Co-financed by the European Union
Trans-European Transport Network (TEN-T)

NAPA:
Market study on the potential cargo capacity of the North Adriatic ports system in the container sector

FINAL REPORT

by

MDS Transmodal Limited

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1 INTRODUCTION & CONTEXT

1.1 Introduction

The North Adriatic Ports Association (NAPA) has commissioned MDS Transmodal (MDST) to carry out a market study on the potential cargo capacity of the North Adriatic Ports system in the container sector. This study, which is part-funded by the European Union TEN-T Programme, will help to determine the future development of the NAPA ports system in the container sector up to at least 2030.

The five NAPA ports - Koper, Ravenna, Rijeka, Trieste and Venice – are all either developing new or enhanced container port facilities and/or have plans to do so. NAPA has a common objective of developing its container traffic and becoming a multi-port gateway, particularly between the dynamic Asian and Central and Eastern European economies; NAPA's guiding principle is "coopetition", where it co-operates internationally but competes internally.

The **key objective** of this study therefore is to provide an independent and objective view as to the potential combined demand for the existing and potential container port facilities up to 2030, based on the port's collective strengths and the likely future business environment.

The **geographic scope** of the study is focused on the existing NAPA ports of Koper, Ravenna, Rijeka, Trieste and Venice and the ports' collective worldwide foreland and European hinterland. The study seeks to define the size and extent of both the existing and potential hinterlands of the NAPA ports by country and, for the larger countries, by region.

The **time horizon** for the study is 2030, with intermediate forecasts required for 2015 and 2020.

1.2 Context

The ports on the eastern side of the North Adriatic were built to serve the Austro-Hungarian Empire and therefore were regarded as the natural gateways to Central and Eastern Europe until the Second World War. However these ports were unable to develop their container traffic to a significant extent during the 1960s, 1970s and 1980s because of the region's location as a border region on either side of the Iron Curtain. After the Iron Curtain fell in 1989, the whole North Adriatic region was affected by the wars in the former Yugoslavia up to 1999. Since 1999 the political environment within which the North Adriatic ports are operating has been stable, with the positive development of the entry of Central and Eastern European countries into the European Union since 2004.

On the western side of the Adriatic, the ports of Ravenna and Venice are in competition with the Ligurian ports for the North Italian market and Venice, historically, has also competed for the Swiss, southern German and south-eastern France markets. After 1966, when a catastrophic flood affected the city of Venice, dredging was not possible in the port canals because of the fear that it would increase the risk of flooding in the Venetian lagoon; this meant that until 2003, when the maximum depth to which dredging could be undertaken in the port canals was clarified, the port of Venice was unable to deepen its approach channels at a time when the size of deep sea container vessels was increasing.

Furthermore, the geography of container trade between in Europe and the rest of the world has changed dramatically in the last 15 years for two main reasons:

- There has been a significant switch in the relative importance of the Far East for manufactured imports (and away from imports from North America), accelerated by the entry of China into the World Trade Organisation in 2001.
- The integration of Central and Eastern European countries into the European Union in 2004, with their more dynamic economies, has switched the centre of gravity of inland origins and destinations of containerised trade in Europe to the south and east.

These trends in containerised trade are shown in Figures 1.1 and 1.2 below. Figures 1.1 shows that containerised imports to Europe and the Mediterranean basin from locations East of Suez have increased by 130% between 1996 and 2011, while those from North America have increased by just 10% over the same period.

Figure 1.1

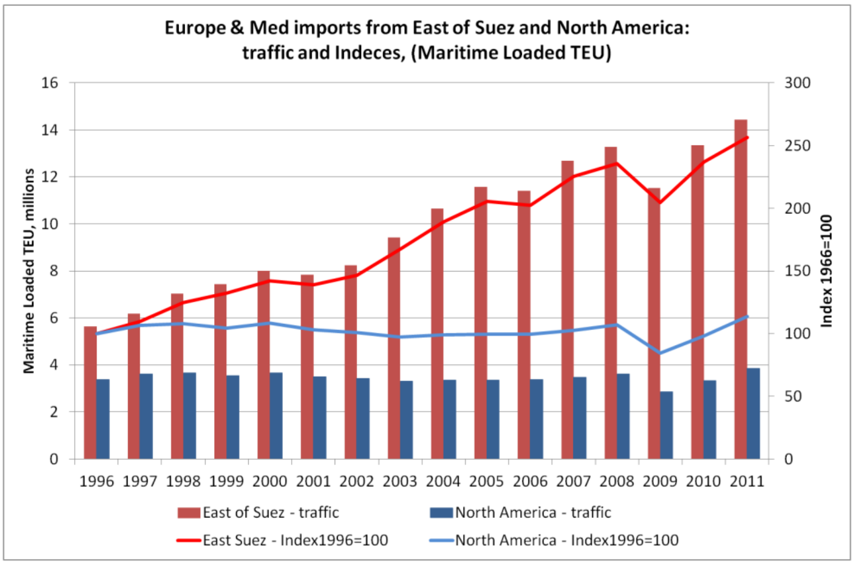
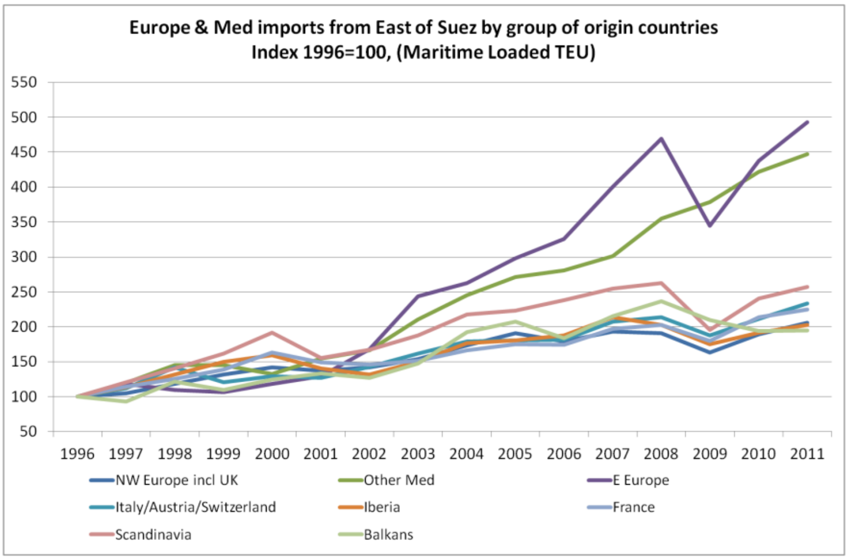


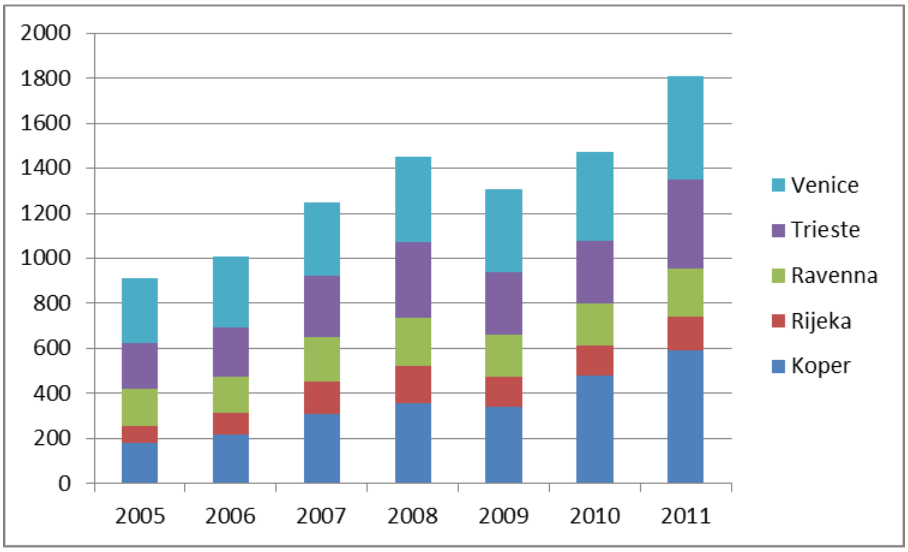
Figure 1.2 shows an index for the growth in containerised imports between locations East of Suez and Europe and the Mediterranean basin by country grouping. This shows that, from a lower base in terms of actual volumes, the fastest growth in containerized trade between 1996 and 2011 has been experienced by Central and Eastern European countries (+390% growth), while North West Europe has experienced growth of only 140% during the same period.

Figure 1.2



These trends have increased the competitive position of the North Adriatic ports because they are located closer to the Suez Canal than ports in the Western Mediterranean and the Northern Range and are natural gateways to Central and Eastern Europe, just as they were before the First World War.

During the period 2005-11 the NAPA ports enjoyed container traffic growth of 98% (measured in terms of TEU) to reach a combined throughput of 1.81 million TEU in 2011. After a slump in throughput volumes in 2009 of 10% due to the world economic crisis, the ports' total traffic increased by 13% in 2010 to marginally exceed pre-recession levels. By contrast, we estimate that over the period 2005-10, deepsea container import traffic into all of Europe and the Mediterranean grew by only 14%. The trends during this period for NAPA as a whole and for the individual ports are shown in the following chart. NAPA's throughput has continued to expand well above trend levels in 2011, when traffic exceeded 2010 levels by 23% to reach 1.81m TEU.



NAPA container traffic volumes, 2005-11 (thousand TEU)

Most of the global growth in trade has been driven by imports of finished and semi-finished manufactured goods and consumer products from the Far East due to the on-going process of globalization of manufacturing. Shipping line capacity on routes to and from Europe is largely determined therefore by the prospects for deep sea container trade imports from Asia.

Existing deep sea container shipping patterns between the Far East and Europe via the Suez Canal are dominated by the main line route between the Suez Canal and the Northern Range of ports via the Straits of Gibraltar, with transhipment of containers for other European regions en route through the making of calls at Mediterranean transhipment ports which involve only a short diversion from the main route. This has led to the world's largest vessels, enjoying the greatest economies of scale, being profitably deployed on this route.

The NAPA ports have marketed themselves as collectively providing an option for shipping lines to provide a more cost-effective and environmentally more sustainable alternative link between Asian markets and both their "natural hinterlands" of Northern Italy and the northern Balkans and Central and Eastern Europe and parts of Western Europe north of the Alps. This is based, in particular, on the North Adriatic providing a shorter maritime distance from Port Said to the NAPA ports than is possible via the Northern Range ports, allowing operators to reduce their carbon dioxide emissions per TEU transported. NAPA has made a significant breakthrough in attracting two services (CMA-CGM/Maersk and Hyundai/Hanjin/Yang Ming/UASC, with vessels that average 6500 TEU and 4300 TEU respectively) from the Far East that call at NAPA ports in the Adriatic and then return to the Far East, without serving the Northern Range ports

Deep sea shipping lines are generally highly cost conscious and seek to minimise their door-to-door costs. While these services may change over forthcoming months as part of a process of considerable change in the way deep-sea liner services are structured as lines deal with a crisis of over capacity, the fact that these services have been launched already demonstrates that lines calling at North Adriatic ports believe they can secure a cost advantage over their competitors serving the same hinterland via direct calls at more distant ports or via a transhipment strategy. While much of the focus of the

NAPA initiative has been on deep sea container shipping markets, the short sea Mediterranean market should also provide significant prospects for growth for NAPA up to 2030; particularly if the East Mediterranean continues to grow as another important source of manufactured goods.

1.3 Report structure

Chapter 2 The NAPA ports in the Container Market provides a description of the relevant container port infrastructure and hinterland links both for each individual port and for NAPA as a whole.

Chapter 3 NAPA Container Port Hinterland & Foreland sets out the results of the origin-destination matrix and container port demand simulation model that have been developed by the consultancy team. The demand model seeks to both describe and "explain" the pattern of deep sea and short sea containerised trade between the European continental mainland and the rest of the world, with a focus on the NAPA ports and provides scenarios for the future development of container traffic through the NAPA ports.

Chapter 4 The position of the deepsea lines sets out some views on how the shipping lines are reacting to the twin pressures of economic recession and the end of the liner consortia and how it may present an opportunity for the NAPA ports.

Chapter 5 Strategic Rail Freight Issues for the NAPA Ports sets out the demand for rail freight services to and from the NAPA ports and, given the number of additional rail freight services that will be required to allow the NAPA ports to achieve their potential up to 2030, provides a strategic analysis of capacity through the Alps in the Mont Cenis-Brenner arc.

Chapter 6 Conclusions sets out the overall results of the study and describes in general terms the infrastructure that will be needed to allow the potential traffic volumes to be secured by 2030.

2 THE NAPA PORTS IN THE CONTAINER MARKET

2.1 Introduction

This chapter provides a description of the relevant container port infrastructure and hinterland links both for each individual port and for NAPA as a whole. It begins by setting out the container ship service patterns deployed in serving all the NAPA ports, based on data included in the MDST Containership Databank, which tracks the deployment of the world's container carrying fleet of over 9,000 vessels.

It then provides a summary of the container facilities at each port and the container shipping and rail services that operate to and from each port, based on factual information obtained from the ports and terminal and rail freight operators and other members of the collective NAPA port community.

2.2 Containership deployment in the North Adriatic

Direct deep sea services

Table 2.1 shows the capacity deployment for the two deep sea container services that currently call in the north Adriatic.

The service jointly operated by **CMA-CGM and Maersk** between the Far East and the North Adriatic started in Q2 2009 with calls at Trieste and Koper, but from Q4 2009 the service added a weekly call at Rijeka. The weekly service deploys vessels of about 6,500 TEU and calls at the Far East ports of Tanjung Pelepas, Chiwan, Hong Kong, Pusan, Shanghai, Singapore and Port Klang before calling at Jeddah in the Red Sea and passing through the Suez Canal; after calls at Port Said and Damietta in Egypt, the service calls at Rijeka, Koper and Trieste on the eastern side of the Northern Adriatic before calling at Piraeus en route to the Suez Canal and the Far East. The vessels deployed are too deep drafted to call at Venice and Ravenna on the western side of the North Adriatic.

Table 2.1: Deep sea container services calling at the NAPA ports, 2010-11

							Weekly deployment					
		NAPA ports visited					2010				2011	
Service	Frequency	Ravenna	Venice	Trieste	Koper	Rijeka	Q1	Q2	Q3	Q4	Q1	Q2
CMA-CGM/MAERSK LINE - PHEX/AE12	Weekly			X	X	X	6,548	6,548				
	Weekly			X	X	X			6,548	5,704	6,548	6,498
HANJIN/YANG MING/HYUNDAI/UASC - AA	Weekly		X	X	X	X			4,365			
	Weekly		X	X	X	X				4,300	4,300	4,300
Total deployment into NAPA region							6,548	6,548	10,913	10,004	10,847	10,797

Source: MDST Containership Databank

The service jointly operated by **Hanjin, Yang Ming, Hyundai and UASC** between the Far East and the North Adriatic, on the other hand, calls at four of the five NAPA ports, only excluding Ravenna. The service started in Q3 2010 and the weekly service deploys vessels of about 4,300 TEU. It calls at the Far East ports of Singapore, Yantian, Ningbo, Shanghai, Pusan and Hong Kong before calling at Colombo in Sri Lanka and passing through the Suez Canal; after calls at Port Said and El Dhakeila in Egypt, the service calls at Mersin in Turkey and then Koper, Trieste, Rijeka and Venice before returning to the Suez Canal. The vessels lighten on the western side of the Adriatic before proceeding to Venice.

Overall, with the addition of the Hanjin/Yang Ming/Hyundai/UASC service, the deep sea container ship capacity deployed in the North Adriatic has increased by 65% since the start of 2010 and now represents about 35% of total LoLo capacity calling at ports in the region.

The deep sea lines are assumed to be securing cost and commercial advantages from making direct calls in the North Adriatic compared to the transhipment and feeder strategy that is used by most deep sea lines to serve the region. Both of these direct deep sea services call at more ports directly in the Far East than the mainline services between the Far East and the North Range ports and also serve Mediterranean markets (calling at Mersin in Turkey and Piraeus in Greece). These additional calls are likely to be required to develop the critical mass of cargo to justify the direct calls in the North Adriatic. However in order to provide the required (weekly) frequency without increasing the number of vessels deployed, the vessels have to compensate by steaming faster than the ships deployed on the Suez-Gibraltar-Rotterdam mainline route.

The reason for the large number of calls that are made in the North Adriatic by these services (in a relatively small area) appears to be to serve Northern Italy via Venice, Southern Germany and Austria via Trieste, Slovenia and Central and Eastern Europe via Koper and Croatia and Serbia via Rijeka. Port rotations in the North Adriatic may involve fewer calls in the future as ship size increases, the Balkan countries become more integrated into the EU and ports further develop their rail services to serve inland markets.

Short sea and deep sea feeder services

Analysis of the intra-Mediterranean services (carrying both short sea trade and deep sea feeder traffics) calling at the NAPA ports is shown in Appendix 1. They are of three main types:

- Specialist intra-Mediterranean short sea services, linking the Adriatic with the Eastern Mediterranean (e.g. Sermar and Borchard).
- Deep sea lines offering short sea intra-Mediterranean services along with feeder services from the deep sea transhipment hubs, such as Gioia Tauro, Malta and Taranto (e.g. Maersk's East Med services, MSC, Evergreen and Zim).
- Specialist feeder operators, providing a feeder service for deep sea shipping lines (X-Press and Adria Maritime).

The Adria Maritime service is the only feeder service with a hub in the North Adriatic. The line, which is owned and operated by the container terminal operator at Trieste, offers a roughly twice weekly service between Trieste, the naturally deepest drafted NAPA port, and Rijeka, Venice, Ravenna and Ancona.

These services represent about 65% of total containership deployment into the Adriatic. The short sea services, particularly to the east Mediterranean, are the trades in which the North Adriatic has traditionally been prominent.

The deep sea feeder services from the Mediterranean transhipment ports are in direct competition with the direct calls by deep sea vessels in the North Adriatic. On the western side of the North Adriatic, the feeder services are mainly carrying traffic for regional hinterlands (principally Northern

Italy) which is mainly distributed inland by road. On the eastern side of the North Adriatic feeder traffic is being distributed by both rail as well because the ports are serving land-locked markets at sufficient distances inland to make rail freight viable.

2.3 Summary of container facilities: Koper

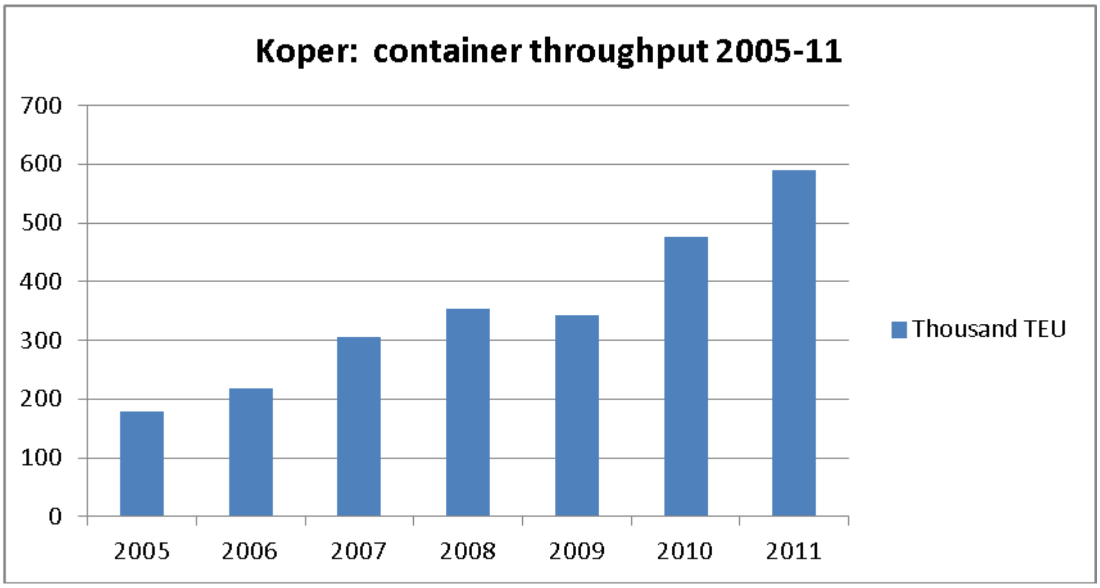
Introduction

Koper is Slovenia's only port and has an integrated structure where the single container terminal at Pier 1 is owned and operated by Luka Koper, the concessionaire for the port.

The port's hinterland mainly covers much of Central and Eastern Europe, the northern Balkans, Austria and Southern Germany. The port has a relatively high rail modal share compared to most European ports.

Container throughput 2005-11

Koper's container traffic in terms of TEU has increased by 230% during the period 2005-11 to reach 590 TEU. Given that the terminal's advertised capacity is some 0.7 MTEU (which is consistent with its quay length and area) capacity utilisation is about 85%.



Existing container-handling facilities

The port's container handling facilities and container shipping and rail services are shown below.

LUKA KOPER

Volume handled in 2011	590,000 TEU
Length of quay	600 m
Max. draft alongside	11.4 m
Number of cranes	8 x gantry cranes
Terminal area	0.3 M m²
Capacity advertised by terminal operator	0.7 M TEU
Rail sidings within terminal	2 x 671 m; 1 x 647 m
Container shipping services (Summer 2011)	*Direct deep sea (Far East):* - CMA-CGM/Maersk (weekly) Hanjin/Yang Ming/Hyundai/UASC (weekly) *East-Med:* MSC (3 x weekly); Maersk (weekly); Sermar (1.5 x weekly); Evergreen/Italia Marittima (weekly) *Feeder (including transhipment port):* CMA-CGM: Cagliari (weekly); CSAV Norasia: Malta (weekly); HDS: Malta (weekly); X-Press/COSCO: Gioia Tauro (weekly); Zim: Haifa (weekly).
Rail services	*Slovenia:* Adri Kombi: Ljubjlana/Maribor 2-3 x day *Germany:* Adria Kombi: Munich via Ljubjlana up to 2 x day *Czech Republic:* Adriakombi: Vratimov 3 x week; Metrans: on demand *Hungary:* Adriakombi: Budapest 5 x week; Navismart: Szolnok, Budaors – Torokbalin 3 x week; ARGO: Budapest: 2 x week; Metrans: Budapest 7 x week. *Slovakia:* Adria Kombi: Zilina up to 6 x week; Adria Kombi: Bratislava 3 x week; Metrans: Dunajska Streda & other destinations etc.: up to 21 x week *Serbia:* Adria Kombi: Ljubjlana/Belgrade 2 x day *Croatia:* Adria Kombi: Zagreb up to 2 x day *Austria:* Adria Transport: Graz 3-5 x week; Villach: 5 x week (RCA-ICA/Adria Kombi) *Poland:* Dabrowa Gornicza, via Vienna: 1 train x week (Adria Transport/LTE/Baltic Rail) *Bulgaria:* Sofia, via Ljubljana: 1 train x week (Adria Kombi) *Romania:* Adria Transport/Navismart: Arad, on demand

The port has direct calls from two deep sea container services, as well as short sea intra-Mediterranean services and deep sea feeder services. The port is served by a range of rail freight services serving southern Germany and Austria, Central and Eastern Europe and the Balkans.

Planned container-handling facilities

There are plans to extend the existing terminal at Pier I and to develop a new container terminal at Pier III.

Hinterland connections

The port's current hinterland for container traffic is international, covering not only Slovenia and some of Croatia and Italy (mainly served by road), but also Slovakia, the Czech Republic, Hungary, Austria, Serbia, southern Germany and parts of Romania (generally by rail).

Immediate access from the port to the strategic road network is good following the completion of a new port access road to the A1/E61/E70 motorway towards Ljubljana; this provides access by road north into Austria via the A2/E61 or south-east towards Zagreb via the A2/E70.

Rail access is provided by a single-track route to the mainline at Divaca; from there access is available westwards towards Sezana and Trieste and eastwards towards Ljubljana. The Slovenian capital acts as a hub for rail services towards Hungary, Austria, Slovakia, the Czech Republic and Serbia and southern Germany. Maximum trailing length and weight of trains from Koper is 500m (excluding the locomotives) and 1300 tonnes respectively, although trailing weight can be up to 1600 tonnes on routes through the Alps to Austria via Ljubljana. The modal split for rail is 61%.

2.4 Summary of container facilities: Ravenna

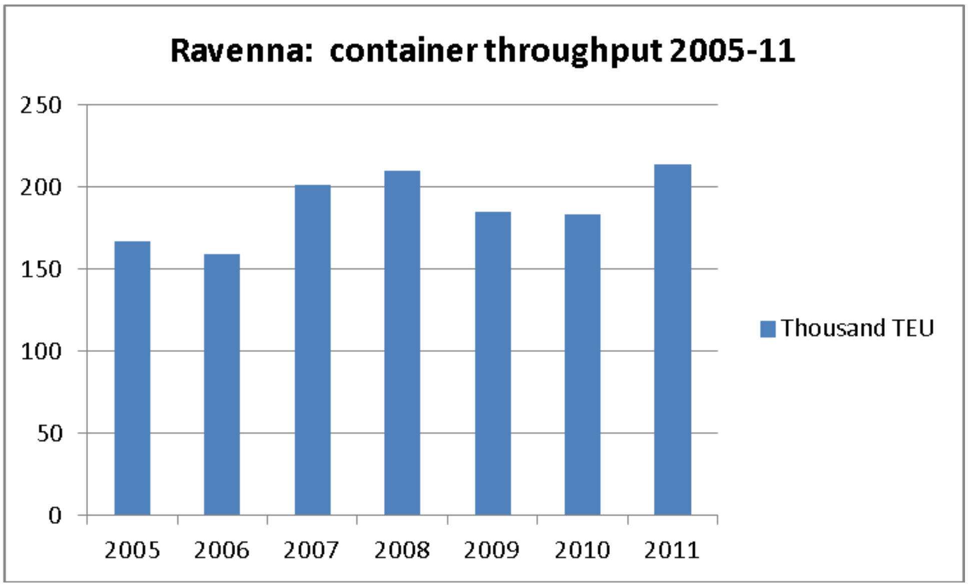
Introduction

Ravenna has a Port Authority that provides concessions to private sector terminal operators and has two terminals that handle containers: Terminal Container Ravenna (TCR) is a dedicated container terminal and handles the majority of the port's container shipping services; Setramar is a multipurpose terminal that handles containers.

