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Maritime traffic and induced pressure on hinterland transport networks

An integrated modelling exercise: the case of Northern Adriatic ports

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Executive Summary

The study presented in this report focuses on the technical evaluation of existing and new Mediterranean shipping routes and their impacts on hinterland transport networks and infrastructure capacity. The rationale and the interest of the study encompass aspects, which are briefly described hereafter.

First, co-modality is at the core of European transport policies yet an unaccomplished task for the vast majority of the European transport system: better integration and enhanced efficiency of transport modes is targeted in its capacity of bringing about reduced congestion and lower CO_2 emissions via enhanced efficiency of the transport system and moving away from a predominantly modal focus.

Secondly, tackling the interaction and smooth interoperability across modes implies addressing the problem from a multiple – and complex – perspective. In the middle of this complexity, practical solutions need to be selected to accommodate a lively European Internal Market, the needs of socio-economic development and the striving towards a low-carbon society.

Thirdly, it is not the ambition of the study presented in this report to explore all technological, economic and regulatory aspects related to such an approach, which range – to name but a few – from interoperable data formats and commercially-protected information flows for ICT platforms to be used by operators in different transport modes to physical interconnections of transport networks at nodal points, passing via socio-economic and environmental impacts generated by choices of infrastructural planning in the short, the medium and the long term. But the study presented in this report does aim to present a robust yet practical approach to identify, characterise and select key transport nodes and territories where prospective transport demand growth allows to foresee – with a reasonable degree of approximation and an equally reasonable time lead – the pressure on the existing transport network and – therefore – the opportunity to adapt it to expected future needs.

Fourthly, given that 90% of Europe's external trade and close to 40% of its internal trade passes through its ports[1], it is not difficult to understand the great challenge that Europe's ports – and the hinterland transport network on which generated traffic insists – face if they are to deal with increasing demand. The European Union via coherent policies, including among others the Trans-European Networks-Transport (TEN-T) and the Motorways of the Sea/ Short Sea Shipping networks, the Marco Polo programme, and the rail liberalisation packages, has been actively seeking to strike a more balanced approach in terms of modal distribution. Whereas some cases are there to show that success can be expected, it is self-evident that the problem is far from solved in general terms.

It seems therefore useful to think/act in perspective by analysing the potential impacts of expected market development so as to analyse induced pressure, and to anticipate and alleviate the already congested situation by identifying priorities of infrastructural investments.

Such is the attempt of this study, which implements and applies a system of models (supply and demand) for the economic evaluation of existing and new maritime services to/from a sample of Mediterranean ports.

The case studies selected for this study are a sample of the Northern Adriatic ports (http://www.portsofnapa.com), which have in the recent past (April 2009) signed an agreement to act

[1] COM(2007) 575 final, "An Integrated Maritime Policy for the European Union" of 10 October 10 2007.

as a Gateway Port so as to attract traffic to the Region, following which phase competition would clearly take lead.

This means that in view of enhancing economic benefits for the ports, increased transport pressure from the ports on the surrounding transport network – and in more general terms the territory – is not simply "happening" but is being actually and actively sought. An increase of frequency of maritime traffic would allow the ports selected for this study to reach the critical mass needed to attract more traffic by removing infrastructural obstacles thus leading to lower costs for port-related activity, particularly at the interface between port infrastructure and hinterland transport networks.

The case studies seem interesting also for the following reasons:

- Congested highway transport network in the densely urbanised and peri-urbanised North-Eastern area of Italy;
- Recent impulse to highway network development in Slovenia;
- Unification of borders between Slovenia and Italy with subsequent opportunities in trade flows, including the development and reorganisation of logistics facilities and dry-ports;
- Partial specialisation of the ports included in the study yet with the existence of considerable areas of overlapping of activities where competition obviously takes place on the basis of price/service reliability yet makes it rather difficult for a single stakeholder to formulate clear needs in terms of infrastructure requirements ahead;
- Partially different target basins of goods yet insisting at least partially on the very same transport network segments;
- Potential for development/ enhanced use of existing rail infrastructure.

For the reasons outlined above, the selected case studies are certainly representative of the European situation although context specificities inevitably play an important role in the dynamics of development. Aware of that and of the difficulty embedded in capturing those, the study presented in this report focuses on the technical evaluation of what is there and what is the expected impact of maritime services on transport infrastructure while considering likely future developments.

The structure of the study is provided in the Introduction and is therefore not provided here. What is relevant though is to track here the main messages issued from the study presented in this report as well as to outline future research needs.

Main messages

The market positioning of the Northern Adriatic ports selected for this study appears to be clearly oriented towards Eastern Mediterranean countries and the Far East. In that respect, a key role is played (in terms of number of services per month) for the RoRo and bulk services with Turkey and Greece, while container services are more uniformly spread over Mediterranean ports and therefore are more likely to rely in the port choice on top of reliability of port services, also on the availability of good quality, highly interconnected hinterland transport infrastructure.

Following the above, and in consideration of the high variability of container traffic as far as the port of choice is concerned, it was decided that the model runs in the study had to focus on the development of further connections with Eastern Mediterranean ports, in particular with Egypt for the development of "fresh" product (fruit and vegetables) trade and in line with the agreement recently signed (May 2010) between Italy and Egypt on the first direct weekly shipping line between the Port of Venice and the Port of Alexandria. The current situation of maritime traffic to/from Egypt shows a remarkable congestion and it is therefore reasonable to expect a perspective need for an increase in capacity in order to meet future demand requirements. In other words, the increase of trade to/from Egypt, even if not the highest in absolute values within the eastern Mediterranean basin, will be the one requiring the largest increase in maritime services.

For both Ro-Ro plus bulk maritime services and container traffic from Egypt, main destinations are the Northern European ports and the Black Sea ports. How much of the maritime traffic towards the Northern range ports could find viable competition and a cost-effective alternative in inland surface transport via the Northern Adriatic ports? Would that be desirable in terms of transport sustainability?

It is worth highlighting that from a pure transport standpoint, there would be no competition in principle, since the average difference in the distance to/from Alexandria in Egypt between the Northern range ports and the Northern Adriatic ports is approximately 2000 miles, equalling more than 3 days of navigation at 24 knots. However, travel time is often not the main aspect, due to the time/reliability of customs procedures at ports as well as and scale economies reached by ocean carriers. As a result, the difference in costs between container fares for the routes Egypt-Northern Adriatic and Egypt-Rotterdam are not as large as the corresponding times. In such context, the competition is played with respect to costs and times for inland distribution.

Indeed Egypt and Italian ports are increasingly well connected: in May 2010 within the frame of the Motorways of the Sea, a weekly service has been established between Venice, Port Tartous (Syria) and Alexandria (Egypt). Thanks to its frequency and transit time, including RoRo and passenger traffic the initiative develops the EU-backed “Green Corridor” project with the aim of developing the fruit and vegetables trade. How well connected are the ports with the hinterland transport infrastructure? Considering the target basin, differences and overlapping between ports presented in this study become more evident. Equally so, pressure exerted by maritime services to/from Egypt on specific transport infrastructures. Results report that – in absolute terms - rail transport to and form the selected ports seem to be already playing a significant role.

In view of perspective traffic volume increases to/from the Eastern Mediterranean basin with specific attention dedicated to the market segment of “fresh” products, the model results combining different routes, pairs of selected ports and different vessel speed options indicate that the actual choice of the best route actually depends only on demand analysis and considerations. From the Egyptian side, both Alexandria and Damietta provide for similar results and the primary option seems to be the implementation of a maritime service between Trieste/Koper on one side and Alexandria/Damietta on the other. What is then the demand captured and what are the likely impacts on inland freight dispatching?

Considering that competition is played essentially with respect to costs and times for inland distribution, the study highlights the area of convenience between the Adriatic ports and the Northern range ports comparing time advantages on the one hand and costs on the other: it is remarkable how the areas of convenience shrink when turning attention to costs. The improvement of hinterland transport infrastructure (road and rail) results therefore as having a strategic role in both sustaining/increasing the Northern Adriatic ports competitive position and gaining market share off the Northern range ports, resulting in a more balanced functioning of the inland transport system in Europe.

Eight scenarios have been defined in the study presented in this report with the years 2020 and 2035 as time horizons. For each reference year, three different country-specific GDP projections have been selected to explore different growth speeds after the economic downturn in 2008-2009. Scenarios make also different assumptions with respect to the adoption of trade agreements and indicate the progressive creation of a common trade area in the Mediterranean.

For the 2020 time horizon the predicted increase in traffic to/from ports selected for this study ranges between 23 and 34% with a slightly higher increase of pressure on inland rail transport. Additionally, rail and road transport exhibit significantly different patterns in freight transport increase when considering each of the selected ports. Similarly, the analysis carried out in the study reports the variation in tons/year between the 2035 baseline scenario and the current scenario respectively for road and rail modes, in order to point out which origin-destination patterns on the side of the Northern Adriatic ports are mostly affected by the demand increase. It is important to highlight that when compared to today's baseline scenario, even the pessimistic scenario with time horizon 2035 highlights a considerably increased pressure on inland transport networks behind the selected ports ranging from a minimum 34.5% for road to an increase of 62% in one single case, while pressure on inland rail network is higher on average ranging from shortly below 40% increase as a minimum to well above 50% increased pressure on average.

Future research needs

The study presented in this report is a starting point aimed identifying and characterising an area of techno-economic analysis not previously dealt with by the Joint Research Centre and only dealt with in a rather fragmented form by the scientific community. Despite European programmes and funding instruments available at European level, there are limited tools being developed to assess the viability of infrastructure developments. Reasons, including the subsidiarity principle, are certainly robust but possibly not enough to overlook the opportunities of enhanced transport system's efficiency and impacts on the achievement of a low-carbon transport system in Europe.

Next steps fore research comprise:

- the development of a tool, or set of tools, consistent with the Marco-Polo calculator[2] having the capacity to define the viability of an infrastructural investment project in and around port areas;
- the definition of a set of criteria to identify priority areas/regions where EU funding would leverage added value at European level in view of European policy objectives and economic , and;
- the definition of research priorities via the establishment of a structured dialogue with stakeholders from both the private and the public sector.

[2] http://ec.europa.eu/transport/marcopolo/files/calls/docs/2010/call2010_calculator_mod_cat_mos_en.xls

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Introduction

This report presents the results of the implementation and application of a system of transport models (supply and demand) for the technical evaluation of existing and new short-sea shipping services to/from the Northern Adriatic ports of Koper in Slovenia, Trieste, Venice and Ravenna in Italy, explicitly taking into account new trade agreements. The technical specifications for the study were defined by the Scientific Officer in charge of the activity at the Joint Research Centre and editor of this report, as formulated in the request for offer issued on 30/11/2009[3]. The study was assigned and carried out by the author of this report under the supervision and through on-going interaction with the Scientific Officer in charge, who is also the editor of this report.

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The supply model includes three different networks: road, rail (combined and traditional) and maritime services (container and Ro-Ro), with connections between modes (rail-road/ rail-sea/ sea-road/ rail-road-sea-inland waterways, as relevant).

The demand model includes freight flows among countries, therefore taking into account port-port o/d but also point of origin and final destination, zonization at NUTS2 level[4] and weighting on zone-related GDP.

The document is structured as follows. *Section 1* describes the system of demand and supply models used for the study, through a transparent definition/provision of assumptions for running the system of models, i.e. the description of parameters split into fixed and variable parameters as well as dummies, and a description of the datasets used. *Section 2* deals with a general overview of the current supply of maritime services to/from the Northern Adriatic port cluster in general, with a specific focus on traffic between the Northern Adriatic area and Egypt due to the potential interest for new maritime services. Consistently, *Section 3* deals with the analysis of the current demand flows in the study area, with specific reference to flows to/from the selected ports (Ravenna, Venice, Trieste, Koper) in terms of both target basins and pressure on inland networks. *Section 4* investigates the opportunity of new short-sea shipping connections between Egypt and the selected ports, both from landside and maritime accessibility standpoints, and taking into account competition with northern range ports (specifically

[3] Request for offer ARES(2009)350404 of 30 November 2009.
[4] http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/introduction

Rotterdam and Antwerp). *Section 5* focuses on the definition and the simulation of future scenarios, characterised by specific assumptions on the evolution of GDP, demand flows and transport costs. Finally, *Section 6* draws preliminary conclusions learned via the exercise and identifies needs for further research.

1. Description of models and methodologies

The quantitative analyses presented in the document have been carried out by means of a *Decision support system (DSS)* encompassing a system of mathematical models – developed in accordance with the state of the art of Transport Engineering – for the simulation of the whole transport system in the Euro-Mediterranean basin. The general structure of the DSS is reported in Figure 1.

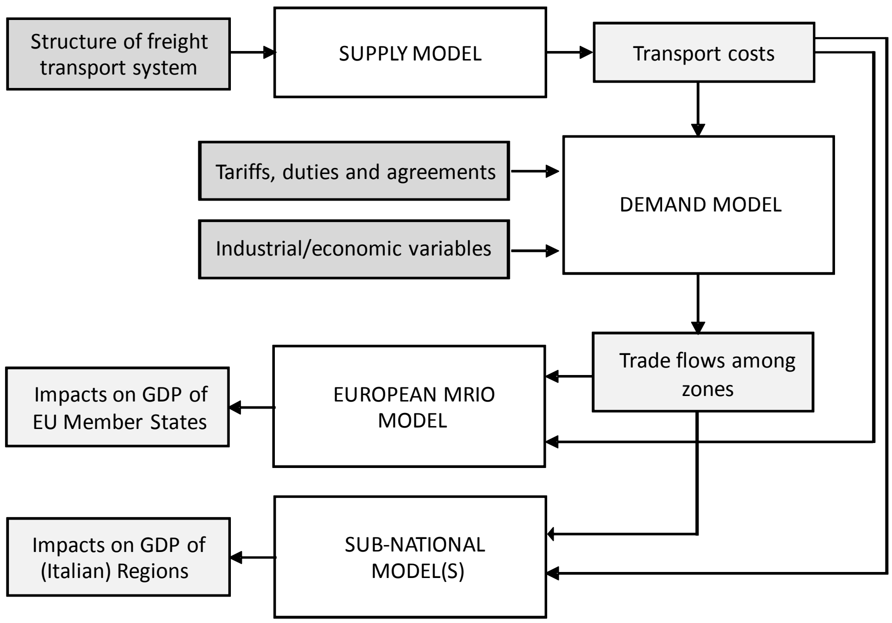

Figure 1 – General structure of the DSS for the Euro-Mediterranean basin

In more detail, the two cores of the DSS are a *supply model*, providing the performances (e.g. times, costs and so on) and the impacts of the transport system on the basis of its topological and functional characteristics, and a *demand model*, providing o-d matrices as a function of transport costs, industrial/economic variables and other trade variables related to the presence of trade agreements (free zones, duties and tariffs reductions and so on). Finally, input-output based models are available for the evaluation of the *economic impacts* of the performances of the transport system, e.g. in terms of GDP and other related economic indicators. The applications carried out in this study have been referred only to the transport system, i.e. not accounting for economic impact analyses. The following sections deal with the description of the supply model (section 1.1) and of the demand model (section 1.2).

1.1 Supply model

The supply model of the DSS refers to a study area encompassing 57 Euro-Mediterranean Countries, with a zonization corresponding to the NUTS3 geographical level for EU Countries and to the administrative regional[5] level for the remaining countries. As a result, 1508 traffic zones have been defined (see Figure 2).

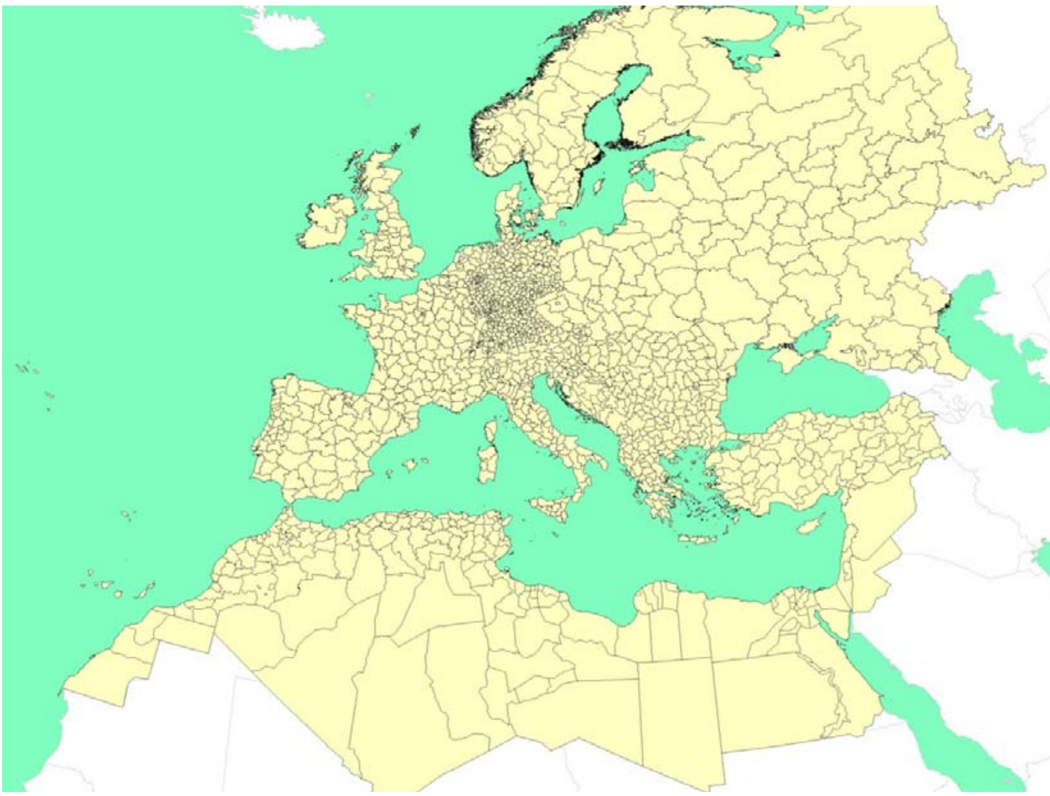

Figure 2 – Study area and zonization of the DSS for the Euro-Mediterranean basin

A zoom of the zonization in correspondence of the selected ports for the study is reported in the following Figure 3.

[5] The actual definition of the regional administrative level may obviously differ among countries.

Figure 3 – Study area and zonization of the DSS for the Euro-Mediterranean basin (zoom)

Consistently with this zonization level, four different supply models have been implemented respectively for road, rail, maritime and inland waterways freight modes. In accordance with the theory of transport systems, the implementation of a supply model requires the definition of the topological and of the analytical characteristics of the network: a brief review of the methodology, of the hypotheses and of the structure of the supply model for each mode is reported in the following subsections. Finally, subsection 1.1.5 deals with the integration of the single-mode supply models into a multimodal model.

1.1.1 Road supply model

1.1.1.1 Topological model

The implementation of the topological model for the road mode takes into account all relevant infrastructures representing significant connections between zones within the study area, leading to a total amount of 704.989 kilometers of infrastructures. The level of detail of the road network can be effectively checked in the following Figure 4 in correspondence of the selected ports for the study.

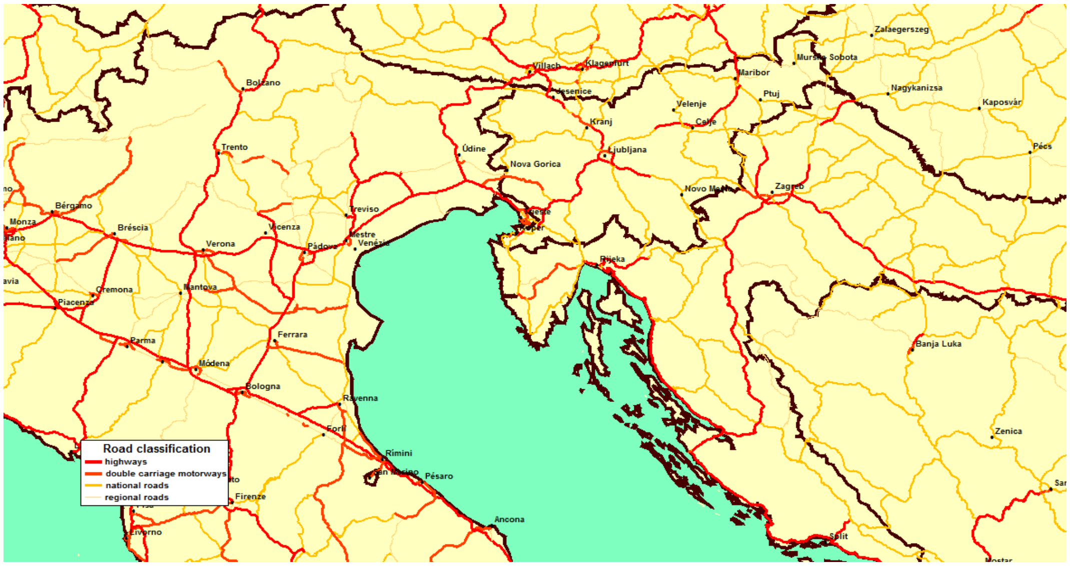

Figure 4 – Topological road model of the DSS for the Euro-Mediterranean basin (zoom)

Consistently, a graph made up by links and nodes was then built in order to model the selected infrastructures, leading to 63.109 links and 50.870 nodes.

Each road link is associated with physical characteristics to be used as explanatory variables in the impedance functions (see Section 1.1.1.2). In more detail, five different road types, identifying the functional classification of links, have been defined: motorways, highways with double carriageway, single-carriageway national roads, regional roads, local roads. Furthermore, each link is associated with a deviousness index and a slope class, the latter derived from advanced geo-spatial analyses based on the availability of detailed altitude geogrids.

1.1.1.2 Analytical model

The analytical model aims at associating quantitative performance/impact characteristics to each element of the topological model. For this aim, different analytical models should be implemented for different road vehicle types; in that respect, the Euro-Mediterranean DSS takes into account four vehicle classes: passenger car, light commercial vehicles, medium commercial vehicles, and heavy commercial vehicles[6].

Firstly, free flow link speeds were defined for each vehicle type, road type, and also country class[7], leading to the values reported in Table 1. Furthermore, average congested speeds, derived from previous studies available in the literature, have been taken into account for the main European metropolitan areas.

[6] In more detail, the classification is based on Gross Vehicle Weight (GVW) in tons: light < 3.5 tons; medium between 3.5 and 16 tons; heavy >16 tons.

[7] Countries have been classified in high, medium and low depending on their level of infrastructural development.

	Type of vehicle and country class											
	car			light vehicles			medium vehicles			heavy vehicles		
Type of road	**h**	**m**	**l**	**h**	**m**	**l**	**h**	**m**	**l**	**h**	**m**	**l**
highways	120	120	120	100	100	100	100	100	100	80	80	80
motorways	110	100	100	90	90	90	80	80	80	70	70	70
national roads	90	90	90	70	70	70	70	65	65	65	55	55
regional roads	80	75	75	70	65	65	65	60	60	55	50	50
local roads	60	55	55	60	55	55	55	50	50	50	45	45

Table 1 – Free flow road speeds [km/h] for vehicle type, road type and country class

In turn, link travel times were calculated as the sum of running times (t_r) and stopping times (t_w), the former calculated on the basis of the length of the link and of the above mentioned link speeds, the latter depending on specific link-related issues, e.g. customs procedures at borders, port and intermodal terminal operations, and so on.

The availability of link travel times allows calculating the shortest additive[8] time path $T^{add}{}_{od}$ for each origin-destination (o-d) pair, i.e. between each pair of zones, in the study area in Figure 1. Notably, road freight transport in EU Countries is forced to comply with regulations limiting the daily and weekly amount of allowed driving hours, depending on the presence of one or two drivers onboard[9]. Such limitations lead to non-additive further travel times, which are accommodated in the DSS by means of a specific algorithm providing the stopping travel time $T^{stop}{}_{od}$ on the basis of the additive time $T^{add}{}_{od}$, so as to obtain finally the total travel time $T^{stop}{}_{od} + T^{add}{}_{od}$.

Similarly, the calculation of travel cost has been carried out by considering the following cost components:

- time-dependent costs (e.g. drivers, vehicle amortization, value of travel time savings)
- length-dependent costs (e.g. parametric tolls, fuel, maintenance)
- other link-specific costs (e.g. border duties)

In general, all parameters and costs have been determined on the basis of various studies and surveys carried out in Italy and in Europe (e.g. CONFETRA, DG-TREN, Italian Ministry of Transport), literature contributions (e.g. Russo (2001)) and proprietary data of the research group in charge of this study.

In more detail, ***time-dependent costs*** are calculated on the basis of the total travel time $T^{stop}{}_{od} + T^{add}{}_{od}$ for each given o-d pair, and are given by the following contributions:

- *driver costs* given by $c_k^{DRI} \cdot n_{DRI} \cdot (T_{od}^{stop} + T_{od}^{add})$ where $c_k{}^{DRI}$ is the driver's hourly cost (variable between 7 €/h and 20 €/h depending on the Country) and n_{DRI} the number of drivers (1 or 2);

[8] A link time component is said to be additive when the total path time component can be calculated as the sum of the time components of all links belonging to that path. This is for instance the case of the running and waiting times.

- *value of travel time savings (VTTS)* defined in between 2.5 and 5 €/ton·h on the basis of literature suggestions, depending on the type of freight carried;
- *vehicle amortization* assumed equal to 4 €/h for the sole trailer (unaccompanied transport) and 16 €/h for trailer and tractor (accompanied transport).

Length-dependent costs are given in turn by the following components:

- *fuel costs* given for each link l as $K_{fuel} \cdot L_l \cdot c_{fuel}$ where K_{fuel} [l/km] is the fuel consumption, L_l [km] the length of link l and c_{fuel} [€/l] the specific fuel cost. In turn, K_{fuel} is estimated using the relationship: $K_{fuel} = (v_l - 70)2/5700 + m$ where v_l is the speed of link l and m is the unitary consumption assumed equal to 0.100, 0.174, 0.298 and 0.393 [l/km] for car, light, medium and heavy vehicles respectively. The unitary value c_{fuel} [€/l] depends on the Country of link l.
- *tolls* for motorways are assumed to be additive, in order to avoid cumbersome calculations. That is, a simplification has been adopted by considering an equivalent toll fare/km, as deduced from a survey on some Italian and European motorways, disaggregated by type of vehicle, leading to the following values: 0.04718 for passenger cars, 0.04834 for light, 0.09388 for medium and 0.11246 [€/km] for heavy commercial vehicles.
- *other costs*, taking into account the following components: insurance, taxes, maintenance, tyres consumption. They have been computed on the basis of the already mentioned analyses carried out by the Italian Ministry for Transport, which cover several European Countries. On average, the incidence of such costs is between 0.06 €/km and 0.22 €/km.

Finally, other ***link-specific costs*** are related to border duties and vignettes, or to link-specific fares due to various reasons.

