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ATLANTIC CORRIDOR

European Commission

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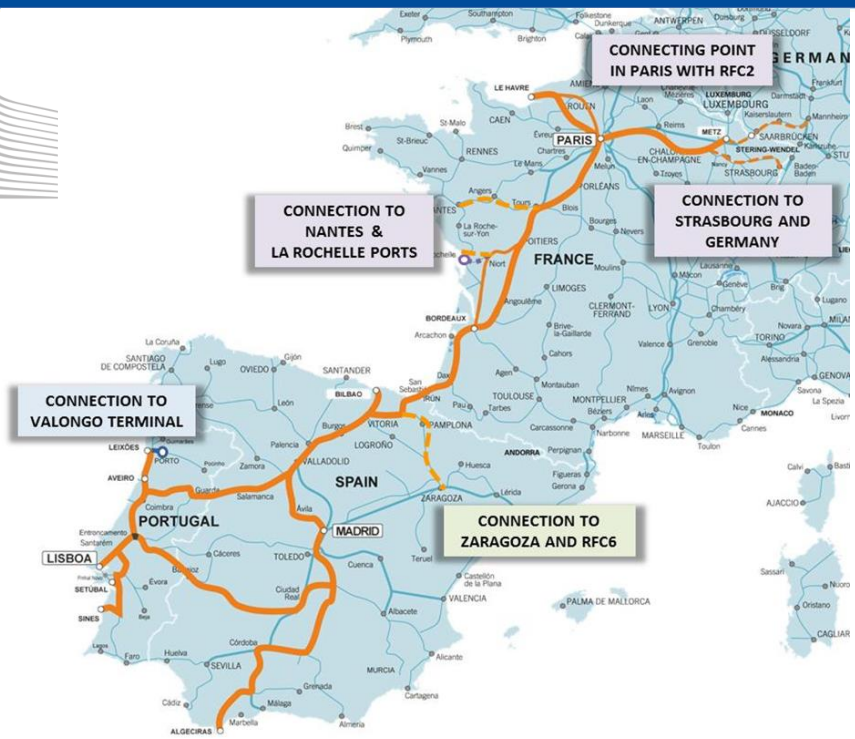


Feasibility of rolling motorway service at short, medium and long term on the Atlantic Corridor

Synthesis

INGÉROP

TEIRLOG INGENIERIA

prognos

Summary

Version	Date	Author	Review	Approval
1	2016 June 10	B. Jalard	Corrido	B. Jalard
2	2016 December 23	B. Jalard	Corrido	B. Jalard
3	2017 January	B. Jalard	Corrido	B. Jalard

1. BACKGROUND AND PURPOSE OF THE STUDY

The European Parliament and the Council adopted on 22 September 2010 the Regulation (EU) No 913/2010 concerning a European rail network for competitive freight.

Within this rail network, the European Parliament has approved nine European rail freight corridors. The rail freight corridor nº 4 includes the railway connection: Sines/Setúbal/Lisbon/Aveiro/Leixões - Algeciras/Madrid/Bilbao - Bordeaux/Paris/Le Havre/Metz. Connecting points with corridors 2 and 6 are located in Metz and Madrid, respectively.

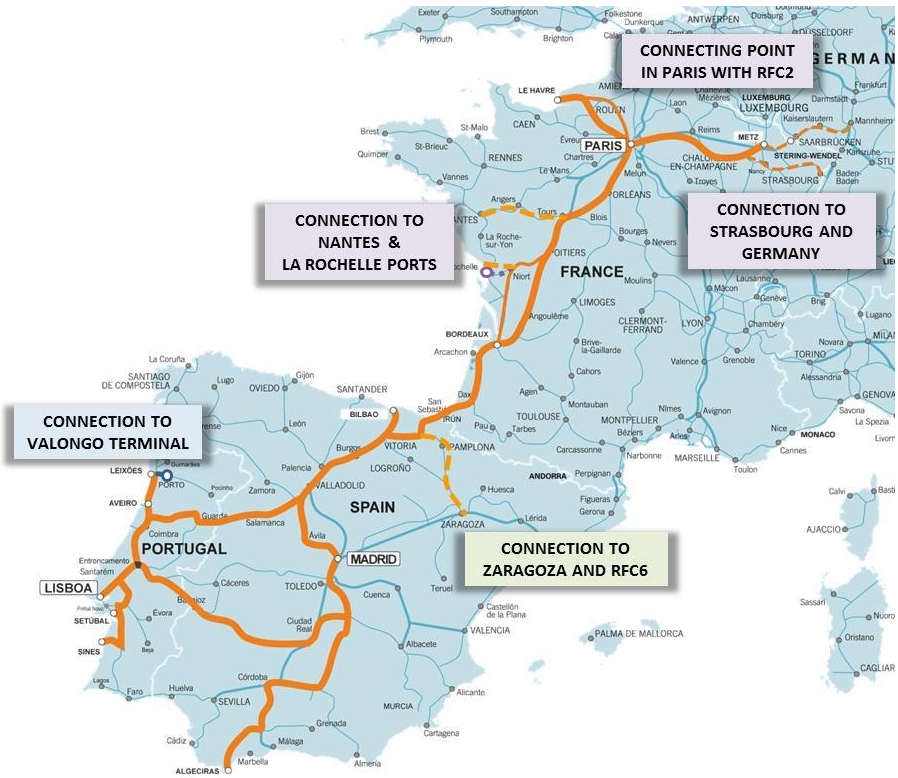
This regulation has been established to reach two main goals:

- Develop the rail freight corridors in terms of infrastructure capacity and performance in order to meet market demand both quantitatively and qualitatively; and
- Lay the groundwork for the provision of good quality freight services meeting customer expectations.

On 11th December 2013, the Regulation (EU) No 1316/2013, establishing the Connecting Europe Facility, revised the list of initial rail freight corridors approved by Regulation No 913/2010. Two amendments were made regarding the rail freight corridor nº 4:

- The corridor was renamed “Atlantic Corridor”; and
- An extension to Strasbourg and Mannheim was included.

The purpose of the study is to carry out feasibility studies to evaluate the potential of rolling motorway services (ROMO) on the Atlantic Corridor at short, medium and long term.



Atlantic corridor

2. METHODOLOGY

The study evaluated the feasibility (technical and financial) of implementing rolling motorway services connecting main nodes in the Iberian Peninsula to main nodes in France and Germany.
Services inside Iberian Peninsula were also tested

The study proceeded under 3 steps :

- Phase A : analysis of characteristics and experiences of today existing rolling motorways in Europe; survey and interviews of trucking and logistics companies;
- Phase B : analysis of technical feasibility of implementing a rolling motorway service on the Atlantic Corridor;
- Phase C : proposal of a business plan for a specific service on the Atlantic Corridor.

Phase A has as objective to understand the back ground of ROMOs existing services : types of OD, types of technologies, types of public support, impact on infrastructure. It leads to a first selection of type of ROMOs.

Phase B is dedicated to the description of infrastructure on the corridor, and to highlight the different parameters that have an impact on ROMOs services. These parameters are quantified all along the corridors.

Phase C is dedicated to simulations of scenarios that could be implemented along the corridors. Those scenarios are built on the basis of first and second steps results. Level of traffics and OD are coming from the study “Traffic and market research update for the Atlantic corridor” – 2014.

On the basis of those scenarios, business plans are elaborated and then calculated, in order to highlight the profitability, or not, of ROMOs services on the Atlantic corridor. In addition, it is possible to have an evaluation of impact of different technologies and type of operation on the profitability of the services.

3. PHASE A : TO DAY EXISTING ROMO SERVICES

3.1. Analysis of the European policies concerning RoMo development

3.1.1. *RoMos in the Connecting Europe Facility Program framework*

The Connecting Europe Facility (CEF) program finances projects that fill the missing links in Europe's energy, transport and digital backbone. Cross border projects are specifically looked after. Nevertheless, in the recent call for proposals, only one rolling motorway service project was taken into account : it was the one regarding the development of a new rail network between France and Italy for wide-gauge heavy freight, rolling motorway and high-speed passenger trains.
Another project was selected, which is the general project to inhance the connection between the Iberian Peninsula and the rest of Europe, involving parts of three railway lines: the existing cross border line and part of two new lines, the High Speed Line (HSL) San Sebastian-Bilbao/Victoria in Spain and the Grand Project of

South West (GPSO) in France. The development of this project will provide better conditions for railway services, including RoMo's.

