,000
3 – Intermodal terminal: complete train / stop & go*	77,500 / 55,500
4 - Technical services area	30,000
5 - General services area	15,000
6 - Parking area	25,000
7 - Green zone	62,000
8 - Internal road	60,000
TOTAL	**602,500 / 580,500***

*Source: Drawn up by FEPORTS. *In designing the terminal, two alternatives have been proposed: the first for a traditional complete-train terminal and the second for a 'stop and go' terminal with horizontal loading/unloading horizontal for a multi-station train.*

The table below shows the number of trips generated in accordance with the area available for different urban development uses similar to those of the planned logistics centre, as featured in the Trip Generation Manual for San Diego for working days.

Table 12. Trip generation according to urban development use. Trip Generation Manual USE Rate

USE	Rate of generated trips (trip/acre)
Industrial/Business Park	200
Small Industrial Park	120
Large Industrial Park	100
Warehousing	60
Truck Terminal	80
Transit Station (rail)	300

Source: Trip Generation Manual. Land Development Code. San Diego Municipal Code. 2003

Therefore, by classifying the uses identified in the logistics centre in line with those in the manual and shown in the above table, and given that 1 acre = 4,046.85 m2, the results are as follows:

- Business Park and General Services Area **->** Industrial business park **->** 55,000 m2 = 13.59 acres
- Loading/Unloading, Quarantine, Packaging/Repackaging, Cargo Consolidation and Technical Services Area **->** Smaller industrial park **->** 243,000 m2 = 60.05 acres
- Warehousing **->** Warehousing **->** 50,000 m2 = 12.36 acres
- Intermodal terminal **->** Transit railway station **->**

  -> Complete train terminal with vertical loading/unloading: 77.500 m2 = 19.15 acres

  '**->** Stop and go' terminal with horizontal loading/unloading: 55.500 m2 = 13.71 acres
- Parking area **->** Truck terminal **->** 25,000 m2 = 6.18 acres.

It should be noted that neither the green zone nor the internal roads have been considered as generating this kind of traffic.

Finally, calculating a weighted average, we obtain the following results:

(1) Trips= T=200*13.59 + 120*60.05 + 60*12.36 + 300*19.15 + 80*6.18= 16,905 → Complete train terminal, vertical loading/unloading

(2) Trips= T=200*13.59 + 120*60.05 + 60*12.36 + 300*13.71 + 80*6.18= 15,273 → Stop & Go terminal, horizontal loading/unloading

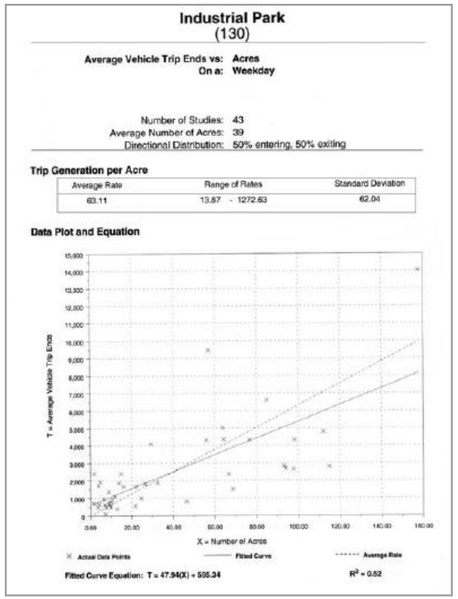
2. Trip Generation Manual of the Institute of Transportation Engineers

Detailed below, and based on the distribution of the surface area of the logistics centre to be developed, as indicated earlier, we have applied the formula of the Trip Generation Manual developed by the ITE (Institute of Transportation Engineers) in the USA to estimate the number of trips that might be generated according to the different types of land use.

In this case, following the guidelines in the abovementioned manual, the whole surface area would be classified as industrial park, applying the following formula.

(3) Trips= T= 47.94*(X)+ 595.34 X being the surface area under consideration.

The percentage of heavy goods traffic established by this formula is 8%.



Industrial Park
(130)

Average Vehicle Trip Ends vs: Acres
On a: Weekday

Number of Studies: 43
Average Number of Acres: 39
Directional Distribution: 50% entering, 50% exiting

Trip Generation per Acre

Average Rate	Range of Rates	Standard Deviation
63.11	13.87 - 1272.63	62.04

Data Plot and Equation

Table 13. Formula of the Trip Generation Manual of the Institute of Transportation Engineers (ITE) for industrial parks.

Source: Trip Generation 8th Edition. Institute of Transportation Engineers.

Considering a total surface area of:

(4) Area of the centre= X= 13.59+60.05+12.36+19.15+6.18=111.33 acres -> Complete train terminal, vertical loading/unloading

(5) Area of the centre= X= 13.59+60.05+12.36+13.71+6.18=105.89 acres -> 'Stop and go' terminal, horizontal loading/unloading

Thus the trips generated by the development of the logistics centre would be as follows:

Trips generated= T= 47.94*111.33+595.34=5,932.50 ≈5,933 -> Complete train terminal, vertical loading/unloading

Trips generated= T= 47.94*105.89+595.34=5,671.71 ≈5,672 -> 'Stop and go' terminal, horizontal loading/unloading.

If we analyse the results, there are considerable differences in terms of size, and the figure provided by the ITE manual has been chosen as this is closer to the Spanish situation. The conclusion is thus that the location of the logistics centre would generate additional traffic at peak times of 5,933 vehicles in the case of the complete train terminal with vertical loading/unloading, and 6,672 vehicles in the case of the 'stop and go' terminal with horizontal loading/unloading.

Finally, in accordance with the provisions of the methodology used in terms of heavy goods vehicles, 503 vehicles per day of this type are estimated in the target year, 2022, which represents between 8% and 9% of the total vehicles.

The figures given above will be taken as a reference for estimating the number of possible users of the washing centre.

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Feasibility Studies in the Castellón Area

Washing center for Dangerous Goods Tankers

Projet cofinancé par le Fonds Européen de Développement Régional
Project cofinanced by the European Regional

AUTHOR: FEPORTS

Instituto Portuario de Estudios y Cooperación de la Comunidad Valenciana

1. Introduction

The main objective of this study is to strengthen the regional cohesion between European chemical-producing regions in the northern Mediterranean area and between the different competent authorities involved in the transportation of chemical goods; promoting the transnational transfer of knowledge and technology with the aim of developing the optimum systems for controlling and managing freight traffic. At the same time, it aims to boost the development of intermodality and achieve higher levels of safety in transport.

The project itself known as LOSAMEDCHEM –How could the logistics and the safety of the transport of chemicals be improved in the Mediterranean area–, forms a part of the MED Programme for Transnational Cooperation co-financed by the European Regional Development Fund. It benefits from the involvement of institutions from various countries (Italy, Greece, Slovenia, Malta and Spain), headed by the Province of Novara (Italy).

The first phase of the project entailed making a SWOT analysis of the chemicals sector in each of the regions involved, enabling us to identify their weak points as well as their potential strengths and opportunities in the immediate future. As a result, and particularly in the case of the region of Castellón (Spain), it was concluded that there was a need to strengthen certain aspects such as intermodality and transport safety as a primary objective.

At this point, the project is moving on to the next phase with the development of proposals geared towards correcting or rectifying the weaknesses identified previously. It is in this precise area that an extremely interesting initiative has emerged, this being the implementation of a washing centre for cisterns and tanker trucks in the area under study, given the significant traffic in this kind of freight in this region.

This initiative will facilitate the reuse of tankers for carrying different products, reducing the time needed to clean them as they will no longer have to travel long distances to reach the nearest washing facility.

This document includes a study of the technical characteristics of a washing centre and the factors that determine its implementation.

2. Feasibility study. Installation of a washing centre for tanker trucks

Goods traffic by cisterns and tanker trucks is particularly widespread in the Castellón area. This fact makes it necessary to provide a washing centre for these vehicles.

Below is a detailed study of the requirements and characteristics for a centre of this type.

2.1. Traffic in chemicals and dangerous goods in the region: the need for a washing centre

There is constant traffic in chemical products and dangerous goods in the Castellón area since there is a flourishing chemical industry and a port with heavy traffic in this kind of freight.

The presence of BP Oil and Infinita Renovables plants in the new southern basin of the Port of Castellón, the latter of which has a potential production of 600,000 tonnes per year, the other centres in the nearby areas (UBE, etc.), and the more than notable activity of the long-established ceramics industry in this region (one of the biggest in Europe), generate a volume of traffic in chemical products of a certain type which entails the use of cisterns and tanker trucks to transport them. The nature of this kind of freight makes it essential to take stringent precautions and measures to minimize any possible risks.

In the case of tanker trucks, there is the need for comprehensive steam cleaning after use so they can be used again to transport other goods that may be chemically incompatible with the previous load, thus preventing any contamination and loss of specifications of subsequent cargoes; and at the same time improving transport safety.

In the area covered by this study there are no public facilities for this type of cleaning, the closest one being on the outskirts of the city of Valencia, in Masassanassa and Riba-roja del Turia (about 100 km away), which is why we are proposing the installation of a washing centre for dangerous goods tankers in the area of the Port of Castellón, with good connections with the industrial sector and logistics hubs already in the area and easy access for users.

At the same time, it is planned for this washing centre to be integrated in an intermodal logistics centre, thus making it even easier for vehicles to access it.

2.2. Applicable legislation and standards for designing the centre

As in most cases relating to dangerous goods that require the utmost safety systems to be observed in their handling and transport, the design of a washing centre such as the one being proposed for Castellón must adhere to the provisions of current legislation.

In this respect, the current legislation that must be complied with is as follows:

• Royal Decree 340/2010, of 19 March 2010, amending Royal Decree 948/2003, of 18 July 2003, which establishes the minimum conditions for interior system washing or degasification or depressurization facilities, and those of hazardous goods tank repair and modification facilities.

Specifically, it establishes the following requirements for washing, degasification and depressurization of hazardous goods tanks:

Article 3. Mandatory requirements for the washing, degasification and depressurization of hazardous goods tanks and their compliance with the provisions established in Chapter II.

1. Without prejudice to the provisions of applicable international treaties, the washing of the inside of tankers of dangerous goods is necessary in the following circumstances:

- Before a regular or exceptional inspection, or a non-regular inspection in accordance with current regulations.

- When there is a change to a product that is incompatible with the one previously transported.

- Before making repairs or modifications to the tanker whenever this affects the surrounding shell.

2. Degasification and depressurization shall be done in advance to Class 2 tankers that need to be repaired or modified, as well as interior washing.

3. The competent body of the Autonomous Community may exempt the washing of tankers that have contained products whose chemical characteristics make this kind of action very difficult without posing a serious risk to the personnel or for the environment in the case of intermediate inspections.

ORDER ITC/2765/2005, of 2 September 2005, amending Annexes I, II and IV of Royal Decree 948/2003, of 18 July 2003, which establishes the minimum conditions for interior system washing or degasification or depressurization facilities, and those of hazardous goods tank repair and modification facilities.

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The above regulation indicates the conditioning factors and the minimum characteristics required by these kinds of facilities and the different cleaning processes carried out in them.

2.3. Planned activity in the facility

As indicated above, this facility will be located within an intermodal logistics centre which is being developed in the proximity of the Port of Castellón. Thus the first step in designing is to estimate the existing demand for services and the number of vehicles that may potentially be users of the facility.

2.3.1. Study of traffic in the Intermodal Logistics Centre

Based on the information on heavy goods vehicle traffic on nearby roads with access to the logistics centre where the facility will be located, estimation can be made of the number of tankers using these roads. To make this calculation, we used the traffic survey conducted at another centre, the CTIA in Bailén (Jaen), to extrapolate in a similar way the number of trips generated/attracted by the planned logistics centre.

Firstly, considering the location of the centre, we analysed the traffic volumes recorded in the vicinity. To do so, the following graph shows the traffic monitoring stations on the access roads to the centre, identified on the Traffic Map 2008 of the General Directorate of Traffic.

Figure 1. Location of the Intermodal Logistics Centre and nearby traffic monitoring stations

Source: Google Maps 2012. Traffic Map 2008. General Directorate of Traffic.

The above figure highlights the following traffic monitoring stations close to the logistics centre:

• Station CS-68-2 **->** A secondary station located on the CS-22 highway at KP 3.09, hence belonging to the Provincial Council of Castellón.

• Station E-89-0 **->** A permanent station located at KP 6.19 on the CS-22 highway which belongs to the Provincial Council of Castellón. It has only data relating to 2008.

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From the above stations, and based on the data provided by the traffic maps of the Ministry of Infrastructures, Territory and Environment, we have also taken into account the following monitoring station:

• Station CV-183-010 **->** Monitoring station located on the CV-183 highway, part of the Highway Network of the Valencian Community.

Below is a table summarising the ADT (Average Daily Traffic) figures for the period 2006-2008 period for each station and the percentage of heavy goods vehicles each year.

Table 1. ADT and percentage of heavy goods vehicles recorded by traffic monitoring stations close to the intermodal logistics centre. STATION 2006 2007 2008 E-89-0 18,497 (7.62%) 18,095 (15.41%) 18,064 (13.98%)

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Taking as a basis the percentages of heavy goods vehicles recorded at each station over the period 2006-2008, an average percentage of heavy goods vehicles can be established for consideration in future years at each station, obtaining an average of the recorded figures. The results obtained are as follows:

• Station E-89-0 **->** p = 12.3%

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• The additional traffic generated by the new urban development; in this case the intermodal logistics centre.

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According to the Analysis of access conditions to general points of interest in the Valencian Community conducted by FEPORTS in 2008, there was a forecast increase in traffic around 3% between 2010 and 2020 for most of the access roads to the Port of Castellón.

From the above, it should be noted that the data used for this study had not yet taken into consideration the opening of the access highway CS-22, so the figures do not exactly match the current situation although they can be used as a reference. We can thus assume an increase in traffic over the coming years of 3% per year up to 2015, and then 2% up to 2020.

Thus the forecast ADTs up to the target year of the access infrastructures of the stations in question are shown in the following table.

Table 2. ADTs forecast for the traffic monitoring stations close to the centre STATION 2012 2015 2022 E-89-0 20,331 22,216 25,520

STATION	2012	2015	2022
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To analyse the impact on traffic generated by the development of the planned intermodal logistics terminal, we resorted to studies on this subject conducted in the English-speaking world, specifically North America. The Federal Highway Administration (FHA), the Institute of Transportation Engineers (ITE) and the states of California, Florida and Oregon, amongst others, have published manuals of the methodology to be used. It is worth emphasising, and the manuals themselves make a point of this and that these methodologies are essentially empirical and use as starting data those that are usually available at the planning stage (distribution of land according to different activities and population densities).