Notably, the calculation of costs is carried out under the hypothesis of either own transport or hiring: the practical difference is that not all the aforementioned cost components are taken into account. For instance, VTTS is not considered for hiring, while some other costs (e.g. amortization and insurances) are not taken into account for own transport. Furthermore, economic aids to road transport in some Countries have been also taken into account, leading to a reduction of the actual costs faced by road carriers. Notably, specific conversion factors can be also considered for the transformation of costs into prices, as reported by Russo (2001).

A summary of the analytical model for road transport is reported in the following Figure 5.

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[9] See for detail EC Regulation 561/2006. The algorithm adopted for the calculation of the stopping times is described in detail in FREEMED deliverable D2 (2007).

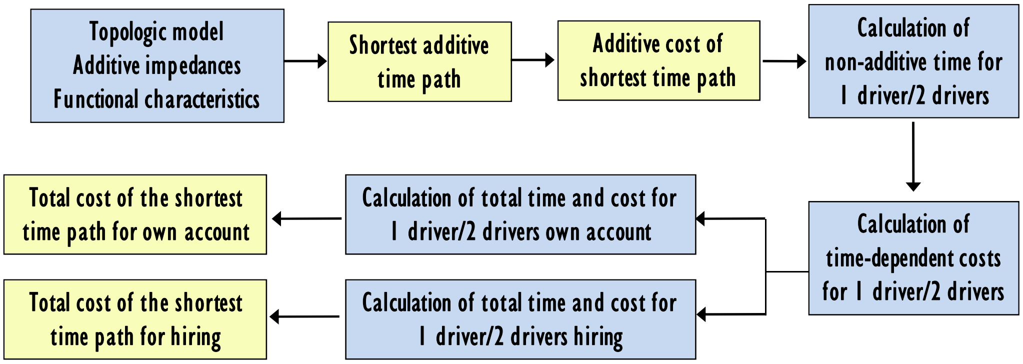

Figure 5 – Analytical model for road freight: summary of calculation procedure

1.1.2 Rail supply model

1.1.2.1 Topological model

The topological model for the rail mode takes into account all relevant infrastructures representing significant connections between zones within the study area, leading to a total amount of 406.975 kilometers of infrastructures. The level of detail of the rail network can be effectively checked in the following Figure 6.

Figure 6 – Topological rail model of the DSS for the Euro-Mediterranean basin (zoom)

Consistently, a graph made up by links and nodes was then built in order to model the selected infrastructures, leading to 90.259 links and 83.462 nodes.

Each rail link is associated with physical characteristics to be used as explanatory variables in the impedance functions (see subsection 1.1.2.2). In more detail, the following classifications were introduced: electrification (yes/no), number of tracks, gauge (six different clusters), allowance for freight transport (yes/no).

A similar classification has been introduced for railway terminals, leading to 5.449 freight stations/terminals in the study area, of which 321 have direct connection to ports and 257 to the inland waterway network. Notably, 200 terminals have been classified as main international terminals.

1.1.2.2 Analytical model

Similarly with the road transport module, two different rail freight "services" have been taken into account for the implementation of the analytical model i.e. combined and traditional (i.e. not unitized).

In order to implement the analytical model, a commercial running speed was associated to each link accordingly with its type and with the country classification. In more detail, the actual commercial running speed for freight trains was collected for some countries, while for the remaining average values have been used, from the 80 km/h of combined services in highly developed countries to the 27.5 km/h of traditional services in low developed countries, depending also on the number of tracks and the electrification type.

With reference to travel times, it should be mentioned that the inherent nature of freight rail services, i.e. not continuous in space and in time, would require a diachronic approach with an explicit representation of the access/egress phases and of the service timetable with the corresponding waiting times (see for instance Cascetta (2009) and Cascetta et al. (2009)). However, due to the impossibility of collecting exhaustive and reliable rail freight timetables on one hand, and the desired departure/arrival time of the shipment on the other hand, a simplified synchronic approach was adopted.

In this approach, all the 200 main international terminals (see subsection 1.1.2.1) are assumed to be connected with each other through direct services, while all the remaining terminals (local terminals) are connected with the closest international terminal, in order to mimic a hub and spoke network structure. From this assumption, travel times have been calculated as the sum of running times (t_r) and waiting times (t_w): the former is determined on the basis of the mentioned link speed, the latter has been assumed equal to 6 hours for connections between main international terminals and to 48 hours for connections implying the presence of one or more local terminals.

It should be also noted that such times do not take into account the contribution given by the last mile of rail freight transport sometimes present in several relations.

Finally, travel times are turned into costs, or more correctly prices since it can be reasonably assumed in a first step the only possibility of hiring, through regressions estimated on disaggregated data and/or available in the literature. For instance, the unit cost function for shipping a loaded intermodal transport unit is given by the relationship $c = -0.427\ln(d) + 3.9668$ [€/ITU·km] where d is the distance.

1.1.3 Maritime supply model

1.1.3.1 Topological model

The implementation of the topological model for the maritime mode considers firstly all the 491 ports within the study area with active freight services, then building a graph of all possible connection routes. This objective was achieved through advanced automatic GIS-based procedures, leading to the topological structure reported in the following Figure 7.

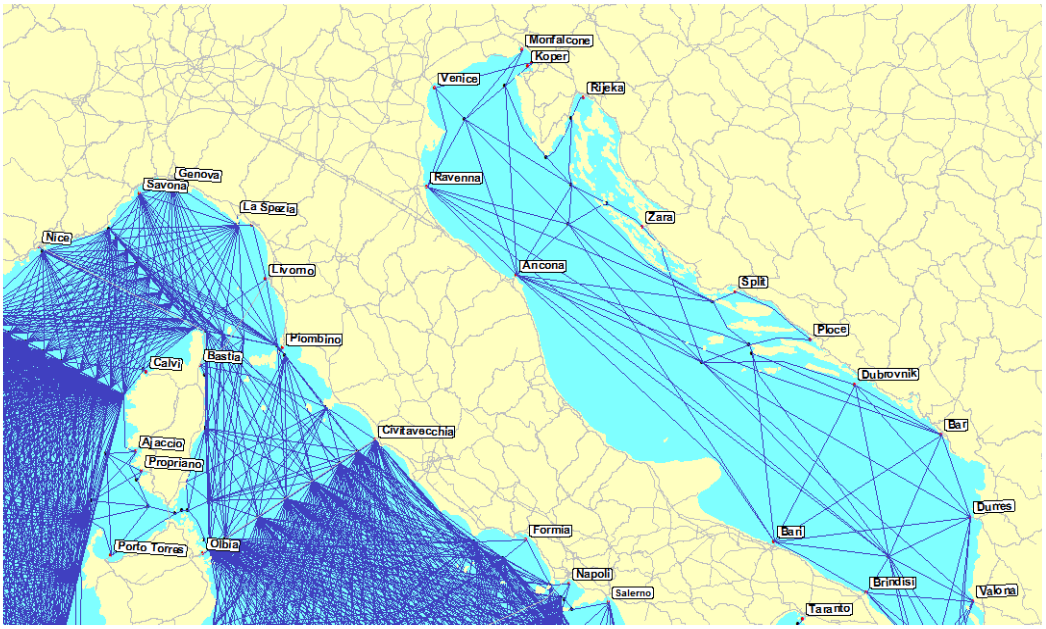

Figure 7 – Topological model for maritime services: zoom on Tyrrhenian Italian ports

1.1.3.2 Analytical model

The development of the analytical model for maritime transport faced the same shortcomings reported for the rail transport module, i.e. a proper simulation of the discontinuity in space and in time for access and egress should be implemented. Differently from the railway transport module, however, some detailed and reliable databases reporting actual maritime services and their timetables are available from various sources.

Therefore, the first activity for the implementation of the model for maritime transport in the Mediterranean dealt with the definition of a database of services connecting ports within the study area. For this aim, two main sources were taken into account:

- the European Shortsea Network (ESN) database[10] and the corresponding national counterparts, which provide information about port of origin and destination, monthly frequency, shipping company and liner agency, for a wide range of Short-Sea Shipping services in the Euro-Mediterranean basin. Transit times are also available, but only for a limited number of observations;
- the AXS-Alphaliner and the Containerization international databases[11], providing the same information also for a wide range of international and intercontinental container deep sea and feeder services. Notably, in addition the capacity of the container vessels and the sequence of ports called by each service are also available.

As a result, after a careful and thorough activity of merging and cleaning, a database of maritime services for the study area was built, covering 9.933 services classified as reported in the following Table 2.

Type of service	count
BB - breakbulk service only	3436
FC - full container service	3297
CR - container / roro service	1312
RR - roro service only	841
CBR - container / breakbulk / roro service	625
CB - container / breakbulk service	294
BR - breakbulk/roro service	117
CB/P - container / breakbulk + reefer pallets	11
total	**9933**

Table 2 – Number of maritime services by type in the DSS database

For each service, the following information is available: sequence of called ports, shipping line(s) and liner agent(s), vessel capacity (for container services), transit time, monthly frequency. Furthermore, service fares have been determined on the basis of market data, with explicit differentiation for Ro-Ro accompanied and not accompanied services. By way of example, on average the fare for a 500 nautical miles (nm) Ro-Ro accompanied service (tractor plus trailer) is about 1.6€/nm.

In order to build the analytical model, the impossibility of dealing with desired departure/arrival times within the level of aggregation of the DSS led to the choice of a synchronic approach. Notably, since the monthly frequency of maritime services would have lead to unrealistic waiting times in a pure synchronic approach, a waiting time component based only on port operations was taken into account. This hypothesis can be regarded as consistent with the behaviour of the customers of maritime services, who normally arrange their operational schedule so as to comply with the often less than one-per-day service departures. The waiting time component has been assumed equal to 4 hours for the first port and to 8 hours for each transhipment port, both for Ro-Ro and containerized services; such

[10] The ESN database is accessible for free at http://www.shortsea.info and the corresponding national services are at *http://www.shortsea.[country code]* .

values can be also incremented for container services, in order to take into account the usual longer storage of containers in port terminals (e.g. several days both in import and export cycles).

As a result, the analytical model is able to calculate travel times and costs for a given type of maritime service between each pair of ports, providing information about the sequence of services used and the consistent sequence of ports called.

1.1.4 Inland waterways supply model

1.1.4.1 Topological model

The topological model for the inland waterway network is made up of 1041 links and 966 nodes, 364 of which are inland ports and/or quays with connection with road and/or rail modes. The physical characteristics taken into account for their impact on the functionality of the inland waterways are: nature of the link (natural/artificial), classification in accordance with the international EU regulations (e.g. EU resolution 92/2 and following). Unfortunately, the information about water direction is not available in the current version of the DSS.

1.1.4.2 Analytical model

The current version of the DSS adopts a simplified analytical model for inland waterways. In more detail, an average travel time is calculated for each link assuming a commercial speed of 5 knots independently of the direction, and an average cost is assumed by considering an average fare of 1€/km for an intermodal transport unit.

1.1.5 Integration into a multimodal supply model

The single-mode supply models described in the previous sections can be effectively integrated between themselves, in order to calculate performances and impacts related to intermodal/multimodal transport services. The integration procedure is based on the presence, within each graph, of intermodal nodes: for instance, if a given port is connected with rail and road networks, both rail and road topological models will have a specific intermodal node tagged with the *id* of that port. Starting from this premise, specific shortest path procedures, implemented in the DSS with ad hoc programming codes, can be defined in order to calculate the times and costs for any combination (i.e. sequence) of modes. Notably, such procedures allow incorporating further impedances (e.g. waiting times and handling costs) to be taken into account in intermodal nodes when switching from a mode to another. Therefore, shortest, cheapest, fastest paths can be calculated using the integrated supply model and optimised via the mode choice model described in subsection 1.2.2. By way of example, the

[11] Available upon registration at http://www.axs-alphaliner.com and at http://www.ci-online.co.uk respectively.

shortest path for an intermodal road-sea-road service connecting a given o-d pair can be calculated through the following steps:

- calculation of the shortest paths from the origin o to each port p_o and from each port p_d to the destination d by road, using the road supply model under the relevant assumptions (e.g. heavy commercial vehicles, accompanied transport, one driver, hiring);
- calculation of the shortest path between each pair of ports p_o-p_d by sea, using the maritime supply model under the relevant assumption (e.g. only Ro-Ro services, fares for accompanied transport);
- implementation of a "virtual" intermodal graph made up by all possible combinations of type o-[*road*]-p_o-[*sea*]-p_d-[*road*]-d, and calculation of the shortest path on such network.

Notably, the preceding procedure can be generalized in order to consider the possibility of a land bridge connection between intermediate ports[12], which can be accommodated calculating also the shortest path between each pair of ports p_{d1}-p_{o2} by road, and then calculating the shortest path on the virtual intermodal network made up by all possible o-[*road*]-p_{o1}-[*sea*]-p_{d1}-[*road*]-p_{o2}-[*sea*]-p_{d2}-[*road*]-d combinations (Figure 8).

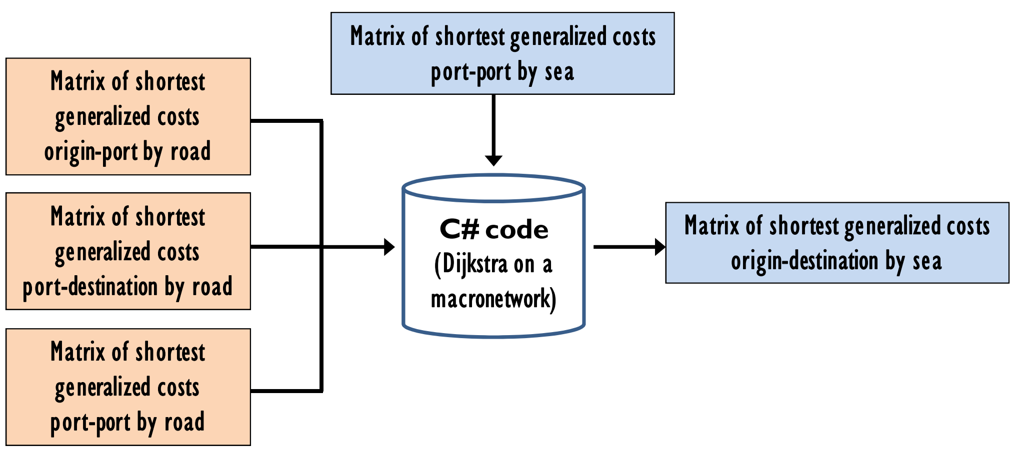

Figure 8 – Example of integration of the road and maritime freight models for a combined road-sea service

Similar procedures can be effectively adopted for any intermodal combination involving also rail and inland waterway networks. As a result, times and costs calculated with the described supply model can be applied in turn as input for the demand model (see Section 1.2) and for the other modelling tools within the DSS (e.g. economic impact models, accessibility analysis, and so on), including the mode choice model described in subsection 1.2.2.

[12] For instance, a transport connection from the Balkans to Morocco using two Ro-Ro maritime services, the former in the Adriatic sea, e.g. to Ancona, and the latter from Civitavecchia to Tangier, with an intermediate road connection between Ancona and Civitavecchia.

1.2 Demand model

In line with the approach outlined at the beginning of Section 1, the demand model aims to reproduce freight flows between countries in the study area as a function of: (a) the socio-economic structure of the territory, (b) the presence of trade agreement and/or other duties and customs regulations, and (c) the performances of transport connections. In order to comply with these requirements, the overall structure of the demand model is therefore characterized by the sequence of a joint generation-distribution model and of a transport mode choice model. The generation-distribution choice dimensions are addressed by means of a gravity model, specified following the state of the art of international trade models. In more detail, estimation has been carried out by means of a panel dataset of trade flows between 1992 and 2008. Details on the estimation database as well as on the results of model specification are reported in subsection 1.2.1. The mode choice dimension may be treated using a mode choice model following the random utility theory in the discrete choice theory framework. The effective implementation of such models would require the availability of a disaggregated (i.e. at individual level) database of observed mode choices, which is unfortunately unavailable at European scale. Therefore, a feasible approach is the use of a national mode choice model specified for Italy, briefly described in subsection 1.2.2. Alternatively, a simplified but still reliable mode choice approach, based on deterministic choice under exogenous thresholds in modal attributes, can be applied[13].

1.2.1 The gravity model

Within the literature on demand models for predicting international trade flows, the gravity approach is widely recognized as reliable and very consolidated both in its theoretical and operational characteristics[14]. Basically, a gravity model is specified as a log-linear relationship between trade flows and a set of explanatory variables usually referenced to the following groups:

- *mass variables*, expressing the magnitude of the exporting (i.e. origin) and importing (i.e. destination) geographical zone;
- *impedance variables*, representing the impedance between each pair of trading zones, usually given by transport costs or simplified proxies (e.g. distance);
- *tariff barriers*, representing duties and tariffs applied to trade flows;
- *dummies*, capturing further explanatory factors, related both to single zones and to pair of zones.

[13] Details and applications of this approach are described in Marzano et al. (2008) and Marzano et al. (2009).

[14] For instance, the reader may refer to Bergstrand (1985), Porojan (2001), Egger (2002), Carrere (2006) and the related bibliographies for further details. Recent state of the art can be found also in Kepaptsoglou et al. (2009).

Therefore, the model takes the form:

$$\ln F_{ij} = \alpha_0 + \alpha_1 \ln M_i + \alpha_2 \ln M_j + \alpha_3 \ln TC_{ij} + \alpha_4 \ln TD_{ij} + \alpha_5 \ln \delta_{ij} + ... + u_{ij}$$

where F_{ij} is the flow between zones i and j, M represent masses, TC represents transport costs, TD represents tariffs and custom duties, δ_{ij} the generic dummy related to the ij pair and u_{ij} is a random residual. Therefore, such specification allows adopting, as policy variables, both transport costs and trade agreement patterns in the form of tariff barriers level and/or agreement dummies.

The subsections below describe the characteristics of the model and the procedure followed for its specification and estimation.

1.2.1.1 Modelling dimensions

The first step for the implementation of the gravity model dealt with the choice of all relevant modelling dimensions, that is:

- definition of study area and its zonization
- choice of commodity nomenclature and its aggregation in clusters
- definition of the temporal horizon for proper model estimation (i.e. # years)
- choice of the measurement unit for the dependent variable (quantity vs. value)

The first issue should be compliant with the supply model implemented, therefore the study area is the same reported in Figure 2. The zonization, however, leads to the problem of dealing with international data normally available only at national level: for this reason, the gravity model has been implemented assuming each country as a single zone, and then disaggregating the resulting trade flows among regions and NUTS3 zones within each country.

The second issue is strictly dependent on the data sources adopted for model estimation, since a wide range of commodity classifications is normally available in the practice, and different data sources may refer to different classifications. This may not be actually an issue *per se*, provided that the different classifications adopted in the study are mutually consistent, i.e. specific correspondence tables exist in the literature[15]. Details about this aspect will be provided in the subsection 1.2.1.2.

The third issue is related to the choice of a proper time horizon for correct estimation of the elasticity of the model parameters. In particular, due to the nature and the characteristics of the study area, the period 1992-2008 was chosen as reference for the analysis, in order to take into account properly the

[15] A complete overview of the nomenclatures and of the correspondence tables is provided by the RAMON EUROSTAT metadata website at http://ec.europa.eu/eurostat/ramon.

effects of the most significant trade agreements (e.g. EMFTA[16], AGADIR[17], GAFTA[18]) recently enforced and/or established in the Euro-Mediterranean basin.

The last issue is motivated by the circumstance that most of the applications based on gravity models assume as dependent variable trade flows in value (i.e. expressed as monetary flows) between each pair of zones of the study area, for a single year and a given commodity group. As known from the literature, some aspects should be carefully addressed in this case. Firstly, enough reliable price deflators should be available for all countries and for the entire time horizon in order to convert trade flows to constant prices. Then, the issue of mirror trade discrepancy should be handled: that is, a trade flow between country *i* and *j* is usually recorded twice, both as free on board (FOB) export of *i* to *j* and cost-insurance-freight (CIF) import of *j* from *i*. Since CIF and FOB estimates differ among each other, and considering that imports are normally recorded in a more precise and reliable manner, the homogeneity of the estimation database should be carefully checked. Finally, the issue of obtaining quantities from values is entirely addressed by means of conversion factors. Therefore, while the choice of value as trade flow unit is straightforwardly justified in macroeconomic analyses, working directly with trade flows in quantities as endogenous variable represents a simpler choice when dealing with transport applications. Notably, when working with quantities, the need of converting, for some commodity nomenclatures, quantity measurement units (e.g. litres, items and so on) in homogeneous weights (i.e. tons) arises: for this aim, conversion factors provided by EUROSTAT can be effectively adopted.

1.2.1.2 Implementation of the estimation database

The activity of implementation of the estimation database requires the definition and the calculation of the dependent variable and of the explanatory variables, in accordance with the general structure of the gravity model described above.

[16] The European Union-Mediterranean Free Trade Area (EU-MED FTA, EMFTA), also called the Euro-Mediterranean Free Trade Area or Euromed FTA, is based on the Barcelona Process and European Neighbourhood Policy (ENP). The Barcelona Process, developed after the Barcelona Conference in successive annual meetings, is a set of goals designed to lead to a free trade area in the Mediterranean Region and the Middle East by 2010.

[17] The Arab-Mediterranean Free Trade Agreement “Agadir Agreement” signed in February 2004 is seen as a building block if the European Union-Mediterranean Free Trade Area. Further steps are envisioned into the ENP Action plans negotiated between the European Union and the partner states on the southern shores of the Mediterranean Sea. The initial aim is to create a matrix of Free Trade Agreements between each of the partners and the others. Then a single free trade area is to be formed, including the European Union. The Agadir Agreement is seen also as a stepping stone to the formation of a Great Arab Free Trade Area (GAFTA)

[18] The Greater Arab Free Trade Area came into existence on 1st January 2005, consisting of most members of the Arab League. This organisation essentially supersedes the Agadir Agreement and achieves the initial aims of the Euro-Mediterranean free trade area by effectively creating a free trade agreement between most Arab Maghreb states along with most of the Middle East.

Dependent variable (o-d trade flows matrices)

The dependent variable is represented by trade flows between countries in the study area. The main source for its calculation is represented by the various international trade databases available in the literature. In more detail, with reference to the study area under analysis, the datasets provided by EUROSTAT and UNCTAD, whose coverage is schematically reported in Table 3, are adopted as reference.

	EU countries	**rest of the world**
EU countries	EUROSTAT (INTRASTAT) UNCTAD	EUROSTAT (COMEXT) UNCTAD
rest of the world	EUROSTAT (COMEXT) UNCTAD	UNCTAD

Table 3 – Data sources for international trade between countries in the study area

Both data sources provide trade data in quantities with reference to various nomenclatures; in the DSS the following are available (depending on the modelling objectives): NST/R, NC2, SITC-3, CPA[19]. In accordance with the reference regulations of each data source[20], a thorough and careful integration was pursued, in order to build reference o-d matrices for a given year and for a given commodity class. A thorough validation procedure was also performed in order to check the reliability of such o-d matrices with other studies and previous estimates.

For the purpose of estimation of the gravity model, a SITC3 1-digit classification (Table 4) has been adopted as commodity disaggregation level for trade flows.

SITC3 1-digit code	Product description
0	Food & live animals
1	Beverages and tobacco
2	Crude mater.ex food/fuel
3	Mineral fuel/lubricants
4	Animal/veg oil/fat/wax
5	Chemicals/products n.e.s
6	Manufactured goods
7	Machinery/transp equipmt
8	Miscellaneous manuf arts
9	Commodities nes

Table 4 – SITC3 1-digit code commodity classification

[19] NST/R Standard Goods Nomenclature for Transport Statistics; NC2 Combined Nomenclature 2-digit level; SITC-3 Standard International Trade Classification – Revision 3; CPA European Classification of Products by Activity.
[20] For UNCTAD: *UN international merchandise trade statistics* (Series M, n° 52 rev 2, 1998). For EUROSTAT: *Statistics on the trading of goods* (ISSN 1725-0153).

Mass variables

Mass variables are expected to capture the impact of the magnitude of origin and destination zones in explaining related trade flows. Country GDP is normally adopted for this aim and therefore GDP data have been collected from EUROSTAT for the European countries, the Arab Monetary Found for most of the African countries and National Statistics Bureaus for the remaining countries (where available). All GDP data have been harmonized by double-checking with the WTO macroeconomic database, and are expressed in US$.

For modelling purposes, it is worth to explore whether a more proper choice of the mass variables may increase model goodness-of-fit. In more detail, it seems natural to adopt the total import and the total export trade of a zone, expressed in quantities, as mass variable respectively for flow destination and origin. These masses have been then introduced in the estimation database as well, simply coming as row and column totals of the base o-d matrices described above.

Transport costs

The most proper impedance variable to be adopted in a gravity approach is represented by the generalized transport cost in trading goods from a zone to another. Normally, as resulting from the literature review, this important variable is simply replaced by proxies such as the straight distance between capitals. Taking into account the objectives of the DSS, a more effective specification of the transport costs was considered, applying the supply model described in Section 1.1. Therefore, for each pair of zones, the travel time of the shortest time path across available modes is associated as measure of transport impedance. Mode choice logsum (Cascetta (2009)) may be also adopted as impedance measure, but at this stage a reliable DSS release using such attribute is not available yet. Furthermore, it is also worth underlining that, following the approach suggested for instance by Martínez-Zarzoso and Suárez-Burguet (2006), the difference CIF-FOB[21] in mirror trade may be also used as a measure of transport costs. However, this procedure is too aggregate and not consistent with the modelling purposes of the DSS. Finally, since transport costs are calculated for each pair of zones, an aggregation at national level should be performed by calculating the cost between countries as weighted average of the costs of all pairs of subzones within those countries.

Tariff barriers

With reference to tariffs and custom duties, three different types of tariffs are usually taken into account in the available databases[22]:

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[21] CIF stands for Cost Insurance and freight, i.e. the shipper/trader has to pay the cost of shipment up to the ship, insurance cost of cargo and freight cost up to destination port. FOB stands for Free On Board, i.e. the shipper/trader pays only costs up to the ship and insurance costs, but freight charges are paid by buyer/consignee.

[22] In this study the reference database was the UN TRAINS database.

- MFN (*most favoured nations*): nominal tariffs applied by WTO member states to other countries, unless preferential agreements are in force;
- PRF (*preferential rates*): usually lower than MFN tariffs, represent the tariffs nominally applied among countries with preferential agreements in force;
- AHS (*effectively applied tariffs*): when available, they denote the tariffs effectively applied to trade between two countries.