3.1.2. *Regulatory framework, policies and strategies of the EU members related to combined transport*

3.1.2.1. Traffic restrictions exceptions for Combined transport (CT)

Every country has developed road traffic restrictions – mostly for Sunday time. The study focused on the countries which develop exceptions for those restrictions, in favor to Combined transport.

The result of the analysis is summarized in the hereafter table.

Country	With traffic restriction for freight transport	With traffic restriction exceptions for combined transport
Austria	✓	✓
Belgium	✓	×
France	✓	✓
Germany	✓	✓
Italy	✓	✓
Luxembourg	✓	✓
Portugal*	×	×
Spain*	×	×
Switzerland	✓	×
United Kingdom	✓	×

It appears that only 2 countries are without any restrictions, which are Portugal and Spain – which is not in favoor of Romo services on the Atlantic corridor. On the other hand, France and Germany do have restrictions, and exceptions for Combined transport; This is in favor of ROMO services on the corridor.

3.1.2.2. Social legislations

The study identifies the changes that appeared since the implementation of the "Study related to development of RoMo within Iberian peninsula by 2020"
In particular, the study listed those resulting from Regulation (EC) no. 561/2006 regarding the harmonization of certain provisions in social legislation on the road transport sector and that modify the Council Regulations (EEC) 3821/85 and (EC) 2135/98 repeal Council Regulation (EEC) no. 3820/85, which are uniformly applied to EU and Swiss drivers.
Those changes are listed in the following table

Country	Social legislation
Belgium	Prohibited taking the 45-hour weekly rest on board the lorry
France	Prohibited taking the 45-hour weekly rest on board the lorry
Germany	Requires that all drivers working for German and non-German companies receive remuneration not less than the Minimum Inter professional Wage (8.50 Euros/hour)

It appears that two main countries on the Corridor (Germany and France) apply specific social legislation, which is in favor of ROMO along the Corridor.

3.1.2.3. Lorry weight

The recently published directive 2015/719 incorporates, among others, the following changes linked to vehicle weight permits **for combined transport**:

- The maximum authorized weight for 2-axle motor vehicles, with a 3-axle semitrailer, which carries (in intermodal transport operations) one or several containers or swap bodies, with a maximum total length of 45 feet, is 42 tons. Previously, this was not allowed for 2-axle motor vehicles.
- The maximum authorized weight for 3-axle motor vehicles, with a 2-axle or 3-axle semitrailer, which carries (in intermodal transport operations) one or several containers or swap bodies, with a maximum total length of 45 feet, is 44 tons. In the previous legislation, this weight was authorized only for 40-foot ISO containers.

These changes are in favor of combined transport, but have no effect for ROMO services.

Maximum lorry weight

- 44 tons in France, Belgium, Luxembourg, the United Kingdom, and Italy.
- 48 tons in Finland.
- 50 tons in The Netherlands.
- 64 tons in Sweden.
- 40 tons in Spain, Portugal, Switzerland, Germany, Austria and most Western European countries.

In Germany, Spain, Portugal, Austria and Switzerland, there is derogation to 44 t. This is in favor of ROMO services.

3.1.3. *EU taxation of goods transportation activities in the Corridor's sphere of influence*

Eurovignette is promoted by the European commission in order to take into account infrastructure costs, and lorries environmental costs. Today, Eurovignette only exists in Belgium, Netherlands Luxembourg, Switzerland and Austria. So, it has no effect on the Atlantic Corridor.

3.1.4. *Incentives and subsidies at various levels (regional, national and EU) applicable to RoMos – Combined transport (CT) incentives*

Exemption of road vehicle tax

Applies to Austria, Czechs republic and Germany

Reduced rail network access charges
Applies to Bulgaria, the Czech Republic, Denmark and Poland ; reduction is between 25 % and 45 %, according to the State.

Aid (direct grants) for CT operations
Applies to Austria, France, Italy, Latvia and the United Kingdom

Aid (direct grants) for investments in CT terminal infrastructure
Applies to 10 EU members states (MS) : Austria, Belgium, the Czech Republic, Denmark, Germany, France, the Netherlands, Poland, Slovakia and the United Kingdom

Aid (direct grants) for investments in CT equipment
Applies to France and Austria

Specific aid granted to existing RoMos
Aiton – Orbassano receives a specific aid (7 M€)

Switzerland, Austria and Germany
Switzerland, Austria and Germany have developed strong strategies in order to help unaccompanied and accompagnied combined traffic.

Switzerland
Switzerland provides specific aids to limit road traffic specifically for Alp transit
For unaccompanied traffic, the aid is decribed on the table below

Traffic that crosses the Alps			
Origin/Destination	**Subsidy per shipment (CHF)**	**Subsidy per service (CHF)**	**Max. subsidy per service w. 30 chargeable shipments**
Netherlands (excl. Limburg)	90	1.000	3.700
Limburg	90	1.150	3.850
France	90	1.000	3.700
Southwest Germany and Switzerland	90	2.150	4.850
Northern Germany, GBR, Belgium, Scandinavia and Luxemburg	90	2.150	4.150
Traffic that does not cross the Alps			
Domestic	48		
Import to/Export from Switzerland	0.4*(6 + 0.5* km in Switzerland)		

Accompanied combined traffic is devoted to Ralpin, a subsidiary of Hupack. SBB Cargo and BLS. Average help for one shipment is 260 CHF.

Help to investment is also provided - through loan up to 60 % of the total amount of investment.

Austria
Funding from 30 % to 50 % of terminal investment costs, as well as equipment (vehicles, containers …)
Help for accompanied traffic, as table below

Route	Euro / RoMo shipment
Brenner	94,00 day / 47,00 night
Tauer	82,00
Pyhrn-Schober	78,00

Help for unaccompanied traffic
From 12 to 50 €, according to the tonnage and the distance
In addition, administrative facilities are given to accompanied CT.

Germany
Funding of terminals: up to 80 %,
Exemption of taxation for trucks
Traffic restrictions exemption (heavy restrictions applies to non combined traffic.

3.2. Analysis of the various Ro-Mo technologies

3.2.1. *Description of the various existing technologies*

Today, there are 3 technologies under operation : ROLA, Pocket Wagon and Modalohr ; CargoBeamer has started partial operation. Other technologies are ready to start or are still under experimental tests.

ROLA

The ROLA (RollandeLandStrasse) is a Swiss system, using trains offering of continuous floor, and thus allowing horizontal longitudinal loading of trucks. This allows quick and costless loading and unloading process.
On the other hand, there are strong costs for operation, because of specific ten axles wagon with small diameter wheels (360 mm) – which leads to high maintenance costs. In addition, the floor level above rail remains high (480 mm), which leads to strong loading constraints

Main advantages and disadvantages of ROLA are the followings :

ADVANTAGES	DISADVANTAGES
1. Minimal need for specific facilities in the terminal 2. Quick and cheap loading / unloading operation	1. Trains need a minimum of a type C gauge for semitrailers of 4 meters height (gauge to which the European rail network is being standardized) 2. High cost of operation maintenance because of reduced-diameter rail wheels 3. Due to its characteristics, it does not allow for intermediate loading/unloading 4. Limited maximum velocity due to the reduced diameter wheels

Pocket waggon

The pocket wagon system is a technique consisting of trains with platform wagons with a wedge-shaped area in which the lorry wheels are housed. Loading and unloading can be performed using classical CT terminals, and thus wagons can be introduced into classical CT trains. Only reinforced and specific semi-trailers can be used, because of vertical loading / unloading. Those semi-trailers are only 2 % of the existing semi-trailors in Europe (0,5% on Iberian Peninsula market. Floor level is 270 mm, which also leads to loading gauge constraints.