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1. Trip Generation Manual of the San Diego Municipal Code

In accordance with the Feasibility Study for the Intermodal Logistics Centre, the planned uses are shown in the following table.

Table 3. Urban distribution of the Intermodal Logistics Centre in Castellón Use Surface (m^2) 1 – Business area 40,000

Use	Surface (m^2)
1 – Business area	40,000
2 – Industrial logistics area	293,000
Loading/Unloading – Delivery/Reception	200,000
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4 - Technical services area	30,000
5 - General services area	15,000
6 - Parking area	25,000
7 - Green zone	62,000
8 - Internal road	60,000
TOTAL	**602,500 / 580,500***

*Source: Drawn up by FEPORTS. *In designing the terminal, two alternatives have been proposed: the first for a traditional complete-train terminal and the second for a 'stop and go' terminal with horizontal loading/unloading horizontal for a multi-station train.*

The table below shows the number of trips generated in accordance with the area available for different urban development uses similar to those of the planned logistics centre, as featured in the Trip Generation Manual for San Diego for working days.

Table 4. Trip generation according to urban development use. Trip Generation Manual USE Rate of generated trips (trip/acre) Industrial/Business Park 200

USE	Rate of generated trips (trip/acre)
Industrial/Business Park	200
Small Industrial Park	120
Large Industrial Park	100
Warehousing	60
Truck Terminal	80
Transit Station (rail)	300

Source: Trip Generation Manual. Land Development Code. San Diego Municipal Code. 2003

Therefore, by classifying the uses identified in the logistics centre in line with those given in the manual and shown in the above table, and given that 1 acre = 4,046.85 m^2, the results are as follows:

- Business Park and General Services Area **->** Industrial business park **->** 55,000 m2 = 13.59 acres
- Loading/Unloading, Quarantine, Packaging/Repackaging, Cargo Consolidation and Technical Services Area **->** Smaller industrial park **->** 243,000 m^2 = 60.05 acres
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- Intermodal terminal **->** Transit railway station **->**
  - **->** Complete train terminal with vertical loading/unloading: 77.500 m^2 = 19.15 acres
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- Parking area **->** Truck terminal **->** 25,000 m^2 = 6.18 acres.

It should be noted that neither the green zone nor the internal roads has been considered as generating this kind of traffic.

Finally, calculating a weighted average, we obtain the following results:

*(1) Trips= T=200*13.59 + 120*60.05 + 60*12.36 + 300*19.15 + 80*6.18= 16,905*

-> *Complete train terminal, vertical loading/unloading*

(2) Trips= T=200*13.59 + 120*60.05 + 60*12.36 + 300*13.71 + 80*6.18= 15,273

-> Stop & Go terminal, horizontal loading/unloading

2. Trip Generation Manual of the Institute of Transportation Engineers

Detailed and based on the distribution of the surface area of the logistics centre to be developed, as indicated earlier, we have applied the formula of the Trip Generation Manual developed by the ITE (Institute of Transportation Engineers) in the USA, to estimate the number of trips that might be generated according to the different types of land use.

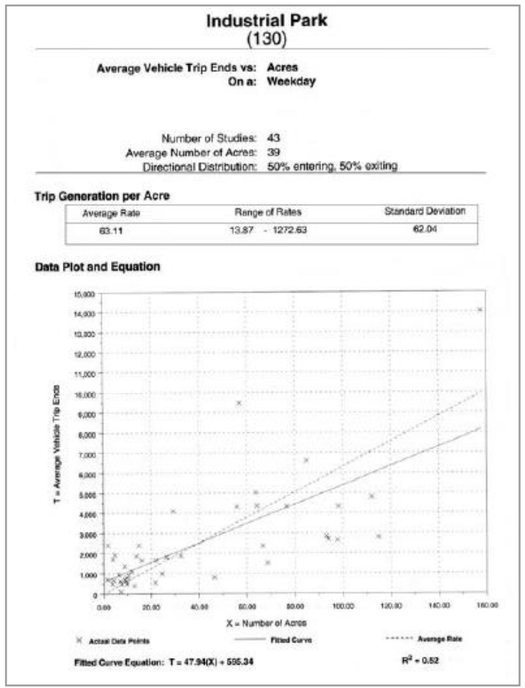
In this case, following the guidelines in the above mentioned manual, the whole surface area would be classified as industrial park, applying the following formula.

(3) Trips= T= 47.94*(X)+ 595.34 X being the surface area under consideration.

The percentage of heavy goods traffic established by this formula is 8%.

Table 5. Formula of the Trip Generation Manual of the Institute of Transportation Engineers (ITE) for industrial pa

Source: Trip Generation 8th Edition. Institute of Transportation Engineers.



Considering a total surface area of:

(4) Area of the centre= X= 13.59+60.05+12.36+19.15 +6.18=111.33 acres Complete train terminal, vertical loading/unloading

(5) Area of the centre= X= 13.59+60.05+12.36+19.15 +6.18=111.33 acres 'Stop and go' terminal, horizontal loading/unloading

Thus the trips generated by the development of the logistics centre would be as follows:

Area of the centre= X= 13.59+60.05+12.36+19.15+6.18=111.33 acres Complete train terminal, vertical loading/unloading

Area of the centre= X= 13.59+60.05+12.36+19.15+6.18=111.33 acres 'Stop and go' terminal, horizontal loading/unloading

If we analyse the results, there are considerable differences in terms of size, and the figure provided by the ITE manual has been chosen because it is closer to the Spanish situation. The conclusion is that the location of the logistics centre would generate additional traffic at peak times of 5,933 vehicles in case of the complete train terminal with vertical loading/unloading, and 6,672 vehicles in case of the 'stop and go' terminal with horizontal loading/unloading.

Finally, in accordance with the provisions of the methodology used in terms of heavy goods vehicles, this is estimated at 503 vehicles per day in the target year 2022, which represents between 8% and 9% of the total vehicles.

The figures given above will be taken as a reference for estimating the number of possible users of the washing centre.

3. Technical characteristics of the facility

This section describes in schematic form the technical characteristics of the plant facilities.

The different elements of the facility are as follows:

- Plant for the external cleaning of vehicles and tankers
- Plant for the internal cleaning of tankers
- Drying centre
- Waste management centre
- Offices
- Service area for drivers

Each of the above areas is studied in more detail below, including the elements that make them up and their operations.

3.1. External vehicle wash

This plant will comprise the following elements:

Two washing tracks of 30 metres long by 4.5 metres wide for pneumatic vehicles, with eight rotary spray heads in 316 stainless steel

These tracks will comprise the following elements:

• Wheel tracks in galvanized steel

• Hot water boiler

• Osmosis plant

• Wheel washer

• Dryer for roofs and upper trim section

• Connection to the waste management centre

Figure 2. External vehicle wash

Source: Domo Ingenieros. 2011.

3.2. Plant for cleaning the inside of tanks and tanker trucks

Cleaning the inside of tankers requires more complex facilities compared to cleaning the exteriors of vehicles and trailers. The plant will need to have the following access corridors:

Two for pneumatic vehicles, and

One that can be used for pneumatic or railway vehicles, given that, as mentioned earlier, the washing centre will form part of an Intermodal Centre.

The elements that make up each of the systems used for cleaning tanks/tankers are described below:

• Tank degasification and depressurization area **->** the tanks or tankers used to transport Class 2 gases must be treated by these processes prior to internal washing.

• Steam generation system **->** according to the relevant legislation, the minimum requirements for hose injection are:

-> Registered pressure of 6 kg/cm^2

-> Steam generation to 120ºC

• System for generating hot water **->** current regulations require the system used to be able to reach a temperature of 70-80ºC.

• Heating area **->** certain products need to be preheated to prevent thermal shock, for which hot water and steam is used as well as electrical measures. This also requires properly qualified staff.

These facilities have waterproof flooring in the event of possible spillages as well as spillage control systems. Finally, any condensate is drained off.

Figure 3. Heating zone

Source: Lavamiranda, S.L. 2011.

• Hot/cold water pressure system, with three lines:

-> One for manually-used hoses with its own pump, with a water output pressure of 25 kg/cm^2 and a flow of 18-20 litres per minute.

-> One with rotary jets with hot or cold water output, being one of the following:

• In the case of tanker trucks, the water pressure expelled by the rotary jets should be 50 kg/cm^2 with a flow of 50-60 litres per minute.

• For the interior washing of multimodal ADR, RID or IMDG tank containers or portable tanks of ≤ 9 metres (30') there should a pumped pressure system that provides 100 kg/cm^2 and a flow of 80-90 litres per minute.

• Finally, for the interior washing of ADR/RID tanker wagons and containers of ≥ 12 metres (40') there should be a pressure system providing a rotary output of 200 kg/cm^2 with a flow of 120-130 litres per minute.

-> Lastly, one line driving from the first with a water connection at 25 kg/cm^2 and a flow of 18-20 litres per minute for a rotary spray destined for plastic tanks reinforced with fibreglass or tanks with plastic coatings or similar which cannot be subjected to the conditions in the above lines.

• A system for dispensing cleaning products for each of the systems mentioned above.

• An advance water-treatment system to ensure the water supply meets the necessary requirements (decalcification and reverse osmosis).

• A compressor set or electrical system suitable for wet zones in accordance with the Low Voltage Regulation for the pneumatic or electrical operation of the installed equipment.

• Mechanical or electrical elevation system (24 V) for raising the heads.

Figure 4. Machine room

Source: Lavamiranda, S.L. 2011.

Figure 5. Chemical washing facility

Source: Lavamiranda, S.L. 2011

• Microbiological steaming and ATP control **->** to ensure the total disinfection of the tanks.

Figure 6. Microbiological steaming

Source: Lavamiranda, S.L. 2011

3.3. Drying centre

For cases where the products to be transported need the tanks to be dried following internal washing, there will be a turbine drying system with hot air at 60-80ºC or an equivalent facility. There will also be an anti-insect filter.

Figure 7. Tanker drying system

Source: Lavamiranda, S.L. 2011.

3.4. Waste management centre

Before it is discharged into the general drainage network, all the waste generated by the centre must be treated. There will therefore be a waste management centre comprising the following elements:

• Waste management system for water from the external washing facility **->** this allows part of the water to be recycled for subsequent use in the exterior washing tunnel and consists of:

-> Water collector. Sand filter

-> Decanter

-> Separation of oils and hydrocarbons

-> Pre-treated water tank

-> Recycler

-> Sampling tank

-> Network for discharge to the main collector.

The figure below shows a diagram of how the above system operates.

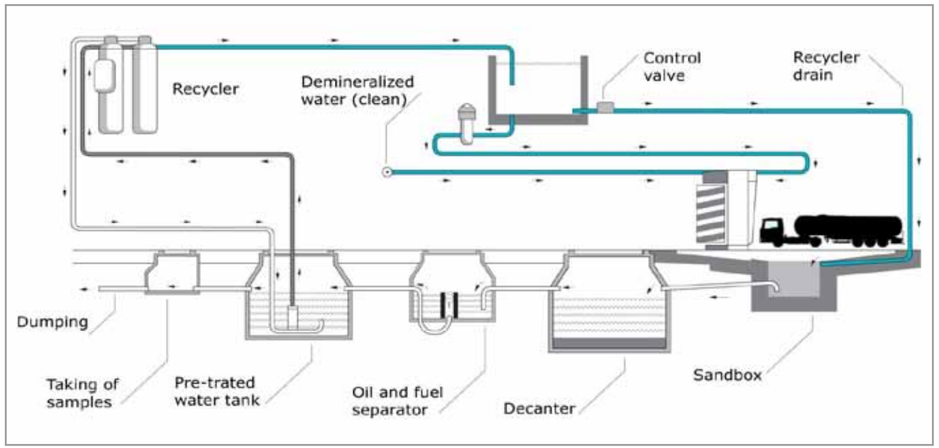


Figure 8. Waste management system for external washing facility

Source: Istobal. 2011.

• Waste treatment system for water from the internal washing facility **->** this allows part of the water to be recycled for subsequent use in the external washing tunnel and consists of:

-> Fenton treatment plant **->** this is based on chemical oxidation in response to the need to treat wastewater that cannot be treated biologically, such as highly toxic or inorganic wastewater. This technology is applied to different industrial currents that contain phenols, aldehydes, colours, pesticides, etc. Given the significant traffic in these kinds of substances in this area, it is regarded as essential to provide this type of facility.

Figure 9. Example of a Fenton treatment plant

Source: Austep Industry. 2011.

-> Physical and chemical treatment plant.

-> Biological treatment plant

-> Sludge treatment

-> Network for discharge to main collector

Figure 10. Water treatment and purification zone

Source: Lavamiranda, S.L. 2011.

It is anticipated that the total surface area occupied by the waste treatment centre described above would be 1,000 m^2

3.5. Offices

The area set aside for offices at the centre would be around 100 m², divided into different departments (management, administration, control, etc.). A staff training area is also proposed.

Figure 11. Example of staff training room

Source: Lavamiranda, S.L. 2011.

3.6. Services for drivers

Finally, facilities would be provided for drivers visiting the centre as follows:

- Waiting room
- Washrooms and toilets
- Showers and changing rooms
- Restaurant

A total of 500 m² would be set aside for this use.

Figure 12. Example of showers.

Source: Lavamiranda, S.L. 2011.

3.7. Design diagram

Following the detailed description given above of the different systems that would make up the centre, a diagram of the possible layout is given on the next page.

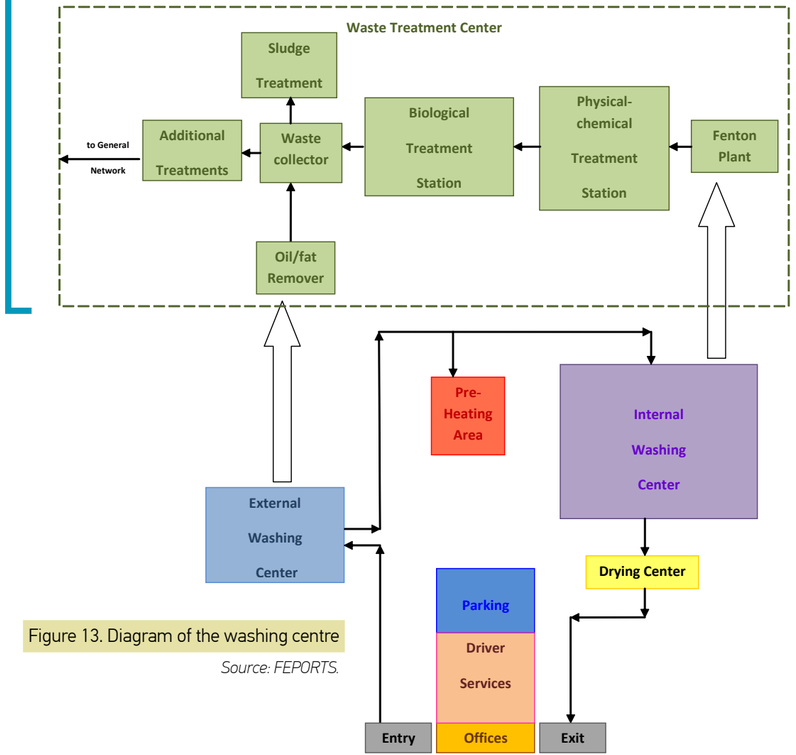


Figure 13. Diagram of the washing centre

Source: FEPORTS.

