Integrated and Sustainable Transport in Efficient Network – ISTEN

DT1.1.3 Local context analysis for Emilia Romagna

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Document information

Abstract

The Port of Ravenna was developed early 1960s to support the industrial development of the Emilia-Romagna Region and Northern Italy. Still today the port represents a key node of the logistics chain of the Italian industry in these areas. The strategic relevance of the port is today predominantly related to the import of goods and particularly of raw materials for the Italian industry in Northern Italy. The dredging works under implementation are aimed at keeping the port competitive and consolidate its position in the market with reference to dry bulks and import of raw materials. In order to reach both the target of greening transport and maximise the potential associated with the availability of a modern and interconnected port infrastructure thanks to the ongoing investments supported by the TEN-T policy and related funds, cross-industry actions towards an increased use of the Port of Ravenna as an export gateway shall be considered for development and implementation.

Keywords

Local context analysis, port-hinterland, bottlenecks, scenarios

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* Abbreviations of editor/contributor name

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AdSP	Autorità di Sistema Portuale del Mare Adriatico Centro-Settentrionale (*Ravenna Port Authority*)
CEF	Connecting Europe Facility
EU	European Union
ISTEN	Integrated and Sustainable Transport in Efficient Network
MoS	Motorways of the Sea
MTO	Multimodal Transport Operator
PCS	Port Community System
PLN	Piattaforma Logistica Nazionale
RNE	RailNetEurope
RFC	Rail Freight Corridor
RFC5	Baltic-Adriatic Rail Freight Corridor
RFI	Rete Ferroviaria Italiana
Ro-Ro	Rolling On, Rolling Off
RRT	Rail Road Terminal
TEN-T	Trans European Transport Network

1 INTRODUCTION

The aim of this report is to provide an in-depth analysis of the Port of Ravenna, including an overview of its local port community and relations among its players, as well as their roles in the local intermodal chain. The scope of the analysis is not limited to the port hard and soft infrastructure but also includes the main hinterland logistics infrastructure and services, with a particular emphasis on the logistics nodes located in the Emilia Romagna Region.

The content of this report is based on a transport analysis, market study and Cost-Benefit Analysis elaborated in 2017 by the *Autorità di Sistema Portuale del Mare Adriatico Centro Settentrionale* (hereinafter, Port Authority) for the final project design of the most relevant initiative under development and implementation at the Port of Ravenna, i.e. the Ravenna Hub Project: *Approfondimento canali Candiano e Baiona, adeguamento banchine operative esistenti, nuovo terminal in Penisola Trattaroli e riutilizzo del materiale estratto in attuazione al P.R.P. vigente 2007*. Further to this study, the report also considers the results of the 2015-2017 Core Network Corridor studies for the Baltic-Adriatic and Mediterranean corridors, completed early 2018, as well as the activities for the updating of the project lists of the Baltic-Adriatic, Mediterranean and Scandinavian-Mediterranean Core Network Corridors as part of the ongoing 2018-2022 Core Network Corridor Studies. These activities also included the consultation of the Port Authority, of the Bologna core Rail Road Terminal (Interporto Bologna), as well as the representatives of the Emilia Romagna Region responsible for rail freight transport and logistics infrastructure and services.

The above analysis follow the structure of the questionnaire prepared by CERTH as WPT1 coordinator. The inputs from the above sources has been assessed and discussed within the ISTEN project team and their collective contribution has been finally integrated in the relevant sections of this report.

Chapter 2 below gives first an overview of the Port of Ravenna and its hinterland chain, and then looks into the relevant operations carried out and governance in place. In Chapter 3, the existing bottlenecks are described together with the planned solutions, their assessment being broken down into whether hindrances pertain to the market, the infrastructure, the operations, the institutional framework or innovative services. Finally, possible medium-term scenarios have been identified and explored in view of increasing the port- hinterland chain efficiency and sustainability and consolidating the role of the port as integrated intermodal hub.