Moreover, tariffs can be either simply expressed as percentage of the value of the imported good (ad-valorem) or given by more complex rules, for instance an increasing-by-step tariff (i.e. zero tariffs for trade up to a certain volume threshold and then tariffs increasing with trade volume itself). Furthermore, non ad-valorem tariffs can be applied as well, for instance related to the quantity of the good imported. For this aim, the TRAINS database allows overcoming this issue by considering an "ad-valorem equivalent" (AVE) tariff, which turns each type of non ad-valorem tariff in a corresponding ad-valorem equivalent. For the implementation of the estimation database, the AVE tariffs for the lowest between MFN, PRF and AHS have been taken into account. Notably, tariffs are expressed in the database as percentage of the traded value. It is also important to underline that sometimes tariffs data for a given pair of country were missing for some years: this lead to an unbalanced panel dataset, with estimation implications as described in Section 1.2.1.3. Finally, since tariffs are available at SITC3 5-digit code, the issue of aggregation by commodity arises, basically handled through two procedures leading to:

- *simple average tariffs*: that is, tariffs for an aggregated commodity group are determined as arithmetic mean of the tariffs of the subgroups belonging to the commodity group;
- *weighted average tariffs*: as the preceding point, but weighting the subgroup tariffs with the corresponding trade value.

Dummies

Normally, dummies introduced into international trade gravity models can be classified into the following groups:

- cultural, historical and political links (e.g. common language dummy, non-tariff barriers);
- economic relationships (e.g. trade agreements, membership to international partnerships);
- geographic characteristics (e.g. common border, island, landlocked).

In order to comply with the scenarios to be simulated, at least dummies capturing all relevant agreements in force within the study area should be necessarily introduced. Details about the nature of these agreements can be found in official documents of the European Union as well as in numerous feasibility studies available in the literature. From a practical standpoint, dummy values corresponding to years for which the agreements were in force have been simply fixed equal to 1, and 0 otherwise.

Some other dummies, belonging to the groups listed above, have been chosen in order to increase model goodness-of-fit, in accordance with the findings of the literature review:

- *orlocked* (*destlocked*): takes value 1 if origin (destination) of trade flow is landlocked;
- *commonborder*: takes value 1 if the exchanging countries share a portion of common border;
- *Israel*: takes value 1 if the origin or the destination of the flow is Israel. This dummy aims at reproducing the particular trade barriers enforced by Israel;
- *medod* (*medor*): takes value 1 if the exchanging countries (the origin country) have direct access to the Mediterranean;
- *notEU15*: takes value 1 if origin or destination does not belong to the list of countries joining the EU prior to 1995.

1.2.1.3 Model estimation

The estimation database described in the previous section has a panel structure, with dimensions given by o-d pairs and time respectively, and is divided in commodity clusters (Figure 9). It is also unbalanced, because of some missing data, and some explanatory variables are substantially constant over the time horizon. The estimation of a log-linear gravity model using this database is therefore not straightforward and should be carefully addressed.

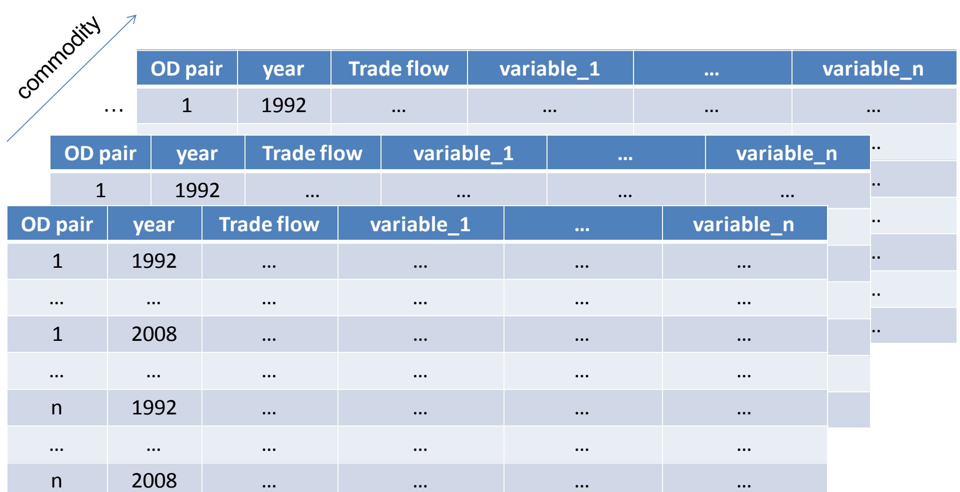

Figure 9 – Scheme of the structure of the gravity model estimation database

In more detail, proper estimation assumptions and hypotheses should be introduced in order to handle the presence and the impact of possible correlation patterns: across countries (cross-sectional), across years (time-series), across countries and years (panel data), panel data plus commodities (SURE[23]).

For this aim, a regression has been firstly estimated separately for each commodity class assuming heteroskedastic errors across o-d pairs and panel specific AR(1)[24] correlation (Washington et al. 2003). Then, some theoretical aspects coming from the structure of the estimation database have been also investigated and addressed in estimation. Firstly, the effect of time-constant explanatory variables, such as travel times and geographical dummies, in panel data estimation was tested following the approach suggested by Plümper and Troeger (2007). However, no significant model improvement was achieved. Another investigated aspect refers to the potential application of a SURE panel-data estimation: that is estimation equations for different commodity sectors may share common variance. From a practical standpoint, this means that a positive correlation is expected between trade flows between two countries for different commodity sectors: this argument is explored in detail in Kepaptsoglou et al. (2009). A first SURE estimation has been performed through the procedure developed by Biorn (2004) and implemented in STATA by Nguyen (2008). Interestingly, tariffs were never significant in the SURE panel-data approach.

Estimation results for the most robust specification are reported for each commodity class in the following Table 5.

Interestingly, tariff barriers are significant not for all the commodities, while trade agreement dummies are always significant and their signs are always proper. This applies entirely to EMFTA and EU dummies, while GAFTA and AGADIR does not enter in the specification for some commodities[25]. Also transport impedances are always significant; it should be however noted that they are substantially meaningless for commodity 3 which mainly makes use of fixed installations (e.g. pipelines).

[23] SURE stands for Seemingly Unrelated Regression Equations.
[24] AR(1) stands for first-order autoregressive correlation structure.
[25] EMFTA stands for Euro-Mediterranean Free Trade Area; GAFTA stands for Greater Arab Free Trade Area; AGADIR stands for Arab Mediterranean Free Trade Agreement.

Variable	Commodity class (SITC 1-digit nomenclature)									
	0	1	2	3	4	5	6	7	8	9
masseor	0.813	0.344	0.434	0.499	0.234	0.778	0.819	0.742	0.605	0.150
	93.53	*97.05*	*76.05*	*169.95*	*19.61*	*403.58*	*168.55*	*119.86*	*105.1*	*25.2*
massedest	0.467	0.219	0.679	0.399	0.225	0.570	0.816	0.774	0.825	0.351
	95.27	*48.1*	*133.97*	*94.01*	*12.03*	*87.87*	*124.18*	*115.3*	*217.89*	*42.04*
transporttime	-0.771	-1.161	-0.866	-0.396	-1.116	-1.150	-1.066	-1.114	-1.371	-1.034
	-55.36	*-117.25*	*-63.4*	*-22.59*	*-22.4*	*-106.86*	*-100.35*	*-89.98*	*-104.05*	*-37.89*
tariff	-	-0.029	-	-0.062	-	-	-	-	-0.026	-0.175
		-10.08		*-5.79*					*-4.33*	*-4.33*
EMFTA	0.321	0.873	0.722	0.049	0.434	0.417	0.823	1.448	1.354	1.924
	11.38	*20.34*	*22.88*	*1.08*	*2.52*	*9.09*	*26.52*	*27.59*	*28.37*	*25.85*
EU	1.470	2.449	1.575	0.704	0.994	1.587	1.994	1.881	2.299	0.180
	18.48	*53.11*	*36.53*	*21.99*	*5.92*	*50.07*	*66.08*	*47.68*	*64.45*	*0.71*
GAFTA	0.672	-	-	-	-	0.549	1.245	0.577	0.032	-
	1.12					*0.81*	*2.34*	*1.43*	*0.07*	
AGADIR	1.492	-	1.297	-	1.904	1.166	0.874	1.776	1.771	-
	2.57		*1.89*		*2.18*	*1.7*	*1.53*	*4.13*	*3.77*	
orlocked	-1.291	-	-2.241	-2.274	-2.741	-1.041	-0.415	-0.806	-0.874	-1.429
	-28.67		*-65.68*	*-30.73*	*-17.22*	*-26.19*	*-11.41*	*-20.74*	*-18.69*	*-13.58*
destlocked	-0.668	-0.867	-0.764	-1.140	-1.272	-2.023	-1.136	-1.148	-0.817	-1.558
	-11.83	*-29.66*	*-11.73*	*-24.86*	*-8.38*	*-32.14*	*-21.58*	*-23.23*	*-16.41*	*-12.55*
commonborder	3.084	2.535	3.935	3.658	1.741	2.707	2.475	1.799	1.747	2.000
	43.71	*72.46*	*85.73*	*93.91*	*10.57*	*66.39*	*75.81*	*28.7*	*30.17*	*17.33*
israel	-4.055	-	-5.955	-	-	-	-2.616	-8.907	0.624	-
	-2.18		*-12.72*				*-4.71*	*-71.07*	*8.61*	
medod	-	0.742	-	-	-	-	2.025	0.632	0.876	-
		31.94					*71.92*	*11.98*	*17.93*	
medor	-	-	-	-1.170	-	-	-	-0.072	-	-0.462
				-40.76				*-2.02*		*-5.58*
notEU15	-	-	-	0.590	-	-	-	1.856	-	-
				8.08				*14.8*		
constant	-4.911	3.535	-3.565	-0.653	6.307	-4.987	-12.071	-8.484	-8.143	2.197
	-31.02	*33.41*	*-20.34*	*-5.17*	*16.94*	*-38.01*	*-37.99*	*-53.8*	*-39.01*	*13.01*

Note: missing values mean not significant parameters.

Table 5 – Gravity model estimation results: coefficient values and significance test results

1.2.2 Mode choice model

As mentioned in the introduction, mode choice can be faced in the DSS either through a mode choice model following the paradigm of the random utility theory, or by means of deterministic target thresholds defined on specific supply attributes (usually travel times and/or generalized transport cost).

The mode choice model available for the DSS is a consignment model, that is reproducing mode choice for a single consignment, belonging to one of two macro-classes, respectively the perishable/high value and the not perishable/industrial. The choice set is made up by the following modes: traditional rail, combined rail, light road vehicles, medium road vehicles, heavy road vehicles, maritime transport. Inland waterways are not considered explicitly in the model and the corresponding traded tons are exogenously calculated on the basis of EUROSTAT data and treated as mode captive. Furthermore, availability thresholds have been defined, that is the train modes are unavailable for consignments between o-d pairs distant less than 300 km and light and medium commercial vehicles unavailable for o-d pair farther than 400 km. The choice probability of mode *m* for a generic *o-d* pair is calculated through a Multinomial Logit model (see for instance Cascetta (2009)):

$$p_{mc}^{w}[m] = \frac{e^{V_{mc\,m}^{w}/\theta}}{\sum_{m'} e^{V_{mc\,m'}^{w}/\theta}}$$

where $V^{w}_{mc\ m}$ is the systematic utility of mode m relative to a consignment of weight class w and macro-class mc, and θ is the variance parameter. The systematic utilities have been specified in the following way:

$$V_{tradrail}^{w} = \beta_1 T_{tradrail}^{w} + \beta_4 P_{tradrail}^{w} + \beta_5 Pe_{30} + \beta_7\, freq + \beta_8 Val / Pe_{40} + \beta_9 Trad$$

$$V_{combrail}^{w} = \beta_2 T_{combrail}^{w} + \beta_4 P_{combrail}^{w} + \beta_6 Container + \beta_{10} Comb$$

$$V_{lightroad}^{w} = \beta_3 T_{lightroad}^{w} + \beta_4 P_{lightroad}^{w}$$

$$V_{mediumroad}^{w} = \beta_3 T_{mediumroad}^{w} + \beta_4 P_{mediumroad}^{w}$$

$$V_{heavyroad}^{w} = \beta_3 T_{heavyroad}^{w} + \beta_4 P_{heavyroad}^{w}$$

$$V_{sea}^{w} = \beta_2 T_{sea}^{w} + \beta_4 P_{sea}^{w} + \beta_{10} Sea$$

where T^{w}_{i} is the total time [min] for a consignment of class w with the mode i, $P^{\ w}_{i}$ the total cost [€x10^3] for a consignment of class w with the mode i, We_{30} a dummy variable equal to 1 if the consignment weight is>30 t and 0 otherwise, *freq* a dummy variable equal to 1 if the consignment frequency is<1/month and 0 otherwise, Val/We_{20} a dummy variable equal to 1 if the value/weight ratio of the consignment is>20.000 €/ton and 0 otherwise, *Container* a dummy variable equal to 1 if the good is containerized and 0 otherwise, and *Comb*, *Trad*, *Sea* are alternative specific constants. Estimation results, obtained through a disaggregated database related only to Italian shippers and carriers, are shown in the following Table 6.

attribute	unit	Mc1: perishable		Mc2: not perishable	
time road	min	-0.00361	*-4.6*	-0.002324	*-4.2*
time train	min	-0.00151	*-6.1*	-0.00129	*-6.4*
time combined	min	-0.007217	*-7*	-0.004933	*-7.4*
cost	€	-0.0023	*-2*	-0.00124	*-1.9*
freq > 1/month	0/1			1.63	*2*
specific value > 20.000 €/t	0/1			3.63	*4.1*
container	0/1	5.29	*3.3*		
weight > 30 t	0/1	3.84	*2.8*	2.59	*3.3*
Sea	0/1	4.35		4.35	
Comb	0/1	3.87		3.87	
Trad	0/1	-11.23		-11.23	
	Ln(0)	-187		-161	
	Ln(β)	-42		-57	
	ρ^2	0.78		0.64	

Table 6 – Mode choice model estimation results: coefficient values and significance test results

Estimation results show that all the parameters are statistically significant and the values of the reciprocal substitution ratios consistent with those expected. VTTS are greater with respect to those generally encountered in the passenger transport, as a consequence of the average high value of the goods transported. Moreover, the positive value of high weight We_{30} and high value Val/We_{20} attributes indicates a greater competitiveness of train mode for consignment with these characteristics.

Notably, from an operational standpoint, the specified mode choice mode introduces 24 demand segments, 8 for perishable goods (4 weight classes per 2 container options) and 16 for not perishable (4 weight classes per 2 frequency options per 2 value/weight ratio options). Therefore, in order to apply the model (i.e. for computing o-d freight demand for each mode and segment) the whole o-d freight demand coming from the gravity model should be converted before from tons to consignments, and then segmented with a sample enumeration method (Ben-Akiva and Lerman 1985) based on the already mentioned disaggregated survey to Italian shippers and carriers.

2. Analysis of current maritime services

2.1 General overview

The aggregate overview of the current monthly frequency of liner maritime services between the four selected Northern Adriatic ports of Ravenna, Trieste, Venice and Koper from one side and the Euro-Mediterranean ports from the other side is presented in the following Figure 10, referring to full and multipurpose container services, and Figure 11, related to RoRo and bulk services.

At a first glance, the market positioning of the Northern Adriatic cluster appears to be clearly oriented towards the Eastern Mediterranean countries, obviously in consequence of the reciprocal geographic position. In that respect, a main role is played in terms of services/month by Turkey and Greece for the RoRo and bulk services, as evidenced by the national figures reported in Figure 12, while container services are more uniformly spread over Mediterranean ports.

The main consequence of the geographical position of the port cluster under analysis, together with the current picture of maritime services, is that the Western Mediterranean basin cannot be regarded as potentially attractive for the Northern Adriatic port cluster, whilst interest should be focused on the enhancement and the development of further connections with Eastern Mediterranean ports.

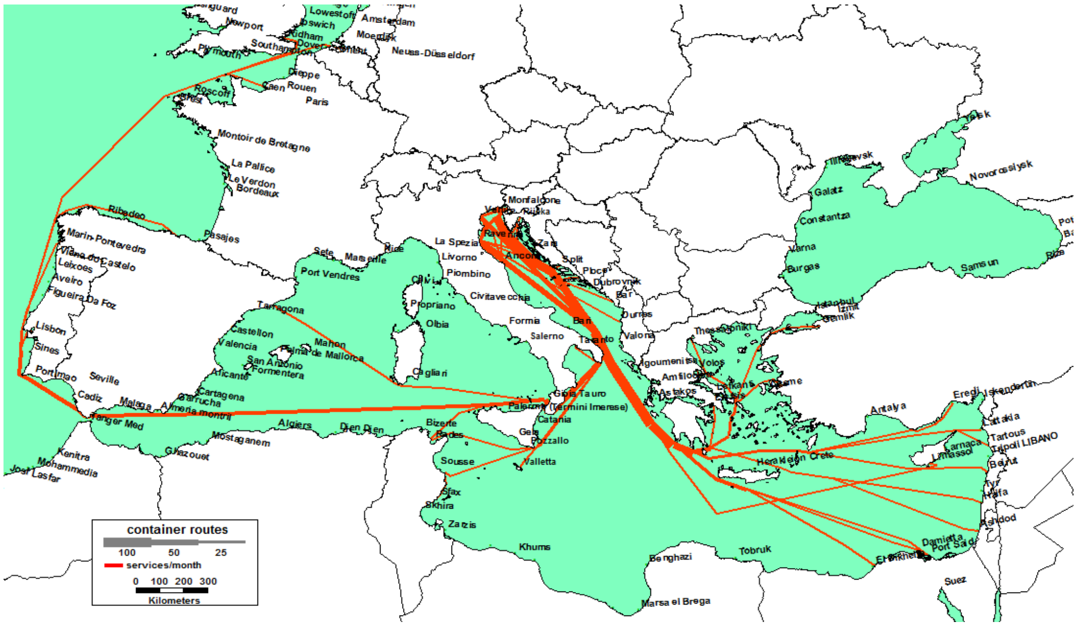

Figure 10 – Current maritime supply between Northern Adriatic ports (Ravenna, Venice, Trieste, Koper) and Euro-Mediterranean countries: full and multipurpose container services

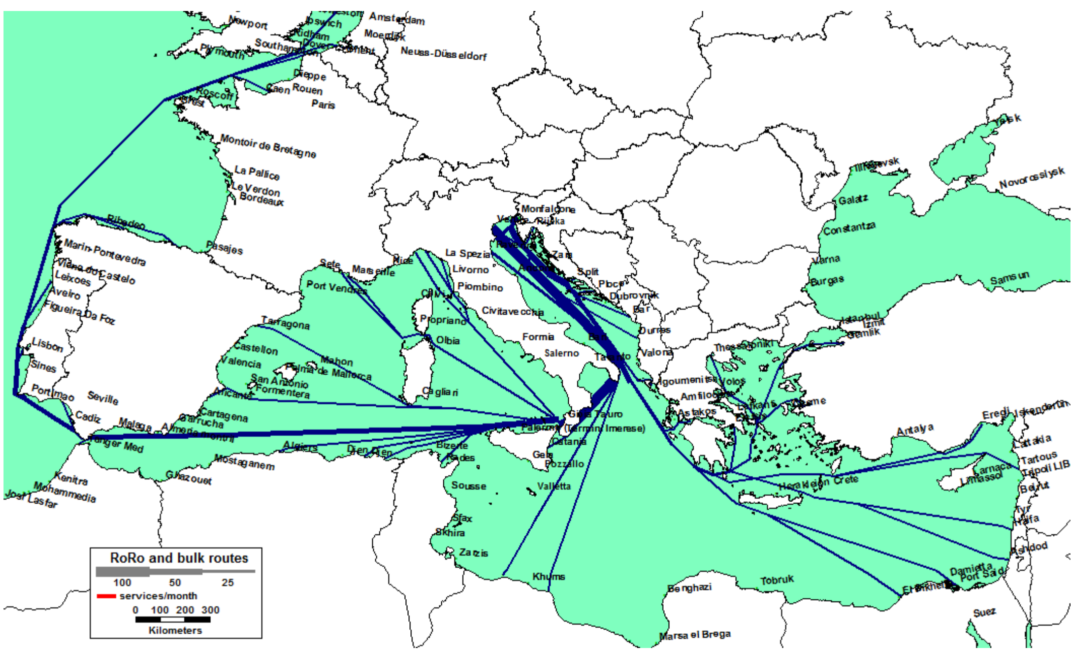

Figure 11 – Current maritime supply between Northern Adriatic ports (Ravenna, Venice, Trieste, Koper) and Euro-Mediterranean countries: RoRo and bulk services

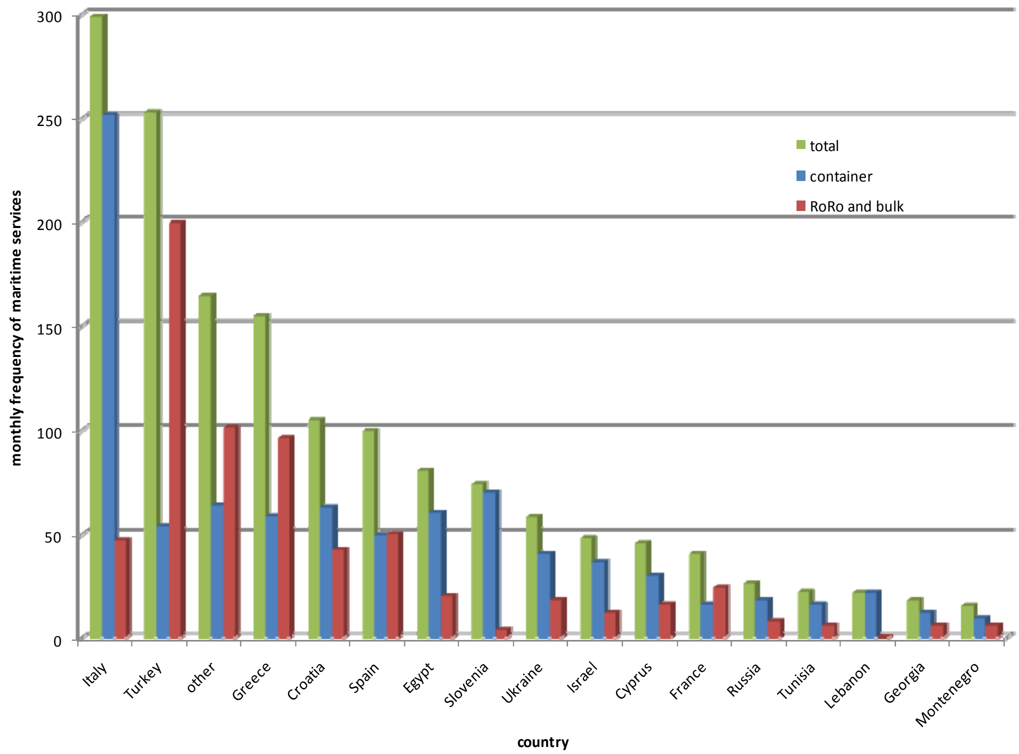

Figure 12 – Current maritime supply between Northern Adriatic ports (Ravenna, Venice, Trieste, Koper) and Euro-Mediterranean countries of origin/destination: aggregate figures

In that respect, once presented the general situation of maritime services for the port cluster under analysis, a basic question should be immediately addressed in order to provide for a proper specialization of the analyses of the study: which country is the first option for the implementation of new maritime services to/from the ports in the Northern Adriatic cluster? In that respect, in accordance with the above, three main options arise within the Eastern Mediterranean basin: Turkey, Egypt, Middle East countries. From a pure supply standpoint, Egypt seems to be more attractive because less served with respect to the other options. Clearly, answering this question means also looking at the demand matrices and at the corresponding trade flows. In that respect, it is useful to anticipate some aspects more thoroughly addressed in Section 3, through presentation of the assignment of the current freight demand in the Euro-Mediterranean basin to the multimodal supply network (Figure 13).

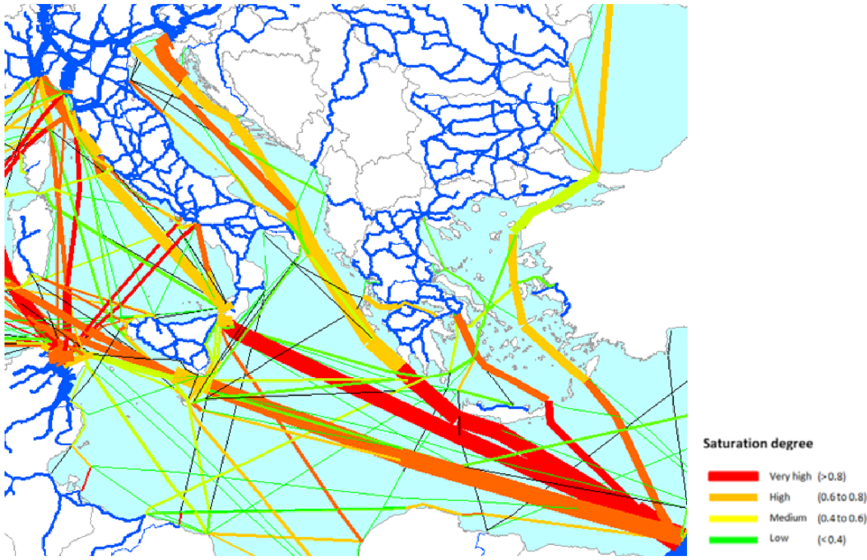

Figure 13 – Saturation degree of the current maritime services in the Adriatic Sea (model simulation)

The main result of the situation depicted in Figure 13 is that the services to/from Egypt face also a remarkable congestion, therefore with a perspective need for an increase of capacity in order to meet the future demand requirements. In other words, in accordance with the outcomes of Section 3.1, the increase of Egyptian trade, even if not the highest in absolute values within the Eastern Mediterranean basin, will be the one requiring the largest increase in maritime services. As a result, it is worth exploring in more detail the supply of maritime services to/from Egypt and the relative market positioning of the Northern Adriatic ports, shown in the next section.

2.2 Focus on maritime services to/from Egypt

In accordance with the demand analysis presented in Section 3.1, the main country of interest for the development of new maritime services to/from the Northern Adriatic cluster is represented by Egypt. It is therefore useful to provide for a more detailed analysis of the maritime services to/from Egypt, in order to understand the magnitude of the potential basins of such new services. For this aim, the current status of liner maritime services between Egypt and the other Countries in the Euro-Mediterranean basin is depicted in the following Figure 14 and Figure 15, respectively for container and Ro-Ro/bulk connections.

In general, for both types of services, the two main corridors of the Egyptian maritime supply pattern are towards the Northern range ports and the Black Sea ports. Within the set of western Mediterranean ports, which are however remarkably served, three main port clusters may be identified in terms of connections to/from Egypt: the cluster of the Eastern Spanish and Southern France ports, the cluster of Italian Tyrrhenian ports, and the cluster of the Adriatic ports which encompasses also the ports under analysis (Ravenna, Venice, Trieste, Koper).