The port's current hinterland mainly covers northern Italy and inland distribution is mainly by road, although small volumes of international traffic are handled via Milan by rail.

Container throughput 2005-11

Ravenna's container traffic in terms of TEU has increased by 28% during the period 2005 - 11 to reach 214,000 TEU. Given that the terminals' advertised capacity is some 0.3 MTEU, capacity utilisation for both terminals is collectively about 65%. However, given that the quay length and area available is equivalent to that of Koper, it would appear its current capacity is only constrained by equipment availability and not infrastructure.



Existing container-handling facilities

The port's container handling facilities and container shipping and rail services are shown below.

TERMINAL CONTAINER RAVENNA (TCR)

Volume handled in 2011	198,000 TEU
Length of quay	640 m
Max. draft alongside	9.6 m
Number of cranes	4 x gantry cranes; 1 x mobile crane
Terminal area	0.3 M m²
Capacity advertised by terminal operator	0.3 MTEU
Rail sidings within terminal	5 x 420 m
Container shipping services (Summer 2011)	Direct deep sea: - East-Med: Borchard (weekly); Cargo Shipping (weekly); Sermar (1.5 x week); Feeder: Adria Maritime: Trieste (2 x weekly); Maersk: Alexandria (weekly); MSC: Gioia Tauro, Trieste & Haifa (all weekly); X-Press: Malta (weekly); Zim: Haifa (weekly)
Rail services (round trip)	Ravenna-Milano Melzo: 3 x week (Sogemar) Ravenna-Modena: 2 x week (Italcontainer) Ravenna-Dinazzano: 2 x week (Dinazzano-Po)

SETRAMAR (MULTI-PURPOSE TERMINAL)

Volume handled in 2010	16,000 TEU
Length of quay	608 m
Max. draft alongside	9.6 m
Number of cranes	4 x gantry cranes; 3 x mobile cranes
Terminal area (for containers)	0.01 M m^2
Capacity advertised by terminal operator	0.2 MTEU
Container shipping services (Summer 2011)	Deep sea: - East-Med: - Feeder: Evergreen: Taranto (weekly)

The port has no direct calls from deep sea container services, but has short sea intra-Mediterranean services and deep sea feeder services. The port is served by a rail freight services that link the port with its northern Italian hinterland and, via Milan, international destinations.

Planned container-handling facilities

There are plans for a new container terminal at Ravenna on land owned by TCR's major shareholder.

Hinterland connections

The port's hinterland for container traffic is very largely national and covers, in particular, the Emilia Romagna region, and also the Lombardia, Piemonte, Marche and Veneto regions.

Immediate access from the port to the strategic road network is good, although it can be congested at peak times. Several stakeholders at the port expressed the view that immediate road access to the tangenziale would need to be improved in the future. There is then a fast motorway link to the A14, providing access north west to Bologna and then via the A1 to the rest of Emilia Romagna and Lombardia, and to the south east into Marche along the Adriatic coast. The A13 via Bologna provides access to the Veneto region.

Rail access is provided by a double-track electrified route to the mainline between Ancona and Bologna at Faenza. The mainline via Bologna then provides access to Ravenna's existing inland rail origins and destinations at Modena and Milano. Access towards Verona is available via a double-track electrified RFI route to Ferrara via Portomaggiore and then using a FER line. Maximum trailing length and weight of trains from Ravenna is 530m and 1300 tonnes respectively. The modal split for rail is estimated to be 7%.

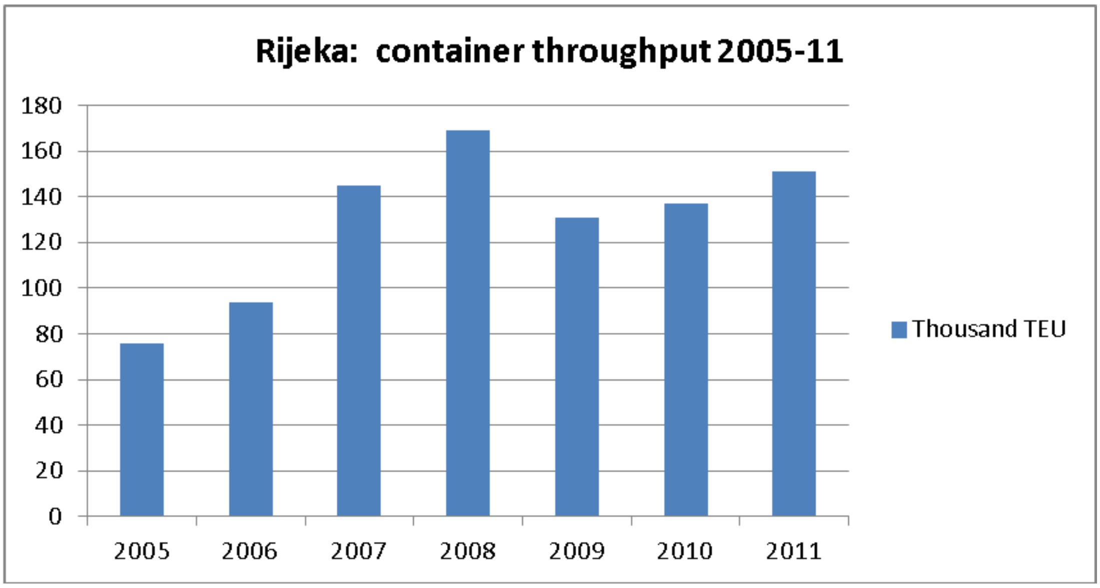
2.5 Summary of container facilities: Rijeka

Introduction

Rijeka has a Port Authority that provides concessions to private sector terminal operators and has a single container terminal, the Adriatic Gate terminal, operated by ICTSI. The port's hinterland mainly covers Croatia, Hungary, Serbia and Bosnia-Herzegovina. Inland distribution is mainly by road, although there are also rail services to Hungary and Serbia.

Container throughput 2005-11

Rijeka's container traffic in terms of TEU has increased by 99% during the period 2005-11 to reach 151,000 TEU. Given that the terminal's advertised capacity is some 0.17 MTEU, capacity utilisation is about 90%. The quay area available could potentially handle some 300,000 TEU per annum.



Existing container-handling facilities

The port's container handling facilities and container shipping and rail services are shown below.

ADRIATIC GATE

Volume handled in 2011	151,000 TEU
Length of quay	460 m
Max. draft alongside	11.7 m
Number of cranes	4 x gantry cranes
Terminal area	0.15 M m^2
Capacity advertised by terminal operator	0.17 M TEU
Rail sidings within terminal	1 x 420m siding, plus marshalling yard with 12 lines
Container shipping services (Summer 2011)	*Direct deep sea (Far East):* - CMA-CGM/Maersk (weekly) Hanjin/Yang Ming/Hyundai/UASC (weekly) *East-Med:* - *Feeder (including transhipment port):* Adria Maritime: Trieste (2 x week); CSAV Norasia: Malta (weekly); COSCO: Pireus (weekly); Evergreen: Taranto (weekly); MSC: Gioia Tauro (weekly); X-Press: Gioia Tauro (weekly).
Rail services	5 x week services to Belgrade and Budapest.

The port has direct calls from two deep sea container services, as well as deep sea feeder services. The port is served by rail freight services that link the port with Hungary and Serbia via the Croatian rail network.

Planned container-handling facilities

The existing Adriatic Gate terminal is being expanded at a budgeted cost of €50 million with the following additional facilities:

- 330m berth with draft of 14.5 metres;
- 7 hectares of new terminal area including stacking yard;
- New terminal gate facilities;
- 4 x 420 m rail sidings.

A contract for the construction of a new container terminal at Zagreb Pier will be signed at the end of 2011 with a completion date of early 2016. This terminal will have 680 metres of berth developed in two phases (1st phase of 400 m, plus 2nd phase of 280 m) with a minimum draft of 18 metres, 25 hectares of terminal area, terminal gate facilities and five 420 metre rail sidings. The total investment cost is budgeted at €120 million, including the participation of a private sector partner.

Also, there are plans for new high capacity container terminal facilities on the island of Krk, where about 100 hectares of space is available with a draft of more than 18 metres. Annual capacity at this terminal would be about 1.5 MTEU.

Planned railway facilities

Construction of a completely new high speed railway line connecting Rijeka (and the island of Krk) to Zagreb is planned to be developed by the end of the decade.

Hinterland connections

The port's current hinterland for container traffic is international, covering Croatia, Serbia and Bosnia-Herzegovina. Most traffic is distributed inland by road, although there are also rail services to the capitals of Serbia and Hungary via Zagreb.

Immediate access from the port to the strategic road network is good following the completion of the D404 port access road to the E71 towards Zagreb and then via the coastal motorway towards Split.

Rail access is provided eastwards by an electrified single-track route towards Zagreb, from where access is available via electrified routes to Hungary and Serbia. There is also an electrified route north towards Ljubljana, although the electricity supply is 3kV DC rather than 25kV AC as for the rest of the electrified network; this route is planned to be 25kV AC from July 2012 (source: Annex 3.7 Croatian Railways Infrastruktura: Network Statement 2012). All the key freight routes described above are single track apart from a double track section between Novska and the Serbian border at Tovarnik. Maximum trailing length and weight of trains from Rijeka is believed to be 500m (excluding the locomotives) and 1300 tonnes respectively. The loading gauge between Rijeka and Zagreb is GB and then GC to the Hungarian and Serbian borders, while the route north to the Slovenian border is GA. These all permit the passage of high cube containers. The modal split for rail is estimated to be about 10%.

2.6 Summary of container facilities: Trieste

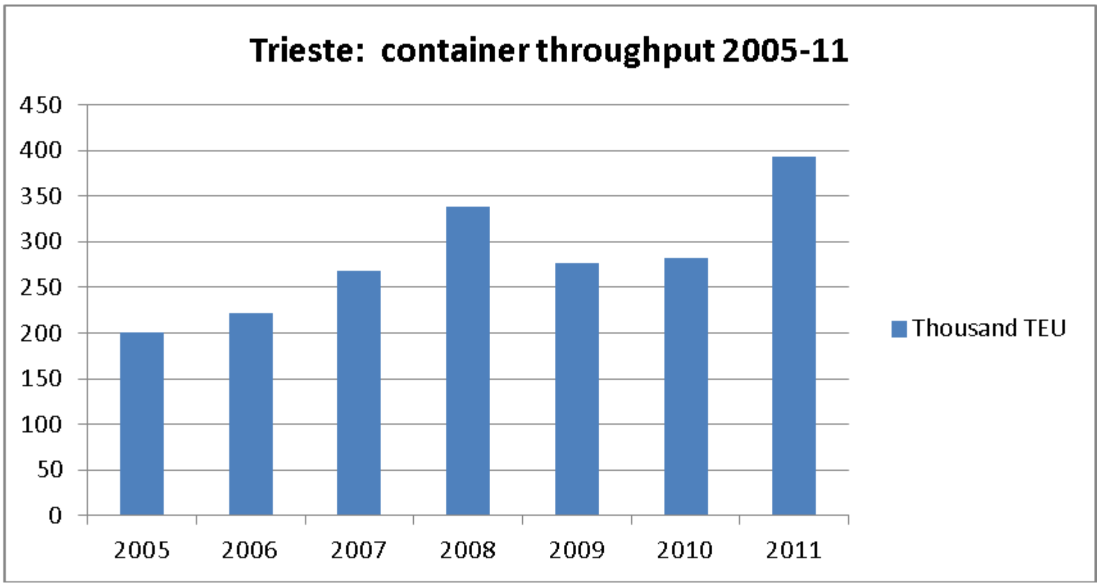
Introduction

Trieste has a Port Authority that provides concessions to private sector terminal operators and has a single container terminal, the Trieste Marine Terminal.

The port's hinterland mainly covers Austria, Southern Germany, Hungary and northern Italy. The port has a relatively high rail modal split compared to most European ports.

Container throughput 2005-11

Trieste's container traffic in terms of TEU has increased by 96% during the period 2005-11 to reach 393,000 TEU. The terminal's advertised capacity is some 0.6 MTEU despite having greater quay length area than that of Koper (0.7m TEU declared capacity). Capacity utilisation is therefore about 65%.


Trieste: container throughput 2005-11
450
400
350
300
250
200
150
100
50
0
2005
2006
2007
2008
2009
2010
2011
Thousand TEU

Existing container-handling facilities

The port's container handling facilities and container shipping and rail services are shown below.

TRIESTE MARINE TERMINAL

	Existing
Volume handled in 2011	393,000 TEU
Length of quay	770 m
Max. draft alongside	17.4 m
Number of cranes	7 x gantry cranes
Terminal area	0.4 M m^2 (stacking surface)
Capacity advertised by terminal operator	0.6 M TEU
Rail sidings within terminal	5 x 600 m
Container shipping services (Summer 2011)	*Direct deep sea (Far East):* CMA-CGM/Maersk (weekly) Hanjin/Yang Ming/Hyundai/UASC (weekly) *East-Med:* Maersk (weekly); MSC (3 x weekly): *Feeder (including transhipment port):* Adria Maritime: Trieste (2 x week); Evergreen: Taranto (weekly); Hapag Lloyd: Cagliari (weekly); X-Press: Gioia Tauro (weekly); Zim: Haifa (weekly).
Rail services	*Austria:* Villach 4-5 x week; Graz 4-5 x week; Vienna 4-5 x week; Linz 4-5 x week; Salzburg 4-5 x week; Wolfurth 4-5 x week (all Alpe Adria – ICA) *Czech Republic:* Prague (on inducement) 1 x week *Hungary:* Budapest 1-2 x week (Alpe Adria); Szolnok 1 x week (Alpe Adria – Navismart); Zahony 1-2 x week (Alpe Adria) *Germany:* Munich 4-5 x week; Ulm 1-2 x week; Ludwigshafen (via Munich) 5 x week; Koln (via Munich) 5 x week; Duisburg (via Munich) 5 x week; Leipzig (via Munich) 5 x week; Berlin (via Munich) 5 x week (all Alpe Adria to Munich & Ulm, then Kombiverkehr to rest of Germany). *Italy:* Padova 3-5 x week; Milano 1-3 x week (on inducement), Bologna 1 x week (on inducement), Fernetti/Trieste 1 x week (on inducement).

The port has direct calls from two deep sea container services, as well as short sea intra-Mediterranean services and deep sea feeder services. The port is served by a range of rail freight services serving southern Germany and Austria, Central and Eastern Europe and Italy.

Planned container-handling facilities

There are plans for an expansion to the existing Trieste Marine Terminal at Molo VII and for a new terminal at Molo VIII.

Hinterland connections

The port's current hinterland for container traffic is international, covering not only Italy (principally the regions of Friuli-Venezia-Giulia, Veneto and Lombardia), Austria, southern Germany, Hungary and the Czech Republic.

Immediate road access from the port to the strategic road network (A4/E70 motorway) is good and provides access to Slovenia to the north east and to the rest of Friuli-Venezia-Giulia and Veneto to the east, as well as to Austria via the A23/E55.

Rail access towards the rest of northern Italy is provided by a double-track electrified route from Trieste to Venezia and Padova. The fastest route to Austrian markets is via the mainline westwards to Cervignano and then on an electrified single track line north towards, and then on a by-pass around, Udine to join the double track electrified mainline between Udine and Tarvisio. The most direct route to Hungary is on the double track electrified route to the Slovenian border at Villa Opicina and then via Ljubljana. Maximum trailing length and weight of trains from Trieste varies according to the destination inland: towards northern Italy, Germany and Austria, the maximum length is 550m, but it is only 505m to Hungary; the trailing weight for Italian services is 1300 tonnes in both directions, while it is 1100 tonnes northbound and 1300 tonnes southbound on international services. The modal split for rail is estimated to be about 40%.

2.7 Summary of container facilities: Venice

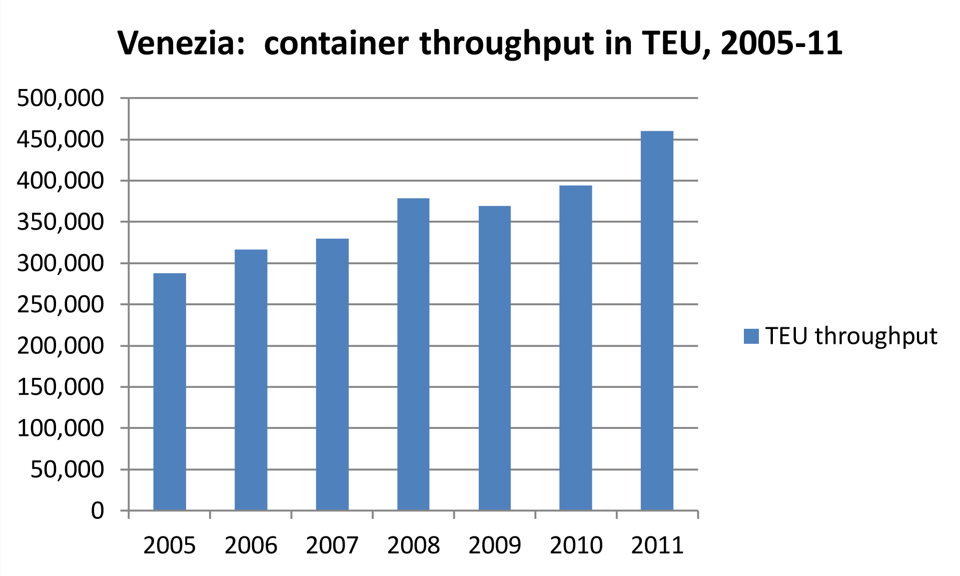
Introduction

Venice has a Port Authority that provides concessions to private sector terminal operators and has two container terminals; Vecon is a dedicated container terminal operated by PSA, while TIV is a multi-purpose terminal with a strong presence in the container market.

The port's hinterland covers northern Italy and inland distribution is mainly by road, although there is a rail service to Milan which provides access to international markets across the Alps.

Container throughput 2005-11

Venice's container traffic in terms of TEU has increased by 60% during the period 2005 - 11 to reach 460,000 TEU. Given that the terminals' advertised capacity is some 0.7 MTEU (consistent with the quay area available), capacity utilisation is about 65%.



Existing container-handling facilities

VECON

Volume handled in 2010	233,000 TEU
Length of quay	850 m
Max. draft alongside	10.60 m
Number of cranes	6 x gantry cranes
Terminal area	0.3 M m²
Capacity advertised by terminal operator	0.5 MTEU (Source: PSA website)
Rail sidings within terminal	4 x 400 m
Container shipping services (Summer 2011)	*Direct deep sea:* Hanjin/Yang Ming/Hyundai/UASC (weekly) *East-Med:* Borchard (weekly) *Feeder, with transhipment port:* Hapag Lloyd: Cagliari, CMA-CMA: Malta/Trieste; Maersk: Gioia Taouro/Trieste; Evergreen: Taranto; X-Press: Gioia Tauro; Zim: Haifa (all weekly)
Rail services	-

TERMINAL INTERMODALE VENEZIA (TIV)

Volume handled in 2010	160,000 TEU
Length of quay	1,060 m
Maximum draft alongside	10,5 m
Number of cranes	3 x mobile cranes
Terminal area	135.000 square metres
Capacity advertised by terminal operator	0.3MTEU
Rail sidings	6 sidings
Container shipping services (Summer 2011)	Deep sea: - East-Med: Sermar (1.5 x week); MSC (3 x week) Feeder: Cosco: Piraeus (weekly); MSC: Gioia Tauro & Trieste (both weekly).
Rail services	Venezia-Milano Melzo: 2 x week (operated by Venezia Logistics)

Planned container-handling facilities

There are plans for a new container terminal on the Montesyndial site in Marghera and for a new offshore container terminal outside the lagoon. There are also plans for two smaller container terminals at Chioggia and Porto Levante for barge traffic to/from the offshore terminal, en route to Mantua by the River Po system.

Hinterland connections

The port's current hinterland for container traffic mainly covers the north of Italy, principally the Veneto, Lombardia and Emilia Romagna regions and so is dominated by road haulage for inland distribution; there is however a twice weekly rail service to Milan, which provides access to a network of international services across the Alps.

Immediate road access from the port to the strategic road network (A4/E70 motorway) is good and the new A4/E70 tangenziale motorway to the north of Mestre has reduced congestion around the port area. The A4 provides access to the east towards Friuli-Venezia-Giulia and west to Verona and Lombardia, while the A13 provides access towards Rovigo and Bologna to the south east.

Rail access towards the rest of northern Italy for existing rail services is provided by a double-track electrified route from Venice Mestre to Padua and then via Vicenza and Verona to Brescia and Milan. Maximum trailing length and weight of trains from Venice is 550m and 1600 tonnes respectively. The modal split for rail is estimated to be about 3%.

An inland waterway service using a push barge and dumb barges (60 TEU capacity) between Porto Marghera and Mantua via the Fissero-Tartaro-Canal Bianco waterways has been tested by a company that is owned by the Port Authority. The waterways as far as Mantua are open 365 days per year.

2.8 Conclusion on NAPA container facilities

The NAPA container facilities, located in three different countries, are quite diverse, with varying depths of water, sometimes quite different hinterlands and modal splits and two different organisational structures. However all the NAPA ports have very similar forelands (the East Mediterranean and markets east of Suez) and face similar challenges, which relate in particular to:

- How to attract additional direct calls from vessels on the Far East-Europe trade corridor;
- How to accommodate increasingly large deep sea container ships that operate on routes between Europe and the Far East/India;
- How to develop efficient rail freight services to link the ports with existing and potential inland markets in the continental and often landlocked heart of Western and Eastern Europe, while reducing the environmental impact of inland distribution.

In many respects a distinction can be made between the western NAPA ports (Ravenna and Venice) and the eastern NAPA ports (Trieste, Koper and Rijeka). The western NAPA ports enjoy very rich local hinterlands (particularly the Italian regions of Veneto, Emilia Romagna, Lombardia and Piemonte), so that inland distribution is usually by road over quite short distances (up to about 150km from the ports). However because of their low-lying locations these ports lack naturally deep water so that significant dredging is required to maintain or increase water depths.

The eastern NAPA ports, on the other hand, are located very close to each other and generally have less rich immediate hinterlands; however, through the development of intermodal rail freight services, these ports have secured access to expanding markets in Eastern Europe, as well as serving Austria and Southern Germany. The importance of rail freight services for these ports to access their hinterlands is demonstrated by the estimated modal split for rail at Trieste and Koper of about 40% and 60% respectively. Trieste and Rijeka enjoy naturally deep water, while Koper requires more dredging to maintain and increase water depth.

Measuring container terminal capacity is affected by a large number of factors, but based on the advertised terminal capacities provided by the terminal operators, estimated capacity utilisation of container terminal capacity in individual ports in 2011 varied from an estimated 65% to 90%. Overall, NAPA container terminal capacity utilisation based on declared capacity is estimated to be 70%.

Table 2.2: Estimated total container terminal capacity utilisation at the NAPA ports in 2011

Port	Traffic volume in 2011 (million TEU)	Approx. advertised terminal capacity (million TEU)	Approx. capacity utilisation based on declared capacity
Koper	0.59	0.7	85%
Ravenna	0.21	0.3	65%
Rijeka	0.15	0.2	90%
Trieste	0.39	0.6	65%
Venice	0.46	0.7	65%
Total	1.80	2.5	70%

Source: NAPA ports; analysis by MDST

3 NAPA CONTAINER PORT HINTERLAND & FORELAND TO 2030

3.1 Introduction

This chapter sets out the results of the origin-destination (OD) matrix and the demand simulation model that have been developed by the consultancy team. The OD matrix describes the origins and destinations of containerized trade between the European continental mainland and the rest of the world and is a key input to the demand simulation model.

The demand simulation model both describes and "explains" the pattern of deep sea and short sea containerised trade between Europe and the rest of the world via port groupings (including the North Adriatic) through a cost model approach. The advantage of this approach is that it allows a range of economic and commercial scenarios to be tested, as an objective means to provide sensitivity tests and central forecasts for the growth in container traffic through the NAPA ports up to 2030.

3.2 Methodology

The OD trade matrix and the geographic scope of the model

The consultancy team has developed an OD trade matrix for the study, which provides foreland-to-hinterland trade flows by direction for 2010 for the whole of the European continental mainland (i.e. excluding the British Isles, Scandinavia and the Baltic States and Mediterranean islands).

The trade data has been extracted from the MDST World Cargo Database (WCD), which is a trade database that is updated on a quarterly basis and offers global coverage on a common basis from 1996. Data from the WCD has been used in this study to provide estimates of the size of containerized trade flows through ports between European countries within the geographic scope of the study and the rest of the world. WCD estimates the proportion of each country x country x commodity trade that is handled by the container shipping industry to provide outputs in terms of maritime TEU. The estimates are produced by applying unitisation factors for each of the 3,000 commodities to determine the volume of goods that are transported in some kind of unit, including maritime containers. Then, for each country-to-country trade flow, an estimate is made to calculate the amount of the unitised trade that is handled in a maritime container through a port (loaded maritime TEU).

The OD trade matrix that was developed for the study contains European country-to-world region trade flows with a regional split for the larger countries (Italy, Germany, Poland, France, Romania and Spain). The OD matrix therefore contains the estimated volume of deep sea and short sea containerized import and export flows in TEU between the NAPA foreland (world regions and some Mediterranean countries) and the NAPA hinterland (European continental mainland countries and regions for some larger countries).

The world regions that are included in the OD matrix are shown in Table 3.1, while the European continental mainland countries (with selected regions) that are included in the OD matrix are shown in Table 3.2.