2 CHARACTERISTICS OF THE LOCAL ENVIRONMENT

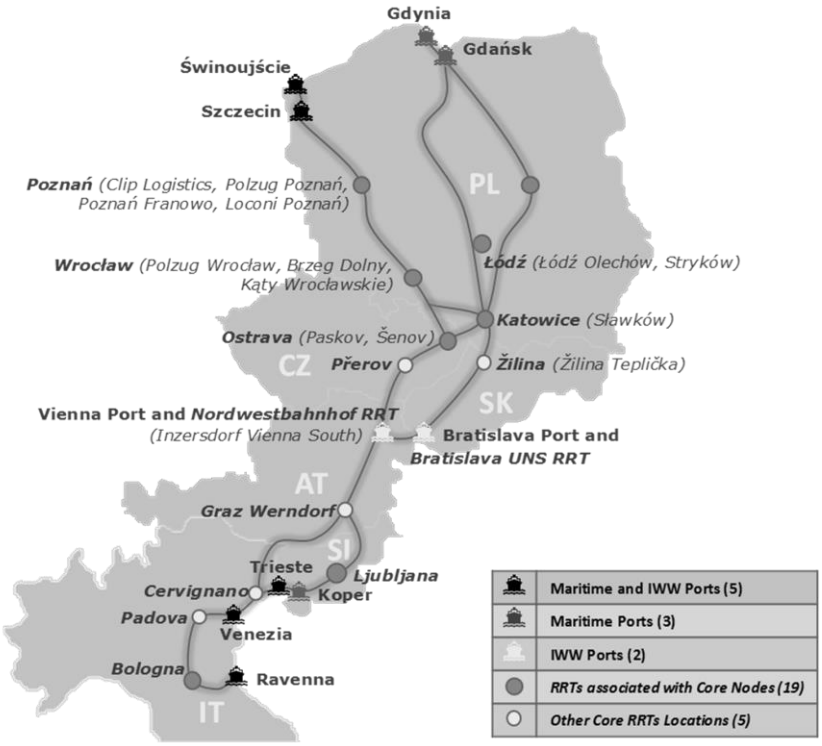
2.1 Port-hinterland chain overview

2.1.1 Geography and main characteristics

The Port of Ravenna is positioned in the central-north western side of the Adriatic Sea, in the Mediterranean basin. It is the main port of the Emilia Romagna region, located in Northern Italy.

The port is a core node of the TEN-T network as defined by Regulation EU 1315/2013. It belongs to the Baltic-Adriatic Corridor as well as to the Baltic-Adriatic Rail Freight Corridor – RFC5 and it also belongs to the Mediterranean Corridor. Within the scope of the Baltic-Adriatic Corridor development, the port is identified as primary logistic platform by the *Connecting Europe Facility* Regulation 1316/2013.

Figure 1 – Multimodal platforms along the Baltic-Adriatic Corridor



Source: Work Plan of the Baltic-Adriatic Corridor

The following table summarises the main infrastructure characteristics of the port. The Port of Ravenna is the only port canal in Italy. The Candiano Canal is 14 km long and offers 14.5 km of operational quays, currently used by 27 terminal operators. The maximum depth of the port is currently 11.5 m. The port is interconnected to the main road and rail network. At present ten 10 terminals are connected to railways. The total area of the port is 21 km^2 and its storage capacity consists of more than 600 thousands m^2, 1,350 thousands m^2 yards and 1.3 million m^3 of storage tanks.

Table 1 – The Port of Ravenna in numbers

General characteristics	
Total area	21 km^2
Port canals length	14 km
Maximum depth	11.50 m
Operational quays	14.5 km
Private terminals	27
Rail tracks	35 km
Terminals connected to railways	10
Storage capacity	
Warehouses	603,000 m^2
Yards	1,350,000 m^2
Storage tanks	1,256,000 m^3

Source: Port Authority

2.1.2 Traffic operations and volumes

Under the functional stand point, the Port of Ravenna covers a relevant role both on the Italian national level and on the Adriatic basin level. According to Eurostat data, Ravenna is indeed the 1st port in the Adriatic Sea and the 1st in Italy for the handling of dry bulk.