Main advantages and disadvantages of pocket wagon system are the following

ADVANTAGES	DISADVANTAGES
1. Can be operate in conventional CT terminals (cranes or reachstacker) 2. Relatively cheap wagons	1. Suitable only for semitrailers with reinforced boxes for performing vertical movements (marginal market share) 2. Loading gauge limitation (limitation height to 3,9 m even under GB 1) 3. Suitable only for un accompanied transport

Modalohr

Modalohr system consists in consists of low-floor wagons, which by rotating the wagon body 45º allows for the lateral loading of semitrailers. It needs dedicated terminals, but wagons can be vertically loaded, provided that semitrailers are cranable. Floor level is 200 mm, which makes loading gauge constraints easier. Any type of semitrailers can be loaded – unloaded. The system is under operation on the following OD : Aiton – Orbassano, Bettembourg – le Boulou, Calais – le Boulou and Sète – Calais (vertical loading in Sète)

The main advantages and disadvantages of Modalohr system are the following

ADVANTAGES	DISADVANTAGES
1. Possibility to carry all type and all size of semitrailers as soon as GB 1 is reached 2. Quick loading/ unloading of trains because parallel operation 3. Available for accompanied transport	1. Specially designed terminals adapted to this system, with the associated costs 2. High cost of investment for wagons (but not for maintenance)

Cargobeamer

The CargoBeamer system consists in "cassettes" on which the tractor rolls; the terminal, using rails perpendicular to the railway, loads automatically the cassettes on dedicated wagons. Automation and low floor (similar to Modalohr) are the main characteristics of CargoBeamer, as well as the possibility to deal with all types of semitrailers (as well as Modalohr). Experimental lines started, but no full commercial operation for the terminals.

Main advantages and disadvantages of CargoBeamer are the following

ADVANTAGES	DISADVANTAGES
1. Possibility to carry all type and all size of semitrailers as soon as GB 1 is reached 2. Quick loading/ unloading of trains because parallel and automatic operation	1. Expensive terminals due to automation High payload because of weight of "cassettes" 2. Suitable only for unaccompanied transport 3. High tare and length of wagons because of the "cassettes" 4. Little operation experience for terminals 5. Unavailable for accompanied transport

In addition to those four systems, it exists experimental systems that did not go into operation

 Megaswing system	 Flexiwagon system	 Ecopicker system

Megaswing and Flexiwagon systems are similar to Modalohr technics.
Ecopicker consists in wagons that can separate in two parts by towing in the terminals, allowing a rolling loading of the semi trailer. After the loading, the two parts are re assembled, by towing back.

Nikrasa

A last system is Nikrasa, which proposes to introduce a cassette, similar to CargoBeamer, in order to handle on cranable semitrailers, which are 98 % of the lorry market

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3.2.2. *Synthesis for ROMOs technologies*

ROLA system is an operating costly system which is interesting for relatively short distance, when the loading gauge is high (G C), and when you have obstacle to go through, such as mountains (provided that you have low ramps tunnels allowing G C loading gauge). That is why it is fully developed for Alp Transit through Switzerland and Austria.

It does not seem to apply to Altantic Corridor, which deals with long distance transport and maximum GB 1 as loading gauge.

Pocket Wagon system is widely used, specifically in central Europe and for Alp transit, also when GC loading gauge is reached. For Atlantic Corridor, we see two main disadvantages:

- Because of maximum GB 1 loading gauge, there would be a limitation to 3.9 meters for semitrailers height,
- Market is limited because of limited number of cranable semitrailers : Pocket wagons could take only a very limited market share of the lorry traffic.

For this reasons, and if we let besides non yet operated technologies, it seems that the two technologies that can apply short term for ROMO on the corridor are Modalohr and CargoBeamer. Those technologies are similar ; both can operate all type of semitrailers.

CargoBeamer appears with the advantage of cheaper wagons, but, on the other hand, appears with higher costs of terminals, and lower ratio for train productivity, because of longer and heavier wagons.

	Modalohr	CargoBeamer
Semi-trailers per meter	1 semi-trailer for 16,5m	1 semi-trailer for 19,3m
Weight of wagon per semi-trailer	20,2 tonnes per semi-trailer	29,4 tonnes per semi-trailer

Modalohr – CargoBeamer comparison of loading efficiency

4. PHASE A – SURVEY RESULTS

In order to define and confirm the service characteristics to offer, interviews of main truckers were performed

4.1. List of interviews

The following interviews were performed :

Name of company	Nationalality	Turnover	Observations
Carreras Gruppo logistico	Spain (Aragon)	195 M€	Logistics and transportation
SJL	Spain(Donosti)	95 M€	General cargo and forwarders
Grupo Panalon	Spain (Albacete)	120 M€	General cargo
Logiters	Spain (Madrid	250 M€	Logistics and transportation
Joao Pires	Portugal (Vilanova)	25 M€	Full truck load
Berger logistik	Austria (Tyrole)	151 M€	Logistics
VGB	Netherlands	3,2 M€	Flower transport lobby group
Geodis BM	France	828 M€	Logistics
Transalliance	France	26 M€	Logistics

4.2. General characteristics of traffic - OD and traffic flows

The Basque Country (Vitoria) prevails as the largest generator of movement, mainly towards Benelux (Bettembourg), Northern France (Paris) and Germany (Mannheim). The center of Spain (Valladolid / Madrid) also has major traffic flows with Benelux, Northern France and parts of Germany. In less volume, respondents claim to have traffic from Portugal with the rest of Europe.

Although most traffic flows are in the South-North direction, it is important to note that the preference for a not accompanied service forces to use the service in both directions.

Traffics are homogeneous both during the week and throughout the year.

70% is conventional load.

4.3. Characteristics of service that is waited for

Two main requirements: the service has to be cheaper than road and reliable.

Several departure per day is also necessary, although one (minimum) is acceptable at the opening of service.

Also, end carriage on destination is highly wished.

Aspects	Importance
High frequency service (various departures per day)	1 2 3 **4** 5
Regular frequency service (one service each day)	1 2 3 4 **5**
Services during weekends only	1 **2** 3 4 5
RoMo service prices lower than road through service price	1 2 3 4 **5**
Guaranteed time of delivery (reliability)	1 2 3 4 **5**
Carriage assured on destination	1 2 3 4 **5**

For international services, minimum distance of 800 km is required, because of lower road transport prices in Spain and Portugal

Parking facilities would be also appreciate.

Companies would be interested in establishing permanent and stable agreements for reserve spaces on the train.

4.4. Obstacles addressed by RoMo

Avoiding the traffic restrictions would be the main interest.

Decreased productivity of vehicles due to rules and regulations regarding driving and resting times, Congestions at border crossing, decrease of theft risk and a less impact on the company's cost structure due to fuel cost rises, are obstacles the interviewed consider can also be reduced, but on a smaller scale,.

Table 1. *Obstacles addressed by RoMo (General result)*

Aspects	Importance
Congestions at border crossing, urban environments, etc.	1 2 3 **4** 5
Decreased productivity of vehicles due to the application of rules and regulations regarding driving and resting times	1 2 3 **4** 5
Decrease theft risk	1 2 3 **4** 5
Less impact on the company's cost structure due to fuel cost rises	1 2 3 **4** 5

Better working conditions for the drivers	1	2	3	4	5
Avoid traffic restrictions (lorry bans during weekends, holidays, etc.)	1	2	3	4	5

5. PHASE B - INFRASTRUCTURE AND TECHNICAL FEASIBILITY

In this phase, are analysed the different parameters which have impact on feasibility and quality of ROMO services, in regards with trucks companies and hauliers requirements.

The main objective of the infrastructure is to allow :

- long and heavy trains,
- good paths and reliability,
- adequate loading gauge;

It must be highlighted that those quality parameters are not specific to ROMO services, but can apply to any freight services (except for the loading gauge specificity).

On the Corridor Atlantic, the main difficulty comes from the fact that trains are going to run through four different networks (German, France, Spain and Portugal) under long distance (up to 2000 km). Thus, it is very difficult to have a common standard of train, that will apply all along the corridor, and that will not be too restrictive in regards to profitability requirements.