Table 3.1 World regions included in 2010 OD matrix

World regions	Size of foreland market (MTEU)
Algeria	0.19
East Mediterranean	1.06
East of Suez	18.35
Egypt	0.59
Greece	0.17
Libya	0.23
North America	5.35
South America	3.03
Tunisia	0.12
Turkey	0.27
West Africa	1.62
Total	30.98

Source: MDST World Cargo Database

Table 3.2 European countries (with selected regions) included in 2010 OD matrix

European countries	Size of hinterland market (MTEU)
Albania	0.04
Austria	0.70
Belgium	2.73
Bosnia and Herzegovina	0.05
Bulgaria	0.15
Croatia	0.16
Czech Republic	0.48
Denmark	0.59
France	3.42
Germany (with selected regions)	6.86 *Of which:* *Baden Wuerttemberg 0.63* *Bavaria 0.52*
Greece	0.46
Hungary	0.33
Italy (with selected regions)	4.17 *Of which:* *Emilia Romagna 0.75* *Friuli-Venezia-Giulia 0.15* *Veneto 0.52*

	Lombardia 1.21
Luxembourg	0.05
Moldova	0.03
Netherlands	4.75
Poland	1.04
Portugal	0.65
Romania	0.35
Serbia & Montenegro	0.09
Slovakia	0.23
Slovenia	0.15
Spain	3.04
Switzerland	0.38
Total	30.98

Source: MDST World Cargo Database

The demand simulation model

The demand simulation model (called the MDST European Container Port Demand Model, ECPDM) is designed to model the allocation of the origin-destination flows in maritime TEU to European port groupings, which were defined as follows:

- North Adriatic (NAPA plus Ancona)
- Northern Range
- Tyrrhenian ports
- Black Sea
- Greece
- Other West Mediterranean ports
- Atlantic coast

The ECPDM then allocates traffic to ports on the basis of the lowest generalised cost on a "door-to-door" basis i.e. taking into account:

- The cost per TEU of container shipping between different world regions and the different ports;
- The port cost per TEU in different ports;
- The road and rail costs from each port.

The model therefore makes the key assumption that the shipping lines and/or freight forwarders will seek to find the route that provides the lowest generalised cost for any OD pairing.

The **costs per TEU for container shipping** were calculated using models that were developed by MDST for its Box Trade Intelligence joint venture with the assistance of former deep sea shipping line executives and mainly take into account the costs of the ships and fuel. They were calculated for world region-port grouping pairings for representative ship sizes, based on actual deployment in 2010-11, and so take into account the size of ships and the economies of scale that are available plus the speed of vessels to achieve the required frequency of service given the number of port calls.

The **port cost per TEU** for each port grouping are based on MDST's estimates, which have mainly been obtained during the NAPA port visits in June and July 2011 and on inputs to Box Trade Intelligence.

The **road freight costs** for inland distribution are based on a cost model that takes into account the fixed and variable costs of operating HGVs, with adjustments to take account of the levels of fuel duty on diesel in the different countries. The **intermodal rail freight costs**, similarly, take into account the fixed costs (traction, track access, wagons etc.) and the variable costs (principally terminal handling costs and road collection and delivery between the inland terminal and the final origin/destination). For both road and rail, the key factor that determines the inland mode of transport from a particular port/port grouping and the inland country/region is the distance and the distances are calculated between each port and a centroid in the region/country. The model contains an algorithm that calculates the split between road and rail based on the inland distance, so that as the distance increases the proportion of traffic by rail increases up towards 100%; this algorithm avoids allocating 100% of traffic to a particular region to road and then 100% of traffic to a neighbouring region to rail because the theoretical cost threshold between road and rail has been reached. **Inland waterway transport** is taken into account in the model by including Duisburg, with an additional cost associated with the inland waterway leg from Rotterdam or Antwerp.

The model then, in essence, allocates each world region-inland region trade flow to ports that form part of the most cost-effective routes on a "door-to-door" basis, taking into account shipping costs, port costs and inland transport costs. However, the model includes an algorithm that avoids allocating 100% of traffic to an inland region to a particular port/port grouping on the basis of the lowest cost alone, but spreads the traffic between the most competitive ports with most traffic going to the cheapest.

The model is then **calibrated** to ensure that the actual containerized traffics passing though individual ports reflect the actual volumes in 2010 by adding or subtracting costs related to individual ports. This calibration accounts for intangible elements that cannot be accounted for directly, such as relative efficiency in customs procedures and in terminal handling and any cultural issues that affects port choice. The objective of calibration is to incorporate fixed costs (positive or negative) into the cost calculation for each route to take into account various attributes that are not included in the transport cost models. For example, if a port has poor labour relations, this may discourage use, effectively adding an extra cost to that port, but this cannot be incorporated directly into a door-to-door freight transport model. Similarly if a particular inland region has cultural ties with a particular port, this port may be looked upon more favourably than cost alone would suggest.

Further details of how the model worked, including some case studies of "door-to-door" flows, are provided in Appendix 1.

3.3 Results of modelling of the 2010 Base Case

The result is a model that both describes and "explains" through "door-to-door" costs the allocation of maritime containerized trade flows between the European continental mainland and the rest of the world by port/port grouping. In total the model allocates **31.0 MTEU of containerized traffic** to the top 40 European ports located on the European continental mainland. The split of this total between the port groupings is shown in Table 3.3. Please note that the traffic volumes exclude transhipment traffic i.e. they only refer to traffic that is distributed inland (gateway traffic).

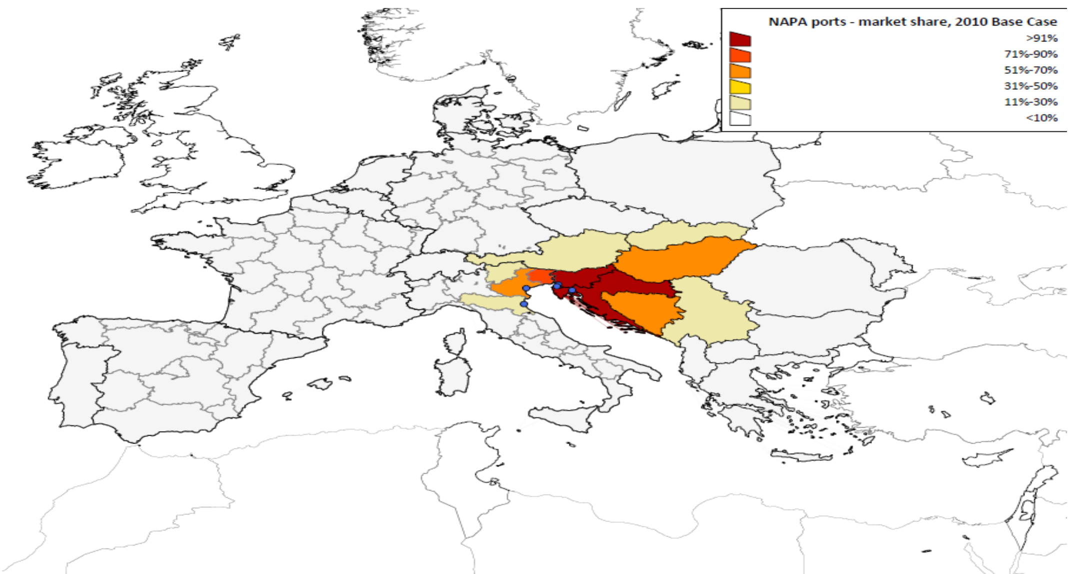
Table 3.3: Calibrated 2010 Base Case – containerized traffic[1] by port grouping

Port grouping	Allocated traffic from model (MTEU)
North Adriatic	1.49
Northern Range	20.4
Tyrrhenian	3.6
Greece	0.8
Black Sea	0.3
West Mediterranean	2.6
Atlantic	1.7
Total	31.0

[1] Excluding transhipment

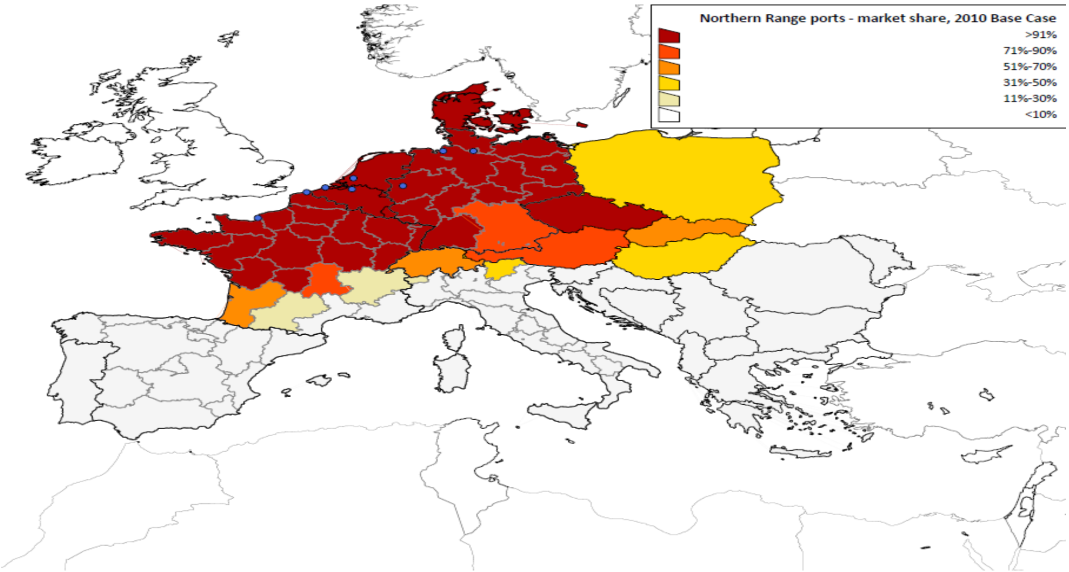
Source: MDST European Container Market Demand Model

The hinterland of the NAPA ports in 2010, as described in the model, is shown in the map below. It shows the proportion of the total maritime containerized traffic that is handled in each inland region and therefore describes where the NAPA ports are most competitive relative to other deep sea container ports.



The core NAPA hinterland that emerges from the model is therefore North East Italy, Austria, Hungary, Slovakia, Slovenia, Croatia and Serbia. The NAPA ports are less competitive for Switzerland, North West Italy or France where there is competition from such ports as Genoa and Fos as well as from the Northern Range ports.

The following map shows the hinterland of the Northern Range ports in the same way and shows the extent of the hinterlands of Rotterdam, Antwerp and Hamburg, in particular, through their use of a network of rail freight services to extend their hinterland beyond North West Europe.



The modelling shows how the combination of large container ships and efficient rail freight services via the Northern Range ports allows ports in North West Europe to secure significant market shares of the container markets in countries/regions which are geographically closer to the North Adriatic ports. The modelling suggest that this can also be explained by some intangible factors such as shipping line/forwarder confidence in the reliability of services from Northern Range ports and the relative under-development of rail freight services between the ports on the western side of the Adriatic and their hinterlands in Italy and beyond. It is important to recognise the benefits of inertia that the Northern Range ports have enjoyed because the European container terminal industry developed by serving the North America to North West Europe market, for which this group of ports is very well located.

3.4 Future scenarios up to 2030

The consultancy team developed scenarios for 2015, 2020 and 2030 to allow a number of "what if?" assumptions to be tested that could affect the competitiveness of the North Adriatic ports in handling containers compared to the current situation and in competition with other port regions. The assumptions included in the model were designed to be reasonable and realistic given existing market and policy trends so that the forecasts should provide a realistic basis for planning for NAPA up to 2030.

Trade forecasts

The first task in determining the potential traffic that could be handled through the NAPA ports was to produce forecasts of the total containerized trade between the European continental mainland and the rest of the world up to 2030.

The total containerized trade volumes included in the OD matrix for 2010 were forecast up to 2030 using the forecasting module of the MDST World Cargo Database. The forecasting technique is based on an algorithm that establishes trends at a detailed commodity level between individual trading partners, with a weighting towards more recent results. In this way the forecasting software can take account of the impact of the global economic recession in 2008-09, while (in aggregate terms) reflecting long term trade growth. The trends reflect the impact of macro-economic factors such as exchange rates and economic growth rates, while also reflecting other important factors such as trends in European manufacturers and retailers to source part-finished industrial goods and consumer goods from factories in the Far East and integration of Central and Eastern European and Balkan States into the European Single Market.

The forecasts are not based therefore on assumptions about future economic growth, but reflect the complex mix of factors that have affected (and will continue to affect) trade flows by individual commodity and between individual trading countries in the future. This also means that the forecasting technique produces a single central trade forecast, although as the trade data upon which the forecasts are developed is up-dated on a quarterly basis, these forecasts change slightly over time. It is not possible therefore to produce sensitivities based on varying assumptions about economic growth rates; this reflects our view, based on three decades of experience in forecasting trade, that changes in trade flows are not adequately explained by changes in the rate of economic growth volumes.

The trade forecasts are the result of the aggregation of a large number of individual commodity forecasts between trading countries based on a time series of trade data from 1996 updated on a quarterly basis. The trade forecasts are based therefore on a trade forecasting model, rather than on assumptions about possible future growth in trade, and the evidence since 1996 suggests that containerised trade generally grows on a straight line basis (so that the percentage increase in trade each year will gradually fall) and not on a compound basis which implies that the amount of trade will increase in absolute terms every year.

The trade forecasts for the European continental mainland are shown in Table 3.4 below:

Table 3.4: Trade forecasts for the European continental mainland, 2010-30

Year	European continental mainland container traffic (MTEU)	Growth compared to 2010
2010	31.0	-
2015	37.6	+21.5%
2020	42.8	+38.1%
2030	53.5	+72.6%

Source: MDST World Cargo Database

These trade containerized forecasts suggest that trade flows will grow by about 70% between 2010 and 2030.

Assumptions for modelling

In order to produce a scenario for the potential development of container traffic throughthe NAPA ports up to 2030, we needed to make a series of assumptions about economic drivers that could affect the relative cost of the door-to-door transport chain between the European continental mainland and the rest of the world via the North Adriatic ports and all other European port groupings. The selected economic drivers, apart from trends in trade growth, were:

- Trends in the oil price;
- Rail freight grants for trans-alpine flows through Switzerland;
- On-going rail freight liberalisation;
- Length of freight trains from ports;
- Ship size, leading to shipping economies of scale;
- Internalization of external costs for all modes, including global container shipping.

The European Commission has produced forecasts for the **price of oil** in the future which suggests that the price of oil will increase as reserves of oil that can easily be exploited are used up and world demand, particularly from the developing world, increases. This trend in the market price of oil will lead to higher fuel costs per tonne for bunkers for container ships and for inland freight transport by road and rail (if diesel locomotives are employed). As the basis of our assumption for increases in oil prices we have used factors included in official UK Government transport planning guidance for the resource cost of oil.

The **Swiss Government provides grants** per unit and per train for rail freight traffic that crosses, including container traffic from Northern Range ports to Northern Italy. The grant is provided, in theory, to ensure that the container traffic remains on rail rather than switching to road and is provided on the basis of a rate per unit and a rate per train up to certain limits. For example, from Rotterdam a train to Northern Italy can receive €75/unit in each direction and €850/train. The grants have to be justified by a financial case that demonstrates that the grant is needed to make the service break even, so assuming that the operators can justify 75% of the maximum available grant from Rotterdam to Northern Italy, the average amount of grant is €76/unit or €45/TEU. Grants rates from Belgian and German ports are even higher. The Swiss Government has a stated aim of gradually phasing out these grants and we have assumed that they will not be available from 2020 onwards.

Liberalisation of the rail freight market has been achieved in legislative terms across all relevant Member States, but the actual ease with which new rail freight traction providers can enter the market varies between Member States. We have assumed therefore that by 2020 rail freight liberalisation across Europe will have achieved a 20% increase in the average utilisation of locomotives due to increased competition in the rail traction market. This has the effect of increasing the competitiveness across the whole of Europe of intermodal rail freight services for the inland distribution of containers in competition with road freight.

The **length of freight trains** has a big impact on the economics of rail freight services because the high fixed costs of rail freight (particularly the traction and the train path) can be spread across more units, leading to lower costs per unit. Trains to and from the Northern Range ports to the north of the Alps are up to 750 metres in length (the maximum length is not always achievable to all inland market because of a limitation on train lengths in other parts of Europe that the train passes through), while trains to and from the NAPA ports are usually no more than 550 metres in length. The standard length of freight trains for the TEN-T is 750 metres. We have assumed in the scenarios that all ports in the computer simulation model can operate trains that are 750 metres long, not just those from the Northern Range ports.

Ship sizes, with the knock-on impact on shipping economies of scale, were grown in line with trade growth in container traffic. Ship size was increased from an average of 5,500 TEU in 2010 and 2015 for direct calls from the Far East to 8,000 TEU in 2020 and 11,000 TEU in 2030, which equates to a reduction in the average shipping cost per TEU of €120 in 2020 and €140 in 2030. This is based on the underlying assumption that rates in the container shipping market between East of Suez and the North Adriatic will be determined by the cost of direct calls by large deep sea container ships, rather than by a transhipment and feeder strategy from 2020 onwards. We believe this is likely to occur in the market once at least three major lines or consortia are operating direct services into the North Adriatic, so that greater competition leads to cost reductions being passed onto freight forwarders, shippers and receivers. **Competitor ports are not capacity constrained in the model, so they are assumed to be able to expand their capacity to accommodate deeper drafted vessels in line with trade growth; it could be argued that some competitor ports (e.g. the Ligurian ports) may be constrained for space in the future, although they may also be able to build additional capacity on reclaimed land.**

The **internalisation of external costs** remains a core policy of the EU, particularly given the stated policy objectives of reducing carbon emissions and congestion. We have assumed that the policy has been implemented in 2030 but not earlier and we have used the values for external costs that were published in October 2011 for all modes for use in the evaluation of projects in the European Commission's Marco Polo Programme. The overall effect of the internalisation of external costs is to increase the costs of shipping and road freight, in particular, favouring shipping solutions that minimise shipping distances and promoting the use of rail for inland distribution.

A summary of the assumptions made is shown in Table 3.5.

Table 3.5: Summary of assumptions for modelling of the NAPA Development Potential Scenario

	2015	2020	2030
Price of oil (increase on 2010)	+2.2%	+7.8%	+18.8%
Swiss trans-alpine rail freight grants	€76-€93/unit grant from Swiss grant for rail freight from Northern Range ports to Italy	Grant phased out	As for 2020
Rail freight liberalisation	No change from 2010	20% increase in the utilisation of locomotives	As for 2020
Length of trains from all ports	No change from 2010	750 metres	750 metres
Ship size at non-NAPA ports	Increases in line with trade growth	Increases in line with trade growth	Increases in line with trade growth
NAPA ship size	5,500 TEU	8,000 TEU	11,000 TEU
Internalisation of external costs for all modes	-	-	Full internalisation of costs for all modes, with container shipping using low sulphur fuel

Source: MDS Transmodal

3.5 Results of modelling of the NAPA Development Potential Scenario

The results of the modelling of scenarios for the NAPA Development Potential Scenario described above in terms of traffic volumes are set out in Table 3.6 below.

Table 3.6: NAPA Development Potential Scenario - Modelled container traffic volumes through NAPA & other port groupings, 2010-30

	2010	2015	2020	2030	Increase 2010-30
NAPA	1.3	1.7	4.0	6.0	+348%
Northern Range	20.4	24.9	25.7	31.5	+52%
Tyrrhenian	3.6	4.2	4.9	6.0	+68%
Black Sea	0.3	0.4	0.5	0.7	+112%
Other	5.3	6.5	7.7	9.5	+81%
Total	31.0	37.6	42.8	53.5	+73%

Source: MDST European Container Market Demand Model

The results of the modelling of scenarios described above in terms of market share are set out in Table 3.7 below.

Table 3.7: NAPA Development Potential Scenario - Modelled container traffic market shares for NAPA & other port groupings, 2010-30

	2010	2015	2020	2030	Change 2010-30
NAPA	4.3%	4.4%	9.4%	11.3%	+6.9%
Northern Range	66.0%	66.1%	60.0%	58.3%	-7.7%
Tyrrhenian	11.6%	11.2%	11.4%	11.3%	-0.3%
Black Sea	1.1%	1.1%	1.2%	1.3%	+0.2%
Other	17.0%	17.2%	18.0%	17.8%	+0.8%
Total	100.0%	100.0%	100.0%	100.0%	

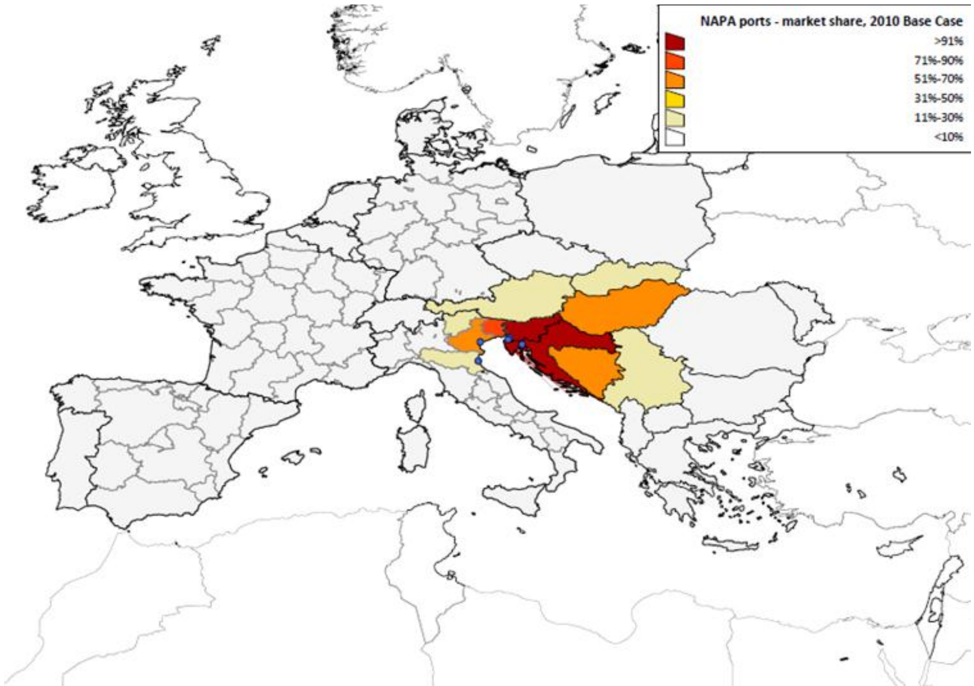
Source: MDST European Container Market Demand Model

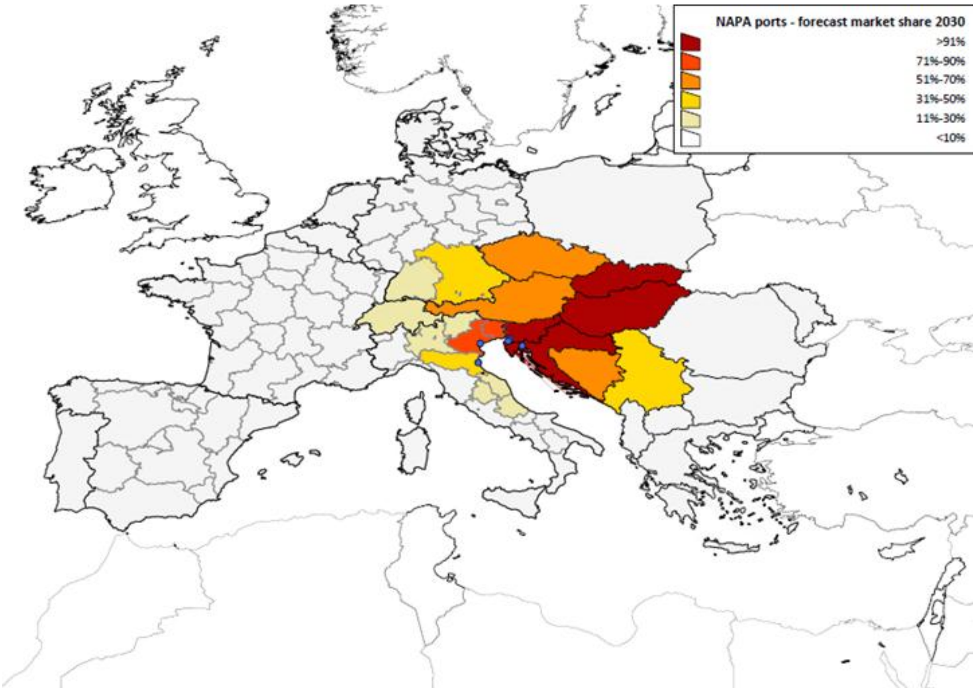
The results show that the major economic drivers of demand and market share through the NAPA ports are the introduction of ships of about 8,000 TEU making direct calls in the North Adriatic from 2020 (and their cost structures determining the market price charged to freight forwarders, receivers and shippers), and about 11,000 TEU from 2030, allied to efficient rail freight services for inland distribution (particularly being able to operate 750 metre long trains). In these circumstances the NAPA ports become more competitive and secure significant additional market share.

In 2030 the internalisation of external costs has the effect of favouring port groupings that offer shorter maritime distances and are closer to the inland origins and destinations of traffic compared to the Northern Range ports. The model suggests that the NAPA ports could secure 6.0 MTEU of traffic by 2030, representing 11.3% of the market; this would represent traffic growth of almost 350% over 20 years. Most other port groupings would also benefit from the assumptions included within the scenario for 2030, with the exception of the Tyrrhenian ports which would lose a small amount of market share in 2030 compared to 2010. The Northern Range would lose some 7.7% of market share, reflecting the "re-balancing" effect of the assumptions made in the modelling, while still securing an additional 11.1 MTEU of traffic in 2030 compared to 2010.

The modelling confirms the hypothesis that a combination of direct calls by larger deep sea container ships in the North Adriatic plus efficient rail freight services to the Balkans, Central and Eastern Europe and north of the Alps to Germany and Austria should be highly competitive with traffic via the Northern Range ports.

The impact on the hinterlands of the NAPA ports and the Northern Range are shown on the following pages.