Table 2 – Main ports in Italy and the Adriatic basin (total traffic in tonnes)

	2007	2012	2015	2016	CAGR '16-12	CAGR '16-07	VAR '16-15
EU ports	3,838,217	3,643,512	3,772,474	3,792,548	1.0%	-0.1%	0.5%
Top 20 ports	1,610,209	1,632,027	1,722,608	1,746,000	1.7%	0.9%	1.4%
Italy	443,250	388,491	368,481	365,510	-1.5%	-2.1%	-0.8%
Adriatic Core	181,585	156,794	155,335	162,053	0.8%	-1.3%	4.3%
Tyrrhenian Core	197,500	175,275	182,983	183,878	1.2%	-0.8%	0.5%
Trieste	39,833	42,144	49,137	49,311	4.0%	2.4%	0.4%
Genova	48,358	42,453	43,426	45,049	1.5%	-0.8%	3.7%
Ravenna	27,008	22,402	25,288	27,503	5.3%	0.2%	8.8%
Livorno	29,798	20,515	29,303	27,008	7.1%	-1.1%	-7.8%
Gioia Tauro	30,639	27,399	26,137	26,966	-0.4%	-1.4%	3.2%
Venezia	32,042	24,598	25,142	25,221	0.6%	-2.6%	0.3%
Koper	15,805	16,907	19,931	21,171	5.8%	3.3%	6.2%
Taranto	49,240	35,210	18,484	20,982	-12.1%	-9.0%	13.5%
Augusta	30,238	24,883	19,943	19,876	-5.5%	-4.6%	-0.3%
Napoli	10,609	12,756	16,247	15,267	4.6%	4.1%	-6.0%
La Spezia	17,353	13,017	15,449	14,567	2.9%	-1.9%	-5.7%
Savona	15,343	14,102	12,164	13,510	-1.1%	-1.4%	11.1%
Cagliari	9,397	12,576	13,153	13,397	1.6%	4.0%	1.9%
Palermo	5,765	7,574	7,161	8,238	2.1%	4.0%	15.0%
Bari	3,197	3,413	3,804	4,696	8.3%	4.4%	23.4%
Ancona	5,167	4,563	4,588	4,518	-0.2%	-1.5%	-1.5%
Patras	4,486	2,783	3,093	3,209	3.6%	-3.7%	3.8%
Igoumenitsa	4,480	2,459	2,952	3,113	6.1%	-4.0%	5.5%
Rijeka	327	2,315	2,916	2,329	0.2%	24.4%	-20.1%

Source: Eurostat

Table 3 - Top 20 EU ports, and main ports in Italy (dry bulk traffic tonnes)

REP_MAR/TIME	2007	2012	2015	2016	CAGR '16-12	CAGR '16-07	VAR '16-15
EU ports	952,869	832,023	862,932	841,372	0.3%	-1.4%	-2.5%
Top 20 ports	345,623	279,504	305,318	274,173	-0.5%	-2.5%	-10.2%
Italy	92629	69543	57568	59826	-3.7%	-4.7%	3.9%
Rotterdam	88,738	71,393	82,693	77,210	2.0%	-1.5%	-6.6%
Amsterdam	48,664	38,954	42,716	43,786	3.0%	-1.2%	2.5%
Hamburg	26,895	25,357	31,250	30,426	4.7%	1.4%	-2.6%
Riga	14,999	20,804	22,624	21,803	1.2%	4.2%	-3.6%
Dunkerque	27,575	23,547	21,832	22,142	-1.5%	-2.4%	1.4%
Constanta	15,206	18,400	21,772	23,185	5.9%	4.8%	6.5%
Izmit		20,883	21,378	21,232	0.4%	n.a.	-0.7%
Immingham	23,830	22,544	18,929	15,712	-8.6%	-4.5%	-17.0%
Aliaga		15,332	16,846	16,747	2.2%	n.a.	-0.6%
London	14,488	11,401	13,949	15,328	7.7%	0.6%	9.9%
Antwerpen	24,200	18,774	13,910	12,588	-9.5%	-7.0%	-9.5%
Marseille	13,112	9,473	13,895	12,958	8.1%	-0.1%	-6.7%
Ravenna	14,047	9,469	11,343	13,881	10.0%	-0.1%	22.4%
Taranto	24,069	18,754	9,597	11,992	-10.6%	-7.4%	25.0%
Botas		8,353	9,900	10,648	6.3%	n.a.	7.6%
Venezia	11,144	8,162	8,064	8,555	1.2%	-2.9%	6.1%
Koper	9,547	7,200	7,080	7,295	0.3%	-2.9%	3.0%
Brindisi	6,378	6,360	4,912	3,158	-16.1%	-7.5%	-35.7%
Bari	1,698	1,247	1,759	2,110	14.1%	2.4%	20.0%
Savona	4,281	3,908	1,928	2,075	-14.6%	-7.7%	7.6%
Genova	2,753	1,829	1,169	1,416	-6.2%	-7.1%	21.1%
Trieste	2,512	1,656	582	905	-14.0%	-10.7%	55.5%
La Spezia	1,990	1,571	1,453	817	-15.1%	-9.4%	-43.8%
Ancona	1,549	618	502	423	-9.0%	-13.4%	-15.7%
Livorno	947	644	897	410	-10.7%	-8.9%	-54.3%