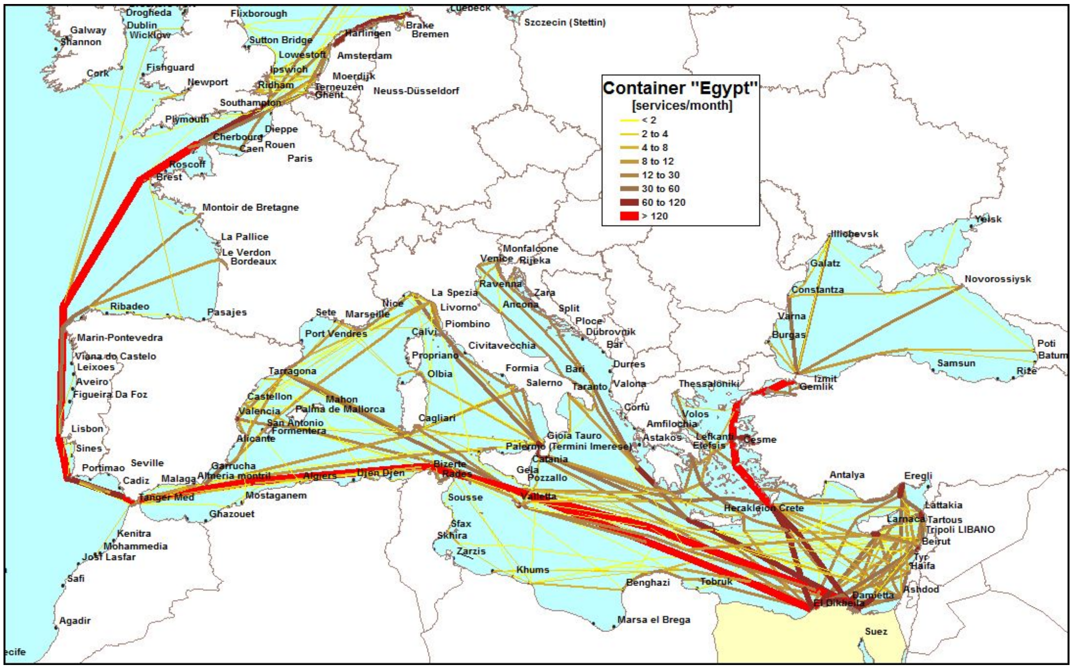

Figure 14 – Current maritime supply between Egypt and Euro-Mediterranean countries: container services

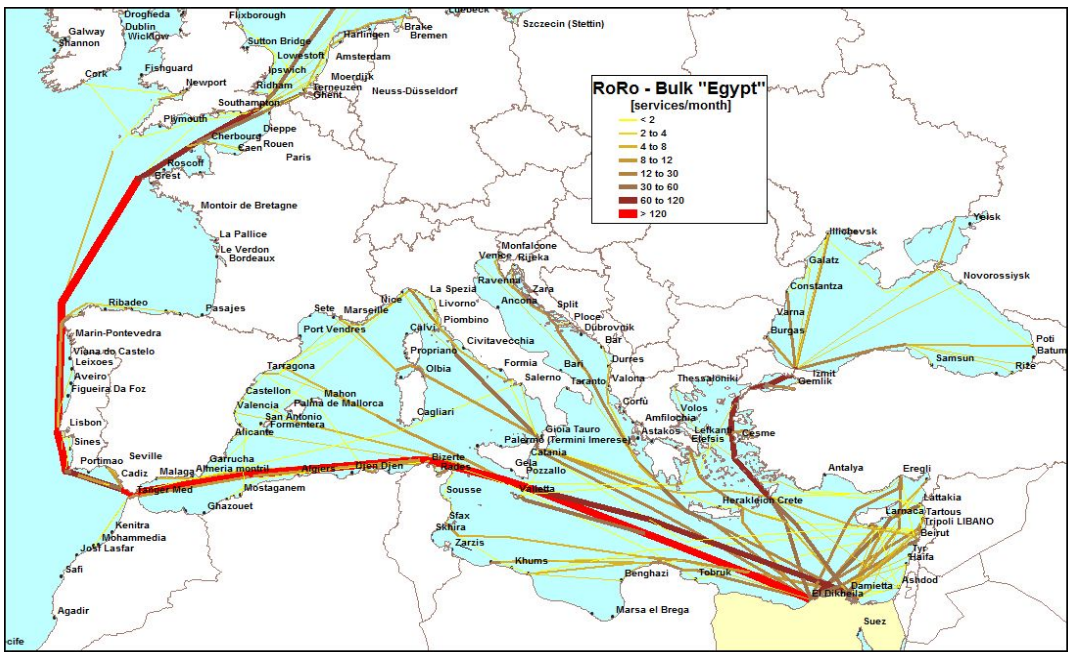

Figure 15 – Current maritime supply between Egypt and Euro-Mediterranean countries: Ro-Ro/bulk services

At a glance, the first two clusters appear to cover all o-d pairs in Western and in part of Central Europe, while the target basin of the Adriatic ports seems to be more oriented towards part of Central and Eastern Europe: this aspect will be investigated in detail in Section 3. It is worth looking now in more detail at the maritime services between Egypt and the ports under analysis: for this aim, Table 7 and Table 8 report the direct services between Egyptian and Italian ports/Koper for Ro-Ro and container respectively.

Egyptian port	Italian port/Koper	Shipping company slot charter
Alexandria	Genova, Voltri	Nordana Line, Demline Egypt for Maritime Transport, ENC, Nordana Line, Ignazio Messina & C.SP.A, Fast Lines, Ignazio Messina & C.SP.A, DEM Line, Fast Lines
	Koper	**Grimaldi**
	La Spezia	ENC
	Livorno	Nordana Line, Demline Egypt for Maritime Transport
	Napoli	Ignazio Messina & C.SP.A
	Ravenna	**Grimaldi, ENC**
	Salerno	Grimaldi
	Savona, Vado	Grimaldi
	Trieste	**Grimaldi, Egyptian Nav. Co.**
	Venice	**Visemar, ENC**
Port Said	Genova, Voltri	Demline Egypt for Maritime Transport
	Livorno	Demline Egypt for Maritime Transport

Table 7 – Ro-Ro (pure and multipurpose) liner services between Egypt and Italian ports/Koper

Egyptian port	Italian port/Koper	Shipping company slot charter
Alexandria	Ancona	Sermar Line Srl, Evergreen
	Cagliari	EMES, United Feeder Services Ltd, MCL Feeders, Metz Cont Line, Hapag-Lloyd
	Genova, Voltri	Egyptian Navigation Co, Maersk Line, Borchard, Egyptian Navigation Co, UFS, Metz Cont Line, Hapag-Lloyd
	Gioia Tauro	MSC ,Metz Cont Line ,Maersk Line
	Koper	**CSCL, MCL Feeders, Sermar Line Srl, MSC, Maersk Line, Evergreen**
	La Spezia	SNCM ,MSC ,Tarros ,Egyptian Navigation Co ,National Navigation Co
	Livorno	Hapag-Lloyd ,Hamburg Sud
	Napoli	Hapag-Lloyd ,MSC ,POL-Levant Shipping Lines Ltd
	Ravenna	**CSCL ,MCL Feeders ,Seatrans Shg ,Maersk Line ,MSC ,Egyptian Navigation Co**
	Salerno	Tarros ,Borchard ,Hapag-Lloyd ,Hamburg Sud
	Savona, Vado	Hamburg Sud
	Taranto	Evergreen
	Trapani	Hapag-Lloyd ,MCL Feeders
	Trieste	**Zim, CSCL ,Evergreen ,MSC**
	Venice	**Zim, CSCL ,Evergreen ,MSC ,Adria Levant Line ,MCL Feeders ,Sermar Line Srl ,Egyptian Navigation Co**
Damietta	Genova, Voltri	Evergreen ,Islamic Republic of Iran Shipping Lines ,CMA CGM ,Grand Alliance (Misc, OOCL, NYK, Hapag Lloyd), New World Alliance (APL, MOL, HMM), Zim
	Koper	**CMA CGM ,Maersk Line ,CMA CGM**
	La Spezia	Hapag-Lloyd, CMA CGM, DAL, ANL, Marfret, Hapag-Lloyd, CMA CGM, DAL, ANL, Marfret
	Napoli	Evergreen
	Ravenna	**Sermar Line Srl, United Feeder Services Ltd**
	Trieste	**Maersk Line, CMA CGM**
	Venice	**Metz Cont Line**
Port Said	Cagliari	APL ,CMA CGM ,UFS ,Hanjin, K Line, United Arab Shipping Co (SAG), Yang Ming, Maersk Line, Emirates Shg L., Hapag-Lloyd, APL
	Genova, Voltri	Islamic Republic of Iran Shipping Lines ,CKYH (Cosco, K Line, Yang Ming, Hanjin) ,APL ,China Shipping Container Lines Co Ltd ,Zim ,Mitsui OSK Lines Ltd ,United Arab Shipping Co (SAG) ,CMA CGM
	Gioia Tauro	CMBT Mios Service ,Maersk Line ,CMA CGM
	Koper	**Evergreen ,Maersk Line ,CMA CGM**
	La Spezia	APL ,China Shipping Container Lines Co Ltd ,United Arab Shipping Co (SAG)
	Livorno	National Shipping Co of Saudi Arabia ,CKYH (Cosco, K Line, Yang Ming, Hanjin) ,Mitsui OSK Lines Ltd
	Napoli	CKYH (Cosco, K Line, Yang Ming, Hanjin) ,Zim
	Ravenna	**Sermar Line Srl**
	Taranto	Evergreen ,Mitsui OSK Lines Ltd ,CMA CGM
	Trieste	**Evergreen ,Maersk Line ,CMA CGM**
	Venice	**Metz Cont Line**

Table 8 – Full container liner services between Egypt and Italian ports/Koper

With reference to pure and multipurpose Ro-Ro services, direct services are available between Alexandria and Port Said from one side and eleven Italian ports from the other side. Notably, all ports under analysis are directly connected, with the remarkable presence of Grimaldi and Egyptian Navigation Company as main shipping companies, together with the recent Visemar service launched in early 2010[26].

[26] Within the European project of the Motorways of the Sea, on May 20 2010 the first maritime service has started connecting Venice with Syria and Egypt, operated by Visemar Line. This is the first weekly service that aims, thanks to its frequency and transit time, to develop import/export traffic between Italy and the Eastern mediterranenan. Prov iding a Ro-

Similarly, there are direct container services between fourteen Italian ports and Koper from one side and Alexandria, Damietta and Port Said from the other side: again, all ports under analysis are directly connected with each of the mentioned Egyptian ports through services operated by the main worldwide container shipping companies. Finally, it is worth mentioning that an analysis of the pure breakbulk services is not feasible because of the inherent nature of the market of such services. However, data coming from the database described in Section 1.1.3 evidence that Hartel and Egyptian Navigation Company provides for direct liner connections between Alexandria and Trieste, Venice, Koper and between Port Said and Venice, Koper.

Summarizing, the ports under analysis are already well connected with Egypt, through both Ro-Ro and container services. However, the market context they face is characterized with a very strong competition with other port clusters, therefore with perspective limitations in their potential target basin.

3. Current demand analysis

3.1 General overview

In consideration of the analyses carried out in Section 2, interest will be focused mainly on trade between the Eastern Mediterranean countries and the European countries of possible interest for traffic towards the Northern Adriatic ports, that is (see also the target basins reported in Section 3.2):

- Italy, Austria, Germany, Slovenia and Hungary from the European side;
- Egypt, Turkey, Israel, Syria, Jordan and Lebanon from the Middle East side.

The overall demand for this set of countries is reported in the following Table 9, in terms of generated and attracted traffic from each of the Eastern Mediterranean countries under analysis. Notably, Turkey and Syria provide for the largest figures, Egypt contributes for a significant trade amount, while the remaining considered countries exhibit more limited trade values.

It is important to stress that year 2008 has been chosen as reference year for the analysis ("current scenario" in the following). This choice is motivated maily by the circumstance that 2009 data were not consolidated yet at the time of this analysis by the official statistical sources described in Section 1.

Ro and passengers transport from Europe to the Middle East (and return), the service connects Venice with Tartous (Syria) in 68 hours, with Alexandria (Egypt) in 60 hours. This initiative develops the EU-backed "Green Corridor" project with the aim of developing the fruit and vegetables trade.

Country	Generated demand	Attracted demand
Egypt	7,575,145	2,870,590
Israel	2,680,763	2,442,415
Jordan	172,041	450,450
Lebanon	139,006	949,726
Syria	11,231,900	1,948,269
Turkey	21,489,099	11,702,402

Table 9 – Overall freight trade between countries under analysis in tons/year for 2008 (model simulation)

A further detailed analysis can be performed with reference to the commodities trade between the same countries, as reported in the following Table 10.

Country	Commodity	Generated demand	Attracted demand
Egypt	agriculture and foodstuff	485,722	193,037
	manufactured products	340,620	976,253
	other	6,748,804	1,701,299
Israel	agriculture and foodstuff	182,486	383,734
	manufactured products	355,083	652,188
	other	2,143,194	1,406,492
Jordan	agriculture and foodstuff	5,721	75,050
	manufactured products	1,743	202,642
	other	164,577	172,758
Lebanon	agriculture and foodstuff	27,970	105,079
	manufactured products	10,928	232,066
	other	100,109	612,581
Syria	agriculture and foodstuff	959,260	124,096
	manufactured products	896,474	283,711
	other	9,376,166	1,540,462
Turkey	agriculture and foodstuff	1,824,130	644,364
	manufactured products	3,733,324	3,259,975
	other	15,931,645	7,798,063

Table 10 – Overall freight trade between countries under analysis in tons/year for 2008 by macro-commodities (model simulation)

A comparison between Table 9 and Table 10 allows understanding that, with respect to the main commodities attractive for multipurpose container/RoRo maritime services, the potential of Egyptian trade is the most promising, mainly in the light of the lack of adequate maritime capacity pointed out in Section 2. For this reason, it is worth exploring in more detail the trade to/from Egypt, in order to check the feasibility of new maritime routes for the Northern Adriatic port cluster.

3.2 Focus on trade to/from Egypt

In accordance with the above tenets, it is worth analyzing the structure of freight flows to/from Egypt for the base scenario (i.e. current situation).

Notably, aggregated imports and exports for the base reference year depicted respectively in Figure 16 and Figure 17 for the EU27 area show that the main trading partners of Egypt of possible interests for the ports under analysis are those along the vertical of Italy (Italy, Austria, Germany) and part of Eastern European Countries. Some more detailed figures are also reported in the following Table 11, which provides also a disaggregation by macro-commodity classes.

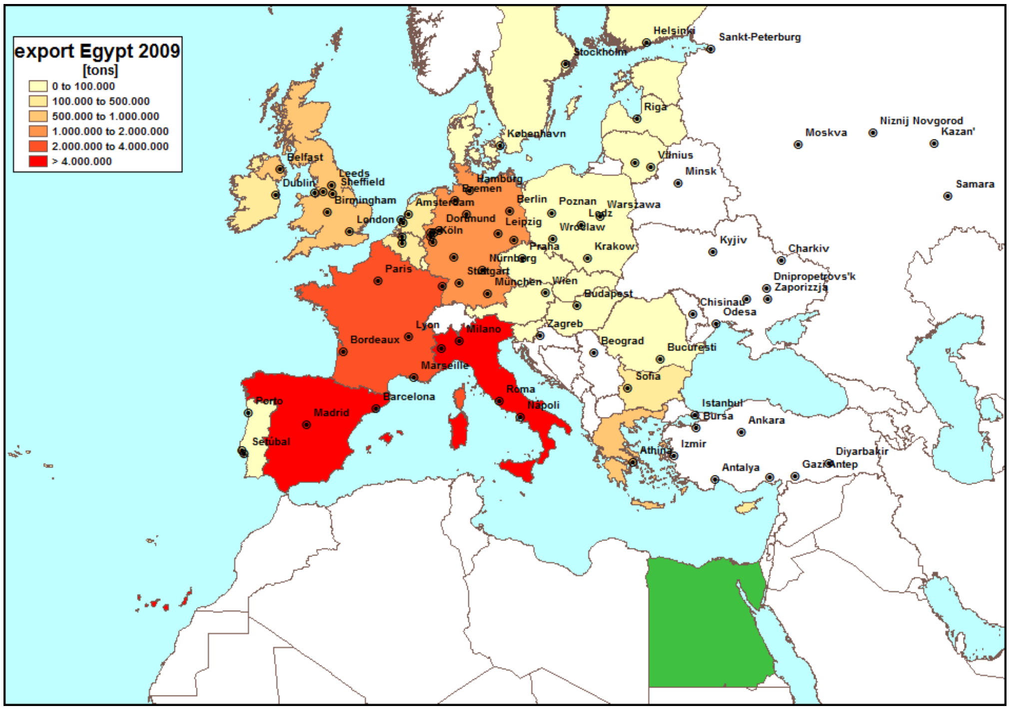

Figure 16 – Total exports of Egypt by country of destination: focus on EU27 (2009 figures)

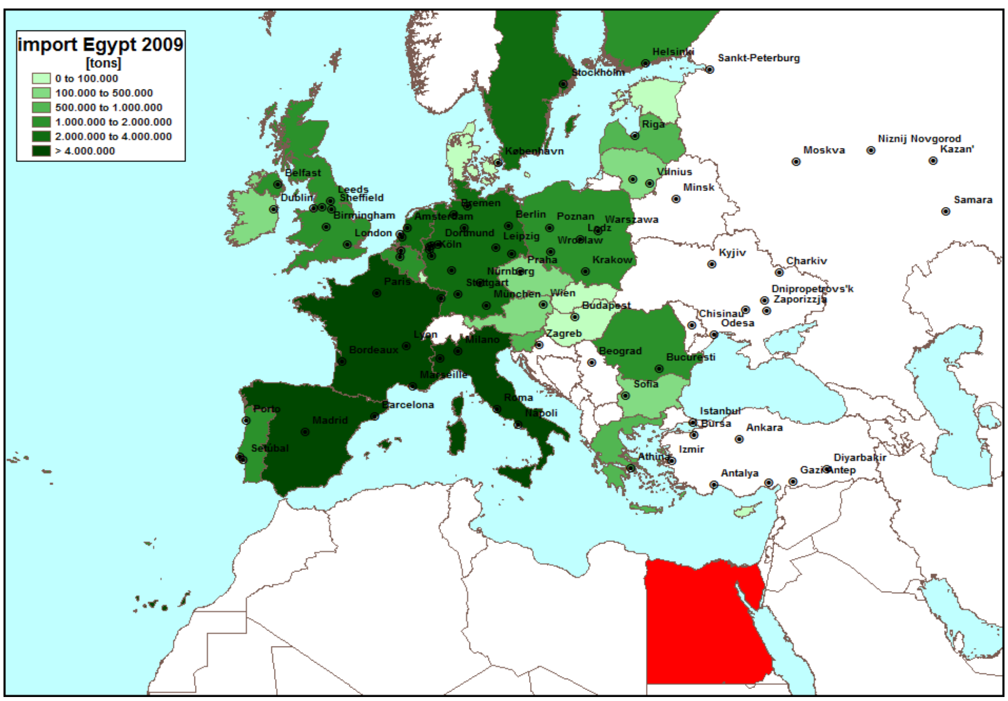

Figure 17 – Total imports of Egypt by country of origin: focus on EU27 (2009 figures)

tons/year	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	29,616	69,396	136,788	*235,800*
Belgium	70,745	76,013	662,240	*808,997*
France	21,455	875,814	947,776	*1,845,044*
Germany	61,842	43,079	1,372,511	*1,477,432*
Italy	390,320	183,107	5,143,329	*5,716,755*
other Countries	635,886	261,209	6,514,694	*7,411,790*
total	*1,209,863*	*1,508,619*	*14,777,337*	*17,495,819*
export to Egypt				
Austria	9,531	118,052	56,206	*183,789*
Belgium	42,415	99,855	473,757	*616,028*
France	693,750	98,298	131,963	*924,011*
Germany	129,972	488,839	327,797	*946,608*
Italy	53,018	355,113	1,262,640	*1,670,771*
other Countries	1,759,825	545,278	3,128,086	*5,433,189*
total	*2,688,512*	*1,705,435*	*5,380,450*	*9,774,396*

Table 11 – Aggregate import/export figures for relevant Countries: base scenario (model simulation)

Looking in detail at the ports under analysis, a model simulation of the base scenario has been performed firstly, in order to calculate the total loaded and unloaded goods for the reference year for each port, and also the market share of the corresponding Egyptian trade. Results are reported in the following Table 12, showing that the largest flows to/from Egypt pass through Trieste and Venice.

tons/year	Unloaded	Loaded	Total	Egypt (total and share)	
Ravenna	12,855,993	3,165,939	**16,021,932**	828,136	*5.17%*
Trieste	26,921,819	3,826,832	**30,748,651**	1,972,586	*6.42%*
Venice	20,277,393	6,490,368	**26,767,760**	1,676,801	*6.26%*
Koper	12,284,022	3,398,810	**15,682,832**	1,032,399	*6.58%*

Table 12 – Total traffic for selected ports and Egypt market share: base scenario (model simulation)

An interesting model analysis of the current situation, useful for the perspective assessment reported in Section 4, refers to drawing the target basins of the selected ports with respect to flows from Egypt to EU27, reported respectively in Figure 18 (Ravenna), Figure 19 (Venice), Figure 20 (Trieste) and Figure 21 (Koper).

The target basin of the port of Ravenna is entirely encompassed in the Italian territory, and is substantially limited by the competition with Northern Tyrrhenian and Northern Adriatic ports. The main contribution in terms of tons/year is provided by the Emilia-Romagna region, however with a remarkable contribution from the area of Milan.

On the contrary, the other ports offer international target basins. Notably, Venice is the preferred port for trade in Northern Italy, with significant contributions from Lombardia and Veneto, with a small international appendix able only to cover marginally the western part of Austria. This is mainly due to the strong competition with the ports of Trieste and Koper, whose target basins are prevailingly international, with substantial areas of superposition. This means that Trieste and Koper are in obvious natural competition, as a consequence of their reciprocal geographic position, and model simulation suggests that Koper seems to be more effective in capturing freight flows from Austria and Germany, excluded Munich area.