The parameters to be considered are the following :

- Rail gauge
- Loading gauge
- Train performance (maximum length, gradients, speed)
- Electrification
- Axle load (t / axis)
- Signalling
- Train paths, overall capacity on the network
- Terminal facilities

5.1. Rail gauge

Rail gauge in France and Germany is 1,435 m (UIC gauge), and is 1,668 m (Iberian gauge) in Spain and Portugal.

This means that a change of wagons or axes is necessary at Hendaye – Irun border point;

In 2019, under the frame of Y Vasca or AVE Vasco the UIC gauge will be reached betwween Astigarraga and Vitoria ; and UIC gauge will be also obtained on existing line Irun – San Sebastian – Astigarraga.

This means that UIC gauge will be in operation till Vitoria in 2019.

Later on, there are projects to have UIC gauge further on the Iberian peninsula : it is planned to have the UIC gauge up to Madrid and Lisboa – Porto, for the year 2030.

5.2. Loading gauge

In Germany, loading gauge is higher than GB 1.

In France, along the corridor, GB1 is also reached, although it remains some restrictions for specific tunnels :

- tunnels between Dax and Hendaye (GB) (3 tunnels for 1200 m total length),
- between Poitiers and Bordeaux (GB) (4 tunnels for 3000 m total length),
- between Meaux and Epernay (GB),(3 tunnels for 2000 m total length),
- between Metz and Strabourg (under Vosges massif) (GB) (one tunnel for 2 650 m length)

Another tunnel (Sery) is to be taken into account in the North of Paris to allow an alternative service in case of incident or maintenance on the normal itinerary.

Preliminary design was performed in 2007 for the tunnels between Poitiers and Bordeaux, as well as between Dax and Hendaye; the crucial tunnel is the Livernon tunnel – 1468 m. There are no studies for the other tunnels

In Spain, GB 1 will be reached in 2019 on new line Vitoria – Astigarraga, as well as on conventional line Irun – Astigarra.

Further on the Corridor, the following tunnels prohibit the implementation of a GB1 gauge from Vitoria to Madrid and to the Portuguese border :

- from Vitoria to Medina del Campo : tunnel Brujala 1 : 1041 m
- from Medina del Campo towards Vilar de Formoso and the border with Portugal : one tunnel : 352 m
- from Medina del Campo towards Madrid :, Navalgrande tunnel 1004 m

There are projects to enlarge the loading gauge of the tunnels until 2030, in relationship with UIC gauge equipment ; this is to be confirmed

In Portugal, loading gauge is compatible with GB 1.

5.3. Train performance (maximum length, maximum tonnage, speed)

In Germany and in France, maximum speed of ROMO trains can be 100 kph or 120 kph. Normally, 100 kph is enough, but 120 kph can be used to ease ROMO trains insertion in between fast passengers trains.

Because of low gradient (smaller than 10 per thousand along the corridor), maximum tonnage of trains is high (up to 2500 t, in France as well as in Germany.

Then, the limiting factor is the maximum length of trains, with is inked to stabling tracks length.

In France and in Germany, the maximum length of trains is 750 m – including locomotives ; in France, some test trains are 850 m long ; in this case, specific operating measures are necessary, and long stabling tracks have been identified.

On the Iberian Peninsula, one has to consider :

- Irun – Vitoria line section,
- Vitoria – Madrid / Lisboa/Porto :

Irun – Vitoria :
Maximum length of trains: 750 m,
Maximum tonnage of trains (because of 18 per thousand gradient) : 1086 t with one locomotive / 1500 t with two locomotives; The 1500 t limitation is due to train performances necessary to insert ROMO trains in between fast passengers trains. Could be 2200 t at night time.

Vitoria – Madrid/Lisboa/Porto
Maximum length of train (due to stabling tracks) : 500 m
Maximum tonnage of trains: could be 2 200 t – with 2 locomotives -, but now reduced by maximum length, which leads to 1500 t

For the future (2030), it is expected that the length of stabling tracks in Iberian Peninsula will be extended to 750 m, which would allow 2 200 t trains. It is supposed that there will not be so many passengers trains in order to allow heavy and slow trains insertion; this has to be confirmed through specific studies.

5.4. Electrification

Germany

The German section is electrified and equipped with AC 15 kV 16.7 Hz

France

The French section is and CC 1500 V electrified. Extension of 25 kV is scheduled for 2019 on Serqueux – Gisors line section, which will give an alternative access to le havre

Spain

The Spanish section is electrified under CC 3000 kv or AC 25 kV 50 Hz (for new lines). Missing section is Medina del Campo – Fuentes de Onoro (Portugal entrance). Electrification of this line section is on going (25 kV)

Portugal

The Portuguese section is electrified with AC 25 kV 50 Hz

Signaling system

Automatic block system is under operation all along the corridor
Double track is also under operation, except on the 200 km mong cross border section Medina del Campo to Pampilhosa.

Nota : in France, the alternativeroute between Poitiers and Bordeaux (via Niort and Saintes) is partially single track, manual block and not electrified

5.5. Axle load

Axle load is 22,5 t per axle all along the corridor

5.6. Train paths allocation

Because of good signalling system and double tracks, there is a possibility to allocate good quality trains paths along the corridor.

Improvement is to come with the construction in France of Sud Europe Atlantic High speed line, which will give additional capacity to Tours – Bordeaux line section. Later, the Grands projets du Sud Ouest (GPSO) line section from Bordeaux to Dax will give also additional capacity.

Nevertheless, it remains a 200 km long cross border section between Spain and Portugal), which is single line.

There are also difficulties to get train paths to go across Ile-de-France, because of Paris very high suburban passengers rail traffic. Difficulties can also be found à Bordeaux, San Sebastian and Madrid.

In addition, there is the key point of maintenance time allocation on the network. Today, on the French side, there is a strong policy in favor of heavy maintenance works, with long periods of time dedicated on line to maintenance works. This creates difficulties to get good train paths, and may alter reliability during operation, if track is no free of works on due time. This is clearly a question that the Corridor and GEIE have to deal with, in connection with National infrastructure managers, and specifically with SNCF Réseau : realistic compromise is to be looked after, taking into account, in a balanced manner, maintenance needs and clients needs.

5.7. Terminals

Along the corridor, there are today no ROMO terminals ; some projects (and yard pre-reservation) exists, for a Modalohr or similar technology in Dourges (near from Lille) and Vitoria. A project was also studied in Tarnos, near Bayonne, but is today cancelled.

On the other hand, there are a certain number of classical CT terminals along the Corridor :

- Mannheim, Ludwigshafen in Germany
- Bettembourg in Luxembourg,
- Champigneulles (Nancy), le Havre, Valenton in France, Cognac, Hourcade (Bordeaux), Mouguerre (Bayonne),
- Irun, Jundiz, Vitoria, Valladolid, Abronigal in Spain,
- TMIP - Alfarelos, Pampilhosa, Multiusos do Norte - TMN

6. PHASE C – BUSINESS PLAN

6.1. Starting point and input data for traffic et OD

It was used the results of ghe “Traffic and Market Research Update for the Atlantic Corridor” study – 2014 - (TMS hereinafter).
This study estimated the traffic seizable for several RoMo services on the Atlantic Corridor at three time horizons (2020, 2030 and 2050). The proposal of the TMS for RoMo service is:

- 2020: only one service between Vitoria and Dourges,
- 2030: 12 services in 2030 (Vitoria-Dourges is maintained and 11 other new services are created).
- 2050: the 12 services are maintained.

At short term time (2020) Vitoria-Dourges traffic prevision is 2,021 million tonnes.