Source: Eurostat

Additionally, the Ravenna Port ranked 3rd in 2016 in Italy for total traffic. If excluding liquid bulk it is the 1st port in the Adriatic Sea.

Table 4 – Main ports in Italy (traffic in tonnes at 2016)

	Total traffic	Share	Liquid bulk traffic	Share	Total traffic without liquid bulk traffic	Share
Italy	365,510	100%	159,763	100%	205,747	100%
Trieste	49,311	13%	37,910	24%	11,401	6%
Genova	45,049	12%	16,262	10%	28,787	14%
Ravenna	27,503	8%	5,712	4%	21,791	11%
Livorno	27,008	7%	6,679	4%	20,329	10%
Gioia Tauro	26,966	7%	911	1%	26,055	13%
Venezia	25,221	7%	7,698	5%	17,523	9%
Taranto	20,982	6%	4,056	3%	16,926	8%
Augusta	19,876	5%	19,149	12%	727	0%
Napoli	15,267	4%	6,243	4%	9,024	4%
La Spezia	14,567	4%	862	1%	13,705	7%
Savona	13,510	4%	7,909	5%	5,601	3%
Cagliari	13,397	4%	841	1%	12,556	6%
Palermo	8,238	2%	1,865	1%	6,373	3%
Bari	4,696	1%	93	0%	4,603	2%
Ancona	4,518	1%	7	0%	4,511	2%

Source: Eurostat

The table overleaf provides further information on the traffic volumes at the Port of Ravenna for the years 2016 and 2017. The port operates passenger and cargo services with a primarily role and specialisation in dry bulk operations. In addition to oil and chemical products, traffic within the port involves raw materials and finished goods from the ceramics district, metallurgical products, timber and agri-food production. Also significant are the operations of containerised traffic handled within two terminals at the port as well as the Ro-Ro segment.

Table 5 - Maritime traffic at Port of Ravenna (2016 and 2017)