3.8. Adjustment of the design to demand

In the traffic study presented in an earlier section, we estimated 503 trips per day by heavy goods vehicles as a result of the implementation of the centre by the target year of 2022.

Also, in relation to the natural evolution of traffic in adjacent roads that connect with the Port of Castellón and the logistics centre, the total heavy vehicle traffic at the centre is estimated between 5% and 10% of the total heavy vehicles using these roads, taking a figure of 400 as reasonable.

Thus the number of trucks that might be expected to pass through the intermodal logistics centre on a daily basis would exceed 900.

In relation to the above, and in view of the industrial activity in this area (chemicals, fuel and the ceramics industry), we can assume a percentage of 20% of tanker trucks. Of these, a reasonable hypothesis would be that 10% would need to be washed. These figures have been established in accordance with the operations of various European logistics centres whose characteristics and circumstances are similar to those of the planned project.

Therefore, the number of trucks that would use the facilities of the washing centre on a daily basis would be as follows:

Regarding the rail traffic, taking the freight traffic study in the Feasibility Study for the development of an Intermodal Logistics Centre next to the Port of Castellón as a basis, a maximum of two trains per day can be assumed. From the study it can be surmised that the total tanks require washing would be two per day (730 per year). Furthermore, it can be assumed that 20 fixed railway tankers (including the chassis) would need to be washed every year. Once again, as there are no available figures for this kind of activity, we have used the figures resulting from a comparison with other transport centres that undertake similar activities to the centre of this study.

Based on all the above information, the proper sizing of the facility to cope with the envisaged demand can be corroborated. To do so, the following hypotheses were used following consultation with various washing centres with similar characteristics in Spain:

- The washing centre would operate six days per week (Monday to Saturday inclusive) with an estimated 300 days of operation every year.
- Opening times would be 10.00 to 20.00, i.e. 10 hours per day (600 minutes)
- It takes approximately 30 minutes to wash the outside of a tanker truck
- It takes approximately 40 minutes to wash the inside of tankers trucks and railway tankers without a chassis
- It takes approximately 60 minutes to wash a railway tanker with a chassis
- The general performance ratio of this kind of facility is 70% (n = 0.7).

Taking the above into consideration, the following calculations can be made:

Tanker trucks

In the case of external washing, each line would be able to wash the following number every day:

(600 ÷30) + n=20* 0.7=14 trucks

If, potentially, 18 trucks per day were to use the washing lines, and assuming that the logistics centre will be operating 365 days per year, 6,570 vehicles of this type would be using the washing centre.

In this case, the number of days necessary to cover this demand would be:

(600 ÷30)* n=20* 0.7=14 trucks

As there are two washing lines of this type, with an annual operation of 300 days each, this demand would be covered.

In the case of the internal cleaning of tanker trucks, each of the washing lines could handle the following on a daily basis:

(600 ÷40)* n=15* 0.7=10.5 ≈10 trucks

Similarly, the number of days necessary to cover this demand would be:

(600 ÷40)* n=15* 0.7=10.5 ≈10 trucks

Once again, if there are two washing lines for pneumatic vehicles operating 300 days per year each, an additional 57 uses of the multipurpose line would be needed to cover the excess demand.

Railway tankers

As in the case of the tanker trucks, each line would be able to wash the following railway tankers:

(600 ÷40)* n=15* 0.7=10.5 ≈10 trucks

The days necessary to cover this demand would be as follows:

730÷10 =73 days

In case of fixed tankers, this would be:

730÷10 =73 days

In this case, the number of days necessary to satisfy demand would be:

730÷10 =73 days

Therefore, the total number of days used to wash railway tankers would be 76, which would correspond to the tunnel that can be used by both pneumatic vehicles and trains (the multipurpose tunnel). If this line, like the other two, is operating 300 days per year, this leaves 224 days to cover the demand by pneumatic vehicles that cannot be met by the other two lines.

It can therefore be concluded that the proposed design covers the potential demand forecast for the target year.

4. Economic and financial analysis

This section makes a feasibility study of the centre and what investments would be necessary.

4.1. Budget for the start-up of the centre

This section makes an estimate of the costs that would need to be covered to start up the washing centre, differentiating between the following items:

• Purchase of a plot of land of 3,000 m2 within the intermodal logistics centre located in the vicinity of the Port of Castellón at a unitary price of 150 €/m2 **–>** 450,000 Euros.

• Preparation and equipping of the plot, classified as urban development land for tertiary use within the industrial land belonging to the Intermodal Logistics Centre **–>** 50,000 Euros.

• Installation of the external washing facility for tanks and tanker trucks **–>** 195,000 Euros.

• Installation of the internal washing facility for tanker trucks **–>**,680,000 Euros.

• Waste management centre, including all the plants and their different treatments **–>** 479,000 Euros.

• Offices**–>** 110,000 Euros.

• Services for drivers **–>** 195,000 Euros.

• Administration (obtaining permits, licences, etc.) **–>** 20,000 Euros.

The table below summarises the total investment that would be needed.

Table 6. Investment for putting the washing centre into operation

Element	Investment (€)
1 – Land Acquisition	450,000
2 – Soil Conditioning	50,000
3 – External Washing Centre	195,000
4 – Internal Washing Centre	1,680,000
5 – Waste Treatment Centre	479,000
6 - Offices	110,000
7 – Driver Services Area	195,000
8 – Administrative	20,000
TOTAL	**3,179,000**

Source: Drawn up by the FEPORTS based on information provided by Istobal, S.A.

4.2. Evaluation of potential revenue

Having consulted various other centres of this type which have been operating for several years, and taking into consideration the main freight traffic in this area (hydrocarbons and products involved in the ceramics industry), the following service rates have been established:

• External wash **–>** 55 € per tank

• Heating **–>** 41 € per hour

• Internal steam clean and wash **–>** Hydrocarbons: 145 € per tank
Ceramics industry products: 70 € per tank
Other products: 115 € per tank

• Drying **–>** 18 € per tank

In order to estimate the potential annual revenue from the washing centre, the following hypotheses have been considered:

• 100% of the vehicles coming to the facility would have an external wash (6,570 tanker trucks).

• To determine the type of freight the vehicles are transporting and thus apply the relevant rate, this study has used the traffic through the port in 2010 as a basis, when approximately 55% of tankers transported energy-related freight (mainly Element Investment (€) 1 – Land Acquisition 450,000

In view of this breakdown, we can surmise the following:

-> Of the 6,570 tanker trucks expected to use the washing facility every year, 3,613 would be carrying hydrocarbons, 1,577 would be transporting products for the ceramics industry, and 1,380 would be carrying other products.

-> Similarly, in the case of railway tankers, of the estimated 750 that would pass through the washing centre (730 free + 20 fixed), 413 would be carrying hydrocarbons, 180 products for the ceramics industry and the remaining 157 would be transporting other products.

• The rate for washing a tanker truck and a railway tanker (fixed or mobile) is the same.

• 50% of the trucks carrying hydrocarbons and chemicals (excluding those related to the ceramics industry) would need heating up before internal washing of the tank (2,496 tanker trucks), taking an average of three hours.

• 100% of the tanker trucks would pass through the drying facility (6,570 vehicles).

In view of the above, the annual revenue has been estimated as follows:

• External wash **->** 6,570 * 55 = 361,350 €

• Heating **->** 2,496 * 41 * 3 = 307,008 €

• Internal steam clean and wash **->**

- Tanker trucks: 3,613 * 145 + 1,577 * 70 + 1,380 * 115 = 792,975 €
- Railway tankers: 413 * 145 + 180 * 70 + 157 * 115 = 90,540 €

• Drying **->** 6,570 * 18 = 118,260 €

The table below shows a summary of the total annual income estimated from the washing centre.

Table 7. Anticipated annual income from services in the washing centre

Concept	Income (€)
1 – External Washing	361,350
2 – Heating	307,008
3 – Internal Washing and Vaporizing	883,515
Tanker trucks	792,975
Railway Tankers	90,540
4 - Drying	118,260
TOTAL	**1,670,133**

Source: FEPORTS.

4.3. Maintenance and service costs

This section estimates the costs that the centre would incur every year from its activities. To make this estimation, we consulted various industrial vehicle cleaning facilities which are currently operating. These costs can be classified as follows:

• Maintenance of the facility -> essential for optimum operations. This is estimated at 6% of the initial investment per year.

• Utility consumption (electricity and water) -> this is a variable cost that depends on the design used and the performance of the machinery. It is assumed that this would incur an annual cost of around 25% of the initial start-up investment, having consulted various washing centres on this matter.

• Labour -> a workforce of eight people is regarded as necessary, with a gross salary of 30,000 € per year.

• Annual depreciation of the facility -> the assumption is for depreciation over 20 years (zero residual value). This would only apply to the equipment.

4.4. Feasibility analysis

Following the economic evaluation described above, it was made a feasibility analysis of the project, calculating the Net Present Value (NPV) and the Internal Rate of Return (IRR). This calculation is based on the following assumptions: Concept Income (€) 1 – External Washing 361,350

• The construction and start-up of the service would be done over a two-year period, the first corresponding to 10% of the total investment and the second to the remaining 90%.

• Annual inflation is estimated at 3%.

• Two different scenarios will be established in terms of NPV profitability: 4.5% and 6%.

This provides the following results:

Table 8. Profitability indicators in euros

NPV to 4.5 %	NPV to 6 %	IRR
1,619,720.45	667,046.91	11.60 %

Source: FEPORTS.

• In both cases, it can be seen that the project would produce profits above the required profit performance, and

• The IRR (Internal Rate of Return) is positive, and higher than the proposed profitability.

The table on the following page shows the different profit factors of the project in greater detail. NPV to 4.5 % NPV to 6 % IRR

Table 9. Calculation of profitability in Euros Inflation Period Infrastructure investment Facility maintenance Energy consumption Staff Depreciation External washing Heating Internal washing and vaporizing Drying Total

Inflation	Period	Infrastructure investment	Facility maintenance	Energy consumption	Staff	Depreciation	External washing	Heating	Internal washing and vaporizing	Drying	Total
	2,012	-317,900									-317,900
	2,013	-2,861,100									-2,861,100
1.03	2,014		-190,740	-794,750	-240,000	-132,950	361,350	307,008	883,515	118,260	311,693
1.03	2,015		-196,462	-818,593	-247,200	-132,950	372,191	316,218	910,020	121,808	325,032
1.03	2,016		-202,356	-843,150	-254,616	-132,950	383,356	325,705	937,321	125,462	338,772
1.03	2,017		-208,427	-868,445	-262,254	-132,950	394,857	335,476	965,441	129,226	352,923
1.03	2,018		-214,680	-894,498	-270,122	-132,950	406,703	345,540	994,404	133,103	367,500
1.03	2,019		-221,120	-921,333	-278,226	-132,950	418,904	355,906	1,024,236	137,096	382,513
1.03	2,020		-227,754	-948,973	-286,573	-132,950	431,471	366,584	1,054,963	141,209	397,977
1.03	2,021		-234,586	-977,442	-295,170	-132,950	444,415	377,581	1,086,612	145,445	413,905
1.03	2,022		-241,624	-1,006,766	-304,025	-132,950	457,747	388,909	1,119,210	149,808	430,310
1.03	2,023		-248,872	-1,036,968	-313,146	-132,950	471,480	400,576	1,152,787	154,302	447,208
1.03	2,024		-256,339	-1,068,078	-322,540	-132,950	485,624	412,593	1,187,370	158,932	464,613
1.03	2,025		-264,029	-1,100,120	-332,216	-132,950	500,193	424,971	1,222,991	163,699	482,540
1.03	2,026		-271,950	-1,133,123	-342,183	-132,950	515,199	437,720	1,259,681	168,610	501,005
1.03	2,027		-280,108	-1,167,117	-352,448	-132,950	530,655	450,852	1,297,472	173,669	520,023
1.03	2,028		-288,511	-1,202,131	-363,022	-132,950	546,574	464,377	1,336,396	178,879	539,612
1.03	2,029		-297,167	-1,238,195	-373,912	-132,950	562,972	478,308	1,376,488	184,245	559,789
1.03	2,030		-306,082	-1,275,340	-385,130	-132,950	579,861	492,658	1,417,782	189,773	580,571
1.03	2,031		-315,264	-1,313,601	-396,683	-132,950	597,256	507,437	1,460,316	195,466	601,977
1.03	2,032		-324,722	-1,353,009	-408,584	-132,950	615,174	522,661	1,504,125	201,330	624,025
1.03	2,033		-334,464	-1,393,599	-420,841	-132,950	633,629	538,340	1,549,249	207,370	646,734
1.03	2,034		-344,498	-1,435,407	-433,467	-132,950	652,638	554,491	1,595,726	213,591	670,125

Source: FEPORTS.

5. Administrative process: certificates required

The start-up of a facility such as the one described in this study requires a certain number of licences and certificates to be obtained, which are listed below:

• Business Licence issued by the relevant City Council

• Registration on the Industrial Registry

• Landfill Permit from the competent City Council

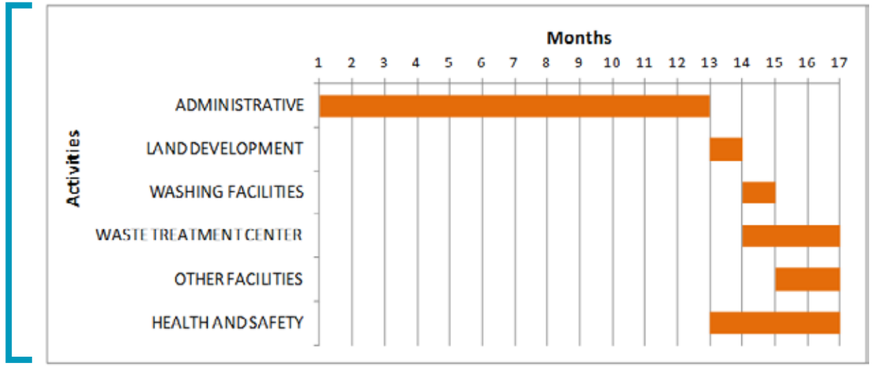
• Compliance with the relevant legislation (Royal Decree 948/2003 and ORDER ITC/2765/2005)

• SQAS certificate (Safety and Quality Assessment Systems) to corroborate compliance with the quality, safety and environmental requirements defined by the chemical industry for its suppliers this certificate is essential to become a member of the Spanish Internal Tank Cleaning Association (ANLIC), whose primary objective is to provide advice and support and encourage all its members to achieve the highest quality and environmental standards in their respective companies.