NAPA ports - market share, 2010 Base Case
>91%
71%-90%
51%-70%
31%-50%
11%-30%
<10%


NAPA ports - forecast market share 2030
>91%
71%-90%
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11%-30%
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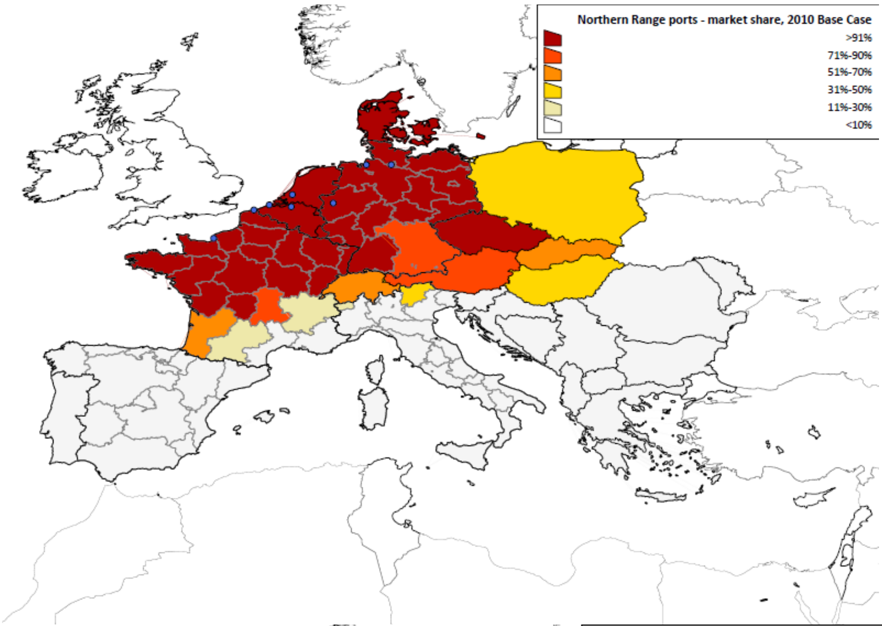
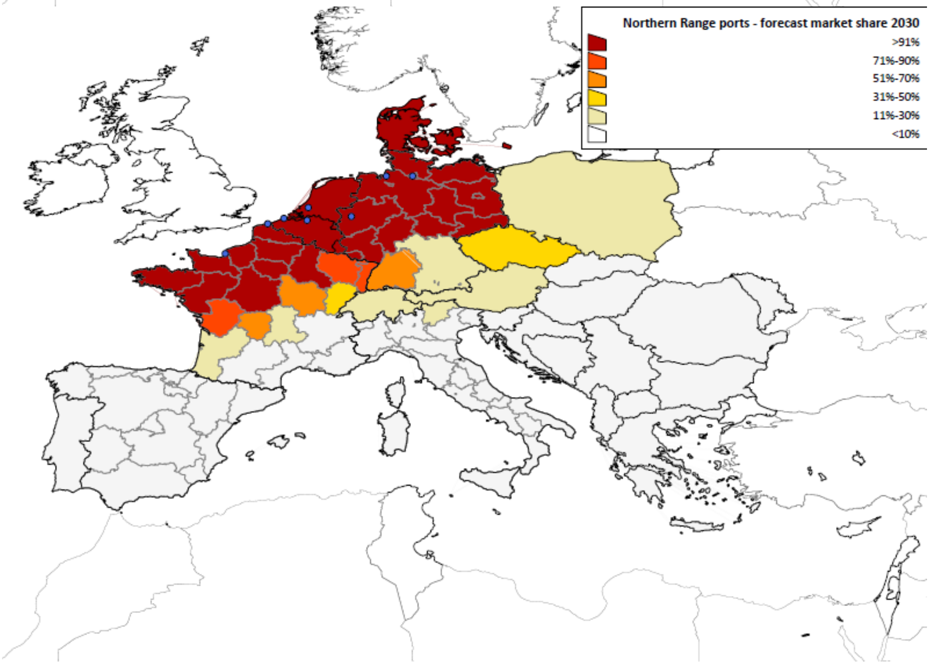

Northern Range ports - market share, 2010 Base Case
>91%
71%-90%
51%-70%
31%-50%
11%-30%
<10%


Northern Range ports - forecast market share 2030
>91%
71%-90%
51%-70%
31%-50%
11%-30%
<10%

3.6 Results of modelling for alternative scenarios

In order to provide comparators and to estimate the relative importance of different economic drivers we have developed a number of different alternative scenarios, which are described in Table 3.8. The assumptions for the NAPA Development Potential Scenario have also been included for the sake of comparison.

Table 3.8: Summary of assumptions for modelling of alternative scenarios for 2030

	NAPA Development Potential	Business-as Usual (BAU)	No Internalisation of External Costs	BAU with Big Ships
Price of oil (increase on 2010)	+18.8%	+18.8%	+18.8%	+18.8%
Swiss trans-alpine rail freight grants	Grant phased out	Grant available.	Grant phased out	Grant available.
Rail freight liberalisation	20% increase in the utilisation of locomotives	No change from 2010	20% increase in the utilisation of locomotives	No change from 2010
Length of trains from all ports (750m at Northern Range ports)	750 metres	No change from 2010	750 metres	No change from 2010
Ship size at non-NAPA ports	Increases in line with trade growth	Increases in line with trade growth	Increases in line with trade growth	Increases in line with trade growth
NAPA ship size for direct calls	11,000 TEU	5,000 TEU	11,000 TEU	11,000 TEU
Internalisation of external costs for all modes	Full internalisation of costs for all modes, with container shipping using low sulphur fuel	-	No internalisation of external costs	-

Source: MDS Transmodal

The **Business-as-Usual** scenario assumes that, while other port groups develop their capacity to accommodate larger container ships, the NAPA ports do not; in addition, the rail freight network is not enhanced so that the Northern Range ports maintain their advantage in terms of train length and Switzerland maintains its rail freight grants scheme for trans-alpine flows. It assumes that a policy of internalising external costs is not pursued by the EU. Overall, this scenario is a "no change" scenario from the point of view of NAPA and provides a view of what, in general terms, is likely to happen without investment in port capacity and enhancements to rail freight infrastructure and services.

The **No Internalisation of External Costs** scenario assumes that the EU decides not to implement a policy by 2030 of ensuring that all modes of freight transport are charged for their full costs, including external costs which are not currently reflected in the price charged. In all other respects the assumptions included in the modelling were as for the NAPA Development Potential Scenario.

The **BAU with Big Ships** scenario assumes that the NAPA ports develop their capacity to accommodate larger container ships, but the rail freight network is not enhanced so that the Northern Range ports maintain their advantage in terms of train length, Switzerland maintains its rail freight grants scheme for trans-alpine flows, no further progress is made in liberalising the rail freight market and external cost are not internalised. It provides a view of what, in general terms, is likely to happen if investment is made in port capacity, without enhancements to rail freight infrastructure and further liberalisation of the rail freight market. It does not, however, actually restrict the number of rail freight services; in other words, where traffic volumes are increasing on a particular flow and the economics of rail freight are suitable, services will grow their volumes and the model assumes that train paths will be available on the network.

The results of the modelling of scenarios described above in terms of market share are set out in Table 3.9 below.

Table 3.9: Modelled container traffic volumes through NAPA & other port groupings for alternative scenarios, 2030

Million TEU

	NAPA Development Potential	**Business-as Usual (BAU)**		**No internalisation of external costs**		**BAU with big ships**	
	Traffic volume	Traffic volume	Difference cf. Central Forecast	Traffic volume	Difference cf. Central Forecast	Traffic volume	Difference cf. Central Forecast
NAPA	6.0	2.6	-3.4	5.9	-0.1	4.9	-1.1
Northern Range	31.5	35.2	+3.7	31.8	+0.3	34.1	+2.6
Tyrrhenian	6.0	5.8	-0.2	5.7	-0.3	4.9	-1.1
Black Sea	0.7	0.7	-	0.7	-	0.6	-0.1
Other	9.5	9.1	-0.4	9.4	-0.1	9.0	-0.5
Total	53.5	53.5		53.5		53.5	

Source: MDST European Container Market Demand Model

In terms of absolute volumes, the results of the **Business-as-Usual** scenario suggest that the NAPA ports would secure only 43% of the NAPA Development Potential volumes in 2030 (2.6 MTEU instead of 6.0 MTEU), with the Northern Range ports increasing their volumes by 12% compared to the NAPA Development Potential. The modelling suggests that the potential growth of traffic through the NAPA ports could be restricted to a significant extent up to 2030 by a failure to develop container terminal capacity with adequate depth of water and to enhance rail network infrastructure and associated rail freight services.

The **BAU with Big Ships** scenario seeks to test the importance of the NAPA ports being able to accommodate larger vessels compared to enhancing rail freight infrastructure and services. It suggests that developing capacity to accommodate larger vessels is unlikely to be sufficient for the NAPA ports to achieve their full potential, with a loss of 1.1 MTEU compared to the NAPA Development Potential Scenario.

In terms of absolute volumes, the results of the **No Internalisation of External Costs** scenario suggest that ports that are seeking to distribute containers over longer distances (i.e. the Northern Range ports, in particular, are most affected by the inclusion of external costs in the calculations of shipping and inland transport costs. The modelling also suggests that the potential growth of traffic through the NAPA ports is not highly sensitive to whether or not a policy of internalising external costs is implemented.

The results of the modelling of scenarios described above in terms of market share are set out in Table 3.10 below.

Table 3.10: Modelled container traffic market shares for NAPA & other port groupings for alternative scenarios, 2030

	NAPA Development Potential	Business-as Usual (BAU)	No internalisation of external costs	BAU with big ships
NAPA	11.3%	4.9%	11.0%	9.1%
Northern Range	58.3%	65.9%	59.4%	63.7%
Tyrrhenian	11.3%	10.8%	10.6%	9.2%
Black Sea	1.3%	1.3%	1.3%	1.2%
Other	17.8%	17.1%	17.7%	16.8%
Total	100.0%	100.0%	100.0%	100.0%

Source: MDST European Container Market Demand Model

Under the Business-as-Usual scenario the modelling suggest that the NAPA ports would gain 0.6% market share between 2010 and 2030, essentially because higher fuel costs would encourage some additional traffic to use more "local" ports. The modelling also suggests that the capability to accommodate ships of 11,000 TEU (the BAU with Big Ships scenario) in 2030 would allow the NAPA ports to gain 4.8% market share compared to 2010 and that enhancements to the rail freight network and services could allow the NAPA ports to secure a further 2.1% share.

3.7 Conclusion

A key message from the results of the modelling is that only the combination of more port capacity with deeper water and improved rail freight services will provide the necessary synergies to provide an offer that will be attractive to deep sea shipping lines up to 2030. Building only the port capacity, without a focus on rail freight capacity will not be sufficient for the North Adriatic to meet its potential as a natural gateway for containerised trade to Central and Eastern Europe, the North Balkans, Austria, Switzerland and Southern Germany.

4 THE POSITION OF THE DEEPSEA LINES

4.1 Introduction

Currently the deepsea lines continue to serve most of the Asia to central European market through the North European ports and the North Italian market mainly through the Ligurian ports. The reasons for this can be mainly explained through inertia. The European deepsea container market was founded by lines that established services from North America where one of the dominant cargoes was military traffic during the Cold War period. In the case of the UK, 82% of deepsea containers were to and from North America in 1970, a figure that had fallen to just 10% in 2010. For mainland Europe as a whole, in 1996 the Atlantic still generated 47% of deepsea containers arriving, but this figure had fallen to just 30% by 2010. Nevertheless, until the present time it has proved generally more commercially attractive to continue to provide incremental port capacity along the Northern Range of European ports rather than invest elsewhere and expand existing services in parallel.

Improved rail services have allowed the Northern Range ports to extend their competitive reach far inland (even to Italy). Governments in North West Europe subsidised this process to protect local employment and (in the case of the Swiss) to protect the local environment.

We have shown in this study that by employing much larger ships from China to the Northern Range ports rather than direct to Mediterranean ports, maritime costs can be equalised as between the port ranges. A failure on the part of most (but not all) railway undertakings working from Mediterranean ports to expand in line with Northern Range counterparts has reinforced this process. Effectively, no one shipping line alone has had a clear incentive or the means to change this process, even though the mean inland distance from the different ports to most of Central and Eastern Europe is shorter and the maritime sailing time is around 5 days shorter at the same sailing speed.

We have been able to demonstrate that if adequate port and rail capacity and capability was not a constraint that by simply assuming operators (service providers) charged shippers (and each other) on a cost plus basis then a much larger proportion of the market would pass through Adriatic ports. A key question is, however, how will the current inertia that influences lines be addressed.

The answer may well lie in the process of radical reorganisation currently taking place within the deep-sea container industry.

4.2 Consolidation in the deep sea shipping industry

Prior to October 2008, the deepsea lines were permitted by the European Commission to operate in conferences (i.e. cartels) that could seek to set prices and collaborate in controlling the capacity available. The coincidence of the ending of this privilege and the deepest recession since World War II disguised the impact of the legislative change. That impact is only now becoming obvious. Very simply, the deep-sea lines have found that long term competitiveness must now be based upon the ability to offer the lowest prices at an acceptable level of service. Costs can be reduced by operating the largest ships, a benefit that is all the greater the higher are bunker prices. However, larger ships imply offering lower frequency given a consistent market share, a dilemma that can be addressed by either consolidation or offering slower transit times (as offering slower transit times allows lower frequencies to be offered).

Over the last few months of 2011, the world's largest line, Maersk, has announced a 'Daily Maersk' service from the Far East that now includes six North European ports. Its existing seven weekly services have been entirely reorganised so that containers can be carried at the lines' (short run) convenience within a guaranteed transit time that is much slower than the quickest possible transit time.

The world's next two largest lines, MSC and CMA-CGM, have announced a vessel sharing/capacity rationalisation process that will allow a similar service offer to be made (and exploited). Meanwhile, the next largest half dozen lines, APL, Hyundai, Mitsui, OOCL, Hapag-Lloyd and NYK have developed a consolidated services schedule that also seeks to employ large ships.

Effectively, the 'stand alone' Maersk offer represents some 24% of market capacity, CMA-CGM and MSC together around 27%, while APL/Hyundai/OOCL/Hapag-Lloyd/NYK ("Group of 6")have collectively about 16% (Table 4.1 below). Consolidation is taking place rapidly, which will mean each of the major actors would be able to offer a weekly service with large ships to the NAPA ports.

Table 4.1: Estimated container service capacity shares, N Europe/Mediterranean – Asia, December 2011

	N Europe -West Asia	Mediterranean-West Asia	N Europe - Far East*	Mediterranean – Far East	Total	Share %
Maersk	710	185	2,900	1,077	4,872	24%
MSC/CMA-CGM	652	148	2,724	1,767	5,291	27%
"Group of 6"	160	-	2,929	-	3,149	16%
Others	401	114	4,152	2,002	6,670	33%
Total	1,924	447	12,705	4,846	19,982	100%

Source: MDS Transmodal Containership Databank

The key feature of all three initiatives is that it has led to the creation of cost minimising and generally exclusive networks where the shipper is expected to relate to the line on the basis that a container will be moved at the lines' convenience within certain service level parameters. It is therefore in the power of a line to begin to re-direct containers within its own 'private' network in whatever way minimises costs; there will no longer be a need to operate to Rotterdam or Hamburg because that is where other partners sail to. Similarly, there will soon no longer be 'weekly' services from a given Asian port to serve all of Europe (via North European ports). Instead, there will be the option to mix and match traffic across the world to allow containers to arrive at the cost minimising port.

That is, a given line will now be able to make a relatively straightforward cost comparison to minimise its network, irrespective of services offered to shippers. Thus, for example, if a line has offered a thrice weekly service from Shanghai to Rotterdam to offer a 38 days transit to Bavaria (33 days at sea, 2.33 day maximum service internal and 2.67 days inland for 834 km overland from Rotterdam), it would be able to deliver the same service time to the shipper via an Adriatic port even if the shipping line employed only operated once per week (29.5 days at sea, 7 day maximum service interval and 1.5 days inland for 497 km from Trieste). Inland savings by rail for a reduction of 337 km of inland haulage could be expected to be around $150 per container.

In this way, the problem of scale (economic ship size) can be readily addressed because the service offer and the service itself (the ship's specific itinerary) have been de-coupled to allow the larger lines to operate competitively and aggressively. Furthermore, by sailing more slowly over the short distance, considerable fuel economies could be achieved.

A relatively simple cost comparison can illustrate the opportunity.

Cost for 15,000 TEU ships, 4 ports Far East to 3 ports North Europe

Ship round voyage:	70 days
Distance:	20,300 miles
Time at sea:	47 days
Time in port/canal:	23 days
Mean speed:	18.0 knots
Bunkers/day at sea:	165 tonnes
Assumed charter rate/day:	$60,000
Assumed cost/port entry:	$6,000
Bunker price:	$670/tonne
Round trip cost/ship:	$9.44m
Assumed service interval:	2.33 days
Assumed mean transit time:	33 days
Assumed inland time:	2.67 days
Service transit offer:	38 days

Based upon 90% load factor and 1.67 TEU/box (8,100 containers carried)

Cost per container round trip: $1,165
(excludes container hire, stevedoring, inland and overhead costs)

Cost for 15,000 TEU ships, 4 ports Far East to 3 ports Adriatic

Ship round voyage:	63 days
Distance:	16,000 miles
Time at sea:	40 days
Time in port/canals:	23 days

Mean speed:	16.67 knots
Bunkers/day at sea:	131 tonnes
Round trip cost/ship:	$7.33m
Assumed service interval:	7 days*
Assumed mean transit time:	29.5 days
Assumed inland time:	1.50 days
Service transit offer:	38 days

Based upon 90% load factor and 1.67 TEU/box

Cost per container round trip: $905
(excludes container hire, stevedoring, inland and overhead costs)

That is, a service able to offer transit time that is 3.5 days shorter would be able to achieve a cost saving per container round trip of $260 (before inland haulage savings) and offer an equivalent level of service in terms of transit days despite only operating weekly instead of thrice weekly.

The implication of such an approach by the lines is that the number of port calls per service will be gradually reduced to cut costs further because there will no longer be a need to offer shippers what appears to be a high level of service (frequency and transit time).

This change in the way in which deep-sea lines appear to be trading assists Adriatic ports, which otherwise have the disadvantage of being difficult to pair with other ports, except each other and east Mediterranean transhipment ports such as in Egypt and Piraeus. The most obvious logistical strategy to promote would be one where ships not bound for the Adriatic but passing through the Suez Canal transhipped containers to ships that were bound for the Adriatic. A close commercial collaboration with one or more Egyptian terminals may be helpful.

The challenge that this future scenario poses for North Adriatic ports is that to turn around a ship of 15,000 TEU implies an exchange of 15 – 16,000 containers with a single vessel, most of which would be forwarded by rail. These trains would need to be dispatched over a couple of days. This could constitute a major logistical challenge.

Just five ships per week of 15,000 TEU capacity would generate a throughput of 6.0m TEU per annum if entirely handled in the North Adriatic. A single company enjoying 20% of the market would therefore be able to justify a weekly ship, save a substantial amount of money and be able to offer a level of service that is at least the equal to that provided via North European ports.

5 STRATEGIC RAIL FREIGHT ISSUES FOR THE NAPA PORTS

5.1 Introduction

This chapter sets out the implications of the Central Forecast set out in Chapter 4 in terms of rail freight volumes and, at a strategic level, rail freight infrastructure, particularly as it will be essential for the NAPA ports to continue to develop efficient rail freight services to serve a wider hinterland. It describes the potential demand for rail freight services to and from the NAPA ports in 2030 based on the Central Forecast set out in Chapter 4, considers whether sufficient capacity is likely to be available through the Alps (Mont Cenis-Brenner arc) and then sets out in broad terms the kind of infrastructure enhancements that are likely to be required to the rail network to allow the NAPA ports to achieve their potential by 2030.

5.2 Demand for rail freight services in 2030

Table 5.1 shows the actual number of daily trains to/from the NAPA ports in 2011 (sum of both directions) and the forecast number of trains in 2030 based on the Central Forecast described in Chapter 4. The trains have been assigned to broad corridors in 2030 based on some simple assumptions, although in practice there is some flexibility in relation to the routing of trains:

- Mont Cenis-Brenner arc – all trains to/from Germany, Czech Republic, Poland, Switzerland and 1/3 of trains to/from Austria (trains that in 2030 are most likely to cross the Western and Central Alps using the Mont Cenis, Gotthard, Simplon and Brenner railway base tunnels)
- Tarvisio-Rijeka arc – all trains to/from Slovenia, Croatia, Hungary, Slovakia, Romania, 2/3 of trains to/from Austria;
- Italy – all trains to/from Italy.

The forecast daily trains for 2030 is an output in TEU from the MDST European Container Port Demand Model, which has been translated into daily trains (sum of both directions) based on the following assumptions:

- 40 platforms per train;
- 80% load factor;
- 300 operational days per year (i.e. 6 days a week).

These assumptions take account of the likelihood that not all trains will operate at maximum length. By taking this cautious approach, the number of trains required (and corresponding capacity required) is estimated at a relatively high level.

Table 5.1: Demand for rail freight services through the NAPA ports, 2010/11 & Central Forecast 2030

Daily trains (sum of both directions)

	2010/11 Actual	2030 Forecast	Change 2010-30
Mont Cenis-Brenner Arc	-	89	+89
Tarvisio-Rijeka	28	113	+85
Italy	3	34	+31
Total	31	236	+205

Source: MDS Transmodal

The modal split for the NAPA ports as a whole that is implicit in this analysis is 29% in 2010, increasing to 76% in 2030. This reflects a considerable extension of the NAPA ports' existing hinterlands.

5.3 The NAPA strategic rail freight network

Based on the result of modelling and NAPA's existing and potential hinterland, the following strategic rail freight network was defined for the NAPA to facilitate further analysis. Note that the local language version of place names is used rather than the English version.

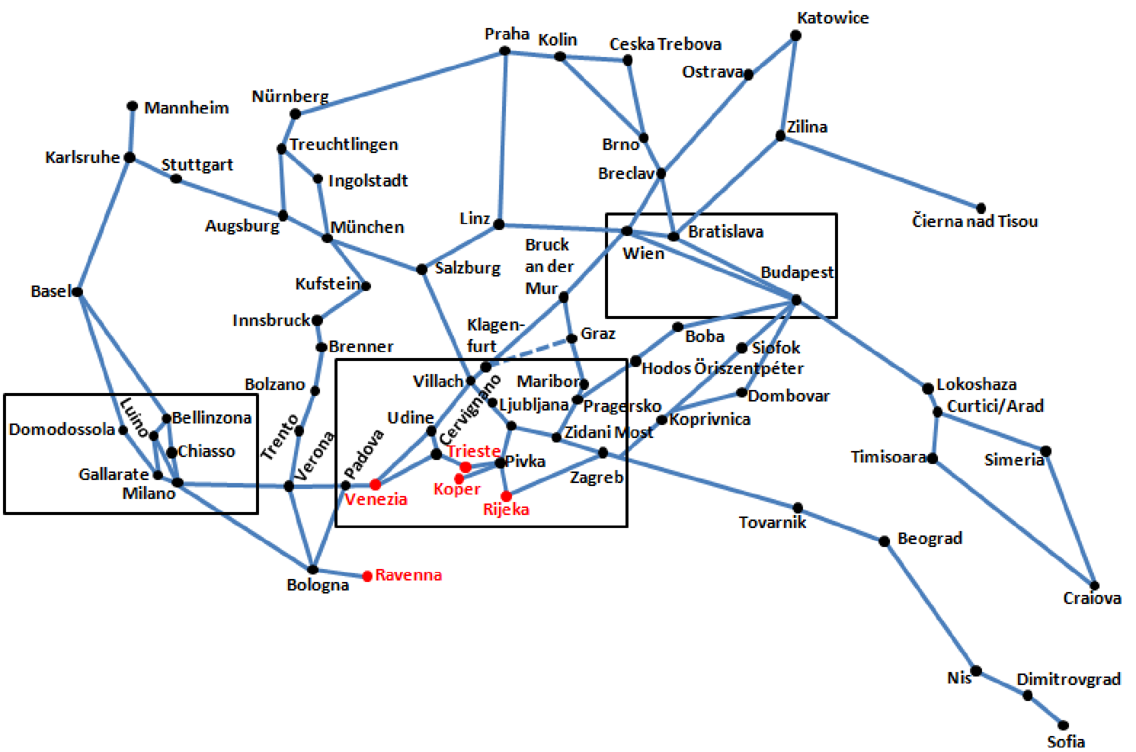


Figure 5.1: NAPA strategic rail freight network

In this report, in addition to the NAPA core network as a whole, we have documented in particular detail three zones of strategic importance within this network:

- The Milano zone (for access to Switzerland and Baden-Wuerttemburg from Northern Italy);
- The immediate zone around the NAPA ports (for access to the Alpine passes);
- The Wien-Budapest zone (access to Austria and the main Central and Eastern European markets).