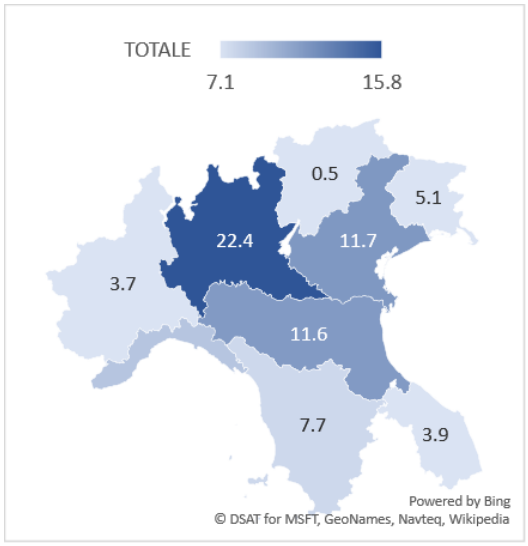
YEAR	2016			2017			Difference	
Time Period Going From	January to December			January to December				
	IN	OUT	TOTAL	IN	OUT	TOTAL	TOTAL	%
TOTAL THROUGHPUT in tons	**22,093,414**	**3,869,350**	**25,962,764**	**22,644,555**	**3,863,930**	**26,508,485**	**545,721**	**2,1%**
LIQUID BULK	***4,049,688***	***289,840***	***4,339,528***	***4,258,406***	***289,297***	***4,547,703***	***208,175***	***4,8%***
Crude oil	151,693	0	151,693	201,155	0	201,155	49,462	32,6%
Refined (petroleum) products	1,615,531	106,558	1,722,089	1,687,035	97,777	1,784,812	62,723	3,6%
Gases, liquefied or compressed petroleum products and natural gas	561,604	12,000	573,604	608,844	9,000	617,844	44,240	7,7%
Chemical products	738,014	166,486	9,045	681,034	182,520	863,554	-40,946	-4,5%
Other liquid bulk	982,846	4,796	987,642	1,080,338	0	1,080,338	92,696	9,4%
DRY BULK	***10,149,115***	***584,918***	***10,734,033***	***10,653,142***	***760,564***	***11,413,706***	***679,673***	***6,3%***
Cereals	1,951,970	20,000	1,971,970	1,841,340	51,085	1,892,425	-79,545	-4,0%
Foodstuff/Fodder/Oil seeds	1,985,748	109,777	2,095,525	2,069,521	141,292	2,210,813	115,288	5,5%
Coal and lignite	218,423	0	218,423	261,855	0	261,855	43,432	19,9%
Ores/cement/lime/plasters	4,700,145	131,719	4,831,864	5,270,866	205,774	5,476,640	644,776	13,3%
Metallurgical Products	22,712	2,216	24,928	60,723	2,496	63,219	38,291	153,6%
Chemical products	0	0	0	0	0	0	0	
Other dry bulk	1,270,117	321,206	1,591,323	1,148,837	359,917	1,508,754	-82,569	-5,2%
GENERAL CARGO	***7,894,611***	***2,994,592***	***10,889,203***	***7,733,007***	***2,814,069***	***10,547,076***	***-342,127***	***-3,1%***
Containerized (including Ro-Ro containers)	1,176,203	1,387,196	2,563,399	1,137,631	1,319,306	2,456,937	-106,462	-4,2%
Ro-Ro (excluding Ro-Ro containers)	753,514	1,123,163	1,876,677	687,828	1,063,701	1,751,529	-125,148	-6,7%
Other general cargo	5,964,894	484,233	6,449,127	5,907,548	431,062	6,338,610	-110,517	-1,7%
ADDITIONAL INFORMATION								
NUMBER OF CALLS			3,034			2,939	-95	-3,1%
GROSS TONNAGE			43,970,384			40,178,696	-3,791,688	-8,6%
NUMBER OF FERRY PASSENGERS	963	1,135	2,098	733	718	1,451	-647	-30,8%
CRUISE PASSENGERS			45,617			50,133	4,516	9,9%
Home Port	345	332	681	391	402	793	112	16,4%
Transits			44,936			49,340	4,404	9,8%
NUMBER OF CONTAINERS (in TEU)	118,436	116,075	234,511	113,924	109,445	223,369	11,142	-4,8%
Hinterland	116,722	114,354	231,076	113,122	108,647	221,769	9,307	-4,0%
of which:								
Empty	49,419	9,498	58,917	45,843	8,774	54,617	4,300	-7,3%
Full	67,303	104,856	172,159	67,279	99,873	167,152	5,007	-2,9%
Transhipped	1,714	1,721	3,435	802	798	1,600	1,835	-53,4%
of which:								
Empty	16	16	32	139	154	293	261	815,6%
Full	1,698	1,705	3,403	663	644	1,307	2,096	-61,6%
Number of Ro-Ro units	37,024	42,012	79,036	33,071	41,735	74,806	4,230	-5,4%
Number of private vehicles			0			0	0	
Number of commercial vehicles	30,225	0	30,225	20,979	27	21,006	9,219	-30,5%

Source: Port Authority

2.1.3 Catchment area

An analysis of the catchment area of the port performed as part of previous studies according to trade statistics by main commodity group shows that the Port of Ravenna can be a strategic node in North of Italy for the trade of agribulk cargoes, as well as metallurgical, construction and chemical products, thanks to the strong industrial nature of the Emilia-Romagna region, which is international leader in the mentioned sectors.

Figure 2 - Total volumes of trade of the Italian regions within the catchment area of the Port of Ravenna.