• ISO-9001 Quality Certificate

• ISO-14001 Environmental Certificate.

6. Start-up plan



Finally, this section aims to establish a plan to put the washing centre into operation, identifying the main activities involved and their timeline.

The table below shows in very schematic form the process of developing the centre and the anticipated timeline. The most costly activity, in terms of time, is obtaining the relevant licences and certificates mentioned above, which would take one year. It should be bear in mind that this process depends very much on the speed of the bureaucratic processes of the city council in question.

Table 10. Start-up plan of the washing centre

Source: FEPORTS.

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• Safety and Quality Assessment Systems (SQAS): www.sqas.org

• TÜV Rheinland: www.tuv.com

Feasibility Studies in the Castellón Area

Sss terminal for chemical goods in the port of Castellón

Projet cofinancé par le Fonds Européen de Développement Régional
Project cofinanced by the European Regional

AUTHOR: FEPORTS

Instituto Portuario de Estudios y Cooperación de la Comunidad Valenciana

1. Introduction

The year 2010 saw the start o the LOSAMEDCHEM - How could the logistics and the safety of the transport of chemicals be improved in the Mediterranean area – which forms part of the MED Programme for Transnational Cooperation co-financed by the European Regional Development Fund. It includes the involvement of partners from various countries (Italy, Greece, Slovenia, Malta and Spain) and different fields headed by the Province of Novara (Italy); all of them in some way are related to transport, logistics, trade and/or the industrial chemicals sector.

Some of its main objectives include the strengthening of regional cohesion between European chemical-producing regions in the northern Mediterranean area and between the different competent authorities involved in the transportation of chemical goods, promoting the transnational transfer of knowledge and technology with the aim to developing the optimum systems for controlling and managing freight traffic. At the same time, it aims to boost the development of intermodality and of alternatives to road transportation, and to achieve higher levels of safety in transport and to reduce associated external costs.

The first phase of the technical activities within the project entailed making a SWOT analysis of the chemicals sector in each of the regions involved, taking into account their associated logistics systems and the factors that characterise the transport of this type of merchandise, with the aim of identifying weak points and bottlenecks as well as any potential strengths and opportunities in the immediate future.

Particularly in the case of the region of Castellón (Spain), one of the main critical points identified was the high percentage of goods carried by road.

At the current stage of the project, and in the wake of the results obtained from the previous stage, a series of studies are proposed in order to rectify the weaknesses and threats identified.

Specifically, with regard to port infrastructures, in order to encourage greater use of maritime transportation in the industrial chemicals sector, it is considered worthwhile the creation of Short Sea Shipping routes connecting the port area of Castellón with other ports in the vicinity of regions with which it has already strong commercial links.

However, setting up this kind of service requires the availability of a series of installations and infrastructures which do not currently exist in this port, starting with a specific terminal for handling chemical products and dangerous goods. For this reason, the proposal is to design an SSS terminal for the transport of chemicals and dangerous goods in the Port of Castellón.

This document therefore includes a feasibility study for a terminal of these characteristics and the more general features of its design and execution.

2. Viability study. Development of an sss terminal in the port of Castellón

As reiterated throughout this study, the province of Castellón is home to major industrial activity in the chemicals and energy sectors. The plants of leading companies such as BP Oil, UBE Chemical and many other firms can be found in the region.

The fact that there is an infrastructure such as the Port of Castellón in this area is very much associated with this industrial sector, serving as a port of entry and departure for goods in the logistics chain.

The majority of the traffic through this port is related directly to chemicals and dangerous goods, representing up to 80% of the total freight movements during the last few years.

The table below shows the evolution of traffic of this kind of merchandise through the Port of Castellón in the period between 2005 and 2010.

Table 1. Traffic of chemicals and dangerous goods through the Port of Castellón, 2005-2010. Figures shown in tonnes

	2005	2006	2007	2008	2009	2010
Embarking	7,152,925	6,799,399	6,124,154	6,232,061	5,896,629	2,952,235
Disembarking	3,817,169	3,247,124	3,096,599	3,108,925	3,389,091	5,888,380
Total	10,970,094	10,046,523	9,220,753	9,340,986	9,285,720	8,840,615

Source: Drawn up by FEPORTS based on APC data.

The following table shows the evolution in the percentage of total traffic corresponding to these kinds of goods during the same period.

Table 2. % Traffic in chemicals and dangerous goods through the Port of Castellón, 2005-2010. Figures shown in tonnes.

	2005	2006	2007	2008	2009	2010
Total Chemical Sector(t)	10,970,094	10,046,523	9,220,753	9,340,986	9,285,720	8,840,615
Total Port (t)	13,372,753	13,257,602	13,086,508	13,530,953	11,073,077	12,446,926
% S/T	82.03	75.78	70.46	69.03	83.86	71.03

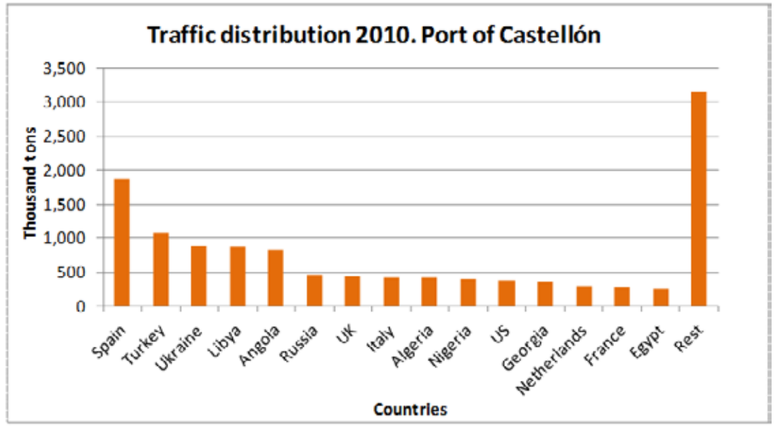
Source: Drawn up by FEPORTS based on APC data.

As we can see from the above table, this traffic is vitally important to the Port.

Most of this traffic is with other ports in the Mediterranean basin (especially North Africa), as shown in the table below.

Table 3. Breakdown of traffic with the Port of Castellón by countries, 2010

	Spain	Turkey	Ukraine	Libya	Angola	Russia	UK	Italy	Algeria	Nigeria	US	Georgia	Netherlands	France	Egypt	Rest
Traffic (Thousand tonnes)	1,875	1,084	895	878	835	465	451	416	415	409	377	353	303	276	255	3,160
% S/T	15.06	8.71	7.19	7.05	6.71	3.74	3.62	3.34	3.33	3.29	3.03	2.84	2.41	2.22	2.05	25.39



Source: Drawn up by FEPORTS based on APC data.

Meanwhile, when analysing the traffic in dangerous goods and chemicals as part of the total for the province of Castellón, the table below shows the main countries with which trading took place in 2010.

Table 4. Main foreign trade from the province of Castellón in chemicals and dangerous goods, 2010

Country	Tonnes	
	Import	Export
Libya	974,002.21	8,505.64
Russia	785,441.76	36,904.33
Angola	635,328.13	23.15
Kazakhstan	479,184.67	3.31
Nigeria	370,408.06	11,588.58
USA	219,073.80	65,932.12
Italy	195,776.3	193,836.18

Source: DATACOMEX.2012.

The above table features Italy, a cou

ntry with various ports along the Spanish Mediterranean coast which have already had Short Sea Shipping type routes (Barcelona, Valencia), with which the balance of trade is fairly well balanced.

At present, Short Sea Shipping stands out as the optimum alternative to road transportation, and is the reason why it is receiving such support in the policies of different administrations in their search for sustainable transport.

The above reasons have led to design a proposal and put into service a Short Sea Shipping terminal in the Port of Castellón, aimed mainly at the shipping goods from the chemical industry.

3. Design of the terminal

The following sections aim to establish the characteristics of the SSS terminal identifying the main elements and determining factors.

3.1. Establishing a sss route. Activity in the terminal

By definition, Short Sea Shipping (SSS) – known as Transporte Marítimo de Corta Distancia (TMCD) in Spanish – refers to the transportation of freight and passengers between ports in the European Union, or between these and non-European ports of countries bordering the Mediterranean, the Black Sea, the Baltic, Norway and Iceland. Short Sea Shipping refers to both national and international traffic along coastlines, to and from islands, and via rivers and lakes.

If we analyse the freight traffic described in the previous section, there are several countries along the Mediterranean basin that engage in significant freight transport in the chemical and energy sectors with the province of Castellón, including Libya and Italy. However, it is the latter country that offers the most attractive option as a connection with the Port of Castellón by SSS for the following reasons:

• There are already shipping routes with several ports along the Spanish Mediterranean coast (Barcelona, Valencia) with positive operating results

• There is a good balance of trade (import ≈ export) in terms of the volume of goods.

The above factors have thus led to the proposal to establish a SSS route to connect the Port of Castellón with an Italian port.

3.1.1. Selection of ports: defining the route

The next step is to select the destination port. To do so, we took into consideration the results of Task 1.1. Identification and analysis of the key demand sectors and corridors to be studied, corresponding to the project known as Estrategia del Transporte Marítimo de Corta Distancia en la Comunidad Valenciana (Short Sea Shipping Strategy of the Valencia Region), with reference to the data on foreign trade from 2007, which was completed in 2010. This study reflects the significant freight shipments recorded between the Valencian Community and the regions of Liguria and Tuscany.

There are several important ports in these two regions: Genoa, Savona and La Spezia in Liguria; and Livorno, in Tuscany. Taking into account the following considerations:

• The existence of various SSS routes connecting Ligurian ports with various Spanish ports on the Mediterranean which are relatively close to the Port of Castellón, thus posing direct competition.

• A history of the start-up of a SSS service between Castellón and a Tuscan port, Marina di Carrara, justified by the significant goods traffic from the ceramic tile sector between the two regions.

The decision was made to establish a SSS route linking the ports of Castellón and Livorno.

Figure 1. Castellón – Livorno SSS route.

Source: FEPORTS.

3.1.2. Characteristics of the route to be put into service

Once the service between these two ports has been established, it is essential to make an estimate of the potential traffic to be handled and the operations that will be taking place in the proposed Terminal.

The previous point described the main import/export traffic of chemicals and dangerous goods recorded in the province of Castellón in 2010, shows the traffic in these products with Italy. To take this step further, the table below shows the total foreign trade between the area and Italy.

Port of Castellón

Port of Livorno

Table 5. Foreign trade between the province of Castellón and Italy, by mode of transport, 2010

Mode of transport	Tonnes	
	Imports	Exports
Maritime	256,569.97	46,230.64
Road	176,992.01	291,351.40
Railway	9.98	25
TOTAL	**433,571.96**	**337,607.14**

Source: DATACOMEX. 2012

Although the above table reflects the data for all trade with Italy, the above figures allow us to propose the establishment of SSS route linking the ports of Castellón and Livorno once a week.

The characteristics of the proposed route would be as follows:

• Castellón – Livorno route

• Weekly service

• Traffic in platforms, truckloads and containers

• Vessel characteristics:

  -> Length 160 metres

  -> Speed: 22 knots

  -> Capacity of 150 Ro-Ro units (platforms, truckloads, roll trailers)

  -> Vessel occupancy: 100%

• Division of cargo: 50% platforms, 50% truckloads

With an approximate weight of 16 tonnes per platform or vehicle, the total annual volume of goods moved by this service would be 124,800 tons.

3.2. Location of the terminal

The facilities of the Port of Castellón and its layout suggest the location of a terminal of these characteristics in the new Southern Basin of the port, where major chemical sector companies are present and it is anticipated that more will join in the near future.

Figure 2. Aerial view of the Southern Basin of the Port of Castellón, 2011

Source: Port Authority of Castellón.

3.3. Size of the terminal

It should be pointed out that this study focuses on the different ty pes of Ro-Ro terminals, due mainly to the fact that this kind of terminal has specific features that make it particularly interesting in terms of its capacity to attract land-based traffic.

The terminal should be equipped with all the infrastructures, equipment and facilities for its optimum operation, focusing on land/maritime intermodality. The main areas to be differentiated include:

- Area for the reception/delivery of goods
- Freight storage area
- Area for loading/unloading goods onto/from the vessel
- Service area
- Area for additional activities.

3.3.1. Area for the reception/delivery of goods

This area includes both the entrance and exit gates of the Terminal and the road and rail access routes.

With regard to the latter, road access is a key element in achieving the optimum levels of efficacy and efficiency in the operations in the terminal. It should be born in mind that fast access to the high-capacity network and a level of service that avoids traffic congestion and delays are vital for the Terminal's operation.

It is advisable to have two-way road systems with two lanes in each direction which do not cross urban centres. In this respect, the main road access to the Port of Castellón is the CS-22 highway which is accessible from the CV-10 (La Plana highway), the AP-7 (Mediterranean toll motorway) and the N-340 (Mediterranean Highway), as shown in the map below.

Figure 3. Map of road accesses to the Port of Castellón

Source: Port Authority of Castellón. 2011.

Once inside the port area, the roads connecting the Terminal to the entrance to the port should be designed, wherever possible, for two-way traffic with at least one lane in each direction, enlarging them to two lanes in the event that a high volume of traffic is anticipated, or very heavy traffic at peak times.

In addition, clear, well-positioned signage (vertical/horizontal) is fundamental for the rapid location of facilities by haulage operators.

A separate mention should be made of the railway, and particularly Section 1 of Article 37 of the Amended Text of the State Ports and Harbours and Merchant Navy Act, which states that Port Authorities are required to "ensure that port infrastructures and services provide adequate facilities for maritime/road haulage intermodality by means of a safe and efficient road and rail network, properly connected to the rest of the transport system, and logistics hubs that might be regarded as being in the general interest", and at the same time "manage the railway infrastructures belonging to it in order to promote the optimum maritime/rail intermodality."