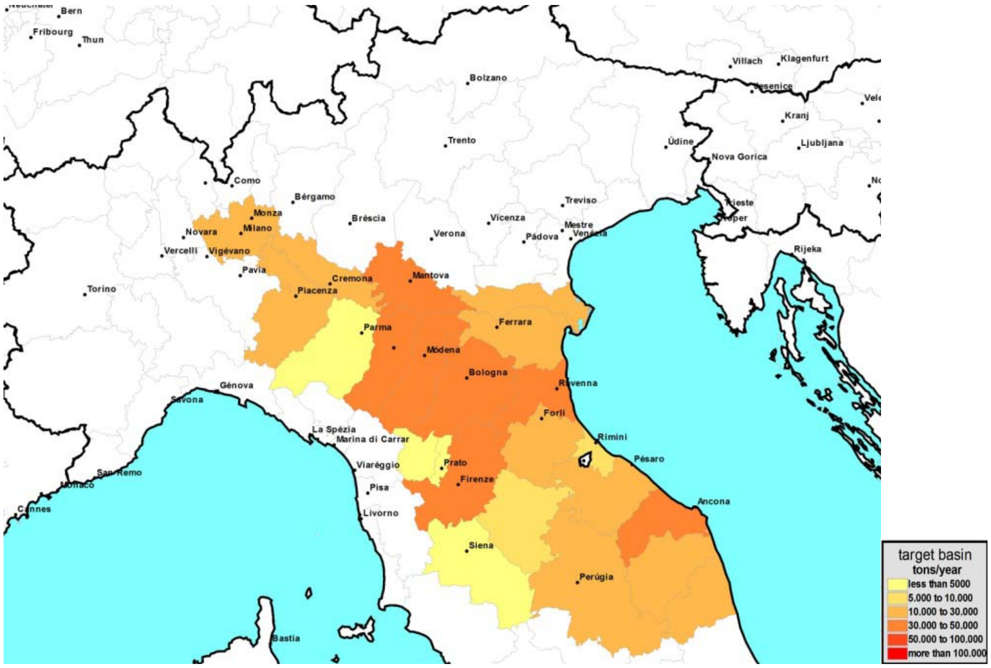

Figure 18 – Target basin of the port of Ravenna for import flows from Egypt

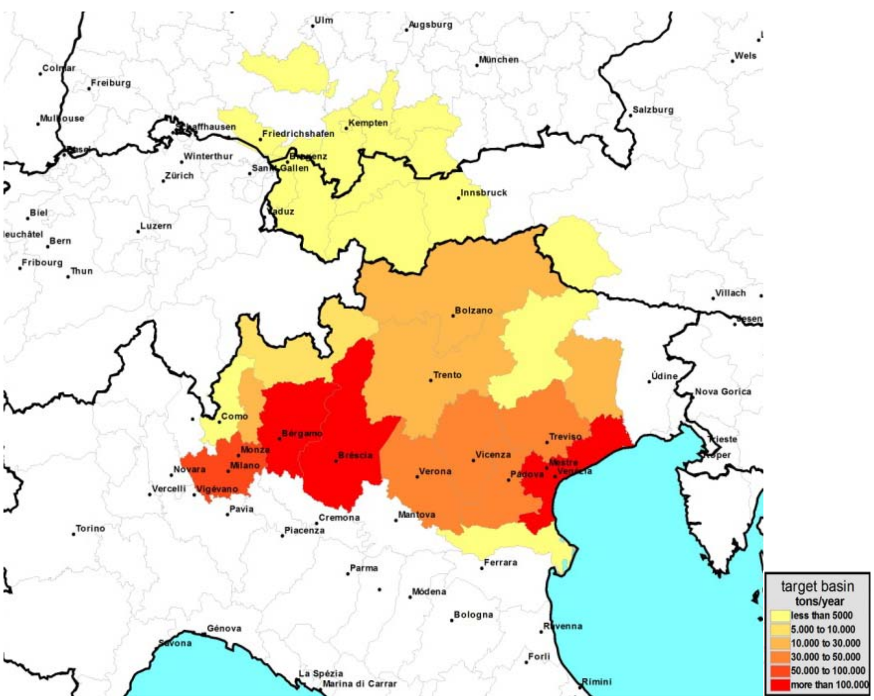

Figure 19 – Target basin of the port of Venice for import flows from Egypt

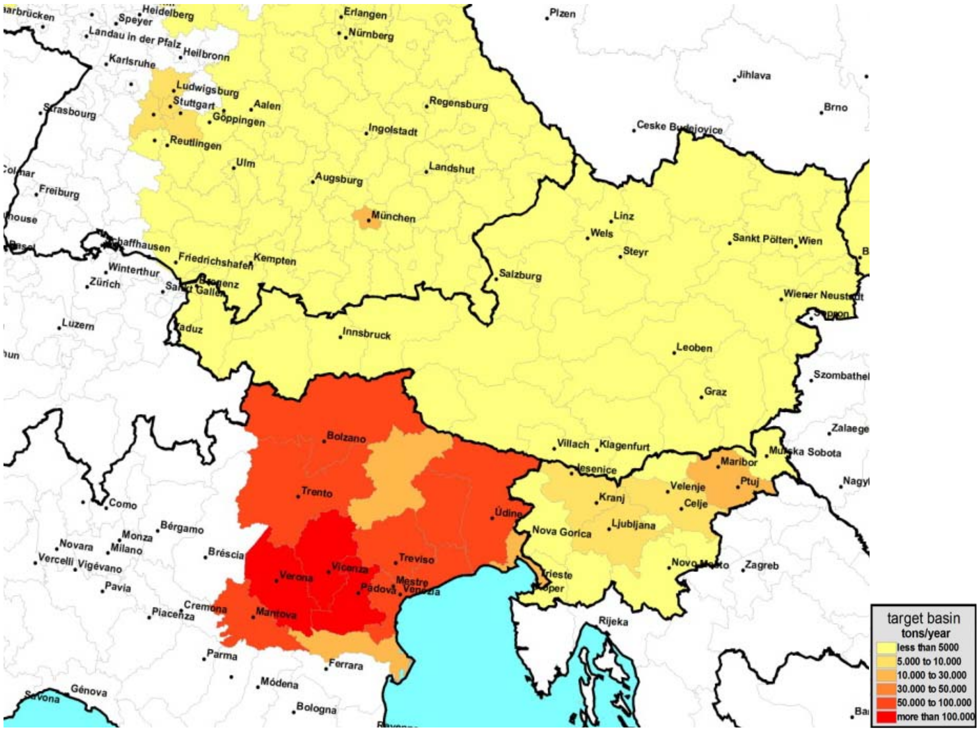

Figure 20 – Target basin of the port of Trieste for import flows from Egypt

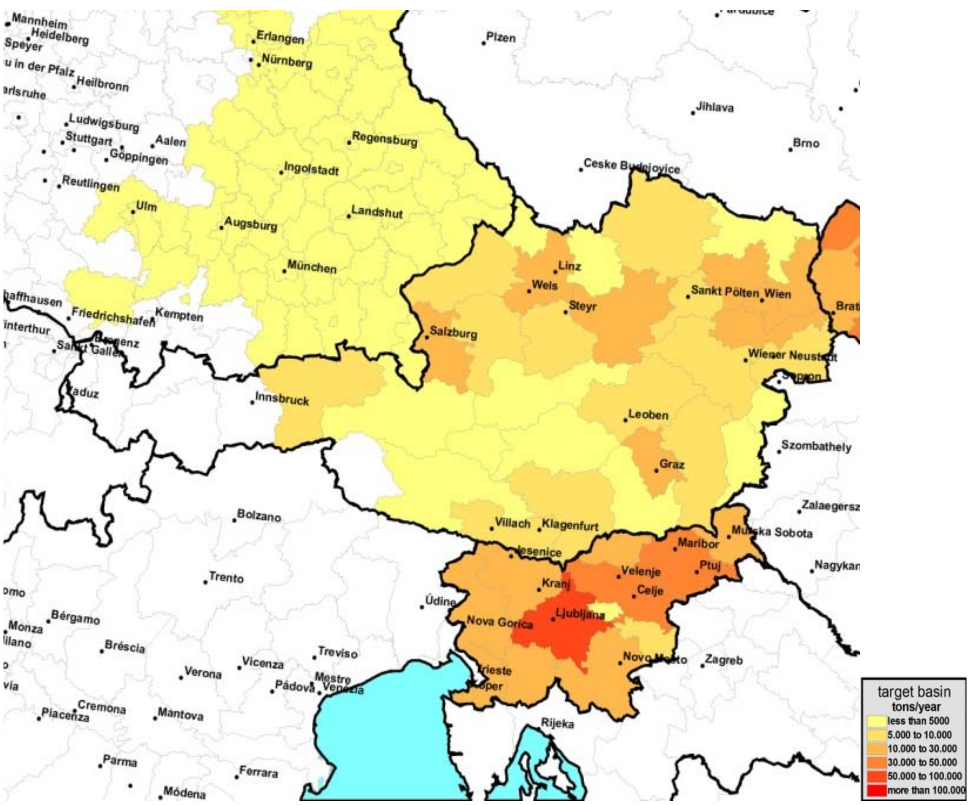

Figure 21 – Target basin of the port of Koper for import flows from Egypt

Finally, the mode choice model reported in Section 1.2.2 allows disaggregation of the flows between each port and each NUTS3 zone within its target basin by transport mode used for inland dispatching. Results are reported in the following Table 13, showing that the presence of railway mode is remarkable in absolute figures; furthermore, a traffic assignment of the sole inland dispatching matrices by transport model can be performed in order to depict the corresponding network flows. Assignment results are reported in Figure 22 for road mode and in Figure 23 for rail mode.

tons/year	from the port		to the port	
	rail	road	rail	road
Ravenna	1,246,784	11,609,181	210,648	2,954,945
Trieste	312,293	26,609,526	24,288	3,802,544
Venice	1,431,370	18,846,023	1,091,202	5,399,168
Koper	435,574	11,848,448	150,421	3,248,389

Table 13 – Pressure on inland transport networks: base scenario

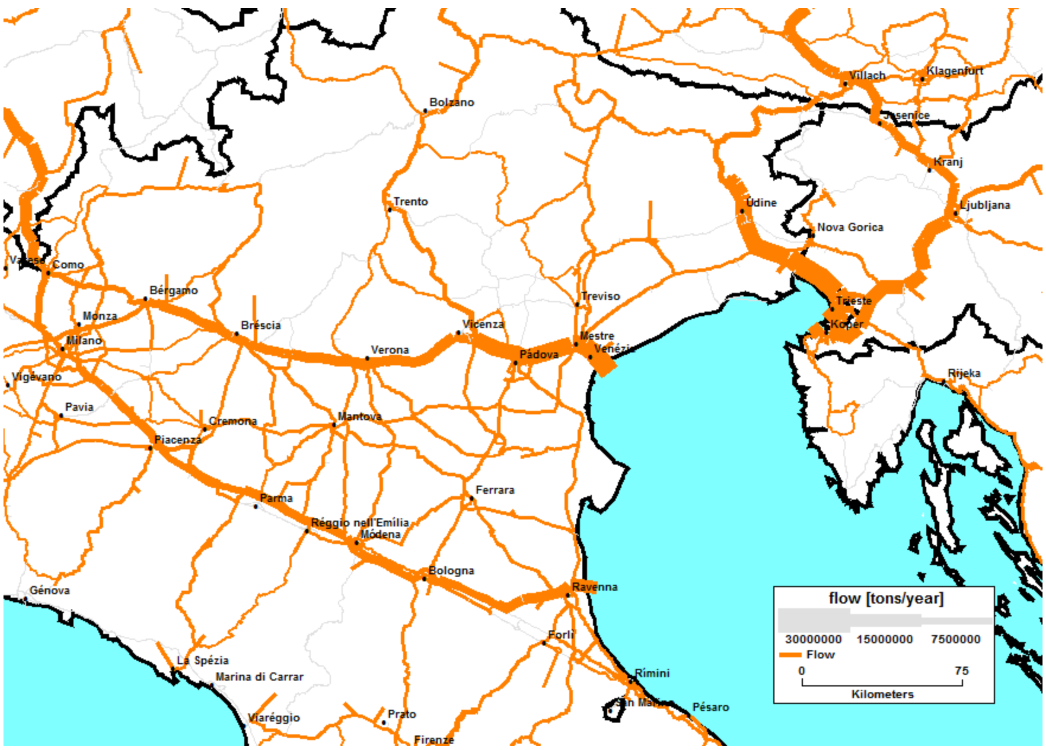

Figure 22 – Pressure on inland road transport network: base scenario

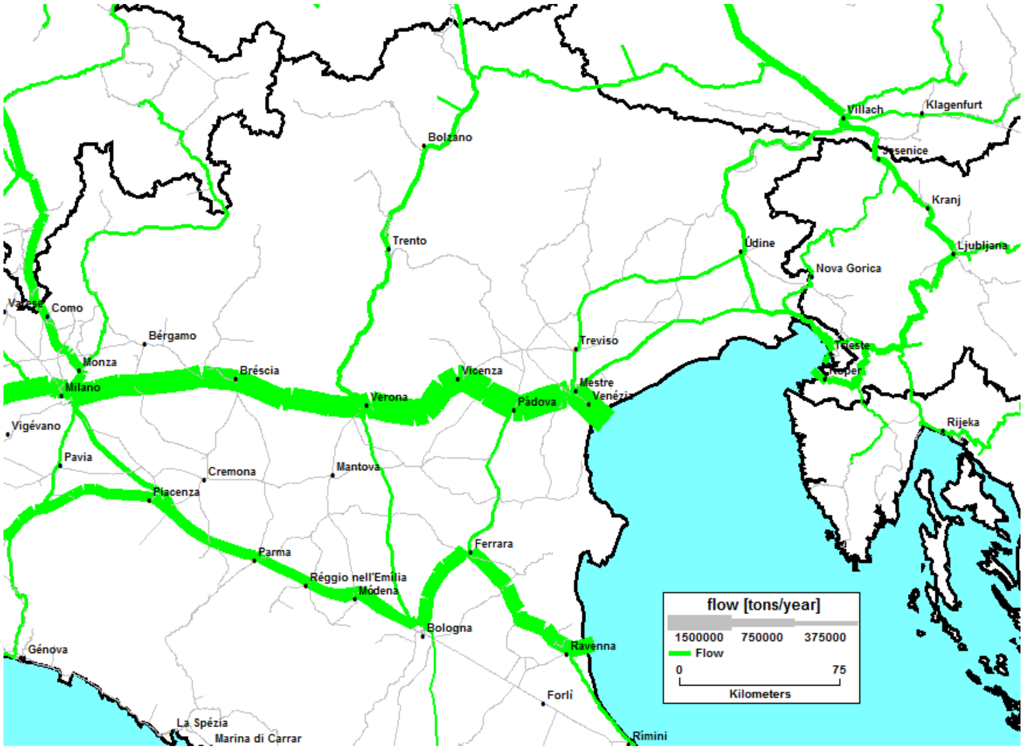

Figure 23 – Pressure on inland rail transport network: base scenario

4. Perspective services between selected ports and Egypt

Once defined the current situation from both supply and demand standpoint, the subsequent step deals with the perspective analysis of the market position of new maritime services between each one of the selected ports and an Egyptian port (Alexandria, Damietta or Port Said), in order to comply with the capacity needs identified in Section 2 and with the demand analyses presented in Section 3.

For this aim, the *maritime accessibility* of the routes under analysis should be firstly evaluated by measuring, for each pair of ports, some performance parameters usually taken into account by shipping companies in order to define the most convenient routes:

- robustness of the schedule with reference to different speeds of the vessel: this allows absorbing any delays due, for instance, to unfavorable weather conditions. In the calculations vessel speeds from 16 to 24 knots have been considered;
- number of vessels needed for supplying a given weekly frequency;
- possibility of triangulation towards a third port, trying to minimize the inactivity of the vessel. In more detail, the distance of the furthest port to be reached with 1 and 2 departures/week respectively has been calculated;

- possibility of designing a “regular” schedule, i.e. with departures at the same time across days within the week.

Above mentioned calculations for all possible combinations of routes between the selected ports are reported in the following Table 14, for three different vessel speed options (16, 20 and 24 knots). The clear result is that a 16 knots speed does not allow for a robust weekly schedule, whilst there are no remarkable differences between ports at 20 and 24 knots: therefore, the actual choice of the best route depends only on demand analyses and considerations.

In that respect, from the Egyptian side both Alexandria and Damietta provide for very similar results, therefore in the light of the target basins depicted in the previous section, the primary option seems the implementation of a maritime service between Trieste/Koper from one side and Alexandria/Damietta from the other. This option will be explicitly simulated in Section 5 in terms of demand captured and impacts on inland dispatching.

origin port	destination port	distance [nautical miles]	overall transit time [h]	vessel speed [knots]	# departures/week	inactivity time [h]	furthest port for triangulation with 1 service/week [natuical miles]	furthest port for triangulation with 2 services/week [natuical miles]	# vessels needed for 2 departures/week	allows constant departure time
Koper	Alexandria	1198	157.8	16	1	10.2	18	-	2	YES
Koper	Damietta	1273	167.1	16	1	0.9	-	-	2	YES
Koper	Port Said	1297	170.2	16	-	-	-	-	-	-
Ravenna	Alexandria	1165	153.7	16	1	14.3	51	-	2	YES
Ravenna	Damietta	1239	162.9	16	1	5.1	-	-	2	YES
Ravenna	Port Said	1264	166.0	16	1	2.0	-	-	2	YES
Trieste	Alexandria	1201	158.2	16	1	9.8	15	-	2	YES
Trieste	Damietta	1276	167.5	16	1	0.5	-	-	2	YES
Trieste	Port Said	1300	170.6	16	-	-	-	-	-	-
Venice	Alexandria	1201	158.2	16	1	9.8	15	-	2	YES
Venice	Damietta	1275	167.4	16	1	0.6	-	-	2	YES
Venice	Port Said	1300	170.5	16	-	-	-	-	-	-
Koper	Alexandria	1198	127.8	20	1	40.2	322	121	2	YES
Koper	Damietta	1273	135.3	20	1	32.7	247	84	2	YES
Koper	Port Said	1297	137.7	20	1	30.3	223	71	2	YES
Ravenna	Alexandria	1165	124.5	20	1	43.5	355	137	2	YES
Ravenna	Damietta	1239	131.9	20	1	36.1	281	100	2	YES
Ravenna	Port Said	1264	134.4	20	1	33.6	256	88	2	YES
Trieste	Alexandria	1201	128.1	20	1	39.9	319	119	2	YES
Trieste	Damietta	1276	135.6	20	1	32.4	244	82	2	YES
Trieste	Port Said	1300	138.0	20	1	30.0	220	70	2	YES
Venice	Alexandria	1201	128.1	20	1	39.9	319	119	2	YES
Venice	Damietta	1275	135.5	20	1	32.5	245	82	2	YES
Venice	Port Said	1300	138.0	20	1	30.0	220	70	2	YES
Koper	Alexandria	1198	107.9	24	1	60.1	626	265	2	YES
Koper	Damietta	1273	114.1	24	1	53.9	551	228	2	YES
Koper	Port Said	1297	116.1	24	1	51.9	527	215	2	YES
Ravenna	Alexandria	1165	105.1	24	1	62.9	659	281	2	YES
Ravenna	Damietta	1239	111.3	24	1	56.7	585	244	2	YES
Ravenna	Port Said	1264	113.4	24	1	54.6	560	232	2	YES
Trieste	Alexandria	1201	108.1	24	1	59.9	623	263	2	YES
Trieste	Damietta	1276	114.3	24	1	53.7	548	226	2	YES
Trieste	Port Said	1300	116.4	24	1	51.6	524	214	2	YES
Venice	Alexandria	1201	108.1	24	1	59.9	623	263	2	YES
Venice	Damietta	1275	114.3	24	1	53.7	549	226	2	YES
Venice	Port Said	1300	116.4	24	1	51.6	524	214	2	YES

Table 14 – Analysis of maritime accessibility

Furthermore, it is worth analyzing the perspective competition between the cluster of selected ports and the Northern range ports of Rotterdam and Antwerp: such analysis will help in understanding the geographical upper bound of the target basins of the ports of Trieste and Koper.

From a pure transport standpoint, there would be no competition in principle, since the average difference in the distance to/from Alexandria between the Northern range ports and the selected ports under analysis is approximately 2000 miles, meaning more than three days of travel difference at 24 knots.

However, shippers normally can comply with such travel time through proper arrangements of their supply chains, taking also into account that often travel time is not the main impedance component when customs and/or other controls should take place in ports. Furthermore, ocean carriers reach significant scale economies in the route from Egypt towards Northern range ports, making it very attractive from a business standpoint. As a result, the difference in costs between container fares for the routes Egypt-Adriatic and Egypt-Rotterdam are not as large as the corresponding times. In such context, therefore, the competition is played with respect to costs and times for inland distribution (leaving aside reliability and other relevant issues for port choice). For this aim, the following Figure 24 and Figure 25 compare respectively times and costs for the inland dispatch of a container from Northern range ports and the selected ports.

In more detail, Figure 24 shows that the area of convenience towards Adriatic ports (colors from yellow to red) reaches just the southern part of Germany, that is the target basins of Trieste and Koper identified in Section 3 appear already to be at their maximum coverage towards north. The situation is even more favorable for Rotterdam and Antwerp if the analysis is carried out in terms of costs (Figure 25), evidencing again that thinking of a target basin for Adriatic ports larger than the current is not a realistic assumption.

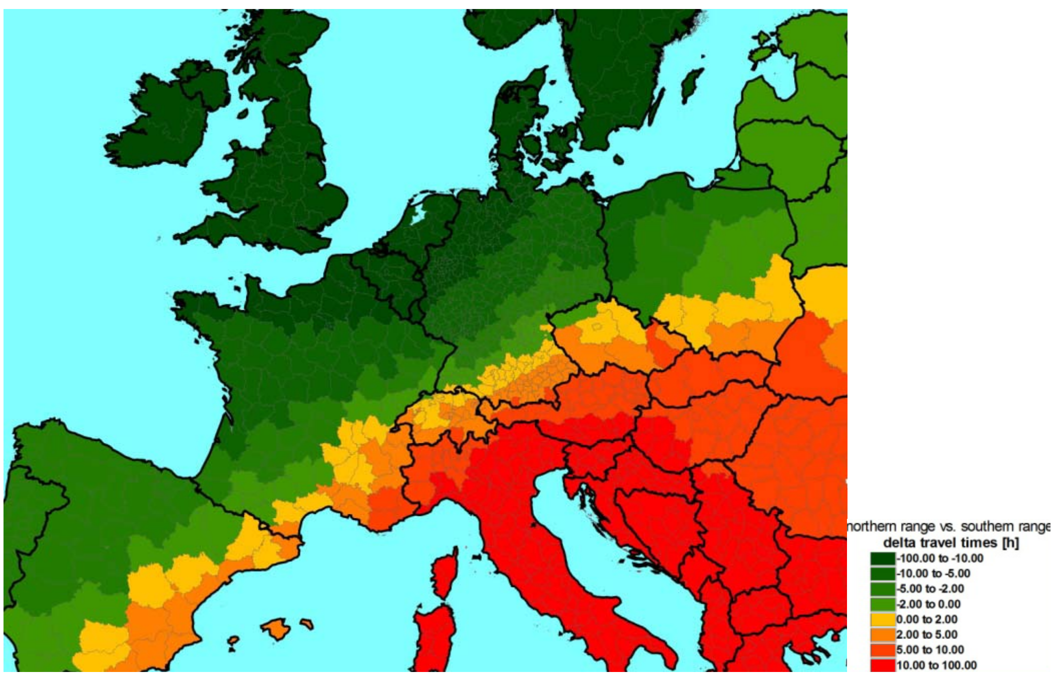

Figure 24 – Northern range vs. southern range: time comparison

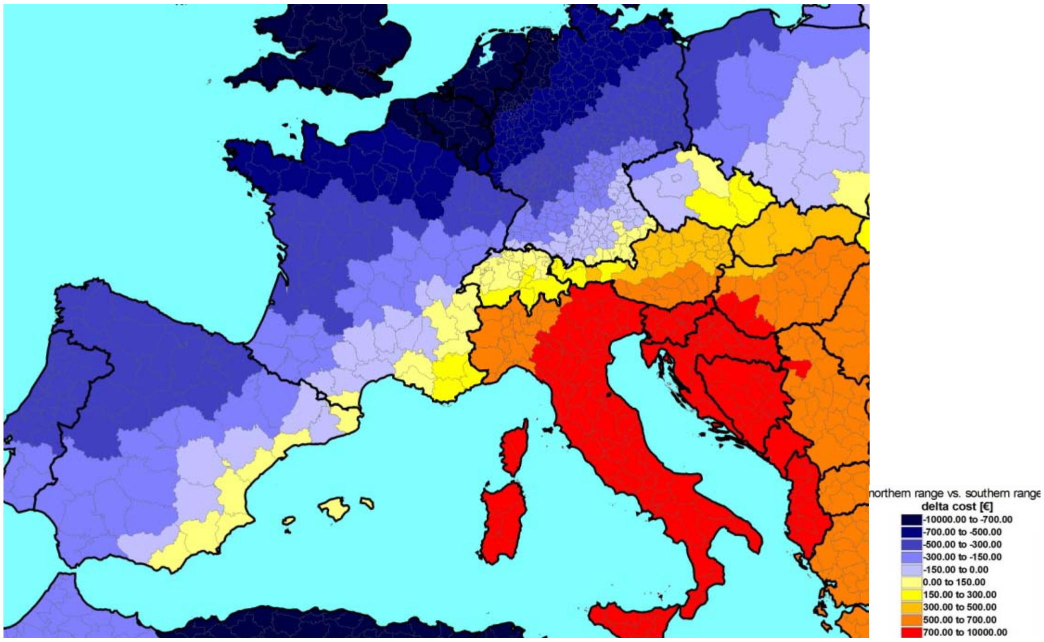

Figure 25 – Northern range vs. southern range: cost comparison

5. Demand forecasts

5.1 Definition of scenarios and assumptions

The final step of the work deals with the analysis of some future scenarios, based on:

- economic trends with respect to current figures;
- new trade agreements (i.e. parametric duties reduction, establishment of the Union for the Mediterranean, and so on);
- possible variation of transport costs due to new maritime services.

In more detail, from the economic standpoint the years 2020 and 2035 have been chosen as future reference for the country-specific projections of GDP, and consistently of the masses of the gravity model. Notably, for each reference year three different hypotheses on GDP projection have been introduced in order to explore different re-growth speeds after the economic downturn:

- *baseline*: this scenario mimics a crisis/recovery scenario up to 2014, based on projections made taking into account the downturn, then a normal growth (i.e. the same before the crisis) from 2015 on. In more detail, the crisis/recovery scenario projection is defined on the basis of the 2007-2009 data projected up to 2014, while the normal growth from 2014 is projected from the 2014 value on the basis of the 2000-2007 trend (i.e. before the crisis);
- *optimistic*: this scenario is based on a projection based on 2000-2009 data with no adjustments for downturn. This means taking into account the economic downturn, since 2007-2009 values

included in the projection provide for a reduction of the derivative of the projection, but in the less possible impacting way;

- *pessimistic*: half of the optimistic trends, so as to mimic a longer downturn[27].

With reference to trade agreements, the following different assumptions have been introduced:

- current scenario: characterized by the current agreements in force, in the way they are implemented at the beginning of 2010;
- year 2020: establishment of formal vertical integration between EU and Northern African countries with 50% reduction of tariffs w.r.t. current values;
- year 2035: establishment of a full common trade area with cancellation of tariffs and duties.

Finally, a transport option has been introduced by considering new maritime lines from Trieste/Koper to Alexandria/Damietta: such option is automatically introduced in the optimistic scenarios, and is simulated also in the context of a specific baseline scenario. In conclusion, the eight scenarios reported in Table 15 have been modeled, leading to the results presented separately for each scenario in the following sections.

<table>
<tr><th></th><th colspan="3">Assumptions</th></tr>
<tr><th>Name</th><th>GDP</th><th>agreement</th><th>new maritime services</th></tr>
<tr><td>**2020 baseline**</td><td>baseline</td><td rowspan="4">vertical integration, 50% duties reduction</td><td>no</td></tr>
<tr><td>**2020 baseline with maritime services**</td><td>baseline</td><td>yes</td></tr>
<tr><td>**2020 optimistic**</td><td>optimistic</td><td>yes</td></tr>
<tr><td>**2020 pessimistic**</td><td>pessimistic</td><td>no</td></tr>
<tr><td>**2035 baseline**</td><td>baseline</td><td rowspan="4">Union for the Mediterranean, 100% duties reduction</td><td>no</td></tr>
<tr><td>**2035 baseline with maritime services**</td><td>baseline</td><td>yes</td></tr>
<tr><td>**2035 optimistic**</td><td>optimistic</td><td>yes</td></tr>
<tr><td>**2035 pessimistic**</td><td>pessimistic</td><td>no</td></tr>
</table>

Table 15 – Summary of modeled scenarios

Results are compared with a current scenario defined, as pointed out in Section 3, by the 2008 freight matrices.