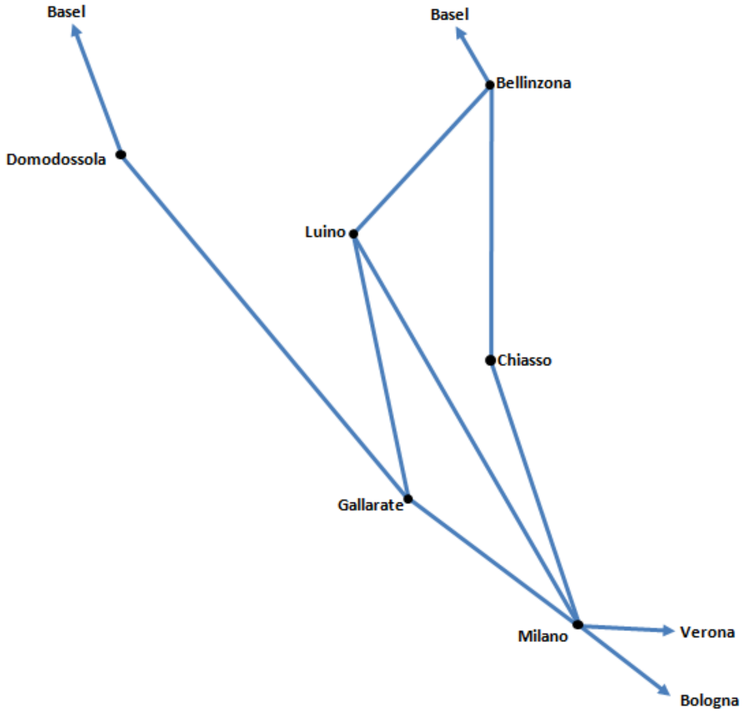


Figure 5.2: NAPA strategic rail freight network - the Milano zone

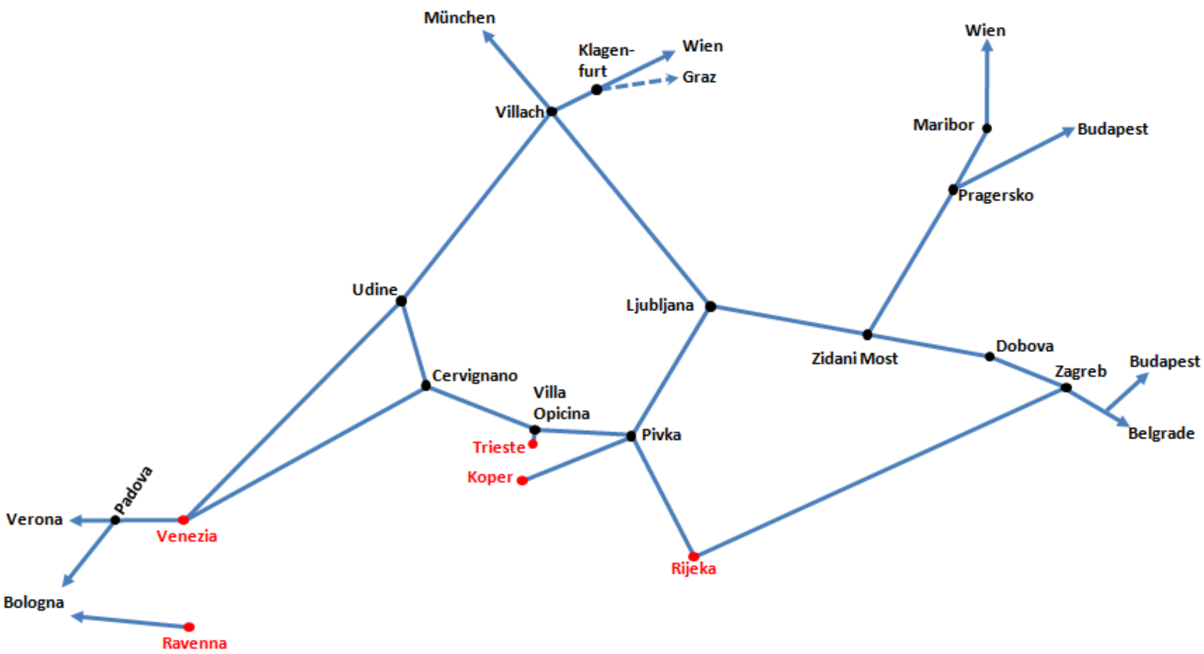


Figure 5.3: NAPA strategic rail freight network – the NAPA ports zone

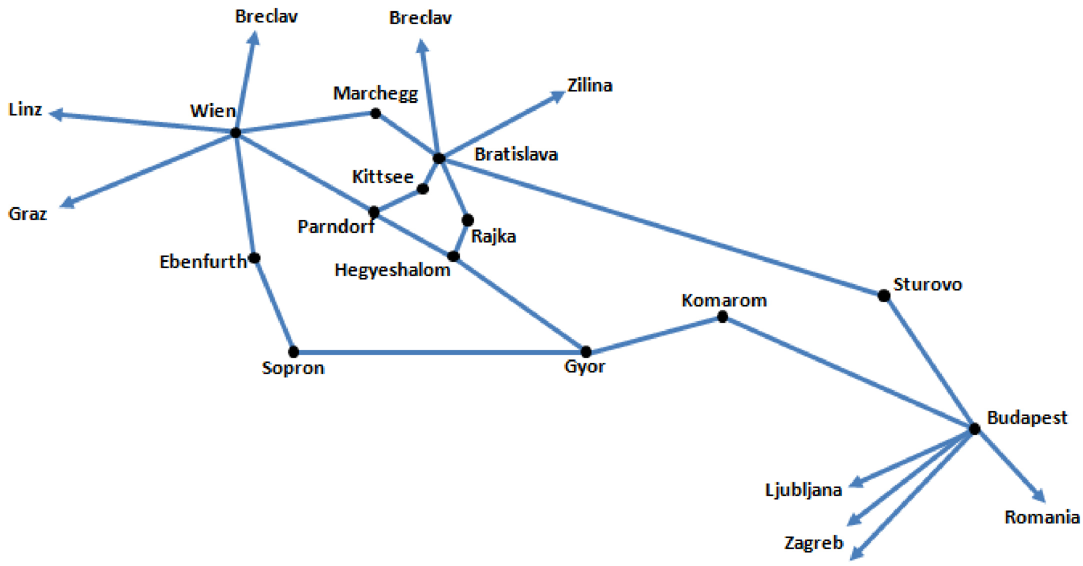


Figure 5.4: The NAPA strategic rail freight network - Wien-Budapest zone

The full analysis of the NAPA strategic rail freight network as defined above (and based only on desk research) is provided in Appendix 2 to this report.

Overall conclusions are as follows:

- Potential bottlenecks – in the form of short trains, low tonnage limits and low speeds – are present on a number of segments within the NAPA network.
- There are most likely to be bottlenecks for the pathing of freight trains due to the number of passenger trains operating during the day on the approaches to the major population centres, but night-time operations are unlikely to be subject to any significant restrictions. The trans-alpine crossings are unlikely to be a bottleneck from this point of view due to the low number of international passenger trains.
- Adequate clearance for high cube containers appears to be available across the whole NAPA strategic rail network, with the exception of the line from Rijeka to Pivka which links the port of Rijeka to the Slovenian rail network.
- The major issue that needs to be addressed, particularly given the results of the modelling in Chapter 3, is the maximum length of trains that can be accommodated between the NAPA ports and their hinterlands. Not being able to operate 750 metre intermodal freight trains will be a significant limiting factor for the growth of container traffic through the ports.

5.4 Capacity through the Alps

The NAPA ports will only be able to increase their traffic volumes if they extend their hinterlands through the use of rail freight and this also requires that there will be sufficient capacity on Alpine crossings. The French, Swiss, Austrian and Italian Governments have sought to increase trans-Alpine rail freight capacity by developing base tunnels that allow freight trains to transit the Alps more quickly and provide more train paths. The available capacity for all rail freight by 2030 through these tunnels is shown in Table 5.2, although the Mont Cenis/Frejus tunnel between Italy and France may be less directly relevant for trains to and from the NAPA ports.

Table 5.2: Trans-alpine base tunnels in the Mont Cenis-Brenner Arc

	Axis	Tunnels	Distance	Capacity (daily trains)	Opening date
Brenner	Munich/Vienna-Verona	2 x 1 track	55 km	220	2026
Gotthard	Zurich-Milan	2 x 1 track	57 km	252	2017
Lotschberg-Simplon	Berne-Milan	1 x 2 track	35 km	108	2007
Mont Cenis/Frejus	Lyon-Turin	2 x 1 track	57 km	220	N/K

Source: Various, including ALBATRASS study (January 2011) for capacity

The most recent study of which we are aware that considered the issue of trans-alpine rail freight demand and capacity was the ALBATRASS study that was completed by a consortium of consultancies in early 2011. The overall objective of the study was to examine the potential impact of various road transport management measures on the modal share between road and rail across the Alps and it included forecasts for the number of freight trains through the railway base tunnels both for a Business As Usual (BAU) scenario (i.e. with no road traffic management measures) and a ACE (Alpine Crossing Exchange) scenario, where road hauliers wishing to transit the Alps would need to purchase the right to do so in an auction for a limited number of transit permits. The latter scheme, which is not official policy for any Government in the Alpine region, would encourage a switch of traffic from road to rail.

The results of the ALBATRASS scenarios are shown below in Table 5.3. “UCT” rail freight traffic is both intra-European and deep sea container traffic that crosses the Alps, while “other” rail traffic is conventional wagon load and rolling motorway traffic.

Table 5.3: ALBATRASS forecasts of rail freight demand & capacity on the Mont Cenis, Gotthard, Simplon & Brenner corridors, 2030

Trains/day

	Capacity (Mont Cenis-Brenner)	UCT	Other	Total demand (ALBATRASS)	Remaining capacity
BAU 2030 low	800	190	180	370	430
BAU 2030 high	800	226	214	440	360
ACE 2030 R low	800	280	310	590	210
ACE 2030 R high	800	349	397	744	85

Source: ALBATRASS (January 2011)

When these capacity utilisation forecasts are compared with our forecast for the number of additional trains that will need to be accommodated on the Mont Cenis-Brenner corridors to/from the NAPA ports in 2030 (89 trains for NAPA plus 67 for the Tyrrhenian ports, see Table 5.4 below), it can be seen that capacity is only expected to be tight in 2030 under the ACE R high scenario where an Alpine Crossing Exchange is implemented with a relatively low cap on the number of trucks that can cross the Alps.

Table 5.4: Forecasts of rail freight demand & capacity on the Mont Cenis, Gotthard, Simplon & Brenner corridors, 2030

Trains/day

	Remaining capacity (ALBATRASS)	Forecast NAPA trains	Forecast Tyrrhenian port trains	Net capacity
BAU 2030 low	430	89	67	274
BAU 2030 high	360	89	67	204
ACE 2030 R low	210	89	67	54
ACE 2030 R high	*85*	*89*	*67*	*-71*

Source: ALBATRASS & MDS Transmodal

Our overall conclusion is that, in general terms, there are likely to be sufficient train paths across the Alps on the Mont Cenis-Brenner arc, once the four base tunnels have been developed, by 2030 to accommodate the number of trains that are likely to be generated by the additional NAPA and Tyrrhenian port traffic, even if a scheme such as ACE is introduced by the trans-alpine countries with a restrictive cap on the number of trucks. This is for the following reasons:

- The base tunnel can accommodate 1500 metre trains, while our modelling for trains to/from NAPA ports and the Tyrrhenian ports are assumed to be only 750 metres long. This means that, if necessary, 1500 metre long trains could be assembled at either end of the base tunnels for transit.
- Viable alternatives to the base tunnels exist for the NAPA ports, even for ports towards the western end of the range, as trains that need to cross the Alps can also use the route via Tarvisio, which will have additional capacity following the completion of the 33km twin bore Koralm Tunnel (due to open in 2022).
- The ALBATRASS forecasts are likely to include some deep sea container trains between Italy and the Northern Range ports, while the assumptions included in our modelling would result in almost no trains from ports such as Rotterdam and Antwerp crossing the Alps because of the distance involved and the stronger competition from the NAPA and Tyrrhenian ports in the Italian market.

5.5 Conclusion

Our overall conclusion on rail freight in relation to the NAPA ports is that the further development of a network of efficient rail freight services to and from the ports is required to allow the ports to achieve the traffic volumes set out in the Central Forecast for 2030, which we estimate will generate about 90 trains per day. Investment will be required at the ports and in the hinterland to ensure that longer intermodal freight trains can be efficiently loaded and unloaded and then operated between the NAPA ports and their hinterland. Further investment is also likely to be required to remove capacity bottlenecks on some segments of the rail network, although the network of trans-alpine base tunnels (Mont Cenis, Simplon, Gotthard and Brenner) should provide sufficient capacity to accommodate the additional trains, particularly as trains from the NAPA ports can also use routes between Tarvisio and Rijeka to access the combined NAPA hinterland.

Issues that may affect capacity on line segments on the NAPA strategic rail network are:

- Presence and type of electrification; modern multi-system locomotives allow through running over lines with different electrification and signalling systems and diesel locomotives are often also a viable alternative. Nevertheless, the fewer systems a train encounters over its route, the less expensive its traction and the more profitable its operations are likely to be.
- Type of signalling (ERTMS or national signalling systems).
- Number of main tracks; information on the number of tracks is not readily available for the entire network in a harmonised form. However, investments in technology such as centralised traffic control and upgraded signalling, and track improvements such as longer passing sidings, double-track islands and high-speed turnouts can significantly raise the capacity of a single-track line without requiring doubling.

The length of intermodal trains that can be operated has a significant impact on the competitiveness of rail freight services from individual ports because it reduces the average fixed cost per TEU of operating the services. In the modelling we carried out during this study we assumed in the NAPA Development Potential Scenario that all the main European container ports would be able to operate 750 metre trains by 2030, in line with EU objectives, so that these ports would be able to operate the same length of trains as is now possible to and from Rotterdam and Antwerp. The impact of longer trains in the market is to extend the hinterland of ports so that inter-port competition is increased. If the NAPA strategic rail freight network and the networks to and from other competitor ports is not improved to secure 750 metre long trains, the Northern Range ports will retain their competitive advantage; if competitors in the Mediterranean (such as the Ligurian ports) are able to achieve 750 metre long trains but NAPA does not, then the western NAPA ports in particular will experience greater competition in their hinterlands. Any net change in the relative length of intermodal trains for the NAPA ports compared to their competitors will therefore have some impact on their relative competitiveness.

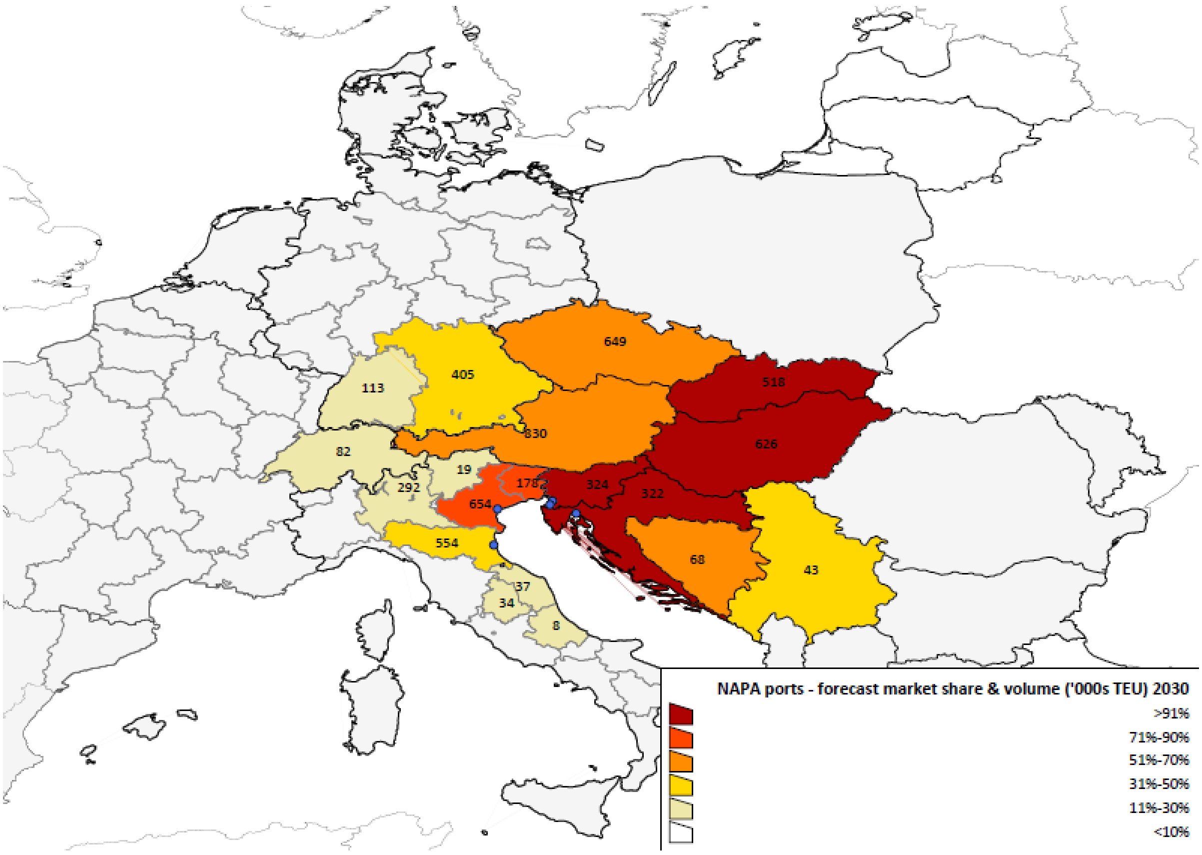
6 CONCLUSIONS

The results of the 2030 NAPA Development Potential Scenario suggest that the NAPA ports could collectively secure 6.0 MTEU of traffic by 2030.

This may appear to be ambitious in terms of the absolute growth it implies (+348% traffic growth from 2010 compared to 73% growth in the market as a whole) and in terms of market share (growing from 4.3% in 2010 to reach 11.3% in 2030). However, the location of the NAPA ports makes them a natural gateway to the more dynamic economies of Central and Eastern Europe and the North Balkans and parts of Western Europe (Switzerland, Austrian and Southern Germany), particularly as Europe's foreland for container trade has been switching away from North America and towards the Far East via the Suez Canal.

These market trends also in part reflect the end of political conflicts (principally the Cold War and the wars in the former Yugoslavia) that severely restricted the development of the North Adriatic ports up to about 10 years ago. In many respects the results of the 2030 NAPA Development Potential Scenario simply reflects the removal of distortions in the market that were caused by these political conflicts, allied to changes in the global distribution of container trade and shipping.

The following map shows the distribution of the forecast traffic volumes in 2030 (expressed in thousand TEU) by country and Italian and German region.



The 2030 NAPA Development Potential Scenario, which is determined mainly by economic rather than political drivers, is also in line with emerging policy at a European level which views the re-balancing of Europe's container trade to some extent away from ports in North West Europe towards southern European ports as providing benefits for Europe as a whole. This is reflected in paragraph 392 of the European Commission Working Paper that was published alongside the Transport White Paper in March 2011 and which stated:

A European infrastructure policy for ports should ensure the availability of ports well connected to the land transport system along the entire EU coastline to allow a more balanced distribution of entry and exit flows into the European transport system.

The public benefits of more direct calls in the North Adriatic by deep sea container ships would be lower costs for shipping lines and for the wider economy (which is implicit in the modelling approach we have taken), a more balanced use of scarce and expensive European port and rail infrastructure and reduced emissions from shipping and hinterland distribution.

The 2030 NAPA Development Potential Scenario has significant implications for the NAPA ports themselves and for policy-makers at regional, national and European levels:

- Sufficient container port capacity will need to be developed by the ports to accommodate the forecast additional volumes of traffic up to 2030, with approach channels and berths that can accommodate vessels of about 15 metres draft;

- Policy-makers at a European and national level need to deliver a market environment that offers a genuinely level playing field for new entrants into the pan-European rail freight market;
- Investment will be required at the ports and in the hinterland to ensure that longer (preferably 750metre) intermodal freight trains can be efficiently loaded and unloaded and then operated between the NAPA ports and their hinterland. Further investment is also likely to be required to remove capacity bottlenecks on some segments of the rail network.

The importance of improving inland infrastructure capacity is also highlighted by the inclusion of the NAPA ports on three European corridors, namely:

- The Baltic-Adriatic Corridor that links the Baltic States to the Adriatic via Austria and Poland and includes rail/multimodal infrastructure improvements in Poland, Austria and northern Italy.
- The Mediterranean Corridor that links Spain to Hungary and the Ukrainian border via southern France, northern Italy (including Venice and Trieste) and Slovenia and includes rail infrastructure improvements in Italy, Slovenia and Hungary.
- The Helsinki-Valetta Corridor that links Scandinavia with Malta via Germany and Italy and includes infrastructure improvements in Germany and Italy.

APPENDIX 1

The European Container Port Demand Model (ECPDM)

Introduction

The ECPDM has been developed to model the traffic of maritime containers to and from mainland Europe via the main container ports. Cost models are used to estimate the transport costs between each world region and European region via each major port, based on:

- inland costs (road and rail);
- shipping costs;
- port costs.

These cost models are applied to origin–destination traffic matrices (between world regions and European regions) to estimate the transport cost for each origin to destination via each major port. The traffic for each origin to destination is shared out between the ports using a multinomial logit model (i.e. so that the cheapest route gets the most traffic, but not on an "all or nothing basis") to give a model output of traffic in terms of TEU by:

- World region;
- European region;
- Port;
- Road or rail.

For the purposes of validation of the model it is calibrated to recreate traffics in the base year (currently 2010).

Forecast OD matrices can then be used instead of 2010 OD matrices to investigate what the likely traffic *demand* will be (by world region, European region and port) in a future year. The impact of alternative inland cost scenarios can be investigated (e.g. reduced future rail costs per unit due to longer trains). Alternative shipping cost scenarios can also be investigated by incorporating cost savings from the operation of larger container ships.

Inland cost models

The inland cost models are derived from first principles – i.e. adding up the costs of the various components required to run a truck or train (e.g. fuel, tyres, maintenance, drivers' wages, asset costs, track access charges, rail subsidies for crossing the Alps through Switzerland, wagons per train, terminal and repositioning costs). The resultant cost models are regularly used for various projects – both public and private sector – and have been validated by freight transport operators. Fuel taxes paid are assumed to be the lower of the taxes paid in the origin and the destination countries.

As an existing major corridor for the distribution inland of containers from Rotterdam and Antwerp, the Rhine is included in the model by including the inland port of Duisburg and adding a cost for the inland waterway leg between the deep sea container ports and the inland port. Other inland waterways, such as the Venice/Ravenna-Mantua-Milan inland waterway system and the Danube have not been included in the model because they only have limited services for containers; it is possible that they will have greater potential in the future for distributing slow-moving containers inland from Ravenna and Venice along the Po Valley and from Constanta to Romania, Serbia and perhaps beyond.

Forecast changes to the inland cost models include increased fuel prices, removing of Swiss rail freight grants, longer trains, improved rail freight asset utilisation and internalisation of external costs using estimates based on work carried out for the European Commission for its Marco Polo Programme.

The model assume that shippers, receivers and freight forwarders are rational economic decision-makers in terms of the mode of transport they choose and therefore seek the lowest cost solution; some containers will in reality be transported by road from a particular port over distances that should only be economic for rail, perhaps because the goods are required very urgently.

Origin – destination matrices from WCD

The geographic scope of the model was guided by the markets that the NAPA ports and their competitors compete in. Inland, this includes Central and Eastern Europe, and most of Western Europe. The UK, Scandinavia (excluding Denmark) and the Mediterranean islands, were excluded. The Eastern boundary was to exclude Estonia, Latvia, Lithuania, Belarus, Ukraine and Turkey. Spain and Portugal were included.

The most important *world* region as far as modelling NAPA's traffic was concerned was "East of Suez". The other world regions were North America, South America, West Africa, Turkey, East Med and each North African country.

The traffic in the OD matrices represents the annual traffic in TEU (sum of both directions). This is estimated by doubling the loaded traffic in the dominant direction. This implicitly therefore includes empty containers in the non-dominant direction.

The traffic is sourced from MDS Transmodal's World Cargo Database (WCD). This is a database of world trade as reported by the world's biggest economies, disaggregated by origin country, destination country and commodity. Tonnes are translated into loaded TEU on the basis of commodity-specific unitisation factors, tonnes per TEU, maritime factors and trade imbalances. See http://www.mdst.co.uk/articles/consultancy_resources/trade_data for further details.

Multinomial Logit model

The multinomial logit model is a well-documented and commonly used model in transport modelling for choosing between costed alternatives. In this ECPDM context a multinomial logit model is used to allocate a share of traffic (any world region to any European region) to each European port, based on the overall estimated cost via each port. The cheapest port gets the most traffic, with the more expensive ports getting (virtually) zero. It is a continuous model, such that small changes in relative costs between ports result in small changes in shares. This can be interpreted as those containers for which the decision as to which port to use is on a knife-edge, will switch to the other port if it becomes very slightly cheaper. The short-term reality may not be this simple, as shipping lines have to make bulk decisions in terms of which ports their ships call at. However in the long term, this approach should reflect shipping lines' actions reasonably well.

The multinomial logit model relies on the Independence of Irrelevant Alternatives (IIA). In this ECPDM context, the IIA can be interpreted in terms of how the decision makers in charge of the cargo operate when choosing the most appropriate port to use; they are assumed to estimate the generalised cost of using each port, and evaluate each port option independently, irrespective of whether the ports are geographically near to each other.

A multinomial logit model requires a parameter that defines how much of each traffic flow is spread across the different ports. A low value means nearly all the traffic goes to the cheapest port. A high value means traffic is spread across many ports, even if they have significant cost differences.

Calibration

The objective of calibration is to incorporate fixed costs (positive or negative) into the cost calculation for each route to take into account various attributes that are not included in the model. For example, if a port has poor labour relations, this may discourage use, effectively adding an extra cost to that port, but this cannot be incorporated directly into a door-to-door freight transport model. Similarly if a particular inland region has cultural ties with a particular port, this port may be looked upon more favourably than cost alone would suggest. Regions are often so linked to ports in their own country, and this link effectively represents a slight cost reduction of using this port.

The objective of incorporating these calibration factors is to produce a model that better reflects the generalised costs felt by the decision makers, and therefore the resultant traffic from the model should better reflect reality. If large calibration factors are included without any justification, simply to arrive at the "correct" answer in the base case, there is a danger that they may be masking some other distortion in the model, and future, alternative scenarios will continue to suffer from this distortion. It is therefore important to allow the model to produce results that are not perfect recreations of the base case, rather than over-calibrating and distorting the model.

Validation

Validation demonstrates that a model's outcome is a good representation of reality. The ECPDM is only considering competition between the 30 largest ports serving inland Europe, so there is therefore some traffic being allocated to these largest ports that is actually entering Europe through a minor port. Transhipment has to be estimated for each of these largest ports so that only inland traffic is included. Inland hinterlands and mode shares are often not well defined for many ports. It is therefore difficult to accurately represent the "true" traffic to enable accurate validation.

Nevertheless, the model has been validated where possible against the above sources, and differences are used to inform the calibration process.

Forecast Origin – destination matrices from WCD

As previously mentioned, WCD is the source of OD data for the base case. WCD also includes forecasts of world trade, largely based on trend with recent data weighted more strongly than historic data from long ago. Forecasts from WCD are published monthly in "Containerisation International".

These forecasts of demand generally do not show rapid growth, but it should still be noted that they represent ***demand*** i.e. if the model predicts a 20% growth in demand via a particular port, there is the implicit assumption that the port is able to accommodate this capacity. Similarly, the model does not include road, rail and inland waterway networks and it assumes that capacity on inland transport networks is available to accommodate the demand that is generated by the model.

Case studies

In order to illustrate how the model works we have set out below four case studies of individual flows from the Suez Canal (for east of Suez trade) to Bavaria via Venice and Hamburgin 2010 (based on the 2010 Base Case) and 2030 (the NAPA Development Potential Scenario). This shows how the relative cost of the Suez-inland OD cost is built up for traffic passing through individual ports and how they change between 2010 and 2030 due to the assumptions made in the modelling. It also shows how the selection is made between road and rail for inland distribution for any individual flow.