For the above reasons, on designing the Terminal it should have a railway branch within the terminal to allow the formation of complete trains. If there is not enough space, the Terminal should be positioned in the vicinity of, and with good connections to, a railway terminal where convoys can be put together.

On analysing the case of the Port of Castellón, up until recently the rail access to its facilities was lacking, although this is currently being upgraded (improving the northern access) with a planned extension (southern rail access).

Figure 4. Plan for the Southern Railway Access to the Port of Castellón.

Source: Port Authority of Castellón. 2011

With regard to the area for bringing in and taking out freight, it should be remembered that this is the interface between the Terminal and the land transportation system. The purpose of this subsystem is to allow the delivery and/or reception of goods in the best possible conditions of safety for the Terminal, the goods themselves and the haulage companies, and to speed up the exchange of information that these operations require.

Thus the number of gates available for vehicles entering or leaving the terminal will depend on the volume of traffic. In this case, it is proposed that there should be made available independently:

- 1 entrance gate
- 1 exit gate

The main reason for differentiating the two gates is the different operations involved in the reception/entry and delivery/exit procedures.

3.3.2. Goods storage area

The esplanade is the part of the Terminal where goods are stored while waiting to leave the Terminal or be loaded onto the vessel. This is the area that requires the largest amount of space, and this area will be used to store chemicals and dangerous goods, amongst others.

When designing this zone, the following areas will be distinguished:

- First Point of Rest (FPR) -> This is the area where the platforms are stored temporarily before being transferred and positioned in the stock zone ready to leave the Terminal. This area should be equipped for the temporary storage of unloaded platforms.

It should be sized for a standard vessel of 160 metres long with a capacity of 150 Ro-Ro units, based on the hypothesis that 50% of them will be platforms and 50% truckloads. Assuming that this area should have a capacity to house 90% of the platforms, it would need to cover an approximate area of 3,000 m^2.

- Import zone -> This is the area for positioning the platforms that were initially housed in the FPR and need to leave the terminal. This area will be divided into two blocks, separated by a 10-metre wide roadway to allow manoeuvring. It is thus estimated that it will need to cover an area of 4,200 m^2.

- Export zone -> This is the area for housing platforms ready to be loaded. As in the import area, the approximate surface area is 4,200 m^2.

Considering the type of goods to be handled, safety is an absolutely crucial aspect. The current regulations for protecting port facilities (ISPS Code) require the provision of protection and security monitoring systems. With this objective, it will have the following:

- Perimeter fencing around the terminal
- Restricted access to users and authorized personnel.
- Lighting
- Automatic intruder-detection devices and security equipment.

Furthermore, the warehousing of dangerous goods should take into account their IMDG Code class (International Maritime Dangerous Goods code). Generally speaking, the goods belonging to one of the first three codes will be stored with the platforms used to transport conventional cargo; all other codes must be located in separate secure areas, duly signalled. It should also be remembered that the administrative formalities for loading this kind of shipment are different. At least 24 hours in advance it is necessary to provide a series of documents that certify the condition of the goods to be transported.

3.3.3. Area for loading/unloading the goods onto/from the vessel

This area includes the berthing lines, the operating quay and the heel and ramps for loading and unloading the cargo.

The dimensions of the quay, assuming an SSS route with a daily frequency, are as follows:

Berthing line -> comprising:

- A 30-metre heel for Ro-Ro. The usual recommendation is for 25-30 metres.

• A 250-metre berthing line, assuming a standard vessel of 160 metres long and a capacity of 150 platforms.

Quay -> we would assume a width of 30 metres, given that it is anticipated that different types of cargo will be handled (platforms, containers, truckloads, etc.)

Therefore the approximate area of this zone would be 8,400 m2 (0.84 Ha).

3.3.4. Service Area

This area is intended to house offices and internal roadways, both the main ones (generally two-way) and the feeder roads.

In the first case there will be an area available for office space, next to a workshop for minor repair work (e.g. changing a wheel) ≈ 2,300 m^2

3.3.5. Internal roads

In the second case, the estimation is for a perimeter road of 15 metres wide for two-way traffic and four secondary roads of 10 metres wide covering an approximate area of 9,500 m^2 and 2,000 m^2 respectively.

The photo below shows an example of a two-way perimeter road.

Figure 5. Perimeter road of a SSS terminal

Source: "Definition of the optimum SSS Terminal". FEPORTS. 2005

3.3.6. Area for additional activities

The additional services mainly refer to modes of transport, the most common being: Rest area and washrooms for drivers -> assuming an area of ≈ 500 m2 for this use

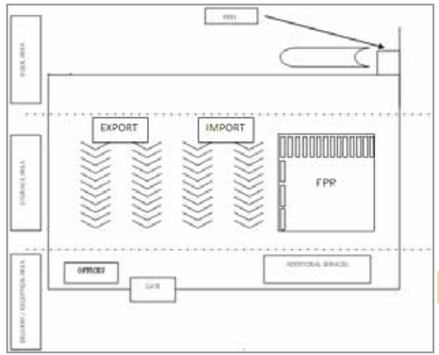
3.3.7. Total area

The table below shows a summary of the distribution of the total surface area of the terminal by usage.

Table 6. Distribution of the surface area of the SSS terminal by usage.

Use	Area (m2)
1 – Delivery/Reception Area (including the Services Area)	2,300
2 – Storage Area	11,400
First point of Rest (FPR)	3,000
Import Area	4,200
Export Area	4,200
3 – Dock Area (including Loading/Unloading Area)	8,400
4 - Internal Roads	11,500
5 - Additional Activities Area	500
TOTAL	**34,100**

Source: FEPORTS.



3.3.8. Layout of the Terminal

The following diagram shows a possible design for the lay-out of the Terminal which identifies the different areas de-scribed above and their layout.

Figure 6. Floor plan of the terminal

Source: "Definition of the Optimal SSS Terminal". FEPORTS. 2005.

3.4. Mechanical equipment

The equipment used for handling cargo in a Ro-Ro terminal depends entirely on the type and volume of traffic to be moved. For this reason, the available resources will depend on the freight, its special features, its size and its efficiency; depending on these characteristics, there is a high level of potential requirements. The most commonly-used mechanical resources in a terminal for these characteristics are given below:

- 15 Tug Master type tractor heads
- 3 reach-stackers
- 75 Platforms (trailers, semi-trailers, roll-trailers)

The photos below show some of these vehicles.

Source: FEPORTS.

4. Administrative procedures

Generally speaking, the operation of port terminals is done by private organizations that have obtained the operating concession either by applying directly to the relevant Port Authority or by bidding for the tender. The concession period lasts for a maximum of 25 years and depends, amongst other factors, on the following:

- The increase in the activity generated in the port Adaptation to port planning and management
- The availability of space within the public domain of the port
- The investment made by each party (Port Authority and concession-holder)
- The time-period for executing the works and the useful life of the investment.
- At the end of this period, the concession reverts to the Port Authority of Castellón.

It is estimated that it would take at least 10 months to obtain the concession, dating from the application or submission of the bid (Deadline for submitting bids – Public information – Resolution - Notification).

5. Economic and financial analysis

Following the above description of the technical characteristics, the sections below describe the economic and financial analysis of the execution and operation of the terminal, studying the necessary investments and potential revenue and estimating the viability of the operation.

5.1. Initial investment

The initial investment in the new SSS terminal planned for the Port can be broken down as follows:

- Execution of the infrastructure **->** this includes the construction of the quay and the esplanade for the different operating areas. The estimated cost is 14,000,000 €.
- Urban development of the area **->** this includes equipping the area with services and internal roadways, signage and the necessary installations, at an estimate d cost of 52 €/m2, amounting to approximately 1,398,100 €.
- Service area **->** the estimated cost of executing all the elements that this comprises (offices and repair workshop) amounts to 1,500,000 €.
- Additional services area **->** this is intended mainly for the drivers of the goods transport vehicles. The investment needed to develop this area is estimated at 500,000 €.
- Security systems **->** this includes the perimeter fencing, the central security system and the automatic intruder-detection systems. The amount for this section is estimated at 400,000 €.
- Equipment for terminal operations **->** this depends on the volume of traffic, its special characteristics, its size and the efficiency of the terminal.

• The machinery deemed necessary for these activities is as follows:

-> 15 tug master-type tractor heads: at a unit price of 180,000 €, the total amounts to 2,700,000 €.

-> 3 vehicles for handling containers: 2 reach-stackers at a unit cost of 400,000 €, and one front-loader at a cost of 350,000 €, amounting to a total of 1,150,000 €.

-> 5 platforms: with a total purchase price of 2,625,000 €.

• Administrative costs: this would include guarantees for the concession (5% of the initial investment) and expenses deriving from the administrative formalities involved in the concession. The total is estimated at 1,150,000 €

The table below shows a summary of the investment necessary to put the terminal into operation.

Table 7. Investment necessary to put the SSS Terminal into operation.

Element	Investment (€)
1 – Infrastructure construction	14,000,000
2 – Urbanization	1,773,200
3 – Services Area	1,500,000
3 – Additional Activities Area	500,000
5 – Surveillance System	400,000
6 – Terminal Operating Equipment	6,475,000
7 – Administrative	1,400,000
TOTAL	**26,048,200**

Source: FEPORTS.

5.2. Anticipated revenue

Once the terminal has been developed, operating revenue will derive from the provision of transport services and warehousing facilities.

• Revenue from handling goods in the Terminal **->** having consulted various other similar terminals in Spanish ports and the rates applied by the Port Authority of Castellón, the following charges have been established:

Table 8. Prices for handling goods in the terminal

Unit	Price (€)
Truckload	268.00
Platform	223.00

Source: Drawn up by FEPORTS. Includes handling of goods, loading and unloading.

Assuming, as mentioned earlier, a division of traffic between truckloads and platforms of 50%-50% and a vessel occupancy rate of 100%, revenue per service would amount to 20,100 € in the first case and 16,725 € in the latter. Thus the total revenue per service would come to 36,825 €, amounting to 1,914,900 € per year.

• Revenue from occupancy of the terminal **->** the table below shows the occupancy rates of the terminal as a storage area for platforms.

Table 9. Warehouse occupancy rates.

	Between 0 – 14 days in transit	Between 15 – 30 days in transit	From 31st
€/Platform	2.50	4.00	8.00

Source: Drawn up by FEPORTS based on data from similar terminals

Assuming that 90% of the platforms will be stored for an average of three days in the terminal, the total amount is estimated at 8,775 € per year.

As a summary, the following table shows the anticipated annual revenue from terminal operations.

Table 10. Anticipated annual revenue from the provision of services at the SSS terminal

Concept	Income (€)
1 – Handling Services	1,914,900
2 – Platforms Warehouse	8,775
TOTAL	**1,923,675**

Source: FEPORTS.

5.3. Other profits to be considered in the economic evaluation. Internalization of external costs

This section estimates the possible savings associated with the reduction of external costs as a result of attracting road traffic by the new SSS route.

The European Commission published the Green Paper entitled "Towards fair and efficient pricing in transport" (1995) to make railways more profitable, which published the external costs of road and rail transport.

In 2004, INFRA and the IWW University of Karlsruhe in Switzerland published an updated version of the study External Transport Costs in Europe with data from 2000. The results in respect of road and rail transport are shown in the following table.

Table 11. External costs of freight traffic by road and rail.

Concept	Freight traffic (€/1,000 tkm)	
	Road (heavy-duty vehicle)	Maritime
Accidents	4.8	0.0
Noise	4.9	0.0
Air pollution	38.3	14.1
Climate change	12.8	4.3
Nature and landscape	2.0	0.8
Urban effects	1.1	0.0
Other	7.4	3.3
TOTAL	**71.3**	**22.5**

Source: External Transport Costs. Updated study 2004. INFRAS/IWW.

Detailed below are the hypotheses used to calculate the savings made by reducing external costs.

• Traffic transferred from road to rail is estimated at 124,800 tonnes per year, this being equivalent to 150 platforms of 16 tonnes per week.

• The maritime route is 511 nautical miles, which is equivalent to 946.37 km.

• The route by road is estimated at 1,305 km.

Thus the external cost of maritime shipping on the route would be:

(22.5) €/(1,000 tkm)*(124,800t/year*946.37 km)= 2,657,406.96 €/year

Meanwhile, the external cost associated with transporting this volume of freight by road is as follows:

71.3 €/(1,000 tkm)*(124,800t/year*1,305 km)= 11,612,203.20 €/year

Overall, the following net savings would be made:

11,612,203.20 €/year- 2,657,406.96 €/year=8,954,796.24 €/year

5.4. Service and maintenance costs

This section calculates the service and maintenance costs that the concession-holder of the terminal will need to cover. The valuations given here have been estimated, based on the results of consulting various other SSS terminals in Spanish ports.

-> Fees payable to the Port Authority of Castellón, established in the specifications for the tender and adjudication of the concession these amounts are payable annually for the following aspects:

-> Fee for occupying the public space of the port: this is broken down further as shown below:

• For occupying land: 4.90 € per m2 per year, which comes to an annual total of 167,190 €.

• For occupying facilities: this is estimated at 5% of the investment in the superstructure plus an amount resulting from dividing this investment between the years of the concession. The result is as follows:

0.05*16,000,000 + 16,000,000/35= 1,257,142.86 €/year

-> Special rate for the use of the public domain: as in the previous case, this is broken down into sub-sections:

• For services and activities involved in freight handling: a fee of 0.50 € per vehicle or platform. Assuming traffic of 150 units per week, this comes to a total of 7,800 per year. The amount payable would therefore come to 3,900 € per year.

• For warehousing and custody services and other added-value activities; as in the previous case, a fee of 0.50 € per vehicle or platform. The amount payable would therefore 3,900 € per year.

Table 12. Annual fees to be paid to the Port Authority of Castellón

Item	Amount (€)
1 – Public Port Occupancy Rate	1,424,332.86
Land Occupation	167,190
Facilities Occupation	1,257,142.86
2 – Public Special Use Rate	7,800
Services and Cargo Handling Activities	3,900
Storage and Custody Services and Other Value-Added Activities	3,900
TOTAL	**1,432,132.86**

Source: FEPORTS.

• Maintenance of installations -> required for the adequate provision of logistics services. This is estimated at 0.50% of the initial investment per year.

• Miscellaneous services -> this includes supplies and the provision of different services, and would represent an annual value of around 1% of the initial investment in starting up the terminal.

• Passage of freight through the terminal -> including the freight handling activities. This is estimated at 75 € per transport unit (vehicle and/or platform).

• Labour -> a team of 6 people is considered necessary, at a gross annual salary of 30,000 €.

• Annual depreciation of the facility -> this assumes a depreciation hypothesis of 35 years, the duration of the operating concession (residual value: zero).