5.2 2020 scenarios

5.2.1 Baseline

Results for the 2020 baseline scenario are reported in the following tables: Table 16, which provides for aggregated demand data in absolute figures and in comparison with the current scenario (see Table 11); Table 17, which provides for detail related to the overall traffic of the ports under analysis, again in absolute terms and in variation with respect to the current scenario (see Table 12); Table 18, which

[27] On average, projections for 2020 lead to an increase of 15.35% for GDP in the pessimistic scenario, 18.53% for the baseline scenario and 30.35% for the optimistic scenario for the whole study area. GDP values have been determined on the basis of World Bank data.

relates to the pressure of port flows on inland infrastructures, in absolute figures and in comparison with the current scenario (see Table 13).

tons/year	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	41,582	99,239	175,966	*316,788*
Belgium	99,109	107,751	841,751	*1,048,612*
France	30,387	1,256,106	1,254,360	*2,540,854*
Germany	86,144	61,085	1,699,688	*1,846,917*
Italy	541,678	256,955	6,515,500	*7,314,133*
other Countries	839,295	374,037	8,173,043	*9,386,375*
total	*1,638,196*	*2,155,174*	*18,660,308*	*22,453,679*
export to Egypt				
Austria	12,880	156,094	70,486	*239,460*
Belgium	57,033	130,130	587,041	*774,203*
France	946,636	130,603	166,106	*1,243,345*
Germany	173,788	637,369	406,223	*1,217,380*
Italy	70,393	455,108	1,550,439	*2,075,940*
other Countries	1,988,874	691,481	3,841,971	*6,522,326*
total	*3,249,604*	*2,200,785*	*6,622,265*	*12,072,655*

% diff from base scenario	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	40.4%	43.0%	28.6%	*34.3%*
Belgium	40.1%	41.8%	27.1%	*29.6%*
France	41.6%	43.4%	32.3%	*37.7%*
Germany	39.3%	41.8%	23.8%	*25.0%*
Italy	38.8%	40.3%	26.7%	*27.9%*
other Countries	32.0%	43.2%	25.5%	*26.6%*
total	*35.4%*	*42.9%*	*26.3%*	*28.3%*
export to Egypt				
Austria	35.1%	32.2%	25.4%	*30.3%*
Belgium	34.5%	30.3%	23.9%	*25.7%*
France	36.5%	32.9%	25.9%	*34.6%*
Germany	33.7%	30.4%	23.9%	*28.6%*
Italy	32.8%	28.2%	22.8%	*24.3%*
other Countries	13.0%	26.8%	22.8%	*20.0%*
total	*20.9%*	*29.0%*	*23.1%*	*23.5%*

Table 16 – Aggregate import/export figures for relevant Countries: 2020 baseline (upper) and percentage difference with 2010 base scenario (lower)

Tons/year	Unloaded	Loaded	Total	Egypt (total and share)	
Ravenna	15,947,158	3,902,070	**19,849,228**	1,074,662	*5.41%*
Trieste	34,618,226	4,542,006	**39,160,232**	2,486,003	*6.35%*
Venice	25,109,896	7,871,385	**32,981,281**	2,177,508	*6.60%*
Koper	16,960,531	4,198,050	**21,158,581**	1,401,580	*6.62%*
delta from base	**Unloaded**	**Loaded**	**Total**	**Egypt (total and share)**	
Ravenna	3,091,165	736,132	3,827,297	246,526	*0.25%*
Trieste	7,696,406	715,174	8,411,580	513,417	*-0.07%*
Venice	4,832,503	1,381,017	6,213,520	500,706	*0.34%*
Koper	4,676,509	799,240	5,475,750	369,181	*0.04%*
% diff from base	**Unloaded**	**Loaded**	**Total**	**Egypt**	
Ravenna	24.04%	23.25%	**23.89%**	29.77%	
Trieste	28.59%	18.69%	**27.36%**	26.03%	
Venice	23.83%	21.28%	**23.21%**	29.86%	
Koper	38.07%	23.52%	**34.92%**	35.76%	

Table 17 – Total traffic for selected ports and Egypt market share: 2020 baseline and differences from the base

tons/year	from the port		to the port	
	rail	**road**	**rail**	**road**
Ravenna	1,560,176	14,386,952	265,710	3,635,954
Trieste	392,475	34,225,750	29,258	4,512,748
Venice	1,789,628	23,320,268	1,343,191	6,528,195
Koper	581,212	16,379,319	177,430	4,020,620
delta from base	**from the port**		**to the port**	
	rail	**road**	**rail**	**road**
Ravenna	313,392	2,777,770	55,062	681,008
Trieste	80,182	7,616,224	4,970	710,204
Venice	358,258	4,474,245	251,990	1,129,028
Koper	145,639	4,530,871	27,009	772,232
% diff from base	**from the port**		**to the port**	
	rail	**road**	**rail**	**road**
Ravenna	25.1%	23.9%	26.1%	23.0%
Trieste	25.7%	28.6%	20.5%	18.7%
Venice	25.0%	23.7%	23.1%	20.9%
Koper	33.4%	38.2%	18.0%	23.8%

Table 18 – Pressure on inland transport networks: 2020 baseline and differences from the base

The predicted increase in traffic to/from the selected ports equals approximately 23% for Ravenna and Venice, 27% for Trieste and 34% for Koper, meaning that its competitive advantage with respect to

Trieste is expected to grow in the future. Furthermore, rail traffic exhibits a slightly greater increase with respect to road; as a result, traffic flows on the infrastructures to/from ports become those reported in Figure 26 and Figure 27 respectively for road and rail.

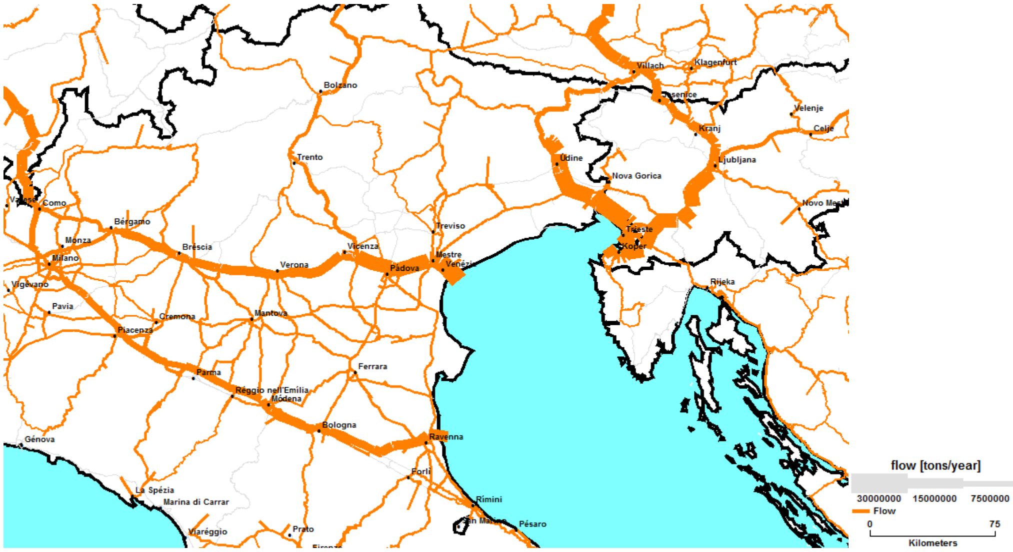

Figure 26 – Pressure on inland road transport network: 2020 baseline

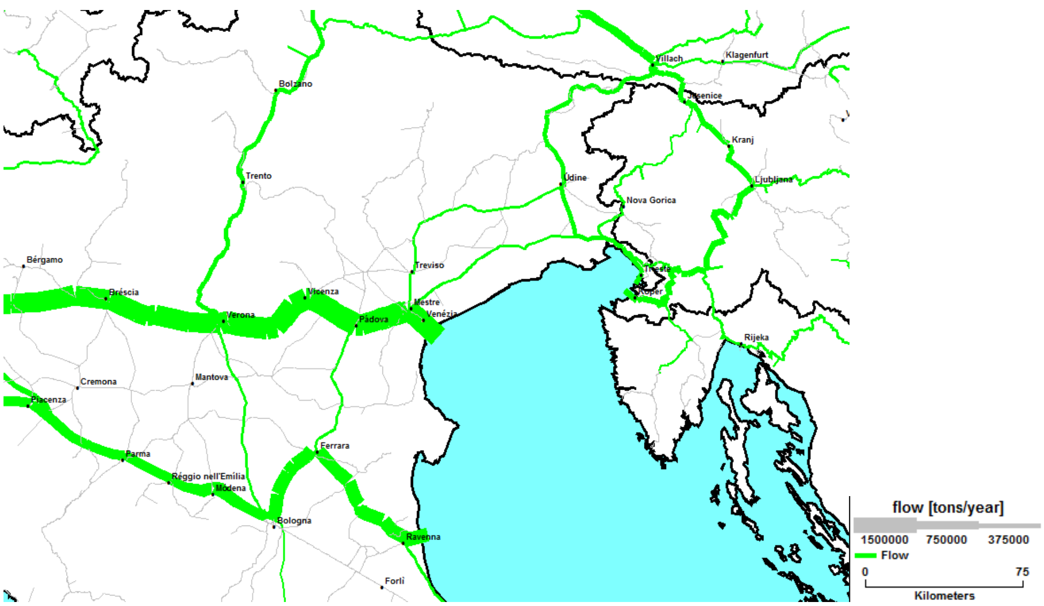

Figure 27 – Pressure on inland rail transport network: 2020 baseline

Furthermore, in order to underline the main variations in the flow patterns with respect to the current scenario, the following Figure 28 and Figure 29 report the variation in tons/year for road and rail respectively between the 2020 baseline scenario and the current scenario. Notably, the considered transport modes exhibit significantly different patterns in freight transport increase.

Figure 28 – Pressure on inland road transport network: difference between 2020 baseline and current scenario

Figure 29 – Pressure on inland rail transport network: difference between 2020 baseline and current scenario

5.2.2 Baseline with new maritime services

In accordance with Table 15, this scenario differs from that presented in Section 5.2.1 only for the presence of the new maritime services linking Trieste/Koper and Alexandria/Damietta.

tons/year	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	43,678	102,550	181,177	*327,405*
Belgium	99,109	107,751	841,751	*1,048,612*
France	30,387	1,256,106	1,254,360	*2,540,854*
Germany	88,315	62,104	1,715,402	*1,865,821*
Italy	575,803	267,670	6,760,476	*7,603,949*
other Countries	844,465	374,739	8,181,275	*9,400,480*
total	*1,681,758*	*2,170,921*	*18,934,442*	*22,787,121*
export to Egypt				
Austria	13,529	161,302	73,824	*248,655*
Belgium	57,033	130,130	587,041	*774,203*
France	946,636	130,603	166,106	*1,243,345*
Germany	178,167	648,000	415,718	*1,241,885*
Italy	74,828	474,086	1,608,214	*2,157,129*
other Countries	1,989,728	693,263	3,846,185	*6,529,176*
total	*3,259,922*	*2,237,384*	*6,697,087*	*12,194,392*

% diff from base scenario	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	47.5%	47.8%	32.5%	*38.8%*
Belgium	40.1%	41.8%	27.1%	*29.6%*
France	41.6%	43.4%	32.3%	*37.7%*
Germany	42.8%	44.2%	25.0%	*26.3%*
Italy	47.5%	46.2%	31.4%	*33.0%*
other Countries	32.8%	43.5%	25.6%	*26.8%*
total	*39.0%*	*43.9%*	*28.1%*	*30.2%*
export to Egypt				
Austria	42.0%	36.6%	31.3%	*35.3%*
Belgium	34.5%	30.3%	23.9%	*25.7%*
France	36.5%	32.9%	25.9%	*34.6%*
Germany	37.1%	32.6%	26.8%	*31.2%*
Italy	41.1%	33.5%	27.4%	*29.1%*
other Countries	13.1%	27.1%	23.0%	*20.2%*
total	*21.3%*	*31.2%*	*24.5%*	*24.8%*

Table 19 – Aggregate import/export figures for relevant Countries: 2020 baseline with maritime services (upper) and percentage difference with 2010 base scenario (lower)

As reported in Table 19, the overall demand between Egypt and the study area increases further, i.e. the difference from current scenario equals 30.2% for imports (against 28.3% of the 2020 baseline reported in Section 5.2.1) and 24.8% for exports (instead of 23.5%). The overall demand generated by the new service is therefore equal to about 344.000 tons captured by the new services, leading to a very satisfactory occupancy ratio. Obviously, the marginal impact of such generated demand on inland pressure is very low if compared with the absolute values, therefore its analysis is omitted.

5.2.3 Optimistic

Results of the optimistic 2020 scenario are reported in the following Table 20 to Table 22, with the same structure of the preceding sections. On average, the impact of the optimistic scenario leads to a further increase of the traffic of the selected ports with respect to the current scenario approximately equal to 15% more than the 2020 baseline.

Notably, the overall rail traffic to/from Koper would reach approximately 800.000 tons/year, meaning a great potential basin for the Sežana intermodal terminal.

tons/year	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	47,274	116,499	197,559	*361,332*
Belgium	112,086	125,785	938,809	*1,176,681*
France	34,200	1,458,783	1,409,421	*2,902,404*
Germany	95,995	70,192	1,848,013	*2,014,199*
Italy	594,450	290,468	7,079,072	*7,963,990*
other Countries	961,223	443,615	9,255,747	*10,660,585*
total	*1,845,228*	*2,505,342*	*20,728,621*	*25,079,191*
export to Egypt				
Austria	14,474	178,937	78,794	*272,204*
Belgium	63,643	147,797	650,949	*862,389*
France	1,049,530	147,073	182,819	*1,379,421*
Germany	190,126	705,235	440,629	*1,335,990*
Italy	75,446	490,113	1,655,548	*2,221,107*
other Countries	2,252,873	805,434	4,308,939	*7,367,246*
total	*3,646,092*	*2,474,588*	*7,317,679*	*13,438,358*

% diff from base scenario	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	59.6%	67.9%	44.4%	*53.2%*
Belgium	58.4%	65.5%	41.8%	*45.4%*
France	59.4%	66.6%	48.7%	*57.3%*
Germany	55.2%	62.9%	34.6%	*36.3%*
Italy	52.3%	58.6%	37.6%	*39.3%*
other Countries	51.2%	69.8%	42.1%	*43.8%*
total	*52.5%*	*66.1%*	*40.3%*	*43.3%*
export to Egypt				
Austria	51.9%	51.6%	40.2%	*48.1%*
Belgium	50.0%	48.0%	37.4%	*40.0%*
France	51.3%	49.6%	38.5%	*49.3%*
Germany	46.3%	44.3%	34.4%	*41.1%*
Italy	42.3%	38.0%	31.1%	*32.9%*
other Countries	28.0%	47.7%	37.8%	*35.6%*
total	*35.6%*	*45.1%*	*36.0%*	*37.5%*

Table 20 – Aggregate import/export figures for relevant Countries: 2020 optimistic (upper) and percentage difference with 2010 base scenario (lower)

Tons/year	Unloaded	Loaded	Total	Egypt (total and share)	
Ravenna	17,494,606	4,246,963	**21,741,569**	1,178,170	*5.42%*
Trieste	38,623,562	4,899,078	**43,522,641**	2,714,181	*6.24%*
Venice	27,933,056	8,651,379	**36,584,435**	2,396,557	*6.55%*
Koper	18,833,129	4,678,596	**23,511,725**	1,599,452	*6.80%*

delta from base	Unloaded	Loaded	Total	Egypt (total and share)	
Ravenna	4,638,612	1,081,024	5,719,637	350,033	*0.25%*
Trieste	11,701,743	1,072,247	12,773,989	741,594	*-0.18%*
Venice	7,655,663	2,161,011	9,816,674	719,756	*0.29%*
Koper	6,549,108	1,279,786	7,828,894	567,053	*0.22%*

% diff from base	Unloaded	Loaded	Total	Egypt
Ravenna	36.08%	34.15%	**35.70%**	42.27%
Trieste	43.47%	28.02%	**41.54%**	37.60%
Venice	37.75%	33.30%	**36.67%**	42.92%
Koper	53.31%	37.65%	**49.92%**	54.93%

Table 21 – Pressure on inland transport networks: 2020 optimistic and differences from the base

tons/year	from the port		to the port	
	rail	road	rail	road
Ravenna	1,721,666	15,772,905	298,105	3,948,390
Trieste	444,779	38,178,783	32,143	4,866,935
Venice	2,025,103	25,907,952	1,492,616	7,158,765
Koper	639,265	18,193,864	197,730	4,480,866

delta from base	from the port		to the port	
	rail	road	rail	road
Ravenna	474,882	4,163,724	87,457	993,445
Trieste	132,486	11,569,257	7,855	1,064,391
Venice	593,733	7,061,930	401,414	1,759,598
Koper	203,692	6,345,416	47,309	1,232,477

% diff from base	from the port		to the port	
	rail	road	rail	road
Ravenna	38.1%	35.9%	41.5%	33.6%
Trieste	42.4%	43.5%	32.3%	28.0%
Venice	41.5%	37.5%	36.8%	32.6%
Koper	46.8%	53.6%	31.5%	37.9%

Table 22 – Total traffic for selected ports and Egypt market share: 2020 optimistic and differences from the base

5.2.4 Pessimistic

Results of the pessimistic 2020 scenario are reported in the following Table 23 to Table 25, with the same structure of the preceding sections. On average, the impact of the pessimistic assumption on

GDP trend leads to approximately a 6% lost of trade for the selected ports with respect to the 2020 baseline (Section 5.2.1).

tons/year	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	39,208	92,033	166,973	*298,213*
Belgium	93,542	100,033	800,269	*993,845*
France	28,461	1,156,608	1,176,251	*2,361,320*
Germany	80,660	56,229	1,612,671	*1,749,560*
Italy	505,501	235,682	6,120,717	*6,861,900*
other Countries	793,959	345,663	7,864,162	*9,003,784*
total	*1,541,331*	*1,986,247*	*17,741,042*	*21,268,621*
export to Egypt				
Austria	12,264	147,700	67,424	*227,388*
Belgium	54,378	123,348	562,318	*740,044*
France	893,334	122,129	157,374	*1,172,837*
Germany	163,937	595,697	384,522	*1,144,156*
Italy	66,106	422,846	1,463,186	*1,952,139*
other Countries	1,884,086	654,515	3,636,672	*6,175,273*
total	*3,074,106*	*2,066,235*	*6,271,496*	*11,411,837*

% diff from base scenario	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	32.4%	32.6%	22.1%	*26.5%*
Belgium	32.2%	31.6%	20.8%	*22.8%*
France	32.7%	32.1%	24.1%	*28.0%*
Germany	30.4%	30.5%	17.5%	*18.4%*
Italy	29.5%	28.7%	19.0%	*20.0%*
other Countries	24.9%	32.3%	20.7%	*21.5%*
total	*27.4%*	*31.7%*	*20.1%*	*21.6%*
export to Egypt				
Austria	28.7%	25.1%	20.0%	*23.7%*
Belgium	28.2%	23.5%	18.7%	*20.1%*
France	28.8%	24.2%	19.3%	*26.9%*
Germany	26.1%	21.9%	17.3%	*20.9%*
Italy	24.7%	19.1%	15.9%	*16.8%*
other Countries	7.1%	20.0%	16.3%	*13.7%*
total	*14.3%*	*21.2%*	*16.6%*	*16.8%*

Table 23 – Aggregate import/export figures for relevant Countries: 2020 pessimistic (upper) and percentage difference with 2010 base scenario (lower)

Tons/year	Unloaded	Loaded	Total	Egypt (total and share)	
Ravenna	15,176,905	3,717,183	**18,894,089**	1,007,629	*5.33%*
Trieste	32,847,670	4,379,208	**37,226,878**	2,348,873	*6.31%*
Venice	24,210,805	7,597,117	**31,807,923**	2,047,193	*6.44%*
Koper	16,083,904	4,044,501	**20,128,405**	1,316,498	*6.54%*
delta from base	**Unloaded**	**Loaded**	**Total**	**Egypt (total and share)**	
Ravenna	2,320,912	551,245	2,872,157	179,493	*0.16%*
Trieste	5,925,851	552,376	6,478,227	376,287	*-0.11%*
Venice	3,933,412	1,106,750	5,040,162	370,392	*0.17%*
Koper	3,799,882	645,691	4,445,573	284,099	*-0.04%*
% diff from base	**Unloaded**	**Loaded**	**Total**	**Egypt**	
Ravenna	18.05%	17.41%	**17.93%**	21.67%	
Trieste	22.01%	14.43%	**21.07%**	19.08%	
Venice	19.40%	17.05%	**18.83%**	22.09%	
Koper	30.93%	19.00%	**28.35%**	27.52%	

Table 24 – Total traffic for selected ports and Egypt market share: 2020 pessimistic and differences from the base

tons/year	from the port		to the port	
	rail	road	rail	road
Ravenna	1,482,831	13,694,046	254,369	3,462,409
Trieste	378,381	32,469,289	28,249	4,350,959
Venice	1,728,876	22,481,929	1,295,017	6,302,102
Koper	545,831	15,538,073	174,122	3,870,379
delta from base	**from the port**		**to the port**	
	rail	**road**	**rail**	**road**
Ravenna	236,047	2,084,864	43,720	507,464
Trieste	66,088	5,859,763	3,961	548,415
Venice	297,506	3,635,906	203,816	902,934
Koper	110,257	3,689,626	23,700	621,990
% diff from base	**from the port**		**to the port**	
	rail	**road**	**rail**	**road**
Ravenna	18.9%	18.0%	20.8%	17.2%
Trieste	21.2%	22.0%	16.3%	14.4%
Venice	20.8%	19.3%	18.7%	16.7%
Koper	25.3%	31.1%	15.8%	19.1%

Table 25 – Pressure on inland transport networks: 2020 pessimistic and differences from the base

5.3 2035 scenarios

5.3.1 Baseline

Results of the 2035 baseline are firstly reported in the following Table 26 to Table 28.

tons/year	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	70,962	167,123	256,285	*494,370*
Belgium	172,014	178,502	1,201,690	*1,552,206*
France	52,599	2,074,928	1,858,037	*3,985,564*
Germany	140,183	97,774	2,265,463	*2,503,421*
Italy	874,691	394,076	8,757,310	*10,026,076*
other Countries	1,497,766	648,212	11,935,610	*14,081,588*
total	*2,808,216*	*3,560,616*	*26,274,394*	*32,643,226*
export to Egypt				
Austria	21,082	241,324	100,556	*362,962*
Belgium	94,447	195,788	818,124	*1,108,359*
France	1,562,001	195,571	230,108	*1,987,680*
Germany	266,890	905,920	539,481	*1,712,290*
Italy	105,818	602,688	1,973,975	*2,682,481*
other Countries	3,412,896	1,119,181	5,597,207	*10,129,284*
total	*5,463,133*	*3,260,471*	*9,259,451*	*17,983,055*

% diff from base scenario	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	139.6%	140.8%	87.4%	*109.7%*
Belgium	143.1%	134.8%	81.5%	*91.9%*
France	145.2%	136.9%	96.0%	*116.0%*
Germany	126.7%	127.0%	65.1%	*69.4%*
Italy	124.1%	115.2%	70.3%	*75.4%*
other Countries	135.5%	148.2%	83.2%	*90.0%*
total	*132.1%*	*136.0%*	*77.8%*	*86.6%*
export to Egypt				
Austria	121.2%	104.4%	78.9%	*97.5%*
Belgium	122.7%	96.1%	72.7%	*79.9%*
France	125.2%	99.0%	74.4%	*115.1%*
Germany	105.3%	85.3%	64.6%	*80.9%*
Italy	99.6%	69.7%	56.3%	*60.6%*
other Countries	93.9%	105.2%	78.9%	*86.4%*
total	*103.2%*	*91.2%*	*72.1%*	*84.0%*

Table 26 – Aggregate import/export figures for relevant Countries: 2035 baseline (upper) and percentage difference with 2010 base scenario (lower)

Tons/year	Unloaded	Loaded	Total	Egypt (total and share)	
Ravenna	21,740,865	5,258,809	**26,999,674**	1,526,713	*5.65%*
Trieste	49,239,756	5,894,979	**55,134,735**	3,398,122	*6.16%*
Venice	35,093,330	10,819,496	**45,912,826**	3,116,791	*6.79%*
Koper	23,913,147	6,032,321	**29,945,467**	2,222,207	*7.42%*
delta from base	**Unloaded**	**Loaded**	**Total**	**Egypt (total and share)**	
Ravenna	8,884,871	2,092,870	10,977,742	698,576	*0.49%*
Trieste	22,317,937	2,068,147	24,386,083	1,425,536	*-0.25%*
Venice	14,815,937	4,329,129	19,145,065	1,439,990	*0.52%*
Koper	11,629,125	2,633,510	14,262,636	1,189,808	*0.84%*
% diff from base	**Unloaded**	**Loaded**	**Total**	**Egypt**	
Ravenna	69.11%	66.11%	**68.52%**	84.36%	
Trieste	82.90%	54.04%	**79.31%**	72.27%	
Venice	73.07%	66.70%	**71.52%**	85.88%	
Koper	94.67%	77.48%	**90.94%**	115.25%	

Table 27 – Total traffic for selected ports and Egypt market share: 2035 baseline and differences from the base

tons/year	from the port		to the port	
	rail	road	rail	road
Ravenna	2,160,034	19,580,783	383,647	4,874,572
Trieste	574,530	48,665,227	40,045	5,854,934
Venice	2,658,442	32,434,888	1,900,075	8,919,424
Koper	803,508	23,109,639	246,594	5,785,727
delta from base	**from the port**		**to the port**	
	rail	**road**	**rail**	**road**
Ravenna	913,250	7,971,602	172,999	1,919,626
Trieste	262,236	22,055,700	15,757	2,052,390
Venice	1,227,072	13,588,865	808,874	3,520,256
Koper	367,934	11,261,191	96,173	2,537,338
% diff from base	**from the port**		**to the port**	
	rail	**road**	**rail**	**road**
Ravenna	73.2%	68.7%	82.1%	65.0%
Trieste	84.0%	82.9%	64.9%	54.0%
Venice	85.7%	72.1%	74.1%	65.2%
Koper	84.5%	95.0%	63.9%	78.1%

Table 28 – Pressure on inland transport networks: 2035 baseline and differences from the base

Then, in order to allow for a direct comparison with the base scenario and the 2020 baseline, the pressure on inland transport networks is presented also in terms of link flows, respectively in Figure 30 and Figure 31.

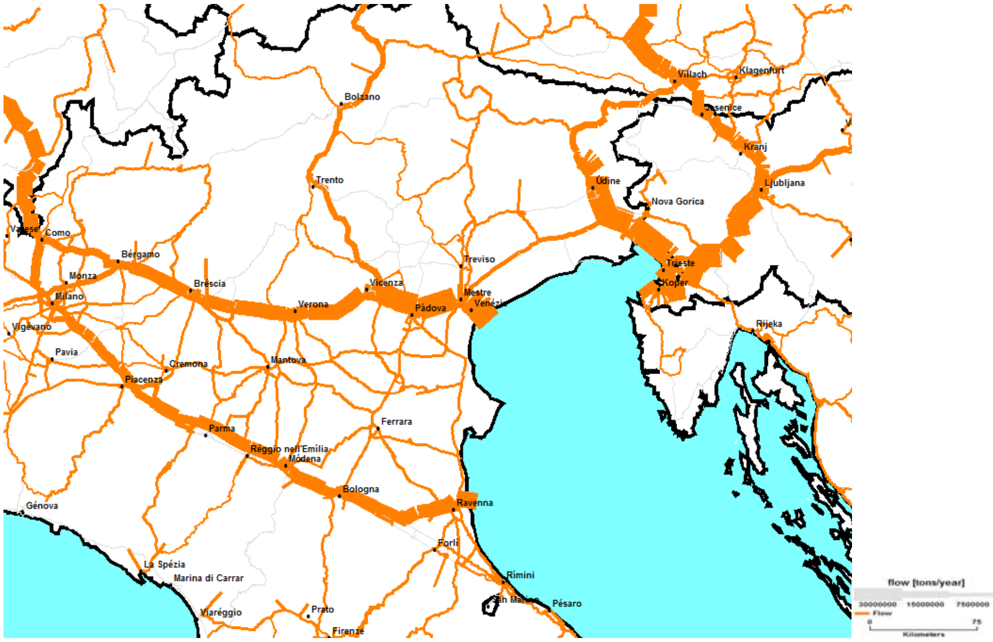

Figure 30 – Pressure on inland road transport network: 2035 baseline

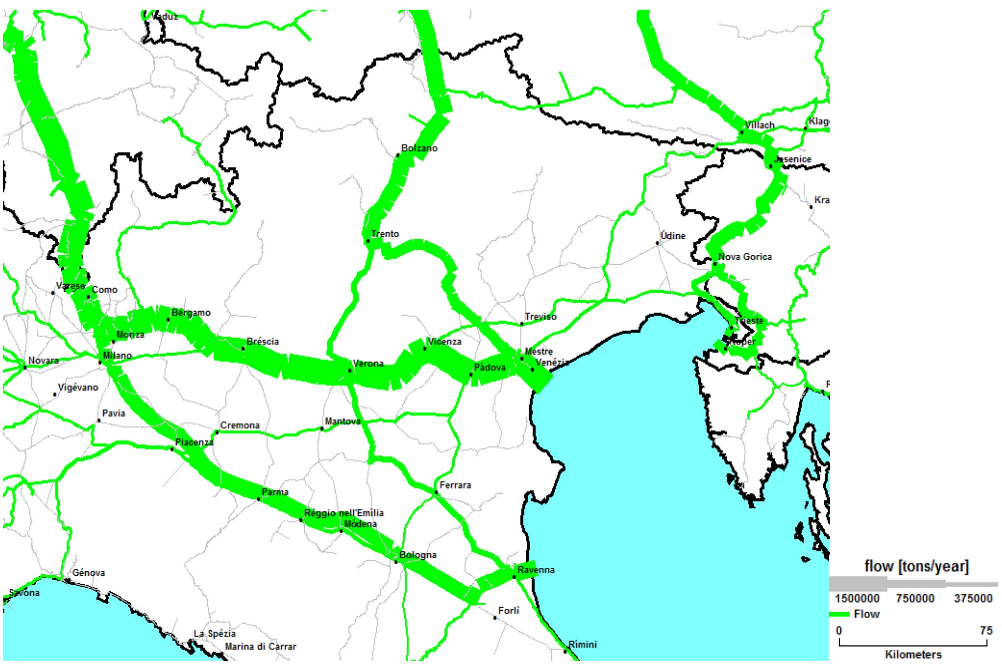

Figure 31 – Pressure on inland rail transport network: 2035 baseline

Similarly to Figure 28 and Figure 29, the following Figure 32 and Figure 33 report the variation in tons/year between the 2035 baseline scenario and the current scenario respectively for road and rail modes, in order to point out which o-d patterns are mostly affected by the demand increase in the Northern Adriatic ports.