Case studies: Relative costs Suez-Bavaria via Venice & Hamburg2010 & 2030

One way €/TEU

Venice 2010	**Hamburg2010**	**Venice 2030**	**Hamburg 2030**
Shipping cost assumptions: t/s in Malta from Far East-Tyrrhenian service, with 1500 TEU feeder with 2 ships & 6 port rotation @ 10.4 knots	Shipping cost assumptions: direct calls with 9000 TEU vessels with 10 ships & 13 port rotation @ 18.5 knots	Shipping cost assumptions: direct calls with 11,000 TEU vessels with 9 ships & 17 port rotation @ 18.9 knots	Shipping cost assumptions: direct calls with 14,200 TEU vessels with 10 ships & 13 port rotation @ 19.9 knots
Additional shipping cost from Suez cf. cheapest: $520 allocated mainline vessel + $119 feeder + $60 lift cost = $699 - $509 for cheapest = $190 = €143	Additional shipping cost from Suez cf. cheapest: $550 mainline vessel - $509 for cheapest = $41 = €31	Additional shipping cost from Suez cf. cheapest: $642 mainline vessel - $617 for cheapest = $25 = €19	Additional shipping cost from Suez cf. cheapest: $723 mainline vessel - $617 for cheapest = $106 = €80
Port cost: €80	Port cost: €80	Port cost: €80	Port cost: €80
Inland distance: 549km	Inland distance: 774km	Inland distance: 549km	Inland distance: 838km
Road costs: Fixed: €96/trip Variable: €0.54/km	Road costs: Fixed: €97/trip Variable: €0.54/km	Road costs: Fixed: €99/trip Variable: €0.73/km	Road costs: Fixed: €99/trip Variable: €0.74/km
Road calibration cost: €55	Road calibration cost: -	Road calibration cost: €55	Road calibration cost: -
Total road cost: €96 + (€0.54 x 548km) + €55 = €447	Total road cost: €97 + (€0.54 x 774km) = €515	Total road cost: €99 + (€0.73 x 548km) + €55 = €554	Total road cost: €99 + (€0.74 x 774km) = €672

Rail costs: Fixed: €157/trip Variable: €0.42/km	Rail costs: Fixed: €146/trip Variable: €0.28/km	Rail costs: Fixed: €142/trip Variable: €0.31/km	Rail costs: Fixed: €143/trip Variable: €0.31/km
Rail calibration cost: €85	Rail calibration cost: -	Rail calibration cost: €85	Rail calibration cost: -
Total rail cost: €157 + (€0.42 x 548km) + €85 = €473	Total rail cost: €145 + (€0.28 x 774km) = €363	Total rail cost: €142 + (€0.31 x 548km) + €85 = €397	Total rail cost: €143 + (€0.31 x 774km) = €382
Road transport used	Rail transport used	Rail transport used	Rail transport used
Total cost = €670 (€143 + €80 + €447)	Total cost = €474 (€31 + €80 + €363)	Total cost = €496 (€19 + €80 + €397)	Total cost = €542 (€80 + €80 + €382)
Traffic: 200 TEU (sum of both directions)	Traffic: 57,900 TEU (sum of both directions)	Traffic: 27,700 TEU (sum of both directions)	Traffic: 7,300 TEU (sum of both directions)

Source: MDST European Container Port Demand Model

The model assumes that for NAPA in 2010 the cost to receivers/shippers/freight forwarders is based on the cost of feeding containers from Malta from a Far East-Tyrrhenian service, with a cost per TEU allocated for space taken up by the TEU on the mainline vessel from Suez and the additional transhipment lifts. In 2030 the market has shifted to one where the cost passed onto receivers/shippers/freight forwarders is based on the cost of direct calls by 11,000 TEU vessels. Note that the final shipping costs are expressed in terms of the additional cost compared to the cheapest shipping cost between Suez and a continental European mainland port in 2010 and 2030 (Suez-Piraeus).

This case study demonstrates how the relative competitiveness of a NAPA port (Venice in this case) against a Northern Range port such as Hamburg is affected by changes in relative ship size, the relative economics of rail freight and other "intangible" factors (cultural issues, customs costs) that are reflected in the calibration factors (included as costs) in the model to develop a base case in 2010. Between 2010 and 2030, rail freight services become more competitive from Venice so that the model chooses to distribute containers between Venice and Bavaria by rail. The increased competitiveness of rail services plus the lower relative cost of shipping from the deployment of larger ships leads to an increase in the modelled traffic to Bavaria from 200 TEU in 2010 to 27,700 TEU in 2030.

APPENDIX 2

Analysis of strategic rail freight infrastructure for the NAPA ports

Introduction

A variety of sources were used to analyse the defined strategic network, but a key source was RailNetEurope (RNE), which is the European organisation for the operational planning and assignment of international train paths. On these corridors, an intermodal operator can (in principle) apply to a single One Stop Shop for a complete international path and to facilitate the planning and application process, RNE has collected corridor information into a harmonised form. In addition to the RailNetEurope corridors, other sets of corridors – often but not always on the RNE routes – are complementary to RNE's for planning, promotion, management and investments. These include TEN-T priority axes and projects (numbered 1 to 30), ERTMS/EEIG corridors (lettered A to F), EU rail freight corridors (numbered 1 to 9) and Pan-European corridors (numbered 1 to 10), which extend outside the EU. Prominent among the many infrastructure projects are the new Alpine base tunnels and their approaches.

Figure 1 shows the RNE corridors for the core rail network of the NAPA hinterland and demonstrates that the immediate NAPA zone and the Wien-Budapest zone are major crossroads for a number of RNE corridors.

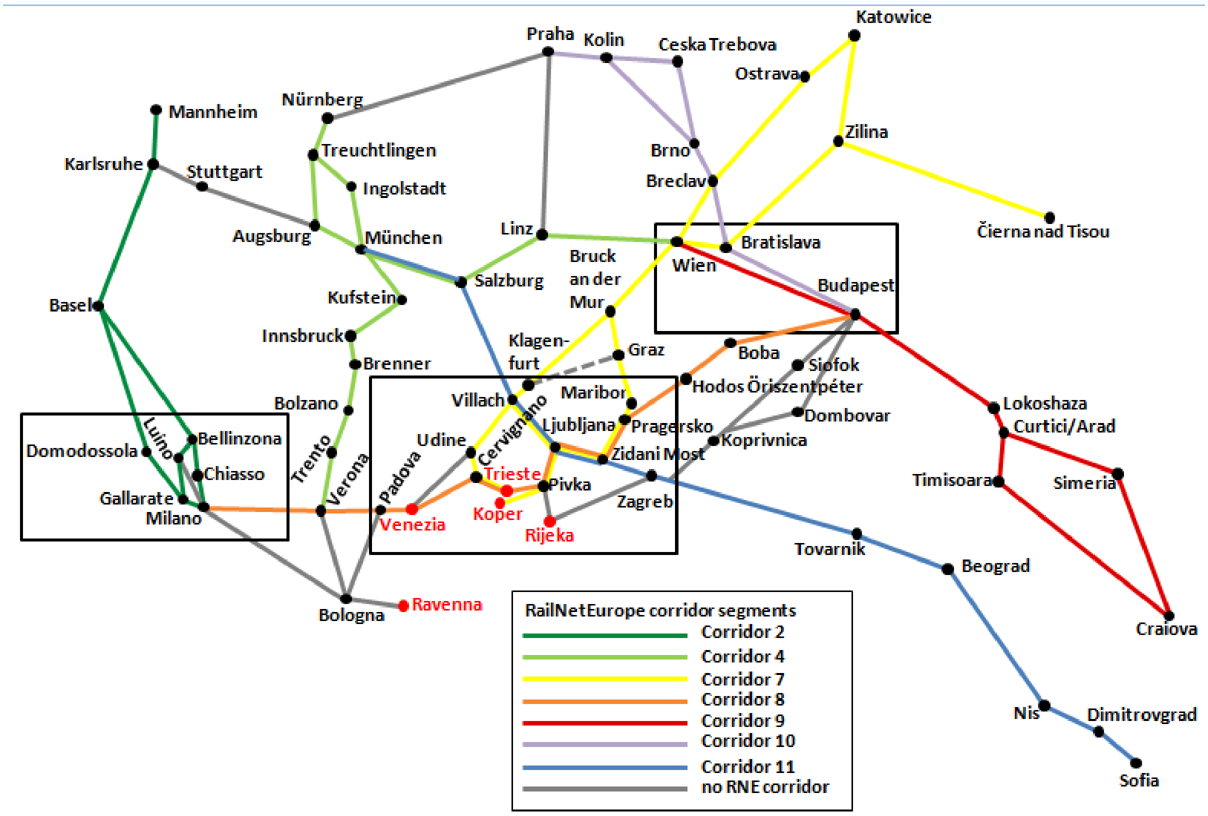


Figure 1: RailNetEurope corridor segments relevant for the NAPA core hinterland network

In order to establish the location of potential bottlenecks in this strategic network we have used some capacity indicators on the network, using data that is publicly available. These indicators are as follows:

- Number of passenger routings on each segment;
- Number of passenger trains on each segment;
- Maximum average start-to-stop passenger train speed;
- Maximum train length;
- Maximum train tonnage;
- Clearance for 9 foot 6 inch containers.

Capacity indicator 1: Passenger train routings

An indicator of the current capacity of a line segment is the number of passenger trains that operate each day as a low number of passenger trains may indicate low line capacity, while a large number of passenger trains may indicate capacity problems for freight trains due to competition for paths with existing passenger services.

In this section, we examine the number of passenger routings on each segment, including both direct trains and routings involving changes. In counting the number of routings, we excluded high-speed trains such as ICEs and TGVs, because these often operate on dedicated tracks. On the Venezia-Padova-Bologna and Venezia-Padova-Verona-Milano line segments, however, the Italian HSTs are operating on the conventional lines and this will reduce line capacity on these segments of the network in Northern Italy.

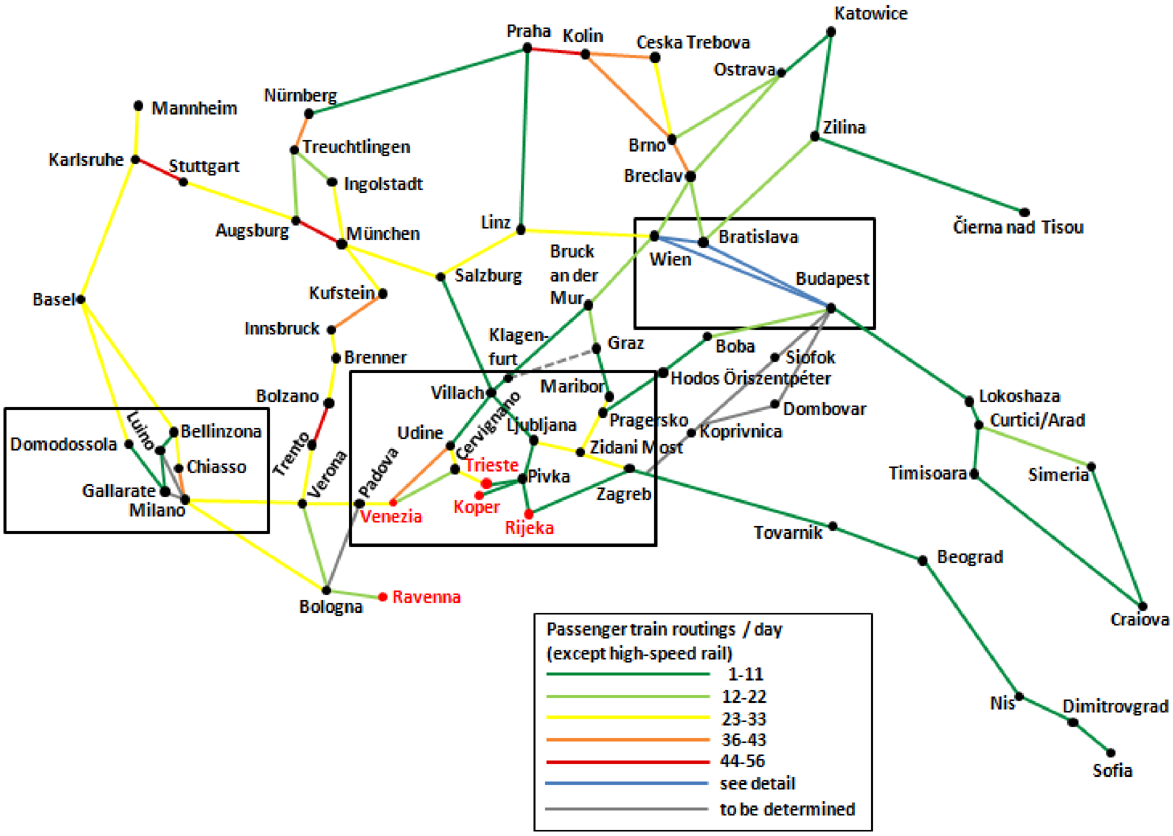


Figure 2: Passenger train routings per day (per direction), including both direct trains and connections

Figure 2 shows that traffic density is higher in northern Italy, Germany, the Brenner route, the München-Wien route and Switzerland, and lower in the rest of Austria and in eastern and south-eastern Europe. Traffic is particularly dense on some approach lines to larger cities such as Karlsruhe, München, Praha, Stuttgart and Venezia.

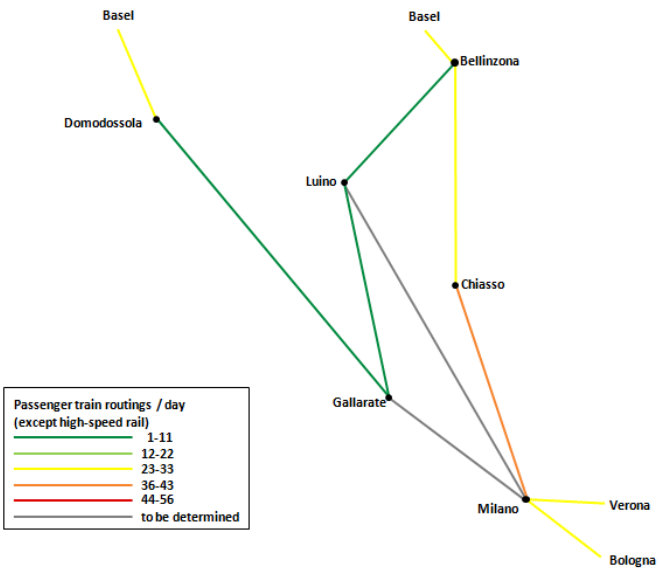


Figure 3 shows that traffic density is higher in Switzerland and on the main lines linking Milano to the rest of Italy than it is in on the Italian lines north of Milano except for the line to Chiasso.

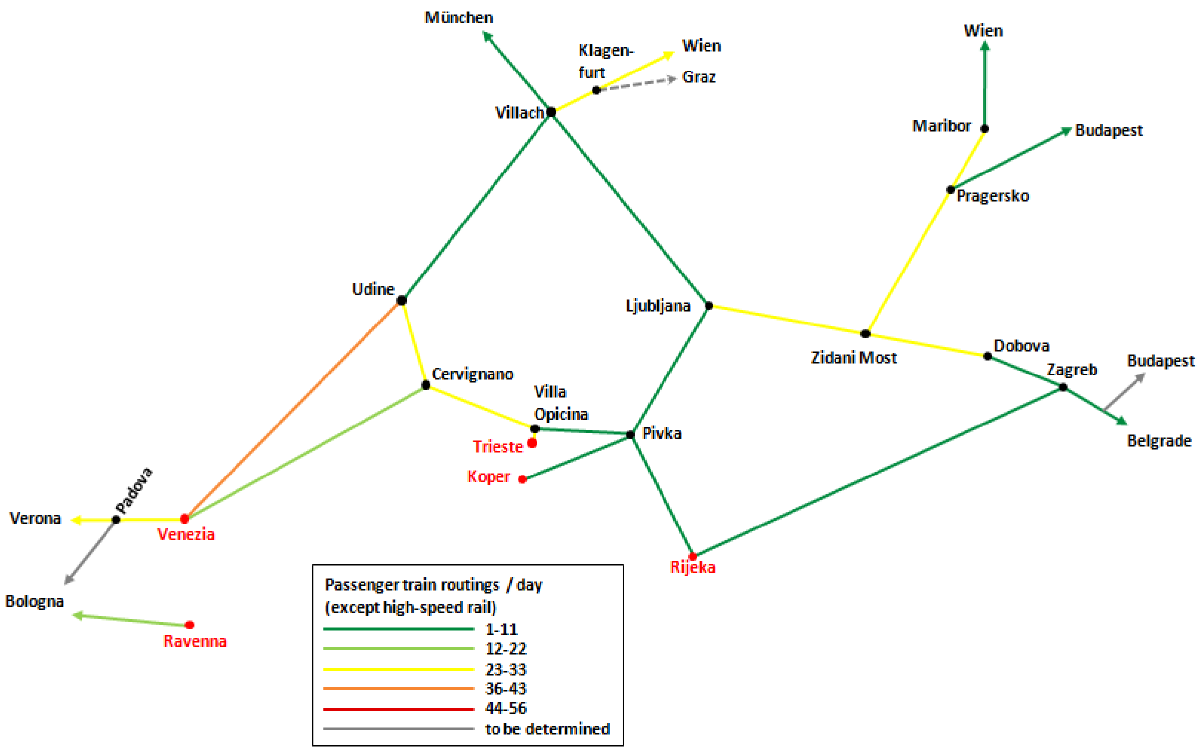


Figure 4: Passenger trains routings per day, per direction, for each segment shown in the NAPA zone

In Figure 4 there is particularly heavy passenger traffic on the approach line to Venezia from Udine. Traffic is also significant east of Ljubljana and west of Venezia. On the other hand, the exit routes via Ljubljana to Villach and via Zagreb towards Belgrade have only relatively light passenger traffic.

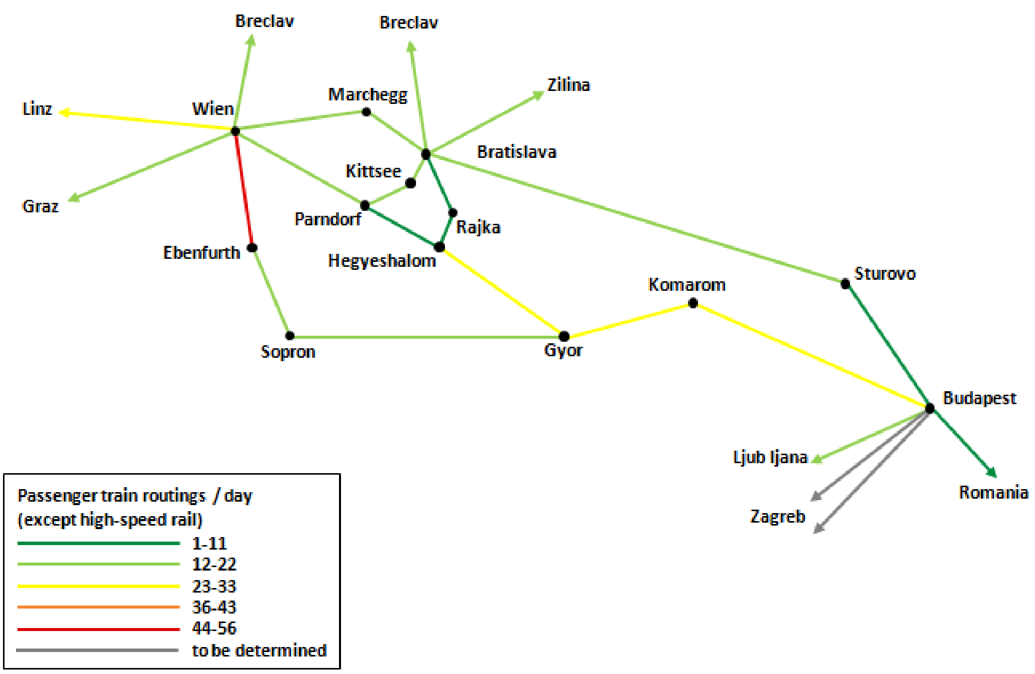


Figure 5: Passenger train routings per day, per direction, for each segment shown in the Wien-Budapest zone

Figure 5 shows potential bottlenecks due to heavy passenger traffic are visible on the approach lines to Wien from the south and to Budapest along the main route from Wien via Hegyeshalom.

Capacity indicator 2: Number of trains

In this section, we examine the number of passenger trains (per direction) on each of a number of strategic line sections in the NAPA hinterland. Determining the **number of trains** requires more analysis than the **number of routings** presented in the previous section because the number of trains on a given line segment from A to B includes not just the trains that stop in A and B, but also those that traverse some or all the line segment without stopping at A or B or both. For the purposes of this analysis we limited our determination of the number of passenger trains to the following critical sub-corridors in the NAPA hinterland network:

- The Swiss Alpine crossings;
- The rail line from Milano to Trieste;
- The Brenner route;
- The Villach-München route;
- The Villach-Wien route.

Figure 6 presents the number of trains on the Swiss Alpine crossings, while Figure 5.14 presents the number of trains on the other four sub-corridors.

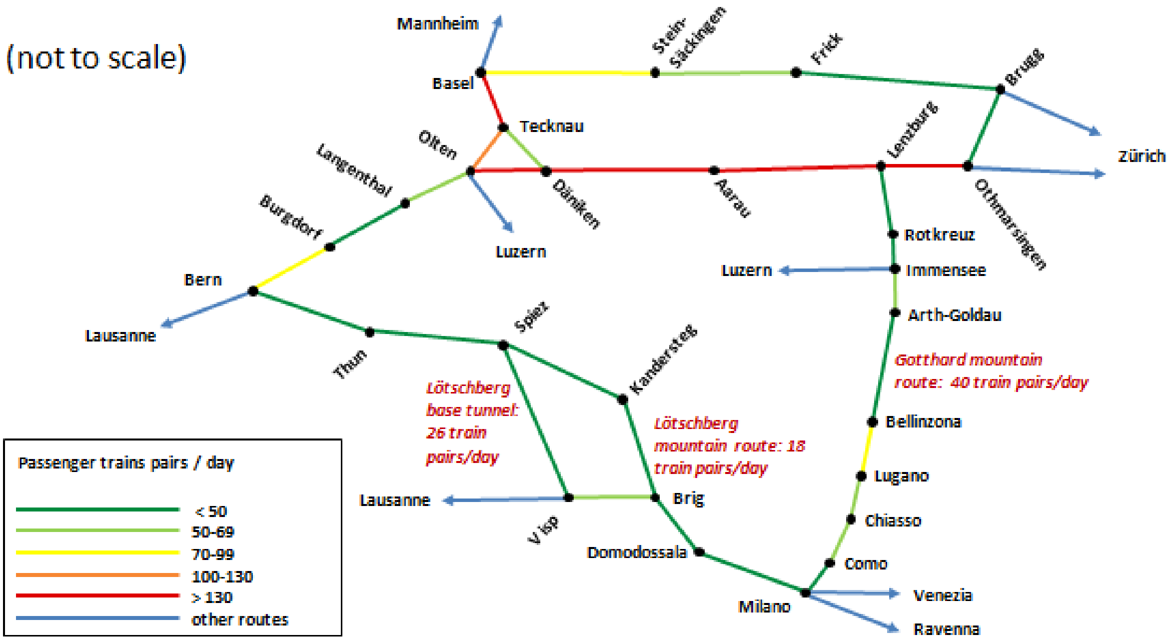


Figure 6: Number of passenger train pairs per day on the Swiss trans-Alpine routes (Lötschberg and Gotthard)

This map shows that the Alpine passes are not the bottleneck in terms of throughput. The bottlenecks are on other lines, either because they are on the approach to large cities or they are on major east-west routes. The major bottlenecks appear to be:

- East of Bern;
- South of Basel;
- East of Basel;
- Between Lugano and Bellinzona, and
- Between Lenzburg and Othmarsingen (although unlike the preceding four sections, which are two tracks, this segment is short and four tracks)

Any evaluation of the impact of the future Gotthard and Brenner base tunnels on the number of available freight paths must include the concurrent improvements – or lack thereof – to the approach lines in Austria, Germany, Italy and Switzerland.

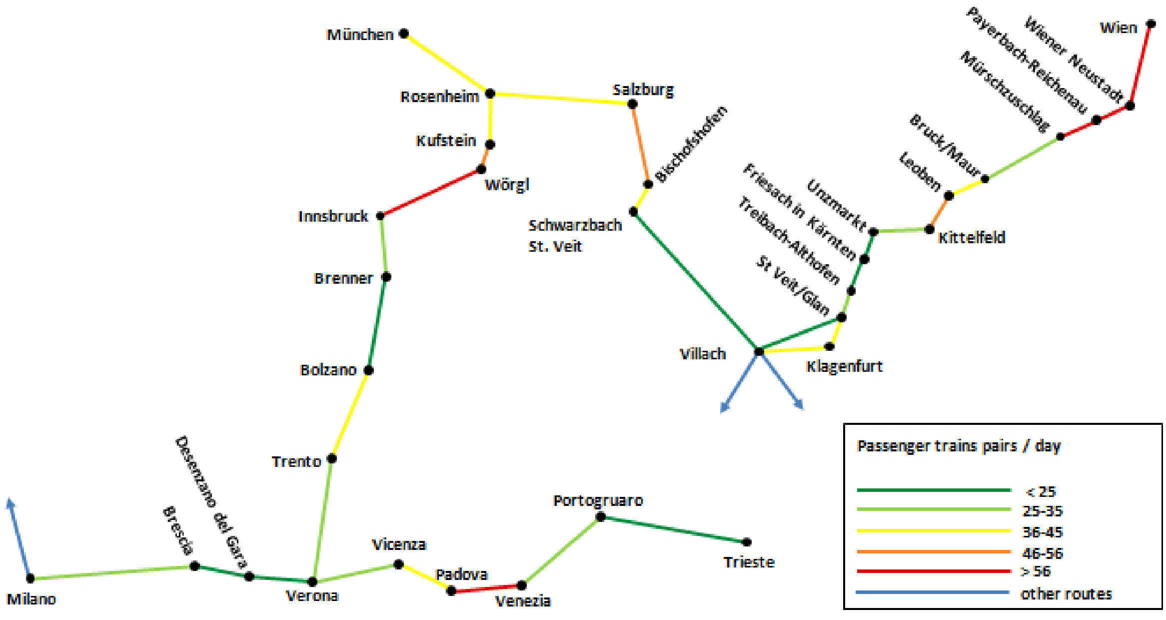


Figure 7: Number of passenger train pairs per day on critical sub-corridors within the NAPA core hinterland network

This map shows that train frequencies – and thus the potential for bottlenecks – are highest on the approaches to cities. Approaches to Milano, München and Villach appear to be moderate bottlenecks and to Salzburg, Innsbruck, Venezia and Wien more severe bottlenecks. The Innsbruck-Wörgl and Kittelfeld-Leoben segments are especially busy because other corridors (not shown here) also use them.