5.5. Feasibility study

Following the economic evaluation described in the previous section, a financial feasibility study of the project was undertaken, calculating the Net Present Value (NPV) and the Internal Rate of Return (IRR) of the project. This calculation is based on the following assumptions:

• The granting of the concession and the construction and start-up of the terminal within a two-year period, the first corresponding to 10% of the total investment and the second to the remaining 90%.

• The concession will be granted for 35 years.

• Annual inflation is estimated at 3%.

• External cost savings are not taken into consideration.

• Two different scenarios are established in terms of NPV profitability: 4.5% and 6%.

The results are as follows:

Table 13. Profitability indicators in Euros

NPV to 4,5 %	NPV to 6 %	IRR
-88,813,691.79	-84,849,957.72	-

Source: FEPORTS.

We can clearly see that the project is not profitable, which indicates that it is not viable in the case of a single weekly service.

5.5.1. New scenario

However, if the terminal was to be used to operate other Ro-Ros currently in service in the Port of Castellón, its profitability would increase considerably.

An example of this eventuality would be to transfer to this new terminal the operations of the service known as BK Shipping, to Algeria, which calls in at the country's main ports (Algiers, Oran, Bejaia, Skikda and Annaba) and operates weekly. In this scenario, the revenue is estimated to be double than of the former case, the profits would be those shown on the following page.

Table 14. Profitability indicators in the new scenario: two different SSS lines operating in the same terminal

NPV to 4,5 %	NPV to 6 %	IRR
3,171,474.73	1,858,944.25	1.51

Source: FEPORTS.

It would also be logical to assume that the development of an infrastructure for SSS would be associated with using it to progressively establish any similar services, both current and future, operating in the Port of Castellón.

Finally, the table on the following page presents a detailed summary of how the project's profitability has been calculated.

Table 15. New scenario: SSS terminal, based on one new route and one existing one – Calculation of profitability in Euros

Inflation Period	Infrastructure investment	Concession rates	Facility maintemance	Platform handling costs	Miscellaneous services	Staff	Depreciation	Freight handling services	Warehousing	Total
	2,012	-2,604,820	-2,604,820							
	2,013	-23,443,380	-23,443,380							
1.03	2,014	-1,432,133	-130,241	-585,000	-520,964	-180,000	-744,234	3,847,350	17,550	272,328
1.03	2,015	-1,475,097	-134,148	-602,550	-536,593	-185,400	-744,234	3,962,771	18,077	302,825
1.03	2,016	-1,519,350	-138,173	-620,627	-552,691	-190,962	-744,234	4,081,654	18,619	334,236
1.03	2,017	-1,564,930	-142,318	-639,245	-569,271	-196,691	-744,234	4,204,103	19,177	366,591
1.03	2,018	-1,611,878	-146,587	-658,423	-586,350	-202,592	-744,234	4,330,226	19,753	399,915
1.03	2,019	-1,660,234	-150,985	-678,175	-603,940	-208,669	-744,234	4,460,133	20,345	434,240
1.03	2,020	-1,710,042	-155,515	-698,521	-622,058	-214,929	-744,234	4,593,937	20,956	469,594
1.03	2,021	-1,761,343	-160,180	-719,476	-640,720	-221,377	-744,234	4,731,755	21,584	506,009
1.03	2,022	-1,814,183	-164,985	-741,060	-659,942	-228,019	-744,234	4,873,708	22,232	543,516
1.03	2,023	-1,868,609	-169,935	-763,292	-679,740	-234,859	-744,234	5,019,919	22,899	582,149
1.03	2,024	-1,924,667	-175,033	-786,191	-700,132	-241,905	-744,234	5,170,517	23,586	621,940
1.03	2,025	-1,982,407	-180,284	-809,777	-721,136	-249,162	-744,234	5,325,632	24,293	662,925
1.03	2,026	-2,041,879	-185,693	-834,070	-742,770	-256,637	-744,234	5,485,401	25,022	705,140
1.03	2,027	-2,103,135	-191,263	-859,092	-765,053	-264,336	-744,234	5,649,963	25,773	748,621
1.03	2,028	-2,166,229	-197,001	-884,865	-788,005	-272,266	-744,234	5,819,462	26,546	793,407
1.03	2,029	-2,231,216	-202,911	-911,411	-811,645	-280,434	-744,234	5,994,046	27,342	839,536
1.03	2,030	-2,298,153	-208,999	-938,753	-835,994	-288,847	-744,234	6,173,867	28,163	887,050
1.03	2,031	-2,367,097	-215,269	-966,916	-861,074	-297,513	-744,234	6,359,083	29,007	935,988
1.03	2,032	-2,438,110	-221,727	-995,923	-886,906	-306,438	-744,234	6,549,856	29,878	986,395
1.03	2,033	-2,511,254	-228,378	-1,025,801	-913,514	-315,631	-744,234	6,746,352	30,774	1,038,314
1.03	2,034	-2,586,591	-235,230	-1,056,575	-940,919	-325,100	-744,234	6,948,742	31,697	1,091,790
1.03	2,035	-2,664,189	-242,287	-1,088,272	-969,147	-334,853	-744,234	7,157,204	32,648	1,146,871
1.03	2,036	-2,744,115	-249,555	-1,120,920	-998,221	-344,899	-744,234	7,371,920	33,628	1,203,604
1.03	2,037	-2,826,438	-257,042	-1,154,548	-1,028,168	-355,246	-744,234	7,593,078	34,636	1,262,039
1.03	2,038	-2,911,231	-264,753	-1,189,185	-1,059,013	-365,903	-744,234	7,820,870	35,676	1,322,227
1.03	2,039	-2,998,568	-272,696	-1,224,860	-1,090,783	-376,880	-744,234	8,055,497	36,746	1,384,221
1.03	2,040	-3,088,525	-280,877	-1,261,606	-1,123,506	-388,186	-744,234	8,297,161	37,848	1,448,075
1.03	2,041	-3,181,181	-289,303	-1,299,454	-1,157,212	-399,832	-744,234	8,546,076	38,984	1,513,844
1.03	2,042	-3,276,616	-297,982	-1,338,438	-1,191,928	-411,827	-744,234	8,802,459	40,153	1,581,586
1.03	2,043	-3,374,915	-306,921	-1,378,591	-1,227,686	-424,182	-744,234	9,066,532	41,358	1,651,361
1.03	2,044	-3,476,162	-316,129	-1,419,949	-1,264,516	-436,907	-744,234	9,338,528	42,598	1,723,229
1.03	2,044	-3,580,447	-325,613	-1,462,547	-1,302,452	-450,014	-744,234	9,618,684	43,876	1,797,253
1.03	2,046	-3,687,861	-335,381	-1,506,423	-1,341,525	-463,515	-744,234	9,907,245	45,193	1,873,497
1.03	2,047	-3,798,496	-345,443	-1,551,616	-1,381,771	-477,420	-744,234	10,204,462	46,548	1,952,029
1.03	2,048	-3,912,451	-355,806	-1,598,165	-1,423,224	-491,743	-744,234	10,510,596	47,945	2,032,917

Source: FEPORTS.

6. Environmental impact assessment

The implementation of an infrastructure of this type requires the introduction of the appropriate environmental measures according to the effects produced by the activity undertaken in it.

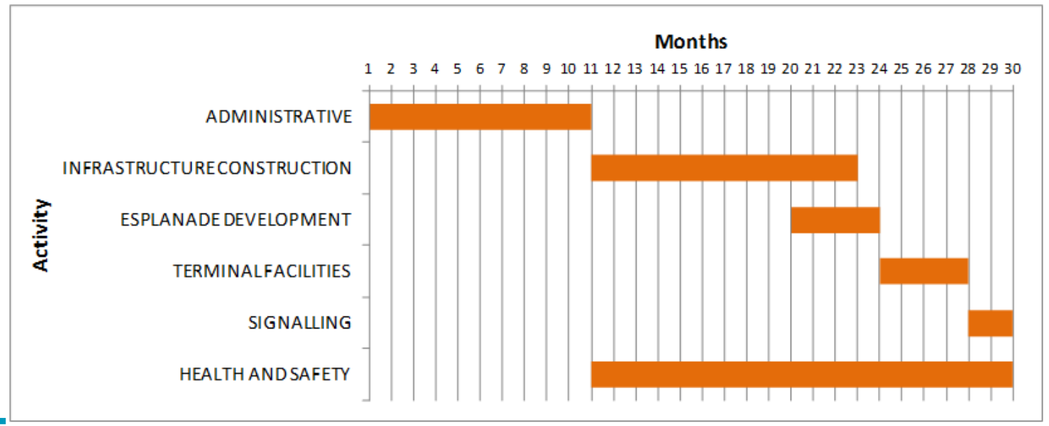
In addition, in 2005, the Port Authority of Castellón joined the Ecoports Foundation whose purpose is to establish a European network of environmentally conscious ports, and once again obtain the PERS certificate in 2011 (Port Environmental Review System), with the objective of associating the economic activities of all the companies that make up the Port Community with the protection of the environment. The PERS certificate is a validated method recommended by the ESPO (European Sea Ports Organisation) and helps ports in the initial stages of implementing the Environmental Management System as a preliminary step towards achieving more far-reaching management systems. This means that any activity that takes place in the port facilities must be in accordance with the conditions required to obtain this certificate.

In addition to the foregoing, it is mandatory to comply with European Parliament and Council Directive 200/59/CE (of 27 November 2000) enforced by Royal Decree 1381/2002 (of 20 December 2002) on port reception facilities for waste generated by vessels and their cargo.

7. Execution and start-up plan

The last point in this study sets out the development and execution plan of the Terminal which is shown as a timeline with the major tasks to be undertaken.

Table 16. Execution and start-up plan for the SSS terminal.



Source: FEPORTS.

The above table shows, in very diagrammatic form, the main activities to be undertaken to put the terminal into service; the most costly activity, in terms of time, is the administrative process associated with the granting of the operating concession and the construction of the infrastructure itself (quay and esplanade).

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Dangerous goods facilities in planned intermodal freight centres of Catalonia

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Consell General de Cambres de Catalunya

Project cofinanced by the European Regional Development Fund

LOSAMEDCHEM

1. Introduction

The conclusive remarks from the SWOT analysis show that there is a universal consensus among the LOSAMEDCHEM partners' evaluations about railways and intermodality from the logistics' point of view.

Railways freight services are considered very poor because of the infrastructures level, the service quality, the bureaucratic constraints and the lack of interoperability. And despite the frequent official statements in favour of its development, the intermodality suffers from the lack of concrete measures, especially at a regional government level.

So, it is needed a better coordination of European plans for developing logistic infrastructures. Member States of the European Union should agree on common priorities for the development of transport routes and on how to speed-up the respective extension of their relevant infrastructures.

Thereby, the European Commission has recently adopted a new proposal for the Trans-European Transport Network (TEN-T), including a core and a comprehensive network.

This new proposal of core network is a remarkable effort to transform the existing patchwork of European roads, railways, airports and canals into a unified transport network. The new core network will remove bottlenecks, upgrade infrastructure and streamline cross border transport operations for passengers and businesses throughout the EU. It will improve connections between different modes of transport and contribute to the EU's climate change objectives.

In conclusion, once that States are close to agreeing on the basic infrastructure and the big figures, now it is time to focus on freight services, especially at local level, which is the battlefield of the real economy enterprises, just like chemical companies are.

Description of current local situation

In Catalonia, the heart of Spanish chemistry, the main focus is the need to improve railway and intermodal freight services along the Mediterranean Corridor. To start with, there is a deficit in adequately designed railway terminals, well connected to the ports, with sufficient capacity and space for proper operations, especially for dangerous goods.

Public initiative is developing four main intermodal freight platforms in Catalonia (Empordà, Vallès, Prat and Penedès, see Figure 1). National and regional governments agreed in 2011 to appraise the economical and logistics feasibility of each platform. Moreover, they also agreed to determine the most suitable management and promotion model, preferably by public-private partnerships. These four logistics platforms, strategically located in Catalan territory and connected to port and airport infrastructures by the Mediterranean Corridor, will boost the competitiveness of Catalan export companies in foreign markets.

Figure 1. Long term railway infrastructures in Mediterranean Corridor

Source: Generalitat de Catalunya.

These new intermodal terminals are conceived as logistics centres that add value to transport chains, with particular attention to road and rail access as well as layout design, and reduce operational manoeuvres and extra operating costs. Cimalsa, a public corporation owned by the regional government, leads two of these terminal projects: Empordà (near the French border) and Penedès (halfway between Barcelona and Tarragona). The other two platforms, Vallès and Prat, are driven by the Ministry of Public Works. Both of them are located in the core metropolitan area of Barcelona, also known as Barcelona Economic Triangle.

This is reflected in the Catalan Mediterranean Corridor agenda, which originally expected to have the platforms running at full capacity by 2015. Three of these facilities (Prat, Vallès and Empordà) are already up and running and aim to expand their infrastructures in order to boost activity. The fourth, which will be located in the Penedès area, is currently preparing the necessary urban planning master plan.

The competitiveness of this area productive industry will increase thanks to the upgraded rail and road access to the main regional logistics terminals. Accordingly, Catalonia will become a vital link to the rest of the Mediterranean coast and one of the most efficient gateways in Europe from the foreign markets. With all these planned intermodal freight centres in operation, all the related areas of economic activity will also have a direct link to Asia through the logistics, airport and port infrastructures.

So, Catalonia aims to excel as an example of a productive model based on sustainable economy, as the Mediterranean Corridor rail connection will reduce heavy freight transport on the roads and, as a result, the level of CO2 emissions.

In this context, the challenge for chemical industry in Catalonia is to set out in due course enough dangerous goods facilities in planned intermodal freight centres, in order to ensure the competitiveness of the sector within the European and global economy. And, in short, the output of this study is to establish the minimum size required for dedicated facilities to hazardous goods logistics and the preferred location within the already planned intermodal terminals.

1.2. General objectives

- To develop the logistic potential of Catalonia within the framework of the European and global economy, with a multimodal approach.
- To promote intermodal freight transport of dangerous goods and to increase the quality of the provided services.
- To improve the perception of a certain rigidity by the Port of Barcelona concerning administrative proceedings and regulations about chemicals.
- To set the master business plan for the operation of the intermodal freight terminal.
- To facilitate public-private partnerships between infrastructure managers and freight operators.

2. Feasibility project

2.1. Specific objective

To determine the minimum size required and the optimal location for dangerous goods facilities among Prat and Vallès planned intermodal freight centres.