The traffic projections on the 12 ODs at medium (2030) and long terms (2050) are as following:

		In thousands of tons
Vitoria	Paris	589
Vitoria	Lille	871
Madrid	Lille	1 019
Madrid	Paris	516
Poceirão	Paris	221
Poceirão	Lille	508
Valongo	Paris	295
Valongo	Lille	262
Vitoria	Bettembourg	266
Madrid	Bettembourg	171
Vitoria	Mannheim	713
Madrid	Mannheim	446
		5 877

		In thousands
Vitoria	Paris	980
Vitoria	Lille	1 457
Madrid	Lille	1 746
Madrid	Paris	895
Poceirão	Paris	372
Poceirão	Lille	876
Valongo	Paris	477
Valongo	Lille	426
Vitoria	Bettembourg	443
Madrid	Bettembourg	298
Vitoria	Mannheim	1 200
Madrid	Mannheim	776
		9 945

Due to low traffic volume, relations to/from Porto (Valongo) or Lisbon (Poceirao) from/to Paris and Lille are

regrouped into a sole portuguese node (Pampilhosa),

Three groups of services were considered :

- **Group of services 1 (Dourges Terminal)**: starts in 2020 with Vitoria-Dourges and extend the service with two other relations –Madrid-Dourges and Lisbon/Porto (Pampilhosa)-Dourges.
- **Group of services 2 (Paris Terminal)**: starts in 2030 with three services Paris-Vitoria, Paris-Madrid and Paris-Lisbon/Porto
- **Group of services 3 (Mannheim – Bettembourg Terminal)**: starts in 2030 with two services Mannheim/Bettembourg-Vitoria, Mannheim/Bettembourg-Madrid.

	LISBON/PORTO	MADRID	MEDINA DEL CAMPO	VITORIA	IRUN/HENDAYE	PARIS	DOURGES	BETTEMBURG/MANNHEIM
2020								
2030								

6.2. Common hypothesis

6.2.1. *General ratios*

- occupancy rate on the trains : 80%
- average load per semi-trailer : 17 tonnes
- semi-trailer tare : 7 tonnes
- maintenance ratio for locomotives : 10% of locomotives required + one reserve loc for each service
- maintenance ratio for wagons 10% of wagons required + one wagon set in reserve for each service
- number of days of operation per year : 260
- vacation rate for drivers : 25% for 7h working hours per day and 43% for 8h working hours per day (2)

6.2.2. *Infrastructure assumptions*

In relationship with phase B diagnosis and analysis, business plan is built under 2 situations for the infrastructure:

- Situation 1 : 2020 :
  - UIC gauge as well as GB 1 loading gauge are reached till Vitoria, and GB 1 is reached between Poitiers and Bordeaux, and Bayonne and Hendaye,
- Situation 2 : 2030 :

- GB 1 between Paris and Metz, and between Vitoria and Madrid.
- UIC gauge between Vitoria and Lisboa, Madrid and Porto
- 750 m train length between Vitoria and Madrid and Pampilhosa.

.
Nota: one scenario Vitoria – Pampilhosa was tested starting in 2020, although loading gauge will not be reached in 2020 on this OD ; this is only to get financial appraisal of such a scenario..

6.2.3. *Train composition*

As it was noticed in phase B, there is a discontinuity at the border between France and Spain for train maximum composition. Trains can be longer and heavier on the French side.

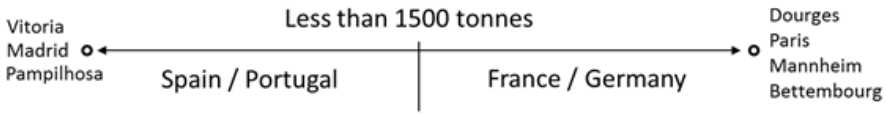
So, there are 2 possibilities :

- to operate with trains composition adequate at the smaller standard : the advantage is to have no transfer at the border (you have nevertheless the obligation to add one locomotive (but change of locomotive is necessary because of change of electrical tension and signalling system – this is scenario 1
- to operate with trains at the larger standard, which are split into 2 trains at the border ; here you can choose between :
  - adapted size of trains on the French side, allowing trains with only 1 loco on the Iberian side, this is scenario 2,
  - maximum size on the French side, which would need 2 locomotives for each trains on the Spanish side, this is scenario 3

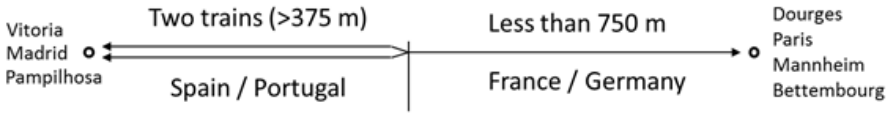
Another scenario consists to consider that off peak hours, heavy trains are suitable on Irun – Vitoria : this is scenario 4.

Those scenario are described hereafter.

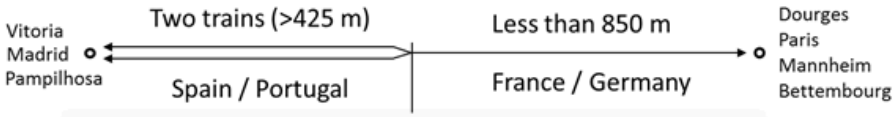
Scenario 1: same train from origin to destination (limited to 1500 tonnes)



Scenario 2: one long train (limited to 750m) in France and Germany, two short trains in Spain and Portugal



Scenario 3: one long train (limited to 850m) in France and Germany, two short trains in Spain and Portugal



Scenario 4: same as scenario scenarios 2, but half on trains (night trains) not split in 2 parts in Irun

Vitoria - Pampilhosa was tested under hypothesis of scenario 1

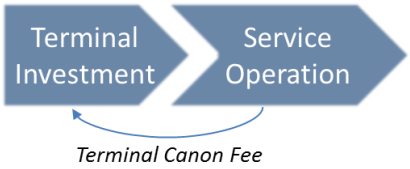
6.3. Economic hypothesis

6.3.1. *Exploitation models*

Two different service exploitation models:

- **Model 1 – Separate Investment and Service Operation**
  RoMo Terminal will be developed by any governmental institution, organization, company or similar which receives a “fee” for the usage of this infrastructure from the railway undertaking. For this model, Business Plan is developed only for railway undertaking.

Model 1: Separate Investment and Operation



- **Model 2 – Join Investment and Operation**
  A global operator which invests in RoMo terminal and also offers the RoMo service.

Model 2: Join Investment and Operation

6.3.2. *Analysis Horizon:*

25 years, considering the year of the first investment as year 1. However, taking into account that Group service 1 (Dourges Terminal) includes new services since 2030, and for comparative reason, the analysis horizon is extended for 35 years.

6.3.3. *Investments*

- The planned investments estimated for each Model, considering unit prices for 2020, are the following:

Rolling stock

INVESTMENTS (Unit Prices)		
Investments	**Modalohr**	**CargoBeamer**
	Euros (2020)	
Locomotives (EU and Iberian)	4.000.000	
Wagons	400.000 (double)	160.000

Terminal

Modalohr terminal

Sc 1	Terminal Modalohr 500m	22 M€
	Extension Modalohr 500m	15 M€
Sc 2	Terminal Modalohr 750m	30 M€
	Extension Modalohr 750m	23 M€
Sc 3	Terminal Modalohr 850m	32 M€
	Extension Modalohr 850m	25 M€

CargoBeamer terminal

Sc 1	Terminal CargoBeamer 500m	26 M€
	Extension CargoBeamer 500m	19 M€
Sc 2	Terminal CargoBeamer 750m	36 M€
	Extension CargoBeamer 750m	29 M€
Sc 3	Terminal CargoBeamer 850m	39 M€
	Extension CargoBeamer 850m	32 M€

- **Amortization of investments:**
  - RoMo Terminal: 50 years
  - Locomotives 25 years
  - Wagons 40 years

- **Liquidation value at the end of the study term:** The residual value corresponds to unamortized investments after 25/35 years.

6.3.4. *Operating expenses.*

INFRASTRUCTURE USE

- **Railway infrastructure tolls.** It refers to canons charged by Infrastructure Managers to railway undertaking for the use of infrastructure. They are different for each country. As France and Spain have similar tolls structure, they are presented jointly.