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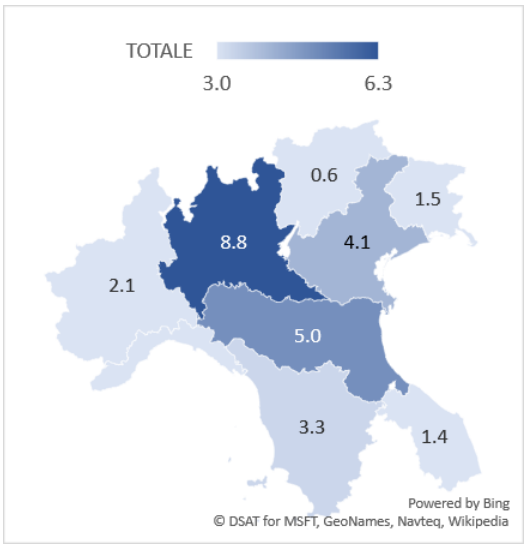
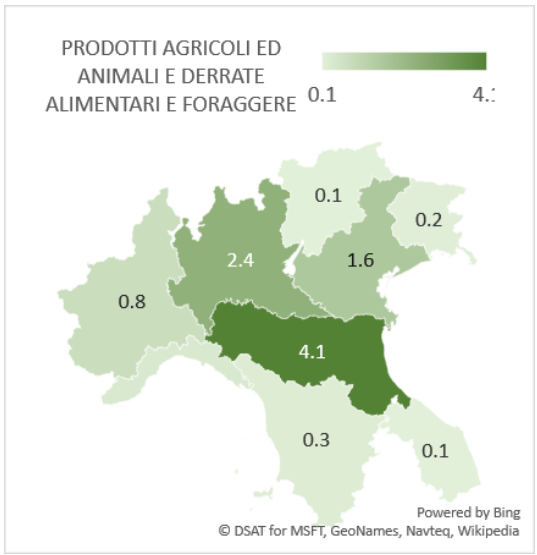


Export

Source: Istat - 2014-2016 average of imported and exported tons (millions)

Figure 3 - Trade of the Italian regions within the catchment area of the Port of Ravenna - Agricultural and animal products and food



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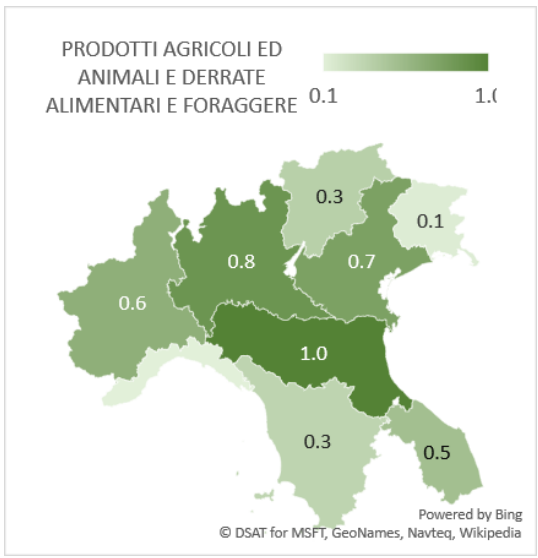
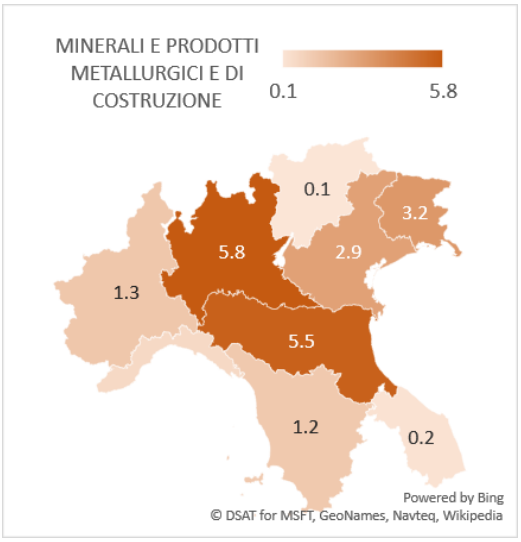


Export

Source: Istat - 2014-2016 average of imported and exported tons (millions)

Figure 4 - Trade of the Italian regions within the catchment area of the Port of Ravenna - Minerals and metallurgical and construction products