2.2. Demand analysis

Regarding these two specific projects, it is relevant to assess which is the optimal location for dangerous goods facilities in planned intermodal freight centres. Candidates are Vallès and Prat terminals, but 'both of them' and 'none of them' are also possible answers to the analysis. In fact, as shown on Figure 2, official strategic planning has set ambitious objectives for 2020, but there is still a lot to decide about prioritization and specialization.

Figure 2. Core rail freight network and main intermodal terminals planned in Spain by 2020

Source: Ministry of Public Works.

According to the official planning (***Plan Estratégico para el Impulso del Transporte Ferroviario de Mercancías en España*** – Ministry of Public Works, November 2010), new intermodal terminals are conceived as real logistics nodes with capacity to add value to transport activities: So the next step is to prioritize the building or the upgrading of those main terminals located in multimodal gateways that guarantee connections to TEN-T Network (as happens with every intermodal terminal within the Mediterranean Corridor).

But there is an extra step to move forward: the specialization of planned intermodal freight centres according to market needs, since operational requirements are significantly different for each specific family of products and the demand is not homogeneous throughout the Spanish territory. In other words, some terminals should specialize in perishable products while others should concentrate on dangerous goods facilities. This study tries to offer clues to answer the question about if it makes any sense to locate dangerous goods facilities whether in Vallès or Prat terminals.

First of all, it is important to point out that this kind of main intermodal terminals are basically oriented to multi client trains, serving many shippers by each composition. The reason is that factories or warehouses which generate freight flows important enough to engage regular mono client trains tend to have its own dedicated rail terminal, just like the example of big chemical companies in Catalonia shows.

In this sense, it is relevant for the demand analysis to bear in mind that top international chemical groups like Bayer, BASF or Dow Chemicals are developing their own-managed intermodal terminals within their premises in the nearby of the port of Tarragona.

For instance, BASF has planned to invest 20 million euros in a brand new intermodal terminal within its Tarragona site that should be fully operational during 2015. This terminal will have the capacity to process up to 6 trains per day and will include a 200 truck parking area and a tank cleaning station. The handling area will offer an interim storage capacity of 675 TEUs and the mid and long term storage area will allow up to 400 TEUs of conventional cargo and up to 250 TEUs of dangerous goods.

In other words, when dimensioning dangerous goods facilities in planned intermodal terminals close to Barcelona, the potential demand forecast must focus on regular but not extremely massive long distance flows and may ignore relations from or to major industrial plants, as far as they will reasonably provide own terminals in their sites.

Consequently, this feasibility study takes only into account the flows of containerized chemicals driven through the Port of Barcelona, which constitute the basic potential demand for the two terminals under analysis. Needless to remember that the Port of Tarragona containerized traffic remains negligible (altogether, about 100,000 TEUs per year). Therefore, total demand of dangerous goods in intermodal freight centres may be simply estimated from chemicals traffic data available from the Port of Barcelona.

The Port of Barcelona registered in 2011 an overall traffic slightly higher than 43 million tons. Goods classified as chemical products represented almost 5 million of that total goods traffic, from which liquid bulk was 1.2 million tons, containerized cargo was 3.6 million tons and non-containerized cargo was 0.1 million tons. Referring to chemical products, dry bulk was non-relevant.

The evolution of chemical containerized cargo has been quite fluctuating during the last five years. (see Figure 3). After the record of 2007 (3.6 million tons), traffics registered two consecutive years of decreasing volumes (-7.8 and -9.9%) and a sudden recuperation (+12.8 and +5.2%, up to 3.6 million tons again) which does not exactly correspond to the general state of the economy.

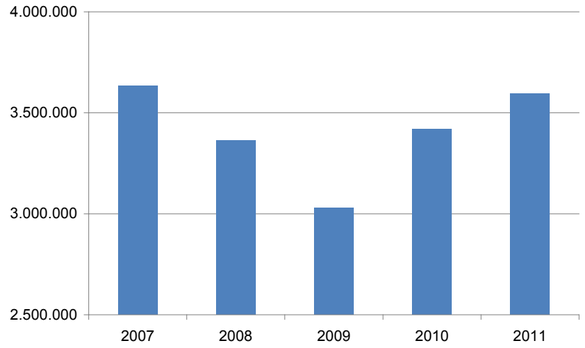


Figure 3. Traffic of containerized chemical products in the Port of Barcelona (in tons)

Source: Barcelona Chamber of Commerce (BCM), based on Port of Barcelona data.

Adopting a moderate growth scenario for the four following years (+3.0%), in 2015 the Port of Barcelona would reach 4.0 million tons of chemical goods transported by container. And that is the reference value for a first estimation of the required dangerous goods facilities in planned intermodal freight centres of the metropolitan area of Barcelona, at least for the first stage of development. So, briefly:

4.0 million tons of containerized chemical goods products in 2015 (distributed by land transport, both road and rail)

A second key issue for the demand forecast is to estimate a credible market share for rail in freight transport. As Figure 4 shows, the Port of Barcelona has achieved remarkable results during the past years. In 2010, rail freight rose up to 8% (and 100,000 TEUs) of all import – export containers, which are the ones that need land transport, as far as transhipment containers do not leave the port premises. But future objectives are ambitious and even though there is a brand new container terminal about to be inaugurated, the Port of Barcelona believes that rail transport will increase up to 20% (and 700,000 TEUs) for import – export containers by 2020.

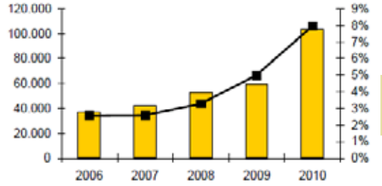


Figure 4. Market share for rail in import – export containers transport in the Port of Barcelona (in TEUs and percentage of use)

Source: Port of Barcelona.

Figure 5. Market share for rail in freight transport (from 2010 to 2020)

Source: Ministry of Public Works.

But this really positive evolution may be too optimistic for the average of the stakeholders. So, according to the mid-term objectives set by the official strategic planning (***Plan Estratégico para el Impulso del Transporte Ferroviario de Mercancías en España*** – Ministry of Public Works, November 2010) and shown in Figure 5, an 8% of market share for rail in containerized freight transport has been adopted as a milestone for 2015. It has been considered as a reachable goal that determines the minimum requirements for dangerous goods facilities in planned intermodal freight centres, which are as follows.

4.0 million tons * 8% rail freight market share ≈ 325,000 tons by rail per year

or

27,000 tons by rail per month

or

900 tons by rail per day of containerized chemical goods in 2015

2.3. Planned intermodal freight centres description

This feasibility study focuses on catchment potential of Prat and Vallès intermodal freight centres of dangerous goods traffics. So, a first step is to appraise their locations and their connectivity to existing transport networks. Furthermore, storage capacity and availability of spaces for specific purposes are also key issues in order to dimension an intermodal freight centre.

2.3.1. Prat Terminal

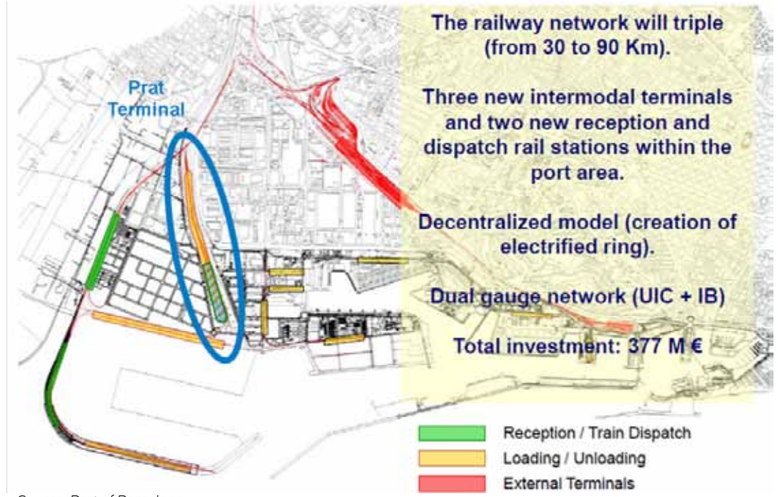
New rail freight Prat Terminal (also known as ZAL Prat Terminal) is planned to be located in the logistics core of the Port of Barcelona, just in the ancient bed of the river Llobregat, taking advantage of the flat terrain gained by diverting the river. Up to 50 useful hectares could be dedicated to build the new intermodal freight centre, with rail connection in both UIC gauge and Iberian gauge.

Prat Terminal would be a good solution for non-port traffics, as an alternative to current Morrot Terminal and as far as maritime traffics could be directly managed by container terminals. Its location conditions its layout, as the bed of the river sets a long and narrow contour. So load and unload tracks and reception and dispatch tracks are conceived in series configuration.

Loading and unloading terminal has been dimensioned by the Port Authority with a beam of 8 tracks of 750 metres length under gantry cranes. With an average yield of two daily trains per track, up to 200 TEUs per track could be processed every day. That means up to 1,600 TEUs daily for the whole terminal and up to 425,000 TEUs per year. Building only one beam of 8 tracks equipped with 2 – 8 – 2 gantry cranes every 200 metres has been considered an optimal solution. Moreover, taking into account standard surface requirements of 15 m^2 per TEU, minimum total surfaces needs are estimated around 24,000 – 30,000 m^2. The main problem of this layout is the lack of adequate storage areas for the containers.

In order to optimize terminal operational management, the ideal proportion among the number of loading/unloading tracks and the number of reception/dispatch tracks is 1:1. So another 8 tracks are planned for train reception and dispatching. Both terminal zones should be connected by an internal road which allows the rotation of trucks and avoids unloaded trips as far as possible (the same truck that brings in a container gets another to deliver).

Figure 6. Port of Barcelona railway general plan



Source: Port of Barcelona.

Internal communications and land accessibility

Road

A 13 kilometres long bypass road with two lanes in each direction connects docks and storage areas all along the Port of Barcelona. There are other accesses and service roads to each berth, but they all play a secondary role compared to the main bypass road already mentioned.

Rail

Altogether, the rail network of the Port of Barcelona is 29 kilometres long. Every wharf and every maritime terminal have rail access, but there is a big diversity in track gauge: from Iberian (1.668 m) to metric (1.000 m), through UIC (1,435 m) and all dual and even triple combinations. There are 9,0 km of Iberian gauge, 8,0 km of dual gauge (UIC – Iberian), 5,0 km of dual gauge (metric – Iberian), 4,5 km of metric gauge and 2,3 km of triple gauge (metric – UIC – Iberian). The remaining length is dedicated to origin – destination tracks.

Land accessibility

The Port of Barcelona, as a main hub of the whole mobility system of Catalonia, is surrounded by a wide range of land transport infrastructures. They consist of a rail and road network that gets the port close to its hinterland.

Main highways for freight traffics are:

• AP-2 (toll highway) and A-2 (free highway), that link Catalonia to northern and central Spain.

• AP-7, all along the Mediterranean Corridor, from southern Spain to the French border, working as a bypass for the metropolitan region of Barcelona.

• C-31 and C-32, metropolitan highways that serve coastal municipalities (and also the airport), connected to AP-7 at both south and north end.

• C-58, from Barcelona to central Catalonia through the Llobregat valley, and connecting to France through central Pyrenees.

Main rail freight services run through these lines:

• High-speed line (UIC gauge – single track) from the Port of Barcelona to the French border.

• Conventional line (Iberian gauge – double track) all along the Mediterranean Corridor, from southern Spain to the French border.

• Conventional lines (Iberian gauge – single track) that link Catalonia to northern and central Spain.

• Conventional line (metric gauge – currently, single track) from Barcelona to central Catalonia through the Llobregat valley, supporting relevant chemical and mining (salt) traffic.

2.3.2. Vallès Terminal

New rail freight Vallès Terminal (also known as la Llagosta Terminal) will provide up to 30 dedicated hectares and dual gauge rail connection (UIC and Iberian gauge simultaneously). It would benefit form a very good location, in a pretty flat terrain and with a full endowment of transport infrastructures.La Llagosta is located towards the northeast of the metropolitan region of Barcelona, in the middle of one of the top 3 industrial zones of Catalonia, within the area of influence of a very dynamic and powerful productive environment.

The new Vallès Terminal would be located in a piece of ground owned by ADIF (Administrador de Infraestructuras Ferroviarias, the Spanish public rail net manager), between the urban passengers station of la Llagosta and the C-17 highway. As Figure 4 shows, this area is currently occupied by an open-air storage area of cars, not directly related to the logistics services provided by the existing rail freight facilities.

The planned layout gives priority to functionality, with a minimal free track length of 750 metres and direct connections both to main rail and road networks. And, of course, it will offer dual track gauge (UIC – Iberian), just like the current net in service is provided for long-distance traffic.

Figure 7. Existing logistics and rail freight facilities at la Llagosta

Source: ADIF (Spanish rail net manager).

Land accessibility

La Llagosta is located in the river Besòs valley, which is one of the main natural communication corridors for the metropolitan region of Barcelona and Catalonia as a whole. As a result, the planned Vallès Terminal will be placed right next to two metropolitan motorways (C-17 and C-33) and will be served by the rail conventional line (Iberian gauge – double track) that runs all along the Mediterranean Corridor. And it will be not far from the high-speed line (UIC gauge – currently, single track) which runs from the Port of Barcelona to the French border. In fact, this proximity to the high-speed line will allow a direct access to the terminal through an exclusive branch.

From a general point of view, la Llagosta is a regional crossroads and a metropolitan railway node. So, its land accessibility is outstanding for the local market but there is still room for improvement; in terms of long-haul connections and trans European traffics. Thus, regional planning foresees new roads and rail connections around the terminal, in order to enhance the binding of secondary network to core network.

Last but not least, it must be stressed that there is another freight-oriented centre nearby of la Llagosta that could generate relevant synergy: the CIM Vallès (Central Integrada de Mercaderies del Vallès). This CIM is the high-rotation logistics platform of the metropolitan region of Barcelona, with a gross floor of 44,2 hectares and exclusively dedicated to road traffic. Since 1997, CIM Vallès offers optimal location and quality services to road freight haulers. It is only a few kilometres far from Vallès Terminal, in Santa Perpètua de Mogoda, directly served by a main highway (AP-7) and a metropolitan motorway (C-33).

2.4. Dimension of dangerous goods facilities

Once that the general layout and accessibility of Prat and Vallès planned intermodal freight centres has been reviewed, now it is time to assess the specific requirements that this kind of terminal should meet in order to be attractive to dangerous goods and chemical products traffics.

Thus, proper operation of an intermodal freight terminal requires some minimum dimensions according to a volume of goods transported and stored. In particular, available floor is distributed by zones depending on their purpose. Common areas in an intermodal terminal are the loading and unloading zone, the classification zone, the storage area and other multifunctional buildings (general control centre, administrative services, customs, telecommunications,...).