  - **France and Spain**
    - **Capacity reserves tolls:**

Table 2. *Capacity reserves tolls*

France		Spain		Hypothesis train distribution along day
Hour	**€/train-km**	**Hour**	**€/train-km**	
7:00 - 9:29 17:30 - 20:29	1,29	7:00 - 9:29 18:00 - 20:29	0,57	25%
05:00 - 06:59 09:30 - 17:30 20:30 - 00:59	0,86	9:30 - 17:59 20:30 - 23:59	0,57	50%
01:00 - 4:59	0,43	0:00 - 6:59	0,57	25%

Source: ADIF y RFF Network Statement

- **Circulation tolls:**

Table 3. *Circulation tolls*

France	Spain

€/train-km	
3,593	0,5

Source: ADIF y RFF Network Statement

- **Germany Tolls**
  Based on DB Netz AG Network Statement 2017, tolls for RoMo service will consider:
  - Base price of 3.17 €/km as the whole section used for RoMo services (F3)
  - Product factor: 1.00 (Standard train path)
  - NDTAC charge of 3% of the product of base price and product factor, considering that not at least 90% of the freight wagons permanently comply with the requirements of TSI Nois

Germany Tolls
€/train-km
3,2651

Source: DB Netz AG Network Statement

- **Portugal Tolls**
  Based on IP Network Statement 2017, tolls for RoMo service will correspond to Tariffs for Essential Services applied to freight trains in "Linha da Beira Alta" (from Pampilhosa to V. Formoso border)

Portugal Tolls
€/train-km
1,34

Source: IP Network Statement

OPERATING COSTS

- **Locomotive Maintenance.**
  It is estimated in 1.5 €/km/locomotive, according to previous studies (source: Vitoria – Dax)

- **Hauled stocks maintenance (wagons)**
  It is estimated in 20.000 €/wagon, according to previous studies (source: Vitoria – Dax) even when it is also possible to use 0,07 €/wagon km

- **Traction Energy**
  It refers to tariffs applied by the Infrastructure Managers for the use of energy to train traction. It differs for each country, invoicing in different units (in Spain €/000's GTR*km). For Germany and Portugal, traction energy price considered refers to the average toll from France and Spain, due to the complexity and particularity of the cost estimation for a standard service.

Table 4. *Traction energy*

Country	Price
France	0,616 €/train-km
Spain[1]	2,869 €/train-km

[1] *In Spain, traction energy tariffs is 2,635221 €/000's GTR*km. For comparison is estimated this value considering GTR/train = 1.089 tonnes*

Germany - Portugal	1,742 €/train-km

Source: ADIF y RFF Network Statement

- **Assembling/Disassembling trains costs**
  For scenarios 2, 3, and 4 where trains are assembling and disassembling at Irun/Hendaye border, it is included a cost for that operation based on ADIF Network Statement Tolls, estimated in **162,3 €/train**.

- **Other expenses (% on amortization of investments, energy, fees and staff)**
  It corresponds to expenses indirectly related to the amortization of investments, energy, fees and staff. It is estimated at 6% of these expenses.

- **Advertising expenses (marketing)**
  It is assumed as a specific expense due to its importance in a new service. It is estimated in 250.000 €/year

- **Wages and salaries**
  New staff refers **only to train drivers**, because other general staff is included indirectly in "Other expenses" item

  It is considered an unique train driver salary for all countries based on the Vitoria-Dax study **96.000 €/year**.

6.4. Operating Incomes

It is considered a RoMo selling price per rail kilometer. This price is evaluated through a cost model analysis that was developed for the business plan.

This cost model makes the comparison between :

- a direct lorry transport cost
- a ROMO door to door transport : from terminal to terminal using the ROMO selling price, to which is added the cost of road end leg transport.

This model comes to the conclusion that with a RoMo price of 0.75 € per kilometre (terminal fees included), the combined road/RoMo alternative is 6 % cheaper than the road through transport and therefore competitive.

This price was taken into account for the calculation

6.5. Transport plan

6.5.1. *Train maximum composition*

Train maximum composition is used to calculate the daily number of trains to assure the transport. It is evaluated per scenario (1 to 3), taking into account Modalohr and CargoBeamer wagons characteristics.

Scenario 1

	Modalohr	Cargo Beamer
Semi-trailer + load	24 tonnes	24 tonnes
Wagon weight per semi-trailer	20,2 tonnes	29,4 tonnes
Total weight per semi-trailer	44,2 tonnes	53,4 tonnes
Number of semi-trailers	**32**	**27**
Total train weight carrying	**1414 tonnes (1500 tonnes limited)**	**1442 tonnes (1500 tonnes limited)**
Length per semi-trailer	16,5m	19,3m
Total train length (without locomotive)	**528m**	**522,1m**

Scenario 2

	Modalohr		Cargo Beamer	
	Train in France	**Train in Spain**	**Train in France**	**Train in Spain**
Semi-trailer + load	24 tonnes	24 tonnes	24 tonnes	24 tonnes
Wagon weight per semi-trailer	20,2 tonnes	20,2 tonnes	29,4 tonnes	29,4 tonnes
Total weight per semi-trailer	44,2 tonnes	44,2 tonnes	53,4 tonnes	53,4 tonnes
Number of semi-trailers	**44**	**22**	**37**	**19 (or 18)**
Total train weight	**1945 tonnes**	**972 tonnes**	**1976 tonnes**	**1015 tonnes**
Length per semi-trailer	16,5m	16,5m	19,3m	19,3m
Total train length (without locomotive)	**726m**	**363m**	**715m**	**367m**

Scenario 3

	Modalohr		Cargo Beamer	
	Train in France	**Train in Spain**	**Train in France**	**Train in Spain**
Semi-trailer + load	24 tonnes	24 tonnes	24 tonnes	24 tonnes
Wagon weight per semi-trailer	20,2 tonnes	20,2 tonnes	29,4 tonnes	29,4 tonnes
Total weight per semi-trailer	44,2 tonnes	44,2 tonnes	53,4 tonnes	53,4 tonnes
Number of semi-trailers	**48**	**24**	**42**	**21**
Total train weight	**2122 tonnes**	**1061 tonnes**	**2242 tonnes**	**1121 tonnes**
Length per semi-trailer	16,5m	16,5m	19,3m	19,3m
Total train length (without locomotive)	**792m**	**396m**	**812m**	**406m**