Capacity indicator 3: Train speeds

The fastest average start-to-stop train speed of a passenger train on a line segment provides a rough indication of freight speeds. Freight speeds will generally be lower than passenger speeds, but a railway tends to minimise this differential to maintain line capacity. Low passenger train speeds indicate longer freight transit times and potential bottlenecks. High-speed trains such as ICEs and TGVs have been excluded.

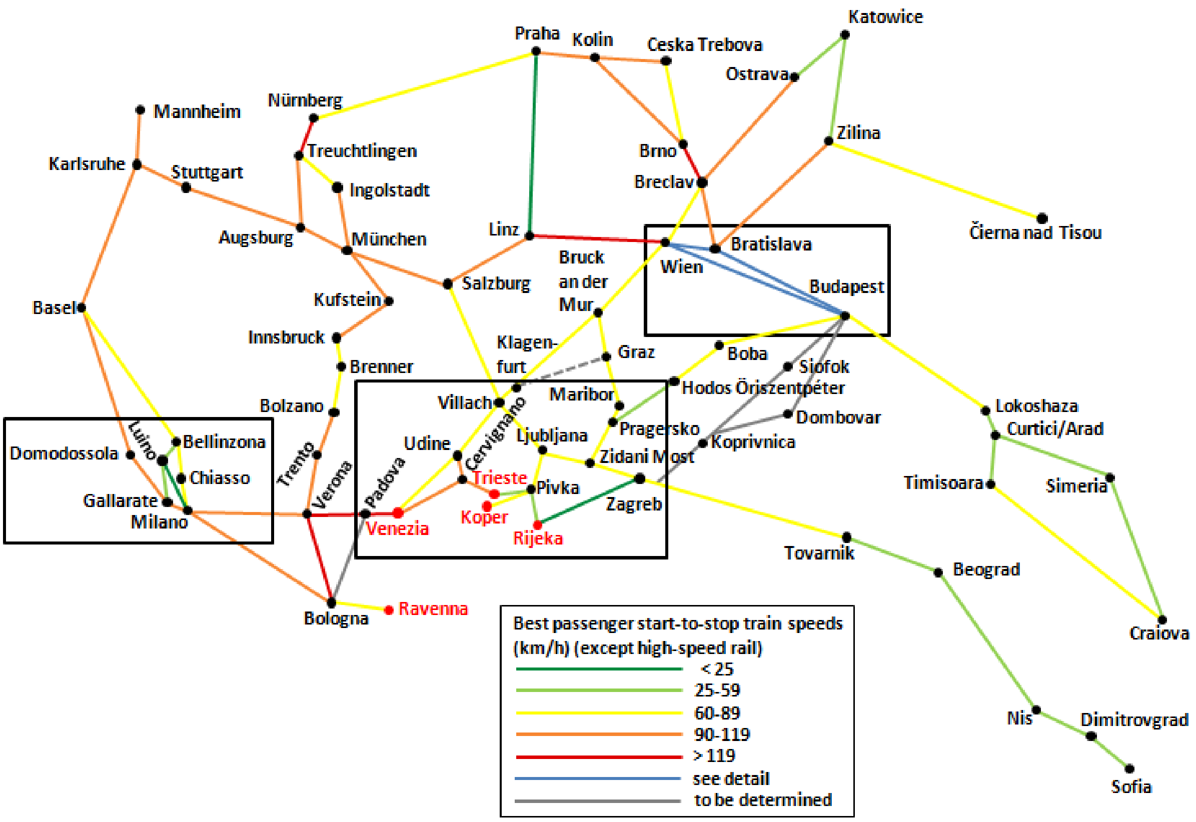


Figure 8: Best start-to-stop passenger train speeds in the NAPA hinterland network

Figure 8 shows consistent medium-to-high passenger train speeds throughout much of the NAPA hinterland network, including the Alpine crossings. Outside the three focus zones, particularly slow speeds are visible on the direct route between Linz and Praha, on the lines between the Czech Republic and Poland and in Serbia and Romania.

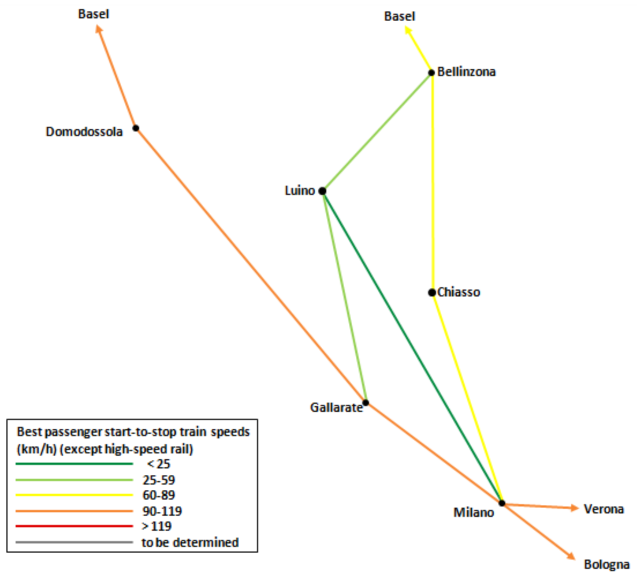


Figure 9: Best start-to-stop passenger train speeds in the Milano zone

Figure 9 shows there are good passenger speeds on the main lines from Milano to Switzerland, but lower speeds on the secondary routings via Luino.

Figure 10: Best start-to-stop passenger speeds in the immediate NAPA zone

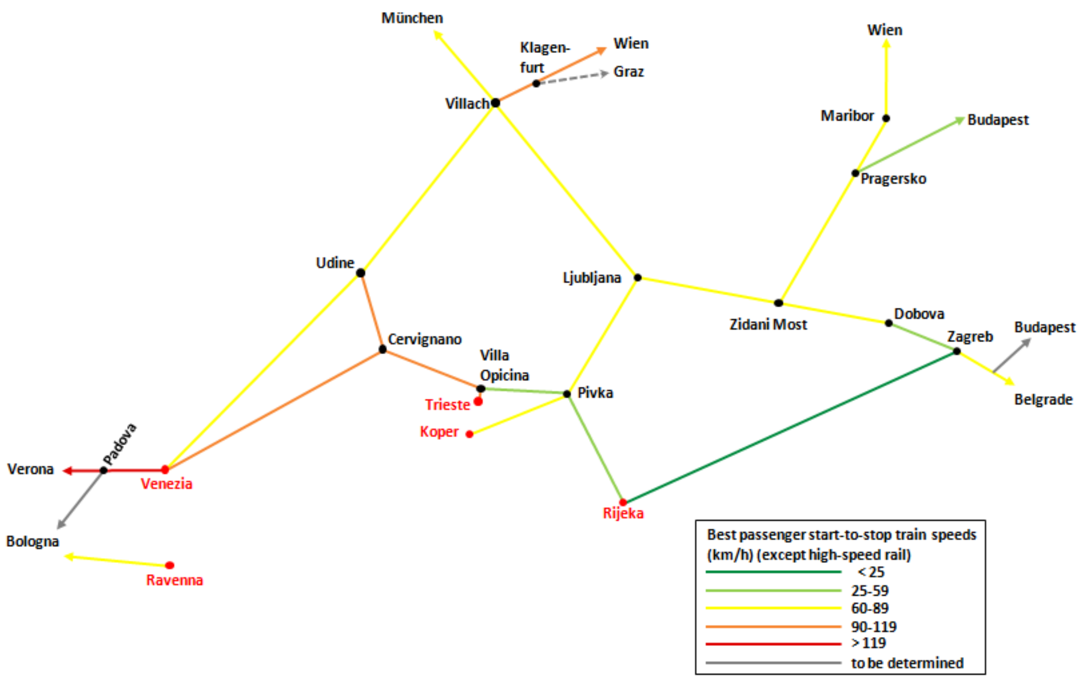


Figure 10 shows the particularly low passenger-train speeds between Trieste and Pivka and between Rijeka and Zagreb. The start-to-stop speed for passengers between Dobova and Zagreb is due to a long stop at the Slovenian-Croatian frontier, although this should be removed once Croatia is a member of the EU.

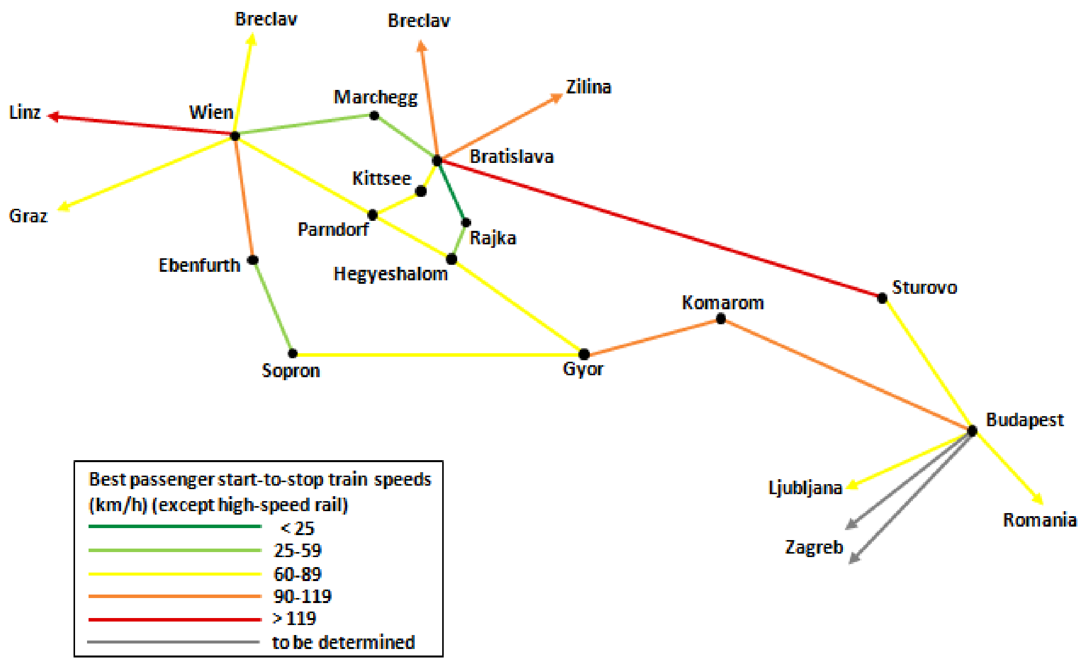


Figure 11: Best start-to-stop passenger speeds in the Wien-Budapest zone

Figure 11 shows cases of "border effects". Here as elsewhere, demand tends to be higher for domestic than for international travel, and this is reflected in investments in rail infrastructure and thus train speeds. The slower cross-border sections are Ebenfurth-Sopron, Wien-Marchegg-Bratislava and Bratislava-Hegyeshalom.

Capacity indicator 4: Maximum train length

Along with maximal tonnage, maximum train length directly affects the number of TEUs a train can carry. Short maximum lengths indicate potential bottlenecks and lines where profitable operation will be more difficult. The source of this data is the RailNetEurope website and the maximum train length provided may or may not include the locomotive; this depends on the convention adopted by each infrastructure manager.

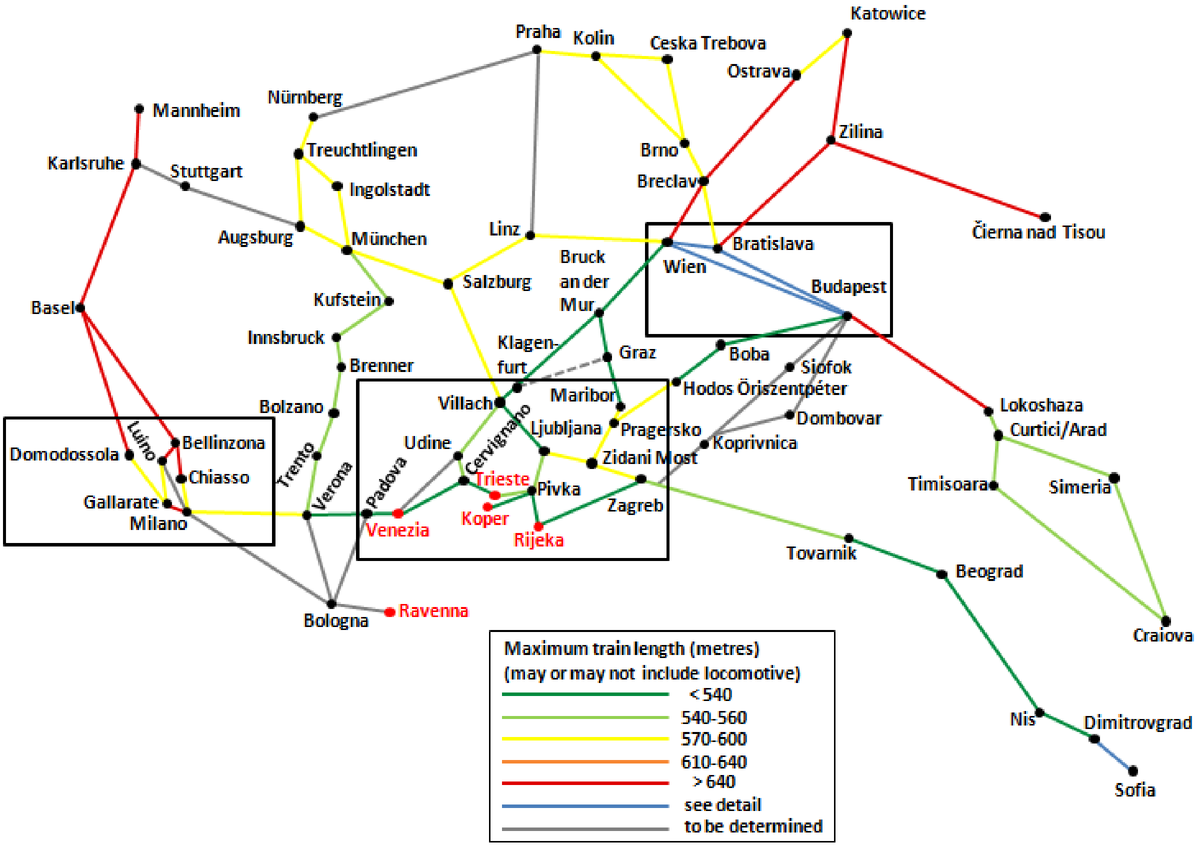


Figure 12: Maximum train lengths in metres in the NAPA core hinterland zone

In mountainous territory, tonnage limitations put a "natural" limit on the lengths of most trains, and so the incentive to provide capacity for the occasional long and light train is reduced. This effect is visible on the existing Brenner route, on the lines leading from the eastern NAPA ports to Ljubljana, Villach and Zagreb and on the Austria trans-Alpine routes from Villach and Graz to Vienna.

Train lengths are generous, however, in the mountainous routes through Switzerland, with some restriction on the Italian segment north of Milan, and northeast and southeast of the Wien-Budapest zone. Restrictions on train length are also visible in Serbia and Romania.

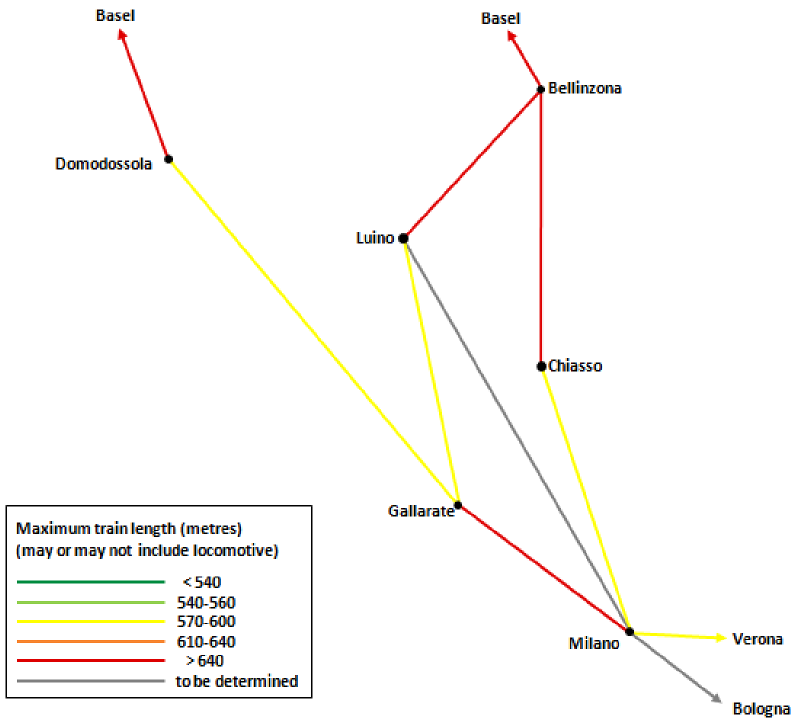


Figure 13: Maximum train lengths in the Milano zone

Figure 13 shows the restrictions on train length in Italy, in contrast to Switzerland.

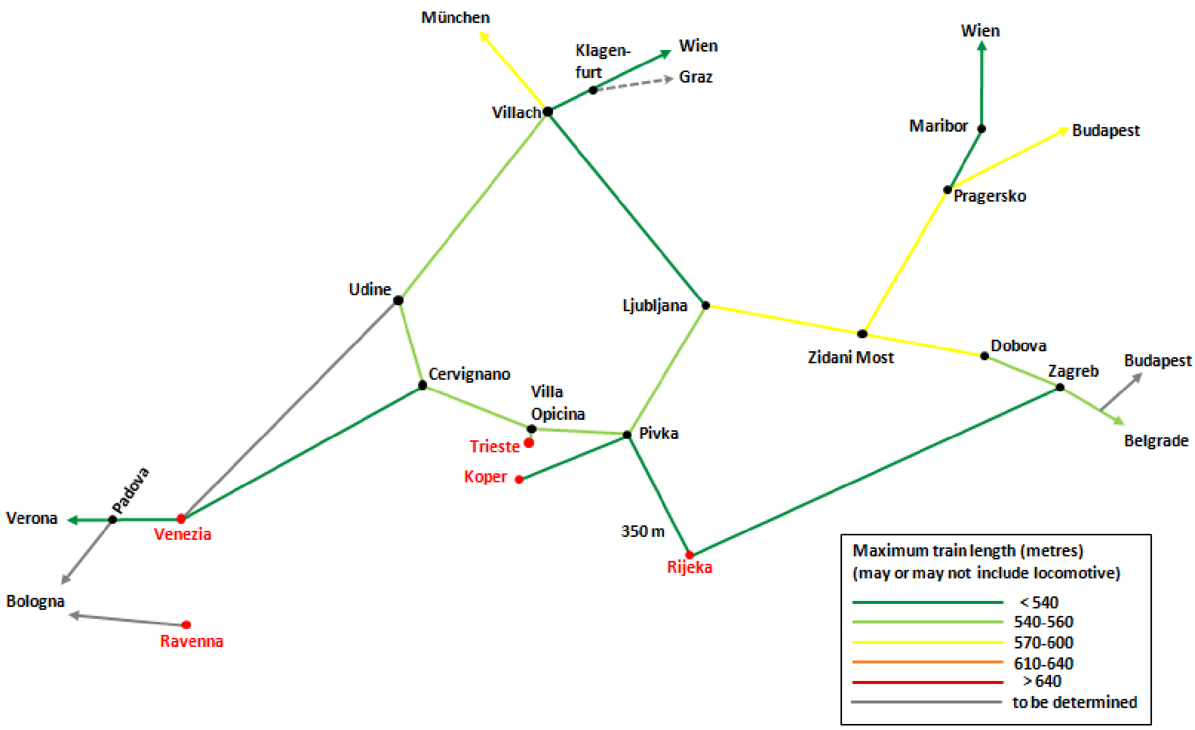


Figure 14: Maximum train lengths in the immediate NAPA zone

Figure 14, in more detail for the immediate NAPA zone, shows the limits on train length in Italy, on the lines leading from the eastern NAPA ports and on the Austrian trans-Alpine routes toward Wien.

Figure 15: Maximum train lengths in the Wien-Budapest zone

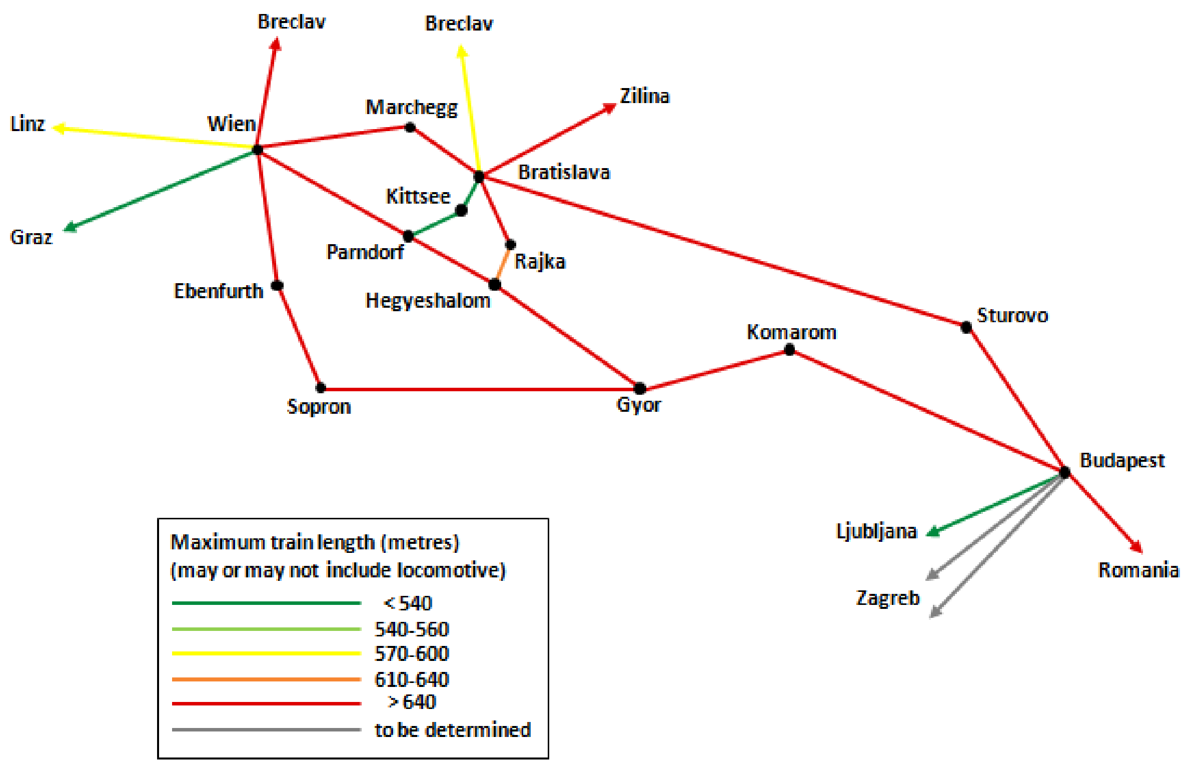


Figure 15 shows that on the lines both within the Wien-Budapest zone, and on the lines to the northeast and southeast, maximum train lengths are generous. Train length is more constrained on the routes to the northwest and southwest. Each of the two main links between Wien and Bratislava are bottlenecks: the routing via Marchegg is slow, whereas the routing via Kittsee only admits short trains.

Capacity indicator 5: Train tonnage

Like maximum train length, maximum tonnage directly affects the number of TEUs a train can carry. Low-tonnage line segments indicate potential bottlenecks and lines where profitable operation will be more difficult. Given the relatively lightweight nature of intermodal traffic (compared to freight trains transporting bulky goods such as coal), weight restrictions may be less of a bottleneck than train length in the container market.

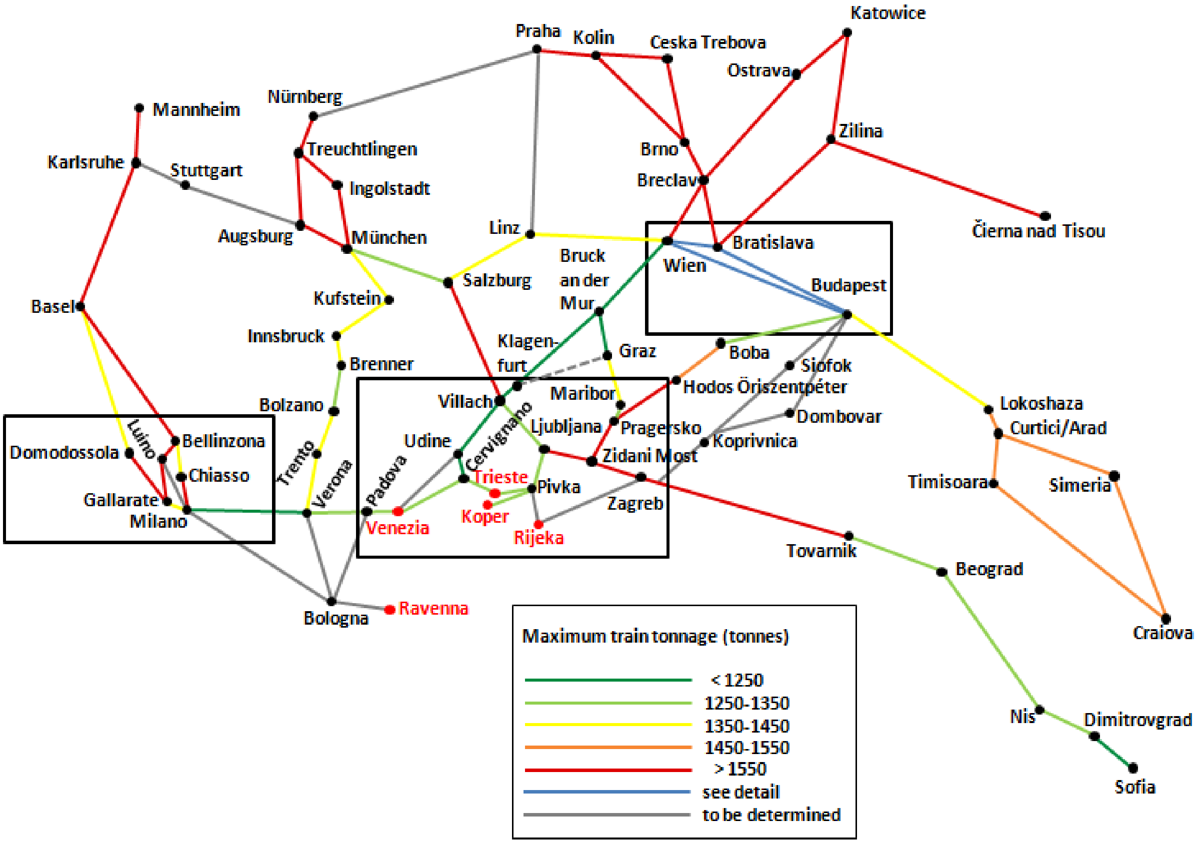


Figure 16: Maximum train tonnage on the core NAPA hinterland network

Figure 16 suggests that the worst bottlenecks in terms of train tonnage are the Trieste-Milan line in Italy, the lines leading from the four northernmost NAPA ports to Wien, the Salzburg-Münich line, southwest of Budapest and in Serbia. The Romanian lines have higher tonnage ratings than many of the segments leading to them from the NAPA zone, while the trans-Alpine lines through Switzerland are less tonnage-constrained than the Brenner pass.