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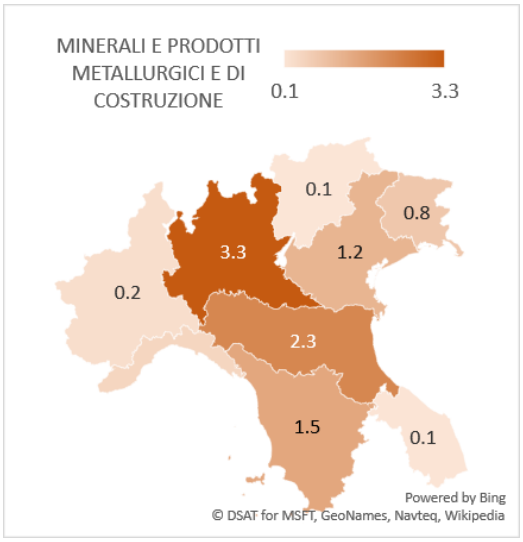
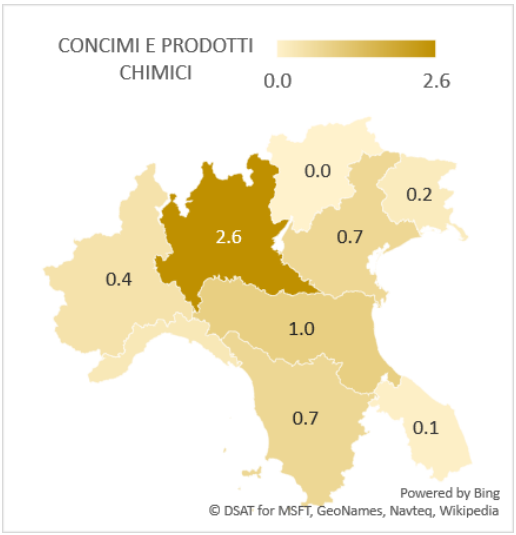


Export

Source: Istat - 2014-2016 average of imported and exported tons (millions)

Figure 5 - Trade of the Italian regions within the catchment area of the Port of Ravenna - Fertilizers and chemical productsi



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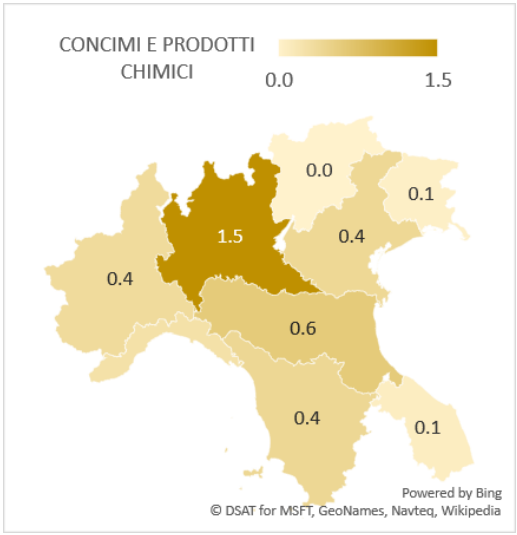
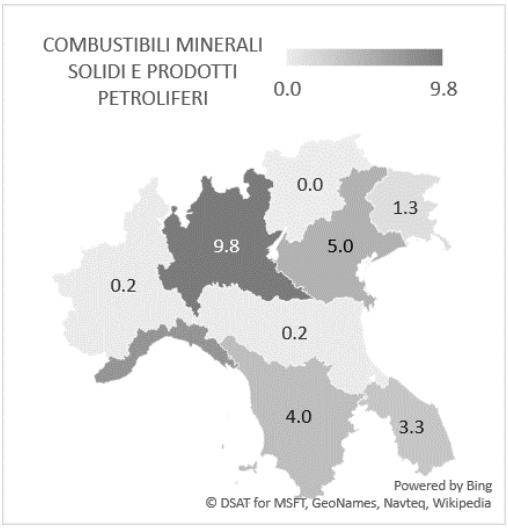


Export

Source: Istat - 2014-2016 average of imported and exported tons (millions)

Such evidences highlight the functional relevance of the Ravenna Port for the traffic of dry bulk and help in understanding the reasons behind the better performances of the port compared to others in Italy and Europe that operate in the same market segments. Accordingly, it is important to invest in the pole of Ravenna in order to guarantee the growth of the port and hence to support the manufacturing and productive activities that represent the excellences of the territory.