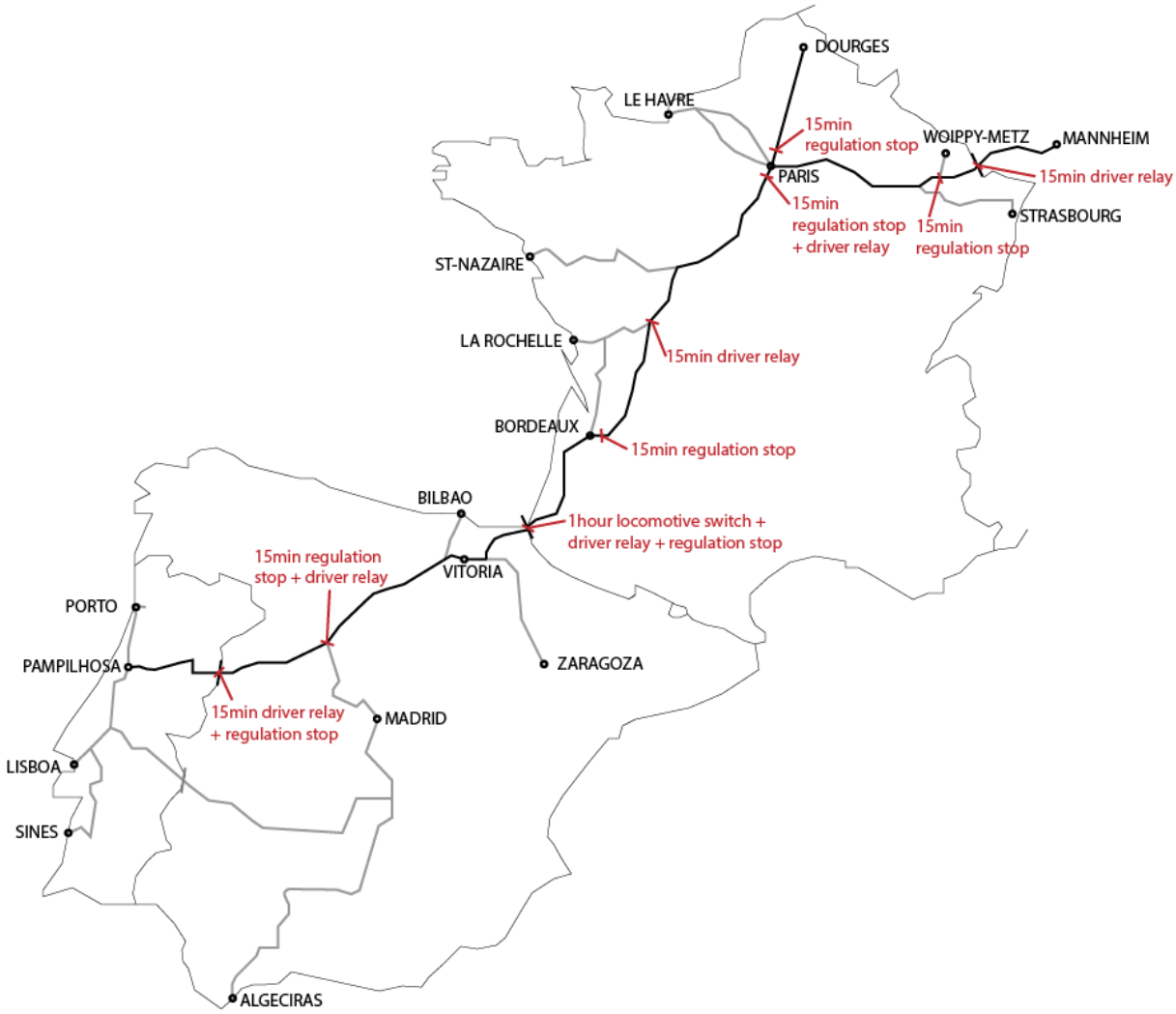
6.5.2. *Travel time*

Travel time is used to calculate, through roster simulation, the number of locomotives, wagons and loc drivers.

Travel time is evaluated on the basis of maximum speed, regularity margin, halting point for services, and, in

addition, margin to take into account difficulties for train paths allocation.

A comparison/verification was made endly with a 2015 INGEROP detailed study on Dourges – Vitoria, which leads to similar journey times to the one calculated using the above described methodology.



Stops taken into account on all the routes used by the RoMo services under study

	Vitoria - Dourges	Madrid - Dourges	Vitoria - Paris	Madrid - Paris	Vitoria - Mannheim	Madrid - Mannheim	Vitoria - Bettem	Madrid - Bettem	Pampilhosa - Paris	Pampilhosa - Dourges
Stops taken in account for regulation, driver change and locomotive switch (15 min except Irun 1h)	Irun (1h) Bordeaux Poitiers Paris Paris	Medina del C. Vitoria Irun (1h) Bordeaux Poitiers Paris Paris	Irun (1h) Bordeaux Poitiers Paris	Medina del C. Vitoria Irun (1h) Bordeaux Poitiers Paris	Irun (1h) Bordeaux Poitiers Paris Metz Forbach	Medina del C. Vitoria Irun (1h) Bordeaux Poitiers Paris Paris Metz Forbach	Irun (1h) Bordeaux Poitiers Paris Paris Metz	Medina del C. Vitoria Irun (1h) Bordeaux Poitiers Paris Paris Metz	Fuentes de O. Medina del C. Vitoria Irun (1h) Bordeaux Poitiers Paris	Fuentes de O. Medina del C. Vitoria Irun (1h) Bordeaux Poitiers Paris Paris
Travel-time with stops and margin (15%)	21:29	30:48	16:48	25:46	26:08	35:06	24:19	33:00	29:31	34:32
Length (km)	1178	1702	925	1434	1465	1974	1341	1850	1613	1881
Average speed (km/h)	54.8	55.2	55.0	55.6	56.1	56.2	55.1	56.0	54.6	54.5

Journey times on the different routes

6.5.3. *Rolling stock roster*

6.5.4. *With longer (or shorter) travel-times it is relevant to study roster through the week in order to know how many wagon sets are needed to operate the service.*

Rolling stock roster has been made for each RoMo considering 4h hours minimum time for awaiting, loading and unloading in terminals.

	Vitoria - Dourges	Madrid - Dourges	Vitoria - Paris	Madrid - Paris	Vitoria - Mannheim	Madrid - Mannheim	Vitoria / Madrid - Bettem	Pampilhosa - Paris	Pampilhosa - Dourges
number of sets for 1 round-trip	3	4	2	4	4	5	4	4	4
number of sets for 2 round-trip	5	7	4	7	7	10	7	7	7
number of sets for 3 round-trip	8	10	6	10	10	15	10	10	10
number of sets for 4 round-trip	10	14	8	14	14	20	14	14	14
number of sets for 5 round-trip	13	17	10	17	17	25	17	17	17
number of sets for 6 round-trip	15	20	12	20	20	30	20	20	20

Number of wagon sets needed for each RoMo depending on the number of round-trips per day

6.5.5. *Transportation plan*

Transportation plan calculations are based on the same methodology exposed before.

The number of locomotives considered for one train on each route is detailed on the chart below:

	Vitoria - Dourges	Madrid - Dourges	Vitoria - Paris	Madrid - Paris	Vitoria - Mannheim	Madrid - Mannheim	Vitoria / Madrid - Bettem	Pampilhosa - Paris	Pampilhosa - Dourges
France/Germany	1	1	1	1	1.25	1.25	1.25	1	1
Iberian	0.25	1	0.25	1	0.25	1	1	1.25	1.25

The number of drivers considered for one train on each route is detailed on the chart below:

	Vitoria - Dourges	Madrid - Dourges	Vitoria - Paris	Madrid - Paris	Vitoria - Mannheim	Madrid - Mannheim	Vitoria / Madrid - Bettem	Pampilhosa Paris	Pampilhosa - Dourges
France and Luxembourg	3	3	2	2	3.5	3.5	3.5	2	3
Spain	0.5	2	0.5	2	0.5	2	2	2	2
Portugal	0	0	0	0	0	0	0	0.5	0.5
Germany	0	0	0	0	0.5	0.5	0	0	0

7. RESULTS

7.1.1. *Results*

Results for each Group of RoMo services considered for each technology, model and scenario are the following:

Scenario 1			
Group - RoMo Service	Technology	Model	IRR
Group 1 - Dourges Terminal	Modalohr	Model 1	11,2%
		Model 2	8,2%
	CargoBeamer	Model 1	5,0%
		Model 2	4,7%
Group 2 - Paris Terminal	Modalohr	Model 1	13,7%
		Model 2	8,6%
	CargoBeamer	Model 1	7,6%
		Model 2	6,0%
Group 3 - Mannheim/Bettembourg Terminal	Modalohr	Model 1	14,7%
		Model 2	9,4%
	CargoBeamer	Model 1	7,9%
		Model 2	6,3%

Scenario 2			
Group - RoMo Service	Technology	Model	IRR
Group 1 - Dourges Terminal	Modalohr	Model 1	15,2%
		Model 2	10,3%
	CargoBeamer	Model 1	7,6%
		Model 2	6,4%
Group 2 - Paris Terminal	Modalohr	Model 1	19,4%
		Model 2	11,0%
	CargoBeamer	Model 1	10,1%
		Model 2	7,3%
Group 3 - Mannheim/Bettembourg Terminal	Modalohr	Model 1	20,2%
		Model 2	11,4%
	CargoBeamer	Model 1	11,4%
		Model 2	8,4%

Scenario 3			
Group - RoMo Service	Technology	Model	IRR
Group 1 - Dourges Terminal	Modalohr	Model 1	15,1%
		Model 2	10,4%
	CargoBeamer	Model 1	7,7%
		Model 2	6,6%
Group 2 - Paris Terminal	Modalohr	Model 1	16,3%
		Model 2	10,6%
	CargoBeamer	Model 1	9,9%
		Model 2	7,5%
Group 3 - Mannheim/Bettembourg Terminal	Modalohr	Model 1	18,7%
		Model 2	11,4%
	CargoBeamer	Model 1	11,0%
		Model 2	8,2%