Figure 32 – Pressure on inland road transport network: difference between 2035 baseline and current scenario

Figure 33 – Pressure on inland rail transport network: difference between 2035 baseline and current scenario

5.3.2 Baseline with new maritime services

With the same argumentations reported in Section 5.3.2, new maritime services along the path Trieste/Koper – Alexandria/Damietta have been added to the 2035 baseline scenario, leading to the aggregate results reported in Table 29.

tons/year	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	74,538	172,699	264,122	*511,359*
Belgium	172,014	178,502	1,201,690	*1,552,206*
France	52,599	2,074,928	1,858,037	*3,985,564*
Germany	143,716	99,405	2,286,959	*2,530,080*
Italy	929,796	410,509	9,098,834	*10,439,139*
other Countries	1,507,290	649,463	11,948,947	*14,105,699*
total	*2,879,953*	*3,585,506*	*26,658,589*	*33,124,048*
export to Egypt				
Austria	22,145	249,374	105,318	*376,837*
Belgium	94,447	195,788	818,124	*1,108,359*
France	1,562,001	195,571	230,108	*1,987,680*
Germany	273,615	921,030	552,088	*1,746,734*
Italy	112,484	627,820	2,046,846	*2,787,150*
other Countries	3,414,453	1,122,326	5,603,721	*10,140,500*
total	*5,479,145*	*3,311,910*	*9,356,204*	*18,147,259*

% diff from base scenario	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	151.7%	148.9%	93.1%	*116.9%*
Belgium	143.1%	134.8%	81.5%	*91.9%*
France	145.2%	136.9%	96.0%	*116.0%*
Germany	132.4%	130.7%	66.6%	*71.2%*
Italy	138.2%	124.2%	76.9%	*82.6%*
other Countries	137.0%	148.6%	83.4%	*90.3%*
total	*138.0%*	*137.7%*	*80.4%*	*89.3%*
export to Egypt				
Austria	132.3%	111.2%	87.4%	*105.0%*
Belgium	122.7%	96.1%	72.7%	*79.9%*
France	125.2%	99.0%	74.4%	*115.1%*
Germany	110.5%	88.4%	68.4%	*84.5%*
Italy	112.2%	76.8%	62.1%	*66.8%*
other Countries	94.0%	105.8%	79.1%	*86.6%*
total	*103.8%*	*94.2%*	*73.9%*	*85.7%*

Table 29 – Aggregate import/export figures for relevant Countries: 2035 baseline with maritime services (upper) and percentage difference with 2010 base scenario (lower)

In this case the demand generated by the new services equals about 501.000 tons/year, again with no need for analysis of the marginal impact on pressure on inland networks.

5.3.3 Optimistic

The following Table 31 to Table 33 summarize the outcomes of the 2035 optimistic scenario modelling, to be compared with results in Section 5.2.3 (2020 optimistic) and in Section 3 (current scenario).

tons/year	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	80,145	194,606	286,298	*561,049*
Belgium	193,445	206,909	1,334,924	*1,735,278*
France	59,206	2,407,483	2,088,416	*4,555,105*
Germany	156,455	112,417	2,471,268	*2,740,139*
Italy	965,185	447,620	9,578,375	*10,991,180*
other Countries	1,694,648	759,867	13,300,355	*15,754,869*
total	*3,149,084*	*4,128,901*	*29,059,635*	*36,337,620*
export to Egypt				
Austria	23,542	274,561	111,713	*409,816*
Belgium	104,865	221,075	902,901	*1,228,841*
France	1,736,432	221,188	254,018	*2,211,638*
Germany	293,323	1,009,259	588,694	*1,891,276*
Italy	114,539	658,073	2,126,034	*2,898,646*
other Countries	3,827,976	1,283,496	6,249,546	*11,361,018*
total	*6,100,677*	*3,667,652*	*10,232,906*	*20,001,235*

% diff from base scenario	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	170.6%	180.4%	109.3%	*137.9%*
Belgium	173.4%	172.2%	101.6%	*114.5%*
France	176.0%	174.9%	120.3%	*146.9%*
Germany	153.0%	161.0%	80.1%	*85.5%*
Italy	147.3%	144.5%	86.2%	*92.3%*
other Countries	166.5%	190.9%	104.2%	*112.6%*
total	*160.3%*	*173.7%*	*96.7%*	*107.7%*
export to Egypt				
Austria	147.0%	132.6%	98.8%	*123.0%*
Belgium	147.2%	121.4%	90.6%	*99.5%*
France	150.3%	125.0%	92.5%	*139.4%*
Germany	125.7%	106.5%	79.6%	*99.8%*
Italy	116.0%	85.3%	68.4%	*73.5%*
other Countries	117.5%	135.4%	99.8%	*109.1%*
total	*126.9%*	*115.1%*	*90.2%*	*104.6%*

Table 30 – Aggregate import/export figures for relevant Countries: 2035 optimistic (upper) and percentage difference with 2010 base scenario (lower)

Tons/year	**Unloaded**	**Loaded**	**Total**	**Egypt (total and share)**	
Ravenna	23,853,421	5,729,547	**29,582,968**	1,682,943	*5.69%*
Trieste	54,548,855	6,334,360	**60,883,215**	3,726,261	*6.12%*
Venice	38,614,010	11,812,837	**50,426,848**	3,446,249	*6.83%*
Koper	26,456,278	6,667,525	**33,123,803**	2,524,472	*7.62%*
delta from base	**Unloaded**	**Loaded**	**Total**	**Egypt (total and share)**	
Ravenna	10,997,428	2,563,609	13,561,036	854,807	*0.52%*
Trieste	27,627,035	2,507,528	30,134,563	1,753,675	*-0.29%*
Venice	18,336,618	5,322,470	23,659,087	1,769,448	*0.57%*
Koper	14,172,257	3,268,715	17,440,972	1,492,073	*1.04%*
% diff from base	**Unloaded**	**Loaded**	**Total**	**Egypt**	
Ravenna	85.54%	80.97%	**84.64%**	103.22%	
Trieste	102.62%	65.52%	**98.00%**	88.90%	
Venice	90.43%	82.01%	**88.39%**	105.53%	
Koper	115.37%	96.17%	**111.21%**	144.52%	

Table 31 – Total traffic for selected ports and Egypt market share: 2035 optimistic and differences from the base

tons/year	**from the port**		**to the port**	
	rail	**road**	**rail**	**road**
Ravenna	2,381,939	21,471,428	426,127	5,302,767
Trieste	640,274	53,908,581	43,682	6,290,678
Venice	2,962,936	35,651,074	2,092,681	9,720,159
Koper	885,624	25,570,654	270,140	6,397,385
delta from base	**from the port**		**to the port**	
	rail	**road**	**rail**	**road**
Ravenna	1,135,155	9,862,247	215,479	2,347,821
Trieste	327,980	27,299,055	19,394	2,488,134
Venice	1,531,566	16,805,051	1,001,479	4,320,991
Koper	450,050	13,722,207	119,719	3,148,996
% diff from base	**from the port**		**to the port**	
	rail	**road**	**rail**	**road**
Ravenna	91.0%	85.0%	102.3%	79.5%
Trieste	105.0%	102.6%	79.9%	65.4%
Venice	107.0%	89.2%	91.8%	80.0%
Koper	103.3%	115.8%	79.6%	96.9%

Table 32 – Pressure on inland transport networks: 2035 optimistic and differences from the base

5.3.4 Pessimistic

Finally, Table 33 to Table 35 provide for the results of the 2035 pessimistic scenario.

tons/year	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	57,009	127,010	210,161	*394,180*
Belgium	139,228	136,746	995,279	*1,271,253*
France	42,447	1,584,476	1,503,933	*3,130,856*
Germany	114,560	75,676	1,930,953	*2,121,189*
Italy	726,765	310,465	7,403,833	*8,441,063*
other Countries	1,198,045	485,497	9,841,363	*11,524,905*
total	*2,278,055*	*2,719,871*	*21,885,521*	*26,883,447*
export to Egypt				
Austria	17,308	191,746	83,378	*292,432*
Belgium	78,322	157,635	686,226	*922,183*
France	1,290,131	156,630	192,502	*1,639,262*
Germany	224,196	741,896	459,014	*1,425,106*
Italy	90,889	508,258	1,712,560	*2,311,708*
other Countries	2,764,284	873,887	4,575,777	*8,213,948*
total	*4,465,130*	*2,630,052*	*7,709,458*	*14,804,640*

% diff from base scenario	agriculture and foodstuff	manufactured goods	other commodities	*total*
import from Egypt				
Austria	92.5%	83.0%	53.6%	*67.2%*
Belgium	96.8%	79.9%	50.3%	*57.1%*
France	97.8%	80.9%	58.7%	*69.7%*
Germany	85.2%	75.7%	40.7%	*43.6%*
Italy	86.2%	69.6%	44.0%	*47.7%*
other Countries	88.4%	85.9%	51.1%	*55.5%*
total	*88.3%*	*80.3%*	*48.1%*	*53.7%*
export to Egypt				
Austria	81.6%	62.4%	48.3%	*59.1%*
Belgium	84.7%	57.9%	44.8%	*49.7%*
France	86.0%	59.3%	45.9%	*77.4%*
Germany	72.5%	51.8%	40.0%	*50.5%*
Italy	71.4%	43.1%	35.6%	*38.4%*
other Countries	57.1%	60.3%	46.3%	*51.2%*
total	*66.1%*	*54.2%*	*43.3%*	*51.5%*

Table 33 – Aggregate import/export figures for relevant Countries: 2035 pessimistic (upper) and percentage difference with 2010 base scenario (lower)

Tons/year	Unloaded	Loaded	Total	Egypt (total and share)	
Ravenna	18,357,847	4,487,415	**22,845,262**	1,272,635	*5.57%*
Trieste	40,706,444	5,149,076	**45,855,520**	2,867,694	*6.25%*
Venice	29,517,740	9,229,647	**38,747,386**	2,588,601	*6.68%*
Koper	19,859,268	5,042,174	**24,901,442**	1,765,535	*7.09%*
delta from base	**Unloaded**	**Loaded**	**Total**	**Egypt (total and share)**	
Ravenna	5,501,853	1,321,477	6,823,330	444,498	*0.40%*
Trieste	13,784,625	1,322,244	15,106,869	895,108	*-0.16%*
Venice	9,240,347	2,739,279	11,979,626	911,799	*0.42%*
Koper	7,575,247	1,643,364	9,218,611	733,136	*0.51%*
% diff from base	**Unloaded**	**Loaded**	**Total**	**Egypt**	
Ravenna	42.80%	41.74%	**42.59%**	53.67%	
Trieste	51.20%	34.55%	**49.13%**	45.38%	
Venice	45.57%	42.21%	**44.75%**	54.38%	
Koper	61.67%	48.35%	**58.78%**	71.01%	

Table 34 – Total traffic for selected ports and Egypt market share: 2035 pessimistic and differences from the base

tons/year	from the port		to the port	
	rail	road	rail	road
Ravenna	1,807,831	16,549,978	317,090	4,169,830
Trieste	472,739	40,233,705	34,171	5,114,906
Venice	2,190,901	27,326,838	1,595,971	7,633,678
Koper	669,141	19,190,127	210,086	4,832,089
delta from base	**from the port**		**to the port**	
	rail	**road**	**rail**	**road**
Ravenna	561,047	4,940,797	106,442	1,214,885
Trieste	160,446	13,624,179	9,883	1,312,362
Venice	759,531	8,480,816	504,769	2,234,511
Koper	233,568	7,341,679	59,664	1,583,700
% diff from base	**from the port**		**to the port**	
	rail	**road**	**rail**	**road**
Ravenna	45.0%	42.6%	50.5%	41.1%
Trieste	51.4%	51.2%	40.7%	34.5%
Venice	53.1%	45.0%	46.3%	41.4%
Koper	53.6%	62.0%	39.7%	48.8%

Table 35 – Pressure on inland transport networks: 2035 pessimistic and differences from the base

6. Conclusions

The market positioning of the Northern Adriatic ports selected for this study appears as clearly oriented towards Eastern Mediterranean countries and the Far East. The main role is played in terms of services per month for the RoRo and bulk services with Turkey and Greece, while container services are more uniformly spread over Mediterranean ports and therefore are more likely to rely in the port choice on the availability of a good quality, highly interconnected, hinterland transport network.

The development of further connections with Eastern Mediterranean ports, in particular with Egypt for the development of fruit and vegetables trade, starts from a current situation of congestion of maritime traffic to/from Egypt. The study demonstrates the likely upcoming need for increased transport infrastructure capacity.

The study highlights that travel time is not the only key variable determining port choice when analysing the competitive advantage of Northern Adriatic and Northern range ports. As a result, the difference in costs between container fares for the routes Egypt-Northern Adriatic and Egypt-Rotterdam are not as large as the corresponding times. In such context, the competition is played with respect to costs and times for inland distribution.

In view of perspective traffic volume increases to/from the Eastern Mediterranean basin with specific attention dedicated to the market segment of “fresh” products, the model results combining different routes, pairs of selected ports and different vessel speed options indicate that the actual choice of the best route actually depends only on demand analysis.

Considering that competition is played essentially with respect to costs and times for inland distribution, the model runs presented in the study highlight the area of convenience between the Northern Adriatic ports and the Northern range ports: it is remarkable how the area of convenience shrinks when turning attention to costs.

For the 2020 time horizon the predicted increase in traffic to/from ports selected for this study ranges between 23 and 34% with a slightly higher increase of pressure on inland rail transport. Additionally, rail and road transport exhibit significantly different patterns in freight transport increase when considering each of the selected ports.

Similarly, the analysis carried out in the study reports the variation in tons/year between the 2035 baseline scenario and the current scenario respectively for road and rail modes, in order to point out which origin-destination patterns are mostly affected by the projected demand increase. It is important to highlight that even the pessimistic scenario with time horizon 2035 highlights a considerably increased pressure on inland transport networks behind the Northern Adriatic ports ranging from a minimum 34.5% for road to an increase as high as 62% in one single case, while pressure on inland rail network is higher on average ranging from short below +40% as a minimum to well above 50% increased pressure on average.

7. References

7.1 DSS references

The DSS described in Section 1 is implemented, maintained and updated by the *Transport demand research group* at the Dipartimento di Ingegneria dei Trasporti – Università di Napoli "Federico II", headed by Prof. Andrea Papola and under the supervision of eng. Vittorio Marzano Ph.D. and eng. Fulvio Simonelli Ph.D. The reader may refer to the following scientific papers and technical reports providing for more details about some characteristics of the model:

- V. Marzano, D. Aponte, F. Simonelli, A. Papola (2009). *A methodology for the appraisal of the competitiveness of Ro-Ro services: the case of the Italy-Spain intermodal corridor.* Atti del 88th Transportation Research Board meeting, Washington DC, 11-15 Gennaio 2009

- V. Marzano, A. Papola, F. Simonelli (2008). *A large scale analysis of the competitiveness of new Short-Sea Shipping services in the Mediterranean.* Atti della 36th European Transport Conference, Noordwijk, The Netherlands.

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Annex

The following table provides mode choice probabilities for inland dispatching of freight flows between Northern Adriatic ports and selected NUTS3 zones in Italy, Austria and Germany.

Country	NUTS3 zone	Ravenna		Trieste		Venice		Koper	
		rail	road	rail	road	rail	road	rail	road
Austria	Ausserfern	2.55%	97.45%	1.91%	98.09%	1.93%	98.07%	1.63%	98.37%
Austria	Bludenz-Bregenzer Wald	2.28%	97.72%	1.72%	98.28%	1.70%	98.30%	1.49%	98.51%
Austria	Graz	1.95%	98.05%	1.78%	98.22%	1.68%	98.32%	0.99%	99.01%
Austria	Innsbruck	2.22%	97.78%	1.66%	98.34%	1.68%	98.32%	1.50%	98.50%
Austria	Innviertel	2.03%	97.97%	1.72%	98.28%	1.70%	98.30%	1.03%	98.97%
Austria	Ístliche Obersteiermark	2.15%	97.85%	2.01%	97.99%	1.84%	98.16%	0.99%	99.01%
Austria	Klagenfurt-Villach	1.48%	98.52%	1.12%	98.88%	0.95%	99.05%	0.75%	99.25%
Austria	Liezen	1.92%	98.08%	1.90%	98.10%	1.65%	98.35%	0.94%	99.06%
Austria	Linz-Wels	2.61%	97.39%	2.20%	97.80%	2.19%	97.81%	1.25%	98.75%
Austria	Lungau	1.62%	98.38%	1.13%	98.87%	1.47%	98.53%	0.75%	99.25%
Austria	Muhlviertel	2.78%	97.22%	2.34%	97.66%	2.33%	97.67%	1.30%	98.70%
Austria	Mittelburgenland	1.75%	98.25%	1.49%	98.51%	1.45%	98.55%	0.78%	99.22%
Austria	Mostviertel-Eisenwurzen	2.23%	97.77%	2.09%	97.91%	1.86%	98.14%	1.00%	99.00%
Austria	Niederosterreich-Sud	1.84%	98.16%	1.60%	98.40%	1.53%	98.47%	0.83%	99.17%
Austria	Nordburgenland	2.56%	97.44%	2.18%	97.82%	2.13%	97.87%	1.10%	98.90%
Austria	Oberkõrnten	1.57%	98.43%	1.13%	98.87%	1.41%	98.59%	0.75%	99.25%
Austria	Oststeiermark	2.00%	98.00%	1.83%	98.17%	1.73%	98.27%	1.00%	99.00%
Austria	Osttirol	1.09%	98.91%	1.40%	98.60%	0.98%	99.02%	1.26%	98.74%
Austria	Pinzgau-Pongau	1.43%	98.57%	1.26%	98.74%	1.23%	98.77%	0.78%	99.22%
Austria	Rheintal-Bodenseegebiet	3.20%	96.80%	2.10%	97.90%	2.08%	97.92%	1.79%	98.21%
Austria	Sudburgenland	2.09%	97.91%	1.91%	98.09%	1.80%	98.20%	1.03%	98.97%
Austria	Salzburg und Umgebung	2.00%	98.00%	1.76%	98.24%	1.71%	98.29%	1.08%	98.92%
Austria	Sankt Polten	2.58%	97.42%	2.20%	97.80%	2.15%	97.85%	1.11%	98.89%
Austria	Steyr-Kirchdorf	2.09%	97.91%	1.98%	98.02%	1.75%	98.25%	0.97%	99.03%
Austria	Tiroler Oberland	2.44%	97.56%	1.83%	98.17%	1.85%	98.15%	1.59%	98.41%
Austria	Tiroler Unterland	2.48%	97.52%	2.15%	97.85%	1.87%	98.13%	1.28%	98.72%
Austria	Traunviertel	2.09%	97.91%	1.77%	98.23%	1.75%	98.25%	1.06%	98.94%
Austria	Unterkõrnten	1.59%	98.41%	1.26%	98.74%	1.44%	98.56%	0.70%	99.30%
Austria	Waldviertel	2.98%	97.02%	2.55%	97.45%	2.48%	97.52%	1.24%	98.76%
Austria	Weinviertel	2.75%	97.25%	2.34%	97.66%	2.28%	97.72%	1.17%	98.83%
Austria	West- und Sudsteiermark	1.81%	98.19%	1.73%	98.27%	1.56%	98.44%	0.96%	99.04%
Austria	Westliche Obersteiermark	1.33%	98.67%	1.31%	98.69%	1.14%	98.86%	0.51%	99.49%

Austria	Wien	2.58%	97.42%	2.19%	97.81%	2.14%	97.86%	1.13%	98.87%
Austria	Wiener Umland/Nordteil	2.63%	97.37%	2.24%	97.76%	2.19%	97.81%	1.14%	98.86%
Austria	Wiener Umland/Sudteil	2.27%	97.73%	1.93%	98.07%	1.88%	98.12%	1.00%	99.00%
Germany	Aichach-Friedberg	4.17%	95.83%	2.87%	97.13%	3.14%	96.86%	1.67%	98.33%
Germany	Alb-Donau-Kreis	4.55%	95.45%	3.46%	96.54%	3.41%	96.59%	1.95%	98.05%
Germany	Alt÷tting	3.49%	96.51%	1.91%	98.09%	2.33%	97.67%	1.14%	98.86%
Germany	Alzey-Worms	4.40%	95.60%	5.17%	94.83%	5.02%	94.98%	2.71%	97.29%
Germany	Amberg, Kreisfreie Stadt	4.52%	95.48%	2.95%	97.05%	3.38%	96.62%	1.65%	98.35%
Germany	Amberg-Sulzbach	4.55%	95.45%	2.98%	97.02%	3.41%	96.59%	1.66%	98.34%
Germany	Ansbach, Kreisfreie Stadt	5.00%	95.00%	3.49%	96.51%	3.76%	96.24%	1.94%	98.06%
Germany	Ansbach, Landkreis	4.88%	95.12%	3.40%	96.60%	3.65%	96.35%	1.88%	98.12%
Germany	Aschaffenburg, Kreisfreie Stadt	4.69%	95.31%	4.16%	95.84%	4.28%	95.72%	2.21%	97.79%
Germany	Aschaffenburg, Landkreis	4.74%	95.26%	4.09%	95.91%	4.20%	95.80%	2.17%	97.83%
Germany	Augsburg, Kreisfreie Stadt	4.44%	95.56%	3.11%	96.89%	3.34%	96.66%	1.80%	98.20%
Germany	Augsburg, Landkreis	4.61%	95.39%	3.17%	96.83%	3.48%	96.52%	1.82%	98.18%
Germany	Boblingen	3.83%	96.17%	3.82%	96.18%	3.87%	96.13%	2.11%	97.89%
Germany	Bad Durkheim	4.10%	95.90%	4.84%	95.16%	4.22%	95.78%	2.56%	97.44%
Germany	Bad Kissingen	6.04%	93.96%	4.25%	95.75%	4.52%	95.48%	2.28%	97.72%
Germany	Bad Kreuznach	4.71%	95.29%	5.53%	94.47%	5.37%	94.63%	2.82%	97.18%
Germany	Bad Tolz-Wolfratshausen	2.77%	97.23%	2.37%	97.63%	2.08%	97.92%	1.40%	98.60%
Germany	Baden-Baden, Stadtkreis	3.44%	96.56%	4.47%	95.53%	3.54%	96.46%	2.40%	97.60%
Germany	Bamberg, Kreisfreie Stadt	5.11%	94.89%	3.56%	96.44%	3.83%	96.17%	1.97%	98.03%
Germany	Bamberg, Landkreis	5.13%	94.87%	3.58%	96.42%	3.85%	96.15%	1.97%	98.03%
Germany	Bayreuth, Kreisfreie Stadt	5.00%	95.00%	3.48%	96.52%	3.75%	96.25%	1.92%	98.08%
Germany	Bayreuth, Landkreis	5.03%	94.97%	3.51%	96.49%	3.78%	96.22%	1.92%	98.08%
Germany	Berchtesgadener Land	2.22%	97.78%	1.30%	98.70%	1.58%	98.42%	0.80%	99.20%
Germany	Bergstrasse	4.30%	95.70%	4.98%	95.02%	4.83%	95.17%	2.64%	97.36%
Germany	Biberach	3.93%	96.07%	3.24%	96.76%	2.91%	97.09%	1.83%	98.17%
Germany	Birkenfeld	4.27%	95.73%	4.84%	95.16%	4.40%	95.60%	2.46%	97.54%
Germany	Bodenseekreis	2.72%	97.28%	2.57%	97.43%	2.24%	97.76%	2.12%	97.88%
Germany	Breisgau-Hochschwarzwald	3.44%	96.56%	4.43%	95.57%	3.52%	96.48%	2.74%	97.26%
Germany	Calw	3.69%	96.31%	4.11%	95.89%	4.15%	95.85%	2.21%	97.79%
Germany	Cham	4.68%	95.32%	3.20%	96.80%	3.39%	96.61%	1.81%	98.19%
Germany	Coburg, Kreisfreie Stadt	4.77%	95.23%	3.34%	96.66%	3.55%	96.45%	1.81%	98.19%
Germany	Coburg, Landkreis	4.75%	95.25%	3.33%	96.67%	3.54%	96.46%	1.81%	98.19%
Germany	Dachau	3.79%	96.21%	2.88%	97.12%	2.85%	97.15%	1.67%	98.33%
Germany	Darmstadt, Kreisfreie Stadt	4.46%	95.54%	5.15%	94.85%	5.00%	95.00%	2.71%	97.29%
Germany	Darmstadt-Dieburg	4.59%	95.41%	4.80%	95.20%	4.94%	95.06%	2.52%	97.48%
Germany	Deggendorf	3.83%	96.17%	2.40%	97.60%	2.55%	97.45%	1.40%	98.60%