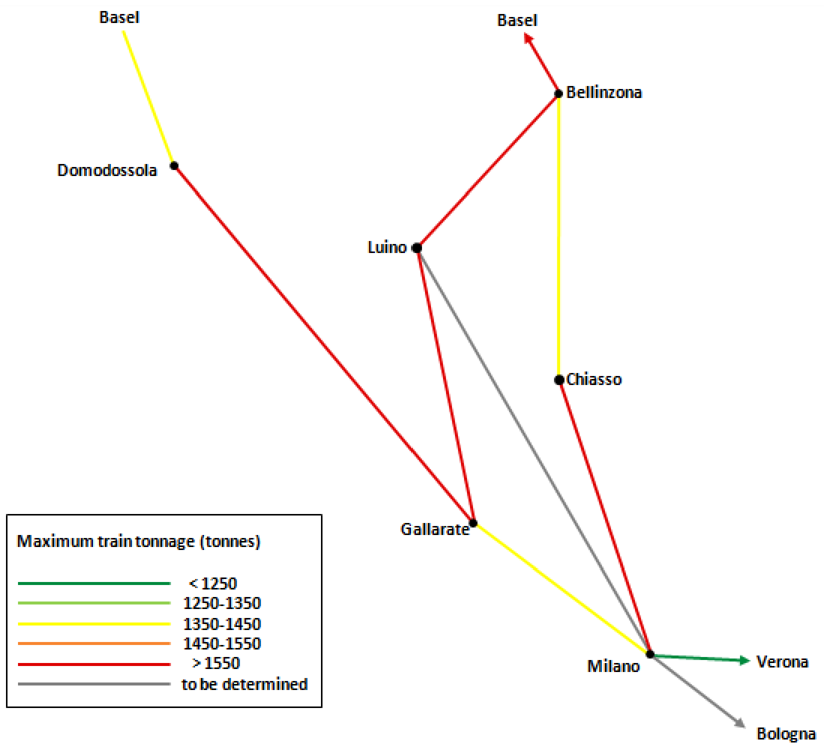


Figure 17: Maximum train tonnage in the Milano zone

Figure 17 shows that constraints are mainly due to geography than to political decisions on investment levels: the mountainous Swiss routes north of Domodossola and between Chiasso and Bellinzona cannot admit as much tonnage on a train as the flatter Italian segments leading to them. The Gotthard route admits more tonnage than the other Swiss segments shown here. Low investment in tonnage capacity is visible on the route east of Milano.

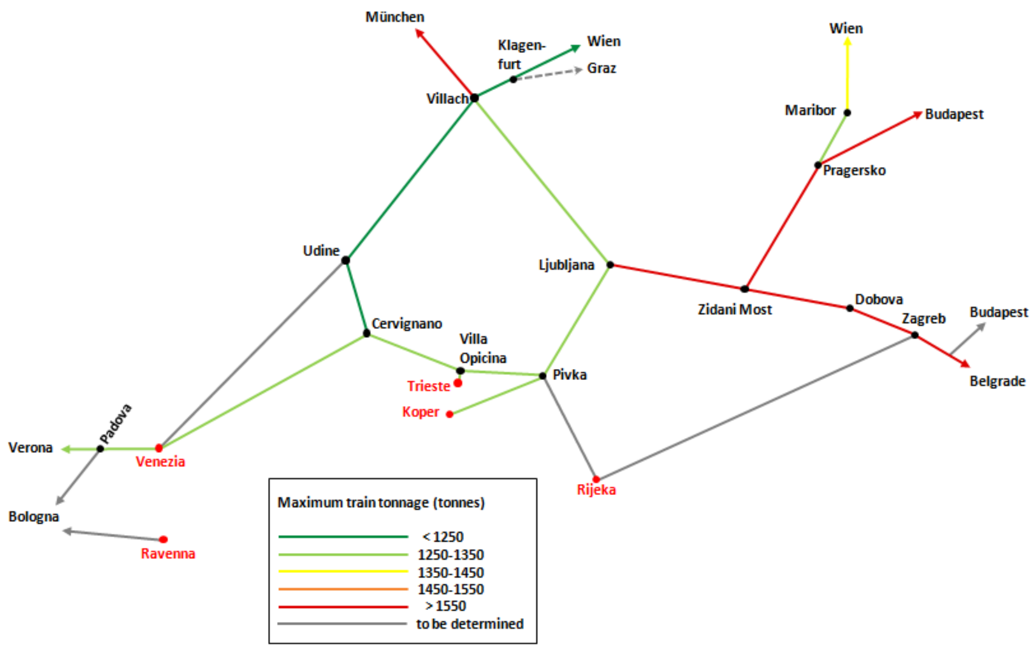


Figure 18: Maximum train tonnage in the immediate NAPA zone

In the immediate NAPA zone, maximum train tonnage is limited by lack of investment in tonnage in Northern Italy, and by high gradients (and lack of investment) from Trieste and Koper via Ljubljana or Udine to Villach; similar constraints are likely to apply from Rijeka towards Zagreb. East of Ljubljana, train tonnage is much less restricted.

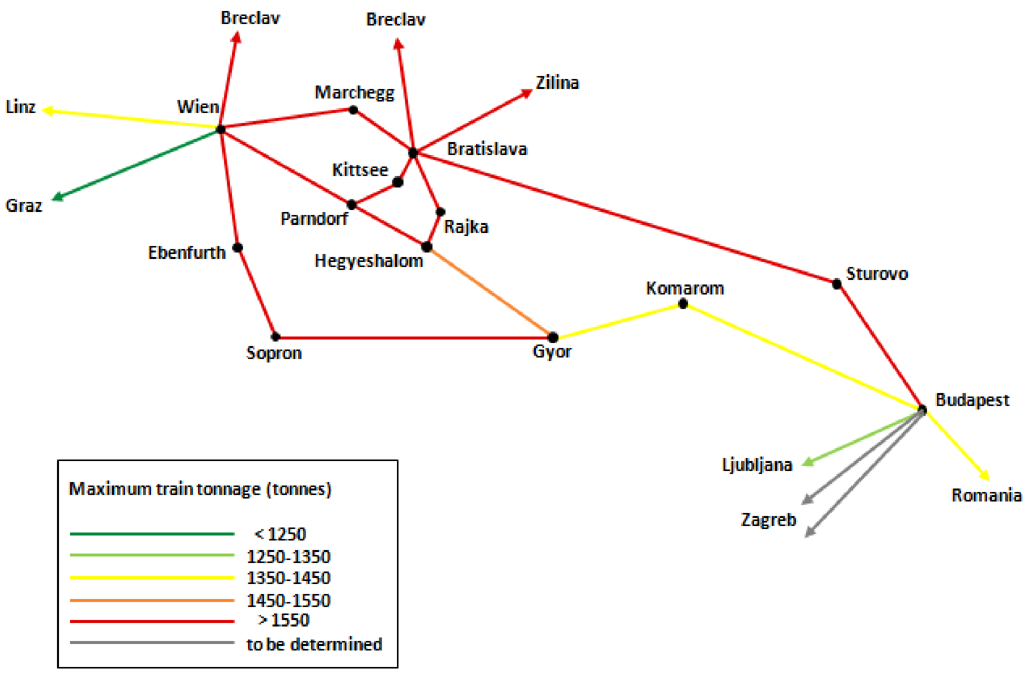


Figure 5.19: Maximum train tonnage in the Wien-Budapest zone

In the Wien-Budapest zone appears devoid of train tonnage bottlenecks. The mountainous lines to the northwest and southwest, and the line to Romania, admit less tonnage per train.

Capacity indicator 6: Clearance for 9 foot 6 inch containers

The overhead clearance for a line segment is indicated by a standard "P/C" code ranging from 22 to 80. The P/C code is the distance by which a container up to 250 cm wide can exceed the base container height of 245 cm if the container is on a standard flat wagon 117.5 cm above the railhead. On such a wagon, the minimum P/C value for a high-cube container 9 feet 6 inches or 2.895 cm high is thus 290 – 245 = 45.

The following maps show just one line segment that cannot carry high-cube containers and a few others whose P/C is at or very close to the minimum.

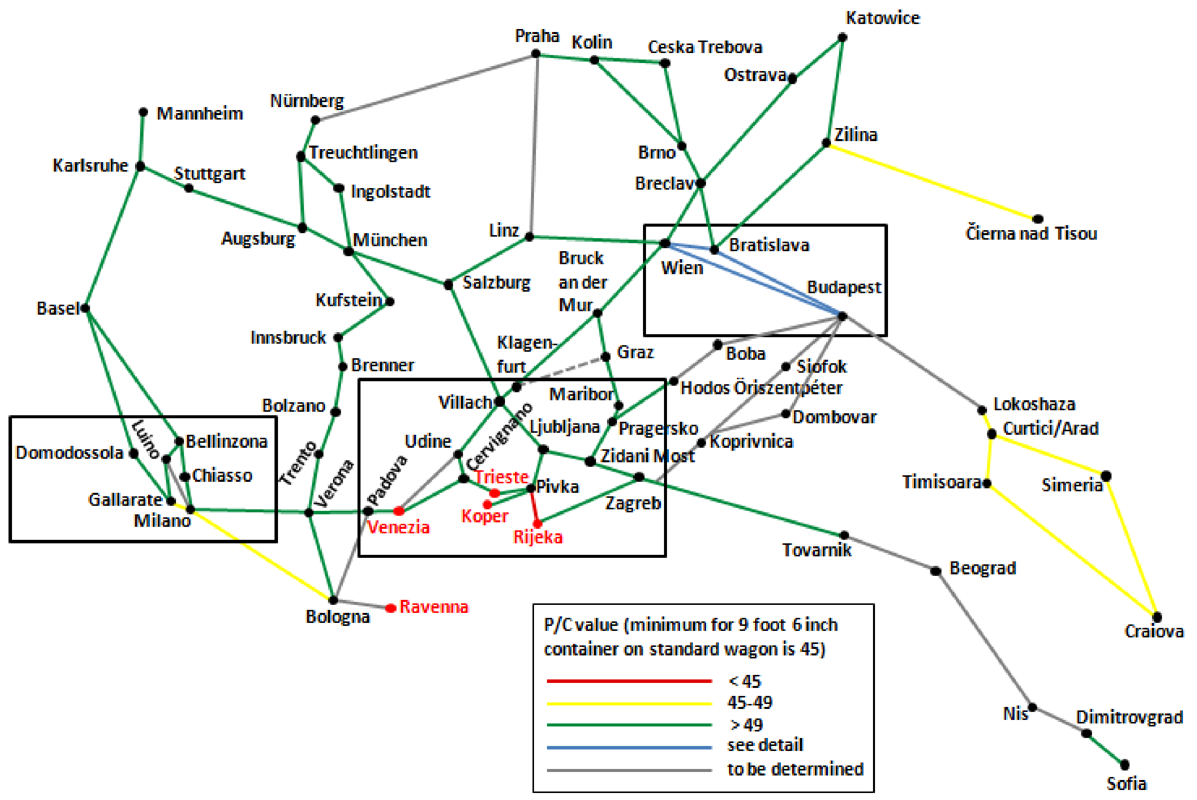


Figure 20: P/C values in the core NAPA hinterland network

Figure 20 shows that for the lines on which data was readily available, outside the immediate NAPA zone, the only possible height restrictions for intermodal transport of maritime containers appear to be between Milano and Bologna, in Romania and east of Zilina in Slovakia. On all these lines, however, the stated clearance is the 45 minimum P/C level or up to 4 cm above. This merely indicates that further verification would be advisable to be sure than all intermodal trains serving the NAPA ports can run on these lines.

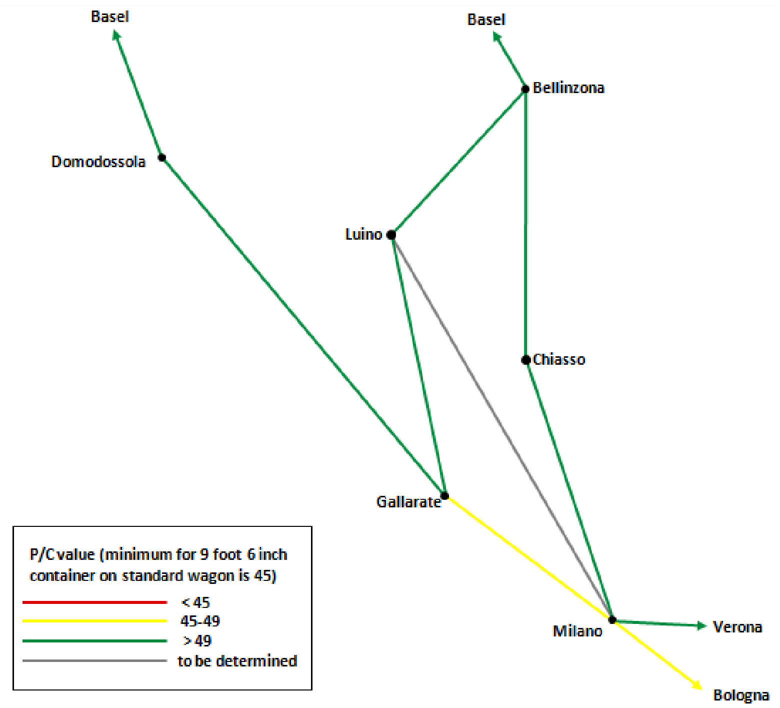


Figure 21: P/C values in the Milano zone

Figure 21 shows that between Bologna, Milano and Gallarate, the stated clearance is the 45 minimum P/C level or up to 4 cm above while the trans-alpine routes towards Basel are cleared to above this level.

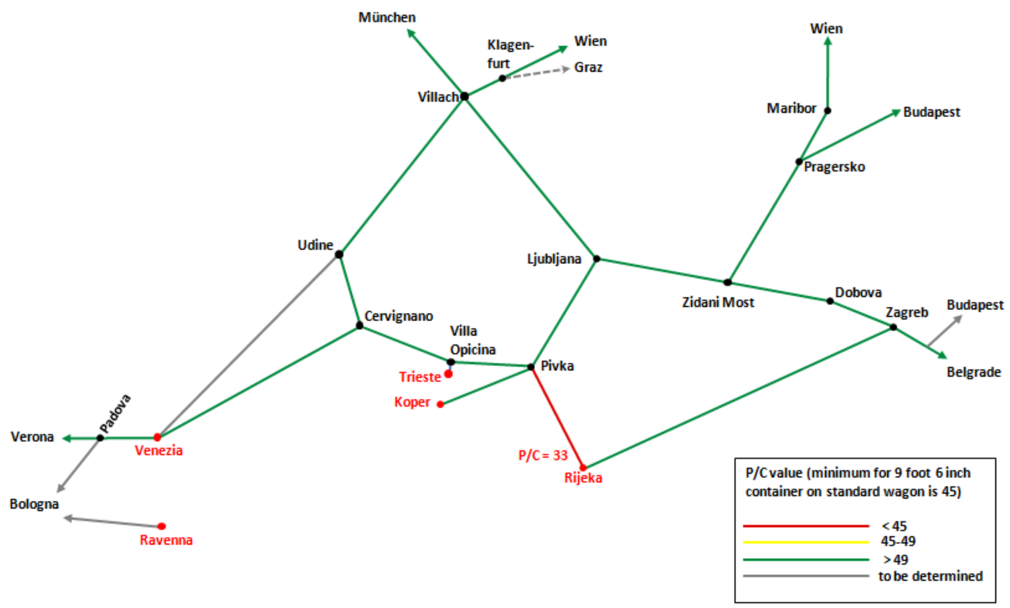


Figure 5: P/C values in the immediate NAPA zone

In the immediate NAPA zone, the only height issue appears to be the Pivka-Rijeka segment, which according to the network statement of the Croatian rail infrastructure manager has a P/C value of only 33 between Rijeka and the border with Slovenia.

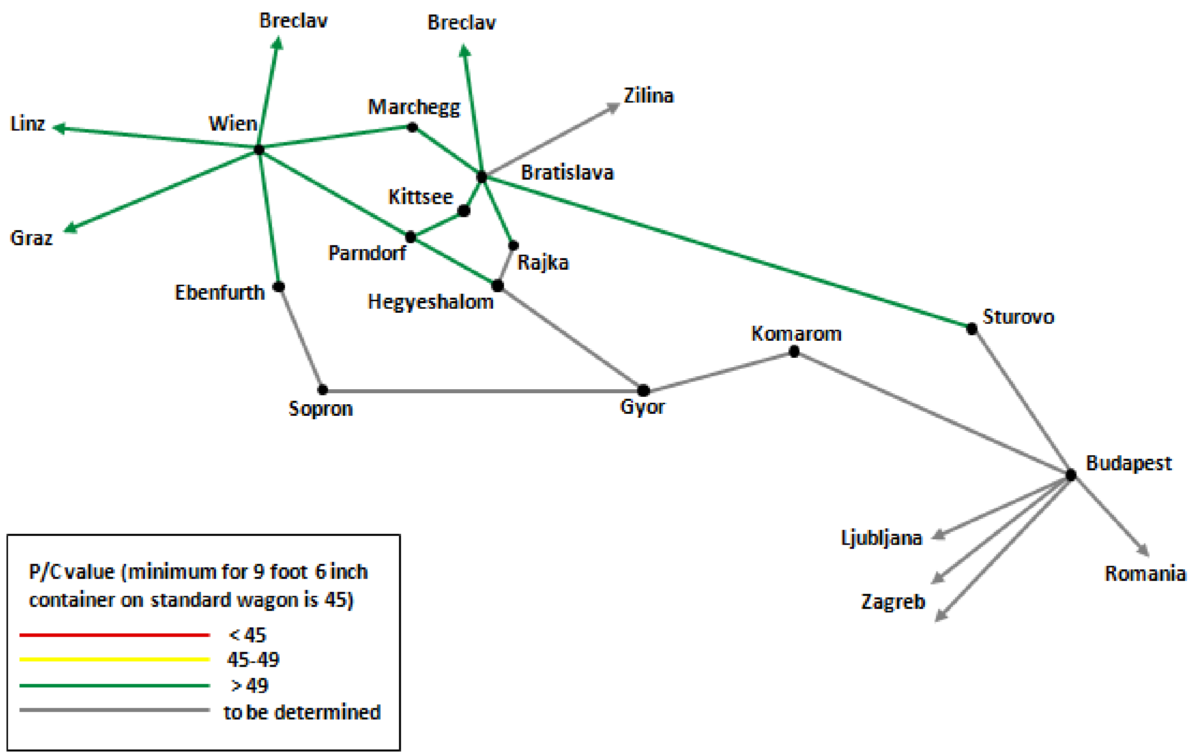


Figure 23: P/C values in the Wien-Budapest zone

For the Wien-Budapest zone and the approach lines for which information was readily available, no height problems for maritime container trains are apparent.

APPENDIX 3

Short sea container lines calling at NAPA ports, 2010-11

Service	Frequency	NAPA ports visited					Weekly deployment (TEU)						Port String
							2010				2011		
		Ravenna	Venice	Trieste	Koper	Rijeka	Q1	Q2	Q3	Q4	Q1	Q2	
ADRIA MARITIME	Twice weekly	X		X		X				743	743	743	Trieste - Rijeka - Ravenna - Trieste
BORCHARD - ADRIATIC	Weekly	X	X				735	735	735	724	724	724	Ravenna - Venice - Ashdod - Haifa - Limassol - Ravenna
CARGO SHPP	Weekly	X					189	189	189	189	189	189	Ravenna - Taranto - Limassol - Beirut - Ravenna
COSCO - AFS	Weekly		X		X	X	1,710	1710	1,710				Gioia Tauro - Naples - Rijeka - Koper - Venice - Ancona - Gioia Tauro
	Weekly		X	X	X	X				1,630			Gioia Tauro - Piraeus - Rijeka - Trieste - Koper - Venice - Ancona - Gioia Tauro
	Weekly		X		X	X					724	724	Piraeus - Rijeka - Koper - Venice - Ancona - Piraeus
CSAV NORASIA - ADRIATIC LINK	Weekly		X		X				860				Marsaxlokk - Ancona - Venice - Koper - Marsaxlokk
	Weekly		X		X	X				1,016	1,216	1,216	Marsaxlokk - Ancona - Venice - Koper - Rijeka - Marsaxlokk
EVERGREEN - ADL	Weekly		X	X	X	X	1,725	1,725	1,360	1,360			Trieste - Koper - Venice - Rijeka - Ancona - Taranto - El Dekheila - Limassol - Ashdod - Mersin - Tarant
EVERGREEN - ADL1	Weekly	X		X							1,577	1,577	Taranto - Trieste - Ravenna - Ancona - Taranto - El Dekheila - Beirut - Limassol - Taranto
EVERGREEN - ADL2	Weekly		X		X	X					1,557	1,557	Taranto - Koper - Venice - Rijeka - Taranto - Ashdod - Mersin - Taranto
MAERSK LINE - ALEX	Weekly	X			X		970	970					Piraeus - Limassol - Alexandria - Ashdod - Koper - Ravenna - Piraeus
	Weekly	X		X	X				1,021	1,021			Port Said - Alexandria - Limassol - Koper - Trieste - Ravenna - Piraeus - Limassol - Ashdod - Port Said
	Weekly	X		X	X						1,046	970	Alexandria - Ashdod - Koper - Trieste - Ravenna - Piraeus - Limassol - Alexandria
MSC - CROATIA EXPRESS	Weekly				X	X					1,380	1,380	Gioia Tauro - Rijeka - Koper - Gioia Tauro
MSC - EAST MED 1	Weekly	X	X	X	X		1,816	2,152	2,152	2,152	2,152	2,152	Gioia Tauro - Mersin - Alexandria - Ravenna - Trieste - Venice - Koper - Gioia Tauro
MSC - EAST MED 2	Weekly	X	X	X	X		1,588	1,588	2,070	2,070			Trieste - Koper - Ravenna - Venice - Izmir - Gemlik - Istanbul - Gioia Tauro - Trieste
	Weekly	X	X	X	X						1,943	1,943	Trieste - Koper - Ravenna - Venice - Izmir - Gemlik - Istanbul - Trieste
MSC - EAST MED 3	Weekly	X	X	X	X		1,380	1,380	1,380	1,380	1,380	1,380	Haifa - Ashdod - Koper - Trieste - Venice - Ravenna - Haifa
MSC - EAST MED 4	Weekly	X	X				1,891	1,891	1,891	1,890	1,891	1,891	Venice - Ancona - Ravenna - Piraeus - Limassol - Beirut - Tartous - Latakia - Izmir - Piraeus - Venice
SERMAR LINE - 1	Fortnightly	X	X		X		255	255	255				Koper - Venice - Ravenna - Alexandria - Limassol - Beirut - Koper
	Fortnightly	X	X		X					273	224	224	Koper - Venice - Ravenna - Alexandria - Port Said - Tartous - Latakia - Mersin - Koper
SERMAR LINE - 2	Fortnightly	X	X	X	X		254	254	254				Koper - Venice - Ravenna - Alexandria - Limassol - Trieste - Mersin - Koper
	Fortnightly	X	X		X					254			Koper - Venice - Ravenna - Alexandria - Port Said - Latakia - Mersin - Koper
	Fortnightly	X	X		X						254	254	Koper - Venice - Ravenna - Alexandria - Port Said - Beirut - Latakia - Koper
SERMAR LINE - 3	Fortnightly	X	X		X		163	163	163				Koper - Venice - Ravenna - Izmir - Istanbul - Thessaloniki - Volos - Koper
	Fortnightly	X	X		X					163			Koper - Venice - Ravenna - Ancona - Thessaloniki - Ambarli - Izmir - Koper
	Every 12 days	X	X		X						188	188	Koper - Venice - Ravenna - Ancona - Thessaloniki - Ambarli - Gemlik - Thessaloniki - Izmir - Koper
X-PRESS - IAX	Weekly		X	X	X	X					1,630	1,630	Gioia Tauro - Marsaxlokk - Rijeka - Koper - Trieste - Venice - Ancona - Gioia Tauro - Cagliari - Gioia Ta
X-PRESS - TEX	Weekly	X		X			699						Gioia Tauro - Bar - Ploce - Split - Trieste - Ravenna - Gioia Tauro
	Weekly	X									816	816	Marsaxlokk - Gioia Tauro - Taranto - Bar - Ploce - Split - Ravenna - Durres - Marsaxlokk
ZIM - ADX	Weekly	X	X	X	X		1,282	1,282	1,214	1,214	1,282	1,282	Haifa - Ashdod - Koper - Trieste - Venice - Ravenna - Alexandria - Haifa

Source: MDST Containership Databank