Scenario 4			
Group - RoMo Service	Technology	Model	IRR
Group 1 - Dourges Terminal	Modalohr	Model 1	16,2%
		Model 2	11,1%
	CargoBeamer	Model 1	7,5%
		Model 2	6,3%
Group 2 - Paris Terminal	Modalohr	Model 1	18,7%
		Model 2	11,1%
	CargoBeamer	Model 1	11,2%
		Model 2	8,1%
Group 3 - Mannheim/Bettembourg Terminal	Modalohr	Model 1	17,6%
		Model 2	10,8%
	CargoBeamer	Model 1	10,4%
		Model 2	8,0%

8. OVERALL CONCLUSION AND RECOMMANDATION

The study has made the conclusion that a Rolling motorway system has to be able to carry all types of semitrailers ; this leads to the conclusion, taking into account loading gauge on the Corridor, that only two technical systems are in a position to fulfil this requirement : Modalohr and CargoBeamer (for the latter, nevertheless, loading gauge confirmation is still necessary).

Even with those systems, there remain today some restrictions that could inhibit the possibilities of ROMO development.

The first is the question of loading gauge : even in France, and for a first step between Dourges and Vitoria, it remains tunnels that do not offer the right loading gauge. So, a first recommendation is to make new inquiries and measurements in order to have a clear assessment of what is to do, how to do it and when it can be done.

Same question is on the Spanish side, for tunnels between Vitoria to Medina del Campo, and Medina del Campo and the border with Portugal, and towards Madrid, taking into account that the loading gauge is already cleared inside Portugal.

A least, control of exact loading gauge, by laser measurements system, should be made, in order to have right information on the importance of the gauge enhancement that is to be made.

Second question is train length, with is a crucial factor, clearly highlighted by the business plan results. 750 m long trains is a basic requirement ; it should be find investments and operation organisation to guarantee this type of trains on Iberian side. On the Iberian side, as a matter of fact, the rate of use on the infrastructure is not very high, and dedicated operation measures may allow to operate longer trains – provided that a minimum number of 750 m long stabling tracks are available. This is necessary to develop ROMO inside the Iberian

Peninsula, and to go further than Vitoria. Between Vitoria and the French border, the distance is short and arrangements are possible, although they are costly.

So, our second recommendation is to start by now the investigations on the ways to operate 750 m trains on the Iberian Peninsula, including operation measures.

Quality of train paths is the third requirement. The business plan we did relies on moderate hypothesises on journey time. But we know that on long distance trips, there could be strong difficulties and insufficiencies, in terms of train path allocation priority, in relationship with passengers' trains (commuters trains and long distance passengers trains) and also maintenance works, that can lead to very high constraints.

So, our third recommendation is that the corridor management looks at very carefully to the question of long distance train path allocation, on which it is in a good position to have a strong impact.

9. APPENDIX: BUSINESS CASE RESULTS PER O/D FOR 2030

The business plan results shows that, under the hypothesis taken into account, the ROMOs services appear with a relative profitability – even if we take into account model 2 results.

Scenarios 2 and 4 allow to obtain higher IRR than rest of Scenarios with small differences between them. Strictly, Scenario 4 is better because requires a lower number of train driver.

- Model 1 is better than Model 2

- Modalohr is better than CargoBeamer.

What is very significant is the key importance of train composition. TIR reached by scenario 4, with 750 trains in Iberic Peninsula is significantly higher to all others results.

For the same reason, it appears that Modalohr scenarios results are better than CargoBeamer scenarios results.

For the same reason, again, the scenario Vitoria – Pampilhosa appears with the lowest TIR– this is due to operation limited to 500 m trains and distance relatively short (500 km).

Comparative analysis between Scenarios			Scenario 1	Scenario 2	Scenario 3	Scenario 4	Conclusion
RoMo Service	Technology	Model	IRR(%)	IRR(%)	IRR(%)	IRR(%)	
Vitoria-Dourges	Modalohr	Modelo 1	8,9%	14,6%	13,3%	15,1%	Scenario 4
		Modelo 2	6,4%	10,9%	10,1%	11,3%	Scenario 4
	CargoBeamer	Modelo 1	3,2%	9,8%	10,2%	11,1%	Scenario 4
		Modelo 2	3,1%	7,5%	7,7%	8,1%	Scenario 4
Madrid-Dourges	Modalohr	Modelo 1	15,4%	20,7%	17,9%	21,2%	Scenario 4
		Modelo 2	13,9%	17,0%	15,3%	17,3%	Scenario 4
	CargoBeamer	Modelo 1	11,2%	16,7%	15,2%	17,1%	Scenario 4
		Modelo 2	10,4%	13,8%	13,1%	14,1%	Scenario 4
Pampilhosa / Dourges	Modalohr	Modelo 1	17,4%	20,5%	18,1%	21,0%	Scenario 4
		Modelo 2	15,2%	16,7%	15,5%	17,0%	Scenario 4
	CargoBeamer	Modelo 1	12,5%	18,0%	16,8%	18,6%	Scenario 4
		Modelo 2	11,5%	14,7%	14,4%	15,2%	Scenario 4
Vitoria-Paris	Modalohr	Modelo 1	10,9%	14,1%	13,9%	14,1%	Scenario 2
		Modelo 2	10,2%	12,6%	12,6%	12,6%	Scenario 3
	CargoBeamer	Modelo 1	8,7%	12,3%	11,7%	10,9%	Scenario 2
		Modelo 2	8,0%	9,7%	9,4%	9,2%	Scenario 2
Madrid-Paris	Modalohr	Modelo 1	13,7%	17,2%	14,1%	17,5%	Scenario 4
		Modelo 2	12,6%	15,1%	12,9%	15,4%	Scenario 4
	CargoBeamer	Modelo 1	10,7%	13,2%	13,1%	13,6%	Scenario 4
		Modelo 2	9,8%	10,8%	11,4%	11,1%	Scenario 3
Pampilhosa / Paris	Modalohr	Modelo 1	15,5%	19,5%	17,6%	20,1%	Scenario 4
		Modelo 2	13,7%	16,6%	15,8%	17,0%	Scenario 4
	CargoBeamer	Modelo 1	11,8%	15,8%	14,3%	16,7%	Scenario 4
		Modelo 2	10,6%	12,5%	12,1%	13,9%	Scenario 4
Vitoria-Mannheim	Modalohr	Modelo 1	13,2%	16,9%	15,8%	16,9%	Scenario 4
		Modelo 2	12,7%	15,4%	14,4%	15,4%	Scenario 4
	CargoBeamer	Modelo 1	9,5%	13,8%	14,3%	13,9%	Scenario 3
		Modelo 2	8,4%	10,8%	10,5%	10,8%	Scenario 4
Madrid-Mannheim	Modalohr	Modelo 1	13,6%	19,7%	18,3%	20,3%	Scenario 4
		Modelo 2	13,0%	17,2%	16,6%	17,7%	Scenario 4
	CargoBeamer	Modelo 1	10,4%	17,7%	15,1%	18,0%	Scenario 4
		Modelo 2	9,4%	13,6%	12,0%	13,8%	Scenario 4
Vitoria / Madrid-Bettembourg	Modalohr	Modelo 1	16,9%	21,0%	19,1%	21,3%	Scenario 4
		Modelo 2	15,4%	17,8%	16,9%	18,0%	Scenario 4
	CargoBeamer	Modelo 1	13,7%	18,8%	16,0%	19,0%	Scenario 4
		Modelo 2	12,6%	15,4%	13,5%	15,5%	Scenario 4
Vitoria-Pampilhosa	Modalohr	Modelo 1	4,3%				Scenario 1
		Modelo 2	4,4%				Scenario 1
	CargoBeamer	Modelo 1	1,7%				Scenario 1
		Modelo 2	2,1%				Scenario 1