Germany	Dillingen a.d. Donau	4.45%	95.55%	3.09%	96.91%	3.34%	96.66%	1.74%	98.26%
Germany	Dingolfing-Landau	3.56%	96.44%	2.44%	97.56%	2.59%	97.41%	1.42%	98.58%
Germany	Donau-Ries	4.68%	95.32%	3.23%	96.77%	3.53%	96.47%	1.83%	98.17%
Germany	Donnersbergkreis	4.41%	95.59%	5.20%	94.80%	4.55%	95.45%	2.69%	97.31%
Germany	Ebersberg	3.79%	96.21%	2.89%	97.11%	2.86%	97.14%	1.69%	98.31%
Germany	Eichstõtt	4.02%	95.98%	2.76%	97.24%	3.03%	96.97%	1.57%	98.43%
Germany	Emmendingen	3.54%	96.46%	4.57%	95.43%	3.64%	96.36%	2.80%	97.20%
Germany	Enzkreis	4.18%	95.82%	3.67%	96.33%	3.78%	96.22%	2.01%	97.99%
Germany	Erding	3.57%	96.43%	2.63%	97.37%	2.69%	97.31%	1.54%	98.46%
Germany	Erlangen, Kreisfreie Stadt	4.90%	95.10%	3.41%	96.59%	3.68%	96.32%	1.92%	98.08%
Germany	Erlangen-Hochstadt	5.06%	94.94%	3.53%	96.47%	3.80%	96.20%	1.96%	98.04%
Germany	Esslingen	4.61%	95.39%	3.41%	96.59%	3.45%	96.55%	1.90%	98.10%
Germany	Forchheim	5.06%	94.94%	3.53%	96.47%	3.80%	96.20%	1.95%	98.05%
Germany	Frankenthal (Pfalz), Kreisfreie Stadt	4.30%	95.70%	4.99%	95.01%	4.85%	95.15%	2.65%	97.35%
Germany	Frankfurt am Main, Kreisfreie Stadt	4.58%	95.42%	4.92%	95.08%	5.06%	94.94%	2.58%	97.42%
Germany	Freiburg im Breisgau, Stadtkreis	3.38%	96.62%	4.35%	95.65%	3.47%	96.53%	2.71%	97.29%
Germany	Freising	3.84%	96.16%	2.92%	97.08%	2.89%	97.11%	1.69%	98.31%
Germany	Freudenstadt	3.15%	96.85%	4.18%	95.82%	3.47%	96.53%	2.23%	97.77%
Germany	Freyung-Grafenau	3.25%	96.75%	2.19%	97.81%	2.32%	97.68%	1.26%	98.74%
Germany	Furstenfeldbruck	3.77%	96.23%	2.87%	97.13%	2.84%	97.16%	1.67%	98.33%
Germany	Furth, Kreisfreie Stadt	4.86%	95.14%	3.38%	96.62%	3.65%	96.35%	1.91%	98.09%
Germany	Furth, Landkreis	4.98%	95.02%	3.47%	96.53%	3.74%	96.26%	1.93%	98.07%
Germany	Garmisch-Partenkirchen	2.32%	97.68%	2.23%	97.77%	1.74%	98.26%	1.94%	98.06%
Germany	Germersheim	4.06%	95.94%	4.51%	95.49%	4.18%	95.82%	2.43%	97.57%
Germany	Goppingen	4.04%	95.96%	2.98%	97.02%	3.02%	96.98%	1.67%	98.33%
Germany	Gross-Gerau	4.58%	95.42%	5.31%	94.69%	5.15%	94.85%	2.76%	97.24%
Germany	Gunzburg	4.29%	95.71%	2.98%	97.02%	3.22%	96.78%	1.69%	98.31%
Germany	Hassberge	5.03%	94.97%	3.53%	96.47%	3.75%	96.25%	1.91%	98.09%
Germany	Heidelberg, Stadtkreis	3.92%	96.08%	4.54%	95.46%	4.41%	95.59%	2.43%	97.57%
Germany	Heidenheim	4.52%	95.48%	3.26%	96.74%	3.40%	96.60%	1.83%	98.17%
Germany	Heilbronn, Landkreis	4.63%	95.37%	4.27%	95.73%	4.33%	95.67%	2.30%	97.70%
Germany	Heilbronn, Stadtkreis	4.62%	95.38%	4.26%	95.74%	4.31%	95.69%	2.30%	97.70%
Germany	Hildburghausen	5.07%	94.93%	3.56%	96.44%	3.79%	96.21%	1.88%	98.12%
Germany	Hof, Kreisfreie Stadt	3.35%	96.65%	2.26%	97.74%	2.48%	97.52%	1.23%	98.77%
Germany	Hof, Landkreis	3.32%	96.68%	2.34%	97.66%	2.45%	97.55%	1.28%	98.72%
Germany	Hohenlohekreis	5.07%	94.93%	3.43%	96.57%	3.79%	96.21%	1.86%	98.14%
Germany	Ingolstadt, Kreisfreie Stadt	3.19%	96.81%	2.77%	97.23%	2.38%	97.62%	1.59%	98.41%
Germany	Kaiserslautern, Kreisfreie Stadt	4.15%	95.85%	4.90%	95.10%	4.27%	95.73%	2.56%	97.44%
Germany	Kaiserslautern, Landkreis	3.80%	96.20%	4.31%	95.69%	3.92%	96.08%	2.26%	97.74%
Germany	Karlsruhe, Landkreis	4.11%	95.89%	4.47%	95.53%	4.61%	95.39%	2.40%	97.60%
Germany	Karlsruhe, Stadtkreis	4.00%	96.00%	4.35%	95.65%	4.48%	95.52%	2.36%	97.64%

Germany	Kaufbeuren, Kreisfreie Stadt	3.69%	96.31%	2.91%	97.09%	2.77%	97.23%	1.67%	98.33%
Germany	Kelheim	3.63%	96.37%	3.15%	96.85%	2.72%	97.28%	1.80%	98.20%
Germany	Kempten (Allgõu), Kreisfreie Stadt	2.77%	97.23%	2.42%	97.58%	2.07%	97.93%	2.06%	97.94%
Germany	Kitzingen	4.67%	95.33%	3.27%	96.73%	3.49%	96.51%	1.80%	98.20%
Germany	Konstanz	2.45%	97.55%	3.44%	96.56%	2.52%	97.48%	2.80%	97.20%
Germany	Kronach	5.59%	94.41%	3.90%	96.10%	4.20%	95.80%	2.08%	97.92%
Germany	Kulmbach	5.18%	94.82%	3.61%	96.39%	3.89%	96.11%	1.96%	98.04%
Germany	Kusel	4.22%	95.78%	4.78%	95.22%	4.34%	95.66%	2.46%	97.54%
Germany	L÷rrach	3.25%	96.75%	4.13%	95.87%	3.33%	96.67%	2.20%	97.80%
Germany	Landau in der Pfalz, Kreisfreie Stadt	4.11%	95.89%	4.56%	95.44%	4.22%	95.78%	2.44%	97.56%
Germany	Landsberg a. Lech	3.78%	96.22%	2.84%	97.16%	2.85%	97.15%	1.64%	98.36%
Germany	Landshut, Kreisfreie Stadt	2.98%	97.02%	2.35%	97.65%	2.22%	97.78%	1.38%	98.62%
Germany	Landshut, Landkreis	3.03%	96.97%	2.40%	97.60%	2.26%	97.74%	1.39%	98.61%
Germany	Lichtenfels	5.35%	94.65%	3.73%	96.27%	4.01%	95.99%	2.02%	97.98%
Germany	Lindau (Bodensee)	2.16%	97.84%	2.04%	97.96%	1.78%	98.22%	1.71%	98.29%
Germany	Ludwigsburg	4.43%	95.57%	4.09%	95.91%	4.14%	95.86%	2.24%	97.76%
Germany	Ludwigshafen am Rhein, Kreisfreie Stadt	4.28%	95.72%	4.95%	95.05%	4.81%	95.19%	2.64%	97.36%
Germany	Main-Kinzig-Kreis	4.82%	95.18%	4.58%	95.42%	4.72%	95.28%	2.39%	97.61%
Germany	Main-Spessart	6.08%	93.92%	4.28%	95.72%	4.55%	95.45%	2.26%	97.74%
Germany	Main-Tauber-Kreis	4.86%	95.14%	3.79%	96.21%	4.02%	95.98%	2.03%	97.97%
Germany	Main-Taunus-Kreis	4.67%	95.33%	5.11%	94.89%	5.24%	94.76%	2.66%	97.34%
Germany	Mainz, Kreisfreie Stadt	4.60%	95.40%	5.32%	94.68%	5.15%	94.85%	2.76%	97.24%
Germany	Mainz-Bingen	4.60%	95.40%	5.40%	94.60%	5.25%	94.75%	2.78%	97.22%
Germany	Mannheim, Stadtkreis	4.36%	95.64%	5.05%	94.95%	4.89%	95.11%	2.69%	97.31%
Germany	Memmingen, Kreisfreie Stadt	3.32%	96.68%	2.79%	97.21%	2.49%	97.51%	1.60%	98.40%
Germany	Miesbach	2.71%	97.29%	2.37%	97.63%	2.03%	97.97%	1.40%	98.60%
Germany	Miltenberg	4.73%	95.27%	4.06%	95.94%	4.30%	95.70%	2.13%	97.87%
Germany	Muhldorf a. Inn	3.35%	96.65%	2.47%	97.53%	2.52%	97.48%	1.45%	98.55%
Germany	Munchen, Kreisfreie Stadt	3.63%	96.37%	2.76%	97.24%	2.73%	97.27%	1.63%	98.37%
Germany	Munchen, Landkreis	3.55%	96.45%	2.70%	97.30%	2.67%	97.33%	1.60%	98.40%
Germany	Neckar-Odenwald-Kreis	4.54%	95.46%	3.58%	96.42%	3.80%	96.20%	1.88%	98.12%
Germany	Neuburg-Schrobenhausen	4.44%	95.56%	3.06%	96.94%	3.35%	96.65%	1.73%	98.27%
Germany	Neumarkt i. d. OPf.	4.78%	95.22%	3.19%	96.81%	3.58%	96.42%	1.78%	98.22%
Germany	Neunkirchen	4.91%	95.09%	5.56%	94.44%	5.06%	94.94%	2.80%	97.20%
Germany	Neustadt a. d. Aisch-Bad Windsheim	5.13%	94.87%	3.58%	96.42%	3.85%	96.15%	1.97%	98.03%
Germany	Neustadt a. d. Waldnaab	4.82%	95.18%	3.95%	96.05%	3.62%	96.38%	2.15%	97.85%
Germany	Neustadt an der Weinstrasse, Kreisfreie Stadt	3.83%	96.17%	4.53%	95.47%	3.94%	96.06%	2.41%	97.59%
Germany	Neu-Ulm	4.20%	95.80%	3.31%	96.69%	3.15%	96.85%	1.87%	98.13%

Germany	Nurnberg, Kreisfreie Stadt	4.84%	95.16%	3.38%	96.62%	3.63%	96.37%	1.90%	98.10%
Germany	Nurnberger Land	4.72%	95.28%	3.29%	96.71%	3.54%	96.46%	1.85%	98.15%
Germany	Oberallgõu	2.80%	97.20%	2.45%	97.55%	2.09%	97.91%	2.05%	97.95%
Germany	Odenwaldkreis	4.51%	95.49%	4.78%	95.22%	4.64%	95.36%	2.51%	97.49%
Germany	Offenbach am Main, Kreisfreie Stadt	4.61%	95.39%	4.67%	95.33%	4.81%	95.19%	2.46%	97.54%
Germany	Offenbach, Landkreis	4.68%	95.32%	4.53%	95.47%	4.65%	95.35%	2.38%	97.62%
Germany	Ortenaukreis	3.80%	96.20%	4.88%	95.12%	3.90%	96.10%	2.92%	97.08%
Germany	Ostalbkreis	4.62%	95.38%	3.33%	96.67%	3.47%	96.53%	1.85%	98.15%
Germany	Ostallgõu	3.27%	96.73%	2.84%	97.16%	2.45%	97.55%	1.70%	98.30%
Germany	Passau, Kreisfreie Stadt	2.67%	97.33%	1.79%	98.21%	1.90%	98.10%	1.05%	98.95%
Germany	Passau, Landkreis	2.69%	97.31%	1.81%	98.19%	1.92%	98.08%	1.06%	98.94%
Germany	Pfaffenhofen a. d. Ilm	3.87%	96.13%	2.95%	97.05%	2.92%	97.08%	1.70%	98.30%
Germany	Pforzheim, Stadtkreis	4.04%	95.96%	3.77%	96.23%	3.89%	96.11%	2.06%	97.94%
Germany	Pirmasens, Kreisfreie Stadt	3.73%	96.27%	4.22%	95.78%	3.84%	96.16%	2.22%	97.78%
Germany	Plauen, Kreisfreie Stadt	3.74%	96.26%	2.48%	97.52%	2.77%	97.23%	1.34%	98.66%
Germany	Rastatt	3.44%	96.56%	4.47%	95.53%	3.53%	96.47%	2.40%	97.60%
Germany	Ravensburg	3.25%	96.75%	3.38%	96.62%	2.89%	97.11%	1.88%	98.12%
Germany	Regen	4.02%	95.98%	2.67%	97.33%	2.82%	97.18%	1.52%	98.48%
Germany	Regensburg, Kreisfreie Stadt	4.35%	95.65%	3.48%	96.52%	3.26%	96.74%	1.99%	98.01%
Germany	Regensburg, Landkreis	4.44%	95.56%	3.48%	96.52%	3.33%	96.67%	1.98%	98.02%
Germany	Rems-Murr-Kreis	4.46%	95.54%	4.07%	95.93%	4.11%	95.89%	2.22%	97.78%
Germany	Reutlingen	3.95%	96.05%	3.61%	96.39%	3.21%	96.79%	1.97%	98.03%
Germany	Rhein-Neckar-Kreis	3.96%	96.04%	4.59%	95.41%	4.45%	95.55%	2.45%	97.55%
Germany	Rhein-Pfalz-Kreis	4.16%	95.84%	4.88%	95.12%	4.75%	95.25%	2.59%	97.41%
Germany	Rhen-Grabfeld	5.99%	94.01%	4.22%	95.78%	4.48%	95.52%	2.26%	97.74%
Germany	Rosenheim, Kreisfreie Stadt	2.57%	97.43%	1.95%	98.05%	1.93%	98.07%	1.18%	98.82%
Germany	Rosenheim, Landkreis	2.60%	97.40%	1.95%	98.05%	1.95%	98.05%	1.17%	98.83%
Germany	Roth	4.71%	95.29%	3.28%	96.72%	3.53%	96.47%	1.84%	98.16%
Germany	Rottal-Inn	3.36%	96.64%	1.99%	98.01%	2.41%	97.59%	1.17%	98.83%
Germany	Rottweil	2.66%	97.34%	3.71%	96.29%	2.74%	97.26%	2.18%	97.82%
Germany	Saale-Orla-Kreis	4.05%	95.95%	2.86%	97.14%	3.00%	97.00%	1.54%	98.46%
Germany	Saalfeld-Rudolstadt	4.65%	95.35%	3.28%	96.72%	3.45%	96.55%	1.74%	98.26%
Germany	Saarlouis	5.55%	94.45%	5.92%	94.08%	5.72%	94.28%	3.06%	96.94%
Germany	Saarpfalz-Kreis	4.90%	95.10%	4.97%	95.03%	5.05%	94.95%	2.59%	97.41%
Germany	Schwabach, Kreisfreie Stadt	4.65%	95.35%	3.24%	96.76%	3.49%	96.51%	1.83%	98.17%
Germany	Schwandorf	4.53%	95.47%	3.70%	96.30%	3.40%	96.60%	2.07%	97.93%
Germany	Schwarzwald-Baar-Kreis	2.52%	97.48%	3.65%	96.35%	2.60%	97.40%	2.90%	97.10%
Germany	Schweinfurt, Kreisfreie Stadt	5.84%	94.16%	4.12%	95.88%	4.37%	95.63%	2.24%	97.76%
Germany	Schweinfurt, Landkreis	5.77%	94.23%	4.05%	95.95%	4.31%	95.69%	2.21%	97.79%
Germany	Schwõbisch Hall	4.64%	95.36%	3.14%	96.86%	3.47%	96.53%	1.72%	98.28%

Germany	Sigmaringen	2.73%	97.27%	3.02%	96.98%	2.77%	97.23%	1.66%	98.34%
Germany	Sonneberg	5.00%	95.00%	3.51%	96.49%	3.73%	96.27%	1.87%	98.13%
Germany	Speyer, Kreisfreie Stadt	3.93%	96.07%	4.55%	95.45%	4.42%	95.58%	2.43%	97.57%
Germany	St. Wendel	4.69%	95.31%	5.30%	94.70%	4.83%	95.17%	2.71%	97.29%
Germany	Stadtverband Saarbrucken	5.28%	94.72%	5.91%	94.09%	5.44%	94.56%	3.06%	96.94%
Germany	Starnberg	3.34%	96.66%	2.80%	97.20%	2.51%	97.49%	1.63%	98.37%
Germany	Straubing, Kreisfreie Stadt	3.95%	96.05%	2.71%	97.29%	2.87%	97.13%	1.57%	98.43%
Germany	Straubing-Bogen	4.12%	95.88%	2.83%	97.17%	3.00%	97.00%	1.63%	98.37%
Germany	Stuttgart, Stadtkreis	4.28%	95.72%	3.95%	96.05%	4.00%	96.00%	2.19%	97.81%
Germany	Sudliche Weinstrasse	4.14%	95.86%	4.60%	95.40%	4.26%	95.74%	2.46%	97.54%
Germany	Sudwestpfalz	3.74%	96.26%	4.25%	95.75%	3.86%	96.14%	2.23%	97.77%
Germany	Suhl, Kreisfreie Stadt	5.61%	94.39%	3.95%	96.05%	4.20%	95.80%	2.08%	97.92%
Germany	Tirschenreuth	4.79%	95.21%	3.92%	96.08%	3.60%	96.40%	2.14%	97.86%
Germany	Traunstein	2.71%	97.29%	1.52%	98.48%	1.84%	98.16%	0.93%	99.07%
Germany	Trier, Kreisfreie Stadt	5.76%	94.24%	5.90%	94.10%	5.93%	94.07%	2.98%	97.02%
Germany	Tubingen, Landkreis	3.61%	96.39%	3.79%	96.21%	3.80%	96.20%	2.08%	97.92%
Germany	Tuttlingen	2.64%	97.36%	3.58%	96.42%	2.72%	97.28%	2.87%	97.13%
Germany	Ulm, Stadtkreis	4.46%	95.54%	3.40%	96.60%	3.35%	96.65%	1.93%	98.07%
Germany	Unterallgõu	3.43%	96.57%	2.65%	97.35%	2.57%	97.43%	1.52%	98.48%
Germany	Vogtlandkreis	3.44%	96.56%	2.70%	97.30%	2.54%	97.46%	1.45%	98.55%
Germany	Waldshut	2.72%	97.28%	3.45%	96.55%	2.78%	97.22%	1.84%	98.16%
Germany	Weiden i. d. Opf, Kreisfreie Stadt	4.68%	95.32%	3.82%	96.18%	3.51%	96.49%	2.11%	97.89%
Germany	Weilheim-Schongau	2.89%	97.11%	2.52%	97.48%	2.17%	97.83%	1.54%	98.46%
Germany	Weissenburg-Gunzenhausen	4.18%	95.82%	2.90%	97.10%	3.13%	96.87%	1.64%	98.36%
Germany	Wiesbaden, Kreisfreie Stadt	4.62%	95.38%	5.22%	94.78%	5.19%	94.81%	2.71%	97.29%
Germany	Worms, Kreisfreie Stadt	4.37%	95.63%	5.09%	94.91%	4.94%	95.06%	2.68%	97.32%
Germany	Wunsiedel i. Fichtelgebirge	4.98%	95.02%	4.07%	95.93%	3.74%	96.26%	2.20%	97.80%
Germany	Wurzburg, Kreisfreie Stadt	5.27%	94.73%	3.70%	96.30%	3.94%	96.06%	2.02%	97.98%
Germany	Wurzburg, Landkreis	5.22%	94.78%	3.66%	96.34%	3.89%	96.11%	1.99%	98.01%
Germany	Zollernalbkreis	2.83%	97.17%	3.97%	96.03%	3.13%	96.87%	2.14%	97.86%
Germany	Zweibrucken, Kreisfreie Stadt	4.60%	95.40%	4.67%	95.33%	4.74%	95.26%	2.45%	97.55%
Italy	Alessandria	0.63%	99.37%	1.27%	98.73%	1.11%	98.89%	1.12%	98.88%
Italy	Ancona	0.30%	99.70%	0.68%	99.32%	0.57%	99.43%	0.61%	99.39%
Italy	Arezzo	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%
Italy	Ascoli Piceno	0.47%	99.53%	1.15%	98.85%	0.95%	99.05%	0.98%	99.02%
Italy	Asti	0.62%	99.38%	1.22%	98.78%	1.04%	98.96%	1.08%	98.92%
Italy	Belluno	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.58%	99.42%
Italy	Bergamo	0.00%	100.00%	0.94%	99.06%	0.00%	100.00%	0.87%	99.13%
Italy	Biella	1.19%	98.81%	1.41%	98.59%	1.23%	98.77%	1.23%	98.77%
Italy	Bologna	0.00%	100.00%	0.79%	99.21%	0.00%	100.00%	0.76%	99.24%
Italy	Bolzano-Bozen	0.00%	100.00%	1.03%	98.97%	0.00%	100.00%	0.94%	99.06%

Italy	Brescia	0.00%	100.00%	0.76%	99.24%	0.00%	100.00%	1.01%	98.99%
Italy	Campobasso	0.86%	99.14%	1.54%	98.46%	1.21%	98.79%	1.23%	98.77%
Italy	Chieti	1.02%	98.98%	1.75%	98.25%	1.46%	98.54%	1.46%	98.54%
Italy	Como	0.00%	100.00%	1.23%	98.77%	0.00%	100.00%	1.11%	98.89%
Italy	Cremona	0.00%	100.00%	0.94%	99.06%	0.00%	100.00%	0.87%	99.13%
Italy	Cuneo	1.12%	98.88%	1.54%	98.46%	1.31%	98.69%	1.31%	98.69%
Italy	Ferrara	0.00%	100.00%	0.63%	99.37%	0.00%	100.00%	0.60%	99.40%
Italy	Firenze	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%
Italy	Frosinone	0.90%	99.10%	1.73%	98.27%	1.36%	98.64%	1.43%	98.57%
Italy	Genova	0.00%	100.00%	1.21%	98.79%	0.00%	100.00%	1.06%	98.94%
Italy	Gorizia	0.55%	99.45%	0.00%	100.00%	0.00%	100.00%	0.81%	99.19%
Italy	Grosseto	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%
Italy	Imperia	1.38%	98.62%	1.77%	98.23%	1.49%	98.51%	1.48%	98.52%
Italy	Isernia	1.04%	98.96%	1.84%	98.16%	1.45%	98.55%	1.47%	98.53%
Italy	La Spezia	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%
Italy	L'Aquila	1.05%	98.95%	1.80%	98.20%	1.50%	98.50%	1.49%	98.51%
Italy	Latina	1.48%	98.52%	2.58%	97.42%	2.11%	97.89%	2.06%	97.94%
Italy	Lecco	0.00%	100.00%	1.16%	98.84%	0.00%	100.00%	1.05%	98.95%
Italy	Livorno	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%
Italy	Lodi	0.00%	100.00%	1.12%	98.88%	0.00%	100.00%	1.02%	98.98%
Italy	Lucca	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%
Italy	Macerata	0.35%	99.65%	0.82%	99.18%	0.68%	99.32%	0.72%	99.28%
Italy	Mantova	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.76%	99.24%
Italy	Massa-Carrara	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%
Italy	Milano	0.00%	100.00%	1.22%	98.78%	0.00%	100.00%	1.11%	98.89%
Italy	Modena	0.00%	100.00%	0.77%	99.23%	0.00%	100.00%	1.00%	99.00%
Italy	Novara	0.00%	100.00%	1.33%	98.67%	0.00%	100.00%	1.19%	98.81%
Italy	Padova	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.79%	99.21%
Italy	Parma	0.00%	100.00%	1.19%	98.81%	0.00%	100.00%	1.07%	98.93%
Italy	Pavia	0.00%	100.00%	1.18%	98.82%	0.00%	100.00%	1.06%	98.94%
Italy	Perugia	0.00%	100.00%	1.17%	98.83%	0.99%	99.01%	1.03%	98.97%
Italy	Pesaro e Urbino	0.00%	100.00%	1.06%	98.94%	0.00%	100.00%	0.93%	99.07%
Italy	Pescara	0.97%	99.03%	1.68%	98.32%	1.39%	98.61%	1.42%	98.58%
Italy	Piacenza	0.00%	100.00%	1.14%	98.86%	0.00%	100.00%	1.04%	98.96%
Italy	Pisa	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%
Italy	Pistoia	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%
Italy	Pordenone	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.52%	99.48%
Italy	Prato	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%
Italy	Ravenna	0.00%	100.00%	0.66%	99.34%	0.00%	100.00%	0.86%	99.14%
Italy	Reggio nell'Emilia	0.00%	100.00%	0.97%	99.03%	0.00%	100.00%	0.90%	99.10%
Italy	Rieti	0.74%	99.26%	1.22%	98.78%	1.00%	99.00%	1.01%	98.99%
Italy	Rimini	0.00%	100.00%	0.96%	99.04%	0.00%	100.00%	0.87%	99.13%
Italy	Roma	1.07%	98.93%	1.88%	98.12%	1.54%	98.46%	1.59%	98.41%
Italy	Rovigo	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.74%	99.26%
Italy	Savona	0.95%	99.05%	1.31%	98.69%	1.11%	98.89%	1.13%	98.87%
Italy	Siena	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%
Italy	Sondrio	0.00%	100.00%	1.32%	98.68%	0.00%	100.00%	1.14%	98.86%

Italy	Teramo	0.52%	99.48%	1.25%	98.75%	1.04%	98.96%	1.08%	98.92%
Italy	Terni	0.41%	99.59%	1.03%	98.97%	0.84%	99.16%	0.90%	99.10%
Italy	Torino	1.25%	98.75%	1.53%	98.47%	1.30%	98.70%	1.33%	98.67%
Italy	Trento	0.00%	100.00%	0.73%	99.27%	0.00%	100.00%	0.96%	99.04%
Italy	Treviso	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.63%	99.37%
Italy	Trieste	0.66%	99.34%	0.00%	100.00%	0.00%	100.00%	0.82%	99.18%
Italy	Udine	0.51%	99.49%	0.00%	100.00%	0.00%	100.00%	0.80%	99.20%
Italy	Varese	0.00%	100.00%	1.31%	98.69%	0.00%	100.00%	1.18%	98.82%
Italy	Venezia	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.69%	99.31%
Italy	Verbano-Cusio-Ossola	0.00%	100.00%	1.42%	98.58%	0.00%	100.00%	1.24%	98.76%
Italy	Vercelli	1.22%	98.78%	1.44%	98.56%	1.26%	98.74%	1.25%	98.75%
Italy	Verona	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.77%	99.23%
Italy	Vicenza	0.00%	100.00%	0.00%	100.00%	0.00%	100.00%	0.78%	99.22%
Italy	Viterbo	0.75%	99.25%	1.31%	98.69%	1.07%	98.93%	1.12%	98.88%

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Abstract
The study presented in this report focuses on the technical evaluation of existing and new Mediterranean shipping routes and their impacts on hinterland transport networks and infrastructure capacity.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

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