A first need is a proper storage service for general cargo. This means that is required a multi-purpose warehouse, both for short and long term stays, to prepare goods distribution. These warehouses must be directly connected to cross-docking activities.

Regarding to dangerous goods, an exclusive storage area is absolutely necessary. In fact, all logistic services oriented to this kind of goods will be placed and will be commercially offered to potential customers within this exclusive area. Moreover, as rail is the most rigid system in an intermodal terminal, rail freight operations and transfer operations from rail to road demand special attention.

Specific areas are also required to handle intermodal transport units (trailers, containers or ro-ro units), because these units need to be stored, consolidated, divided, cleaned and maintained. In addition, trucks also need special areas and dedicated services (parking, garage, petrol station) within the intermodal freight centre.

2.4.1. Terminal areas distribution

As a preliminary estimation to dimension dangerous goods facilities in planned intermodal freight centres, it has been assumed that future captured demand could be directly estimated from chemical products traffic through the Port of Barcelona. It has been estimated that containerized dangerous goods demand by rail could reach 900 tons per day[8] in the metropolitan region of Barcelona.

Public handling terminal and interim storage area of load units

This first estimation considers the area needed by transport operators for loading and unloading activities, classification, interim container storage and long-term container storage. According to previous European experiences, every 120 tons per day require at least 1 gross hectare, so:

900 / 120 ≈ 7.5 ha

Dangerous goods demand by rail in Barcelona requires 7.5 hectares to accommodate specific transport activities.

Facilities required:

- Modules of 3-4 handling tracks of 750 m working length under crane.
- Stabling tracks.
- Gantry cranes.
- One truck-loading trail and one truck-driving trail per module.
- Minimal storage capacity about 1.000 TEU.

Equipment required (for pre-carriage and onward carriage with truck):

- Vehicle fleet with ADR approval of classes 2-6 and 8-9 (truck tractor, container chassis, container-side loader, load transfer systems, reach stackers ...).
- Computer assisted management system.

Services required:

- Handling road/rail, rail/rail and road/road.
- Temporary storage of empty and full load units.
- Computer assisted check-in, check-out and stock management.
- Loading and unloading of all European loading systems with standardised procedures.
- Date coordination with loading and unloading locations.
- Just-in-time computerized vehicle disposition.
- Checking of load units before departure to loading place.
- Weight control.
- Tank cleaning service (at least, in near located tank cleaning facilities).

Container storage area

Mid and long term warehousing requires specific areas and facilities, for cross-docking and freight forwarding purposes. The estimation of the general storage area required has been calculated according to the following assumptions:

- An average 20% of dangerous goods need warehousing services within the intermodal freight centre.
- An average of 60 tons per day can be handled per hectare.

900 * 20% ≈ 180 tons/day to store

180 / 60 ≈ 3.0 ha

Dangerous goods demand by rail in Barcelona requires 3.0 hectares to accommodate general storage areas.

Facilities required:

- Dangerous goods stock with 3 trays.
- Electric power for heating/cooling of unit loads and hot-water heating.
- Gantry cranes.
- Minimal storage capacity for full load units with harmless goods, empty dirty dangerous goods load units and other empty load units about 250 TEU.
- Minimal storage capacity for hazardous goods about 250 TEU.
- Depot for empty containers for about 500 TEU.

Services required:

Daily checking of dangerous goods load units on store.

Heating/cooling with temperature control.

High security standards (additional surface sealing treatment, fire detection system).

Computer assisted handling.

Ancillary services:

Management of damaged wagons.

Repairing of load units.

Fixing and removing labels on load units (especially for hazardous goods).

Issuing of transport documents.

Customs clearance.

General services area

Approximately a 20% of total dangerous goods need some kind of value added services and special handling, related to their final commercial presentation. Moreover, under these conditions, a mean of 40 tons per day can be handled per hectare.

900 * 20% ≈ 180 tons/day to handle
180 / 40 ≈ 4.5 ha

So an estimation of 4.5 additional hectares is assumed to accommodate required general services facilities, which also include multipurpose warehouses, operators' offices and parking area for trucks.

2.4.2. Total area required

As a conclusion of the previous paragraphs and considering the daily containerized dangerous goods demanded by rail which could easily reach 900 tons in the metropolitan region of Barcelona, the total area required by dangerous goods logistics in planned intermodal freight centres reaches **15 hectares**.

Considering that Prat Terminal may offer up to 50 net hectares and Vallès Terminal up to 30 net hectares, the first conclusion is that **one single location is enough** to locate upgraded and efficient rail freight facilities dedicated to dangerous goods logistics, especially chemicals. Furthermore, due to its higher capacity and deeper project maturity, **Prat Terminal should be the first site to be developed**.

As stated before, almost 50% of the considering area should be devoted to the handling terminal and the interim storage area, whilst container storage area would require another 20% and the general services area the remaining 30%.

- Key factors for success

Best practices at terminals concern the implementation of infrastructural and operational measures as well as measures to generate an increase in the efficiency of operation and infrastructure usage. The identified key factors can be seen as important conditions for an optimised and efficient terminal.

- Key factors for the infrastructure of a terminal are as follows:
- Key elements for optimised design and layout of terminals
    - No rail-crossing for trucks (internal separation of rail and road operation).
    - Connection of the terminal on both sides to the network.
    - Capable connection to the rail net (e.g. two tracks for big-sized terminals).
    - Transhipment tracks with train length.
- Direct/easy connection of the terminal with the network (location).
- Adequate capacity in the rail yard in front of the terminal for empty train sets (floating procedure).
- Adequate capacity for interim storage of loading units in the transfer area (regarding current trends).
- End-of-track electrification (for direct train departure).

Key factors for the operation of a terminal are as follows:

- Integrated coordination and controlling of all processes (rail, road, transfer) in responsibility of one party.
- IT-based terminal management system.
- Automated identification systems (road in and out / rail in and out).

Key factors for the increase of efficiency of operation and infrastructure usage are as follows:

• Bonus – malus system applied for interim storage.

• Task management according to information e.g. in case of train delays.

• Optimal usage of train capacity (length, weight) in cooperation between intermodal operator, terminal operator and railway undertaking.

• Extension of terminal opening times (from approx. 5 days and 16h per day to 7 days and 24h per day).

• Increase of flow factor regarding the use of handling tracks.

2.6. Recommended corridor – oriented fields of action

The recommended action fields of action regarding dangerous goods logistics by rail all along the Mediterranean Corridor are as follows:

1. Synchronisation and coordination of infrastructure extension along the whole Mediterranean Corridor.

Adequate capacities in terminals are the key element for efficient terminal services. To continue the current positive development of intermodal transport, the performance of the terminals as the interface between rail and road is indispensible. To avoid regional capacity gaps and also disharmonious extensions in the terminals along the Mediterranean Corridor, it is very important to synchronise the development of terminal infrastructure. This has to be done by the observance of the growing importance of the international services as well as of the foreseen capacity gaps up the year 2020. The involved actors are the Ministries of Transport (policy), the terminal investors and operators and the infrastructure managers.

2. Monitoring of the realisation of all foreseen and planned measures.

The realisation of all foreseen/planned measures in the terminals is essential to improve capacity and thus intermodal transport chains along the whole Mediterranean Corridor. Especially the terminals which have a main function as a gateway/hub are important for the overall improvement of transport chains along the Corridor and have to be extended as soon as possible.

To control the realisation of the already planned extensions along the corridor, a monitoring concept should be implemented. This should be done in preposition of the extensions to identify problems and to generate solutions in time. The involved actors are the Ministries of Transport (policy) as well as the terminal investors and operators and also the infrastructure managers.

3. Improvement and intensification of the cooperation between all actors to optimise efficiency and quality of infrastructure use.

An efficient use of terminal infrastructure can only be reached if all actors who are responsible for different processes are working and cooperating closely together.

The main actions fields for intensified cooperation are:

• Increasing train punctuality on the corridor (e.g. by an introduction or improvement of an overall quality management system).

• Task management in case of train delays.

• Reduction of storage periods for loading units in the terminals (e.g. by implementation of a bonus – malus system).

• Implementation of integrated terminal management concepts (coordinating all operations/processes in one responsibility).

• Improvement of data exchange and communication between all actors.

• Improvement of train capacity use (optimal utilisation of train length and weight).

• Implementation of a neutral feeder railway to avoid uncoordinated shunting processes in the terminals and to organise processes in one responsibility.

To improve cooperation, all actors which are involved and responsible for different processes in the terminals or all along the transport chain, are important. These are the terminal and intermodal operators, the railway undertakings and the infrastructure managers.

4. Implementation of a terminal operator panel to improve the efficiency of terminal operation.

In general, all terminal operators are confronted with same challenges due to shared demands of suppliers and customers. To meet those demands in an adequate way and to solve existing problems, it is important and purposeful to act in a common sense in face of other partners along the logistics chain by implementing a kind of terminal panel for a reasonable exchange of experiences.

The following functions are important for a terminal panel concerning terminal operators:

• Dissemination of knowledge (exchange of experiences and best practices).

• Definition of guidelines for state-of-the-art standards for terminal layout.

• Development and promotion of a concept for an integrated coordination of all terminal-related procedures in responsibility of the terminal operator.

5. Development of an 'incentive' program for investments in terminals.

In consideration of the competitiveness with road freight traffic, the possibilities for pricing of terminal services are limited. On the other hand a terminal has to be seen as a profitable business unit. Previous experiences offer clear evidence that without public funds for the required construction or development of terminal infrastructure, the terminal can not operate on a profitable way; or the resulting pricing does affect the competiveness of the intermodal transport chain negatively. This can not be the interest of the political purpose to shift freight traffic from road to rail.

Thus the development and implementation of adequate "incentive" programs for investments in terminals regarding the different national funding schemes and programs as well as various business cases for ownership and operating to support the required extension of terminal infrastructure are indispensible. The involved actors are policy makers (Ministries of Transport, regional and local authorities).

6. Implementation of a 'pushing group' to extend the general operation time.

To reach a higher efficiency of available terminal infrastructure, the extension of the opening time is an important step. The existing procedure shows that this is in particular reasonable if there are no limiting factors all along the transport chain. Thus, the terminals which are working even today at their capacity limits would be used as buffers and therefore the efficiency of terminals would be much more constricted.

The aim is to extend the general logistics operation time along the whole Mediterranean Corridor and along the overall transport chain towards 7 days per week and 24 hours per day. This can only happen in coordination with all involved actors which are port operators, terminal operators, intermodal operators, railway undertakings, customers and policy makers (Ministries of Transport, regional and local authorities).

7. Implementation of a terminal platform.

The listed recommended actions are essential for the development of the terminal performance along the Mediterranean Corridor and thus for the continuation of the general positive development of intermodal transport all across Europe. To evaluate the implementation of the named measures and recommended actions, the installation of a terminal platform with an access for all involved actors is very important. Thus the effects of the already accomplished measures and the information how to go on with the development of the terminals on the Corridor can be recognized and regarded for further steps.

This platform can only be efficient if all relevant actors (terminal and intermodal operators, railway undertakings and infrastructure managers) are involved and committed with it.

2.7. Time schedule

A first estimation of the time required for the implementation of Prat new intermodal freight centre is about 4 years. Planning and designing the whole platform may extend up to 2 more years, and the construction process is estimated in 2 years time. Hence, if there are not unforeseen delays, the dangerous goods facilities may be fully operational within Prat terminal in 2015.

2.8. Expected benefits

As far as specific dangerous goods facilities will be promoted within an already planned intermodal freight terminal, a number of territorial and economic positive effects may happen, such as the following ones:

- Promotion of intermodal freight transport in Catalonia and increasing in the quality of the services provided, specially of those related to dangerous goods logistics.
- Reinforcement of the Port of Barcelona as multimodal gateway at national, European and global level and basic logistics node along the Mediterranean Corridor, thanks to the upgraded commercial offer to hazardous and chemical products.
- Deeper support to import – export activities basedoin Barcelona and Catalonia, and improvement of competitiveness of local industry and commerce.
- Improved distribution and managing of freight transport, especially by offering better traceability of supply chains and by increasing the safety of operations now based on the intermodal freight centre.
- Overcoming the perception of a certain rigidity concerning administrative proceedings and regulations about hazardous goods of the whole logistics community based on Barcelona, which is a key issue in order to improve the competitive position of Mediterranean ports in relation to the ports of Northern Europe.
- More effective planning of terminal operations and enhancement of efficiency, reliability and cost control compared to intermodal terminals now in service.
- Promotion of less pollutant and less congesting freight transport modes within the metropolitan area of Barcelona.

3. Conclusive remarks

Availability of transport infrastructure and efficiency of traffic flows are crucial for the chemical industry and chemical logistics. Therefore, stakeholders should actively be involved in this coordination process, in order to ensure that their actions are focused on the removal of the most critical deficits, both on a national and on a transnational level.

If the main target is the development of an optimal global logistic system, where coherent and sustainable goals are pursued along the whole multimodal supply chain, countries and regions must engage with industry to solve local problems and to coordinate their efforts.

And defining where to locate a new adequately designed railway terminal, with enough capacity and space for operations related to the flows of containerized chemicals transported through the Port of Barcelona, is a first step in the right direction, as a pilot action at a regional level which could be extended.

Concerning Catalonia, the current feasibility study has identified up to 4.0 million tons of containerized dangerous goods that require long distance land transport every year. And, according to market conditions, rail may transport every day up to 900 tons of containerized chemical goods with origin or destination in the metropolitan area of Barcelona.

So, this demand forecast justifies the dedication of 15 hectares of an intermodal freight terminal in one single location to offer efficient services to dangerous goods logistics, especially chemicals. Furthermore, due to its higher overall capacity and deeper project maturity, the study concludes that Prat Terminal should be the first site to be developed among the four planned intermodal freight centres all along the Catalan section of the Mediterranean Corridor.

Proposed next steps

The further development of this initiative requires deeper analysis, so these are the proposed next steps:

- To set the master business plan for the operation of the dangerous goods facilities within the intermodal freight terminal.
- To facilitate public-private partnerships between infrastructure managers and freight operators.
- To develop a detailed urban plan that takes into account the implementation of the whole intermodal terminal and its specific facilities for hazardous goods in different stages.
- To define the management and business plan for the operational phase of the intermodal freight centre.
- To support public initiative to solve financing, building and putting in service issues.
- To micro simulate local traffic conditions to assess future accessibility to the terminal and the generated local impacts.
- To implement the recommended corridor – oriented fields of action, as a way to exploit the synergies offered by intermodal freight market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