Figure 6 – Trade of the Italian regions within the catchment area of the Port of Ravenna – Solid mineral fuels and petroleum products



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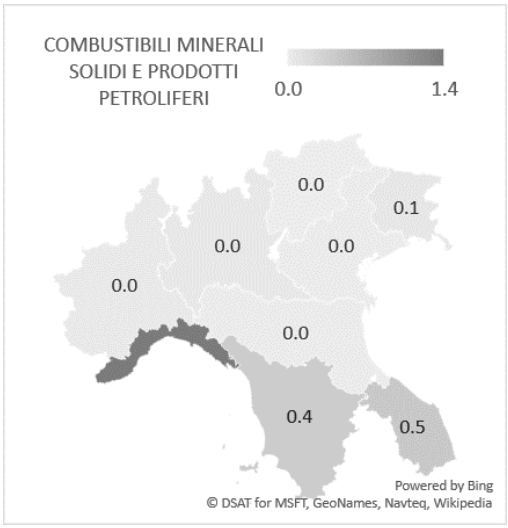
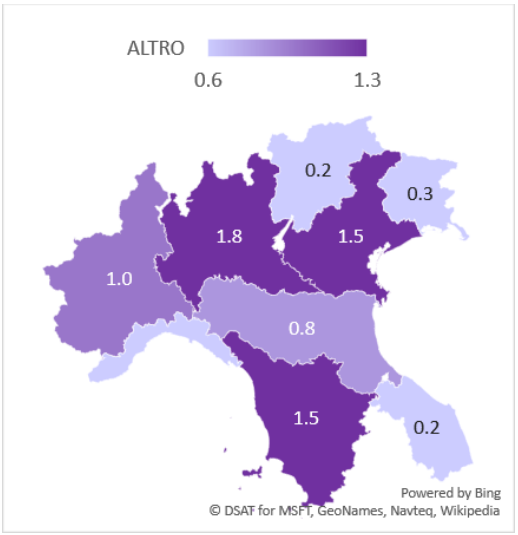


Export

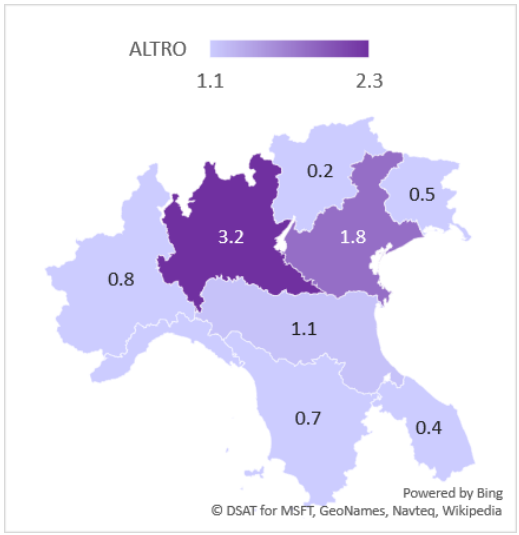
Source: Istat – 2014-2016 average of imported and exported tons (millions)

Differently, the strategic relevance of the Ravenna Port results to be minor with regard to fuel products and the residual categories. However, these categories represent a limited share of totality of goods that are imported and exported in the regions within the catchment area of the port.

Figure 7 – T rade of the Italian regions within the catchment area of the Port of Ravenna – Other products



Import



Export

Source: Istat – 2014-2016 average of imported and exported tons (millions)

2.1.4 Main stakeholders

The public and private actors, involved in the wide-ranging and complex cargo operations and processes taking place along the logistic chain, are listed below:

- Ravenna Port Authority (*Autorità di Sistema Portuale del Mare Adriatico Centro-Settentrionale*);
- Customs Agency;
- Harbour Masters Office/Coast Guard;
- Maritime Health Office;
- Phytosanitary Office;
- Financial Police;
- State Police;
- State Prefecture;
- Freight forwarders;
- Shipping agents;
- Terminal operators;
- Rail transport operators:
    - Railway undertakings;
    - Rail shunting (Dinazzano Po and Serfer).
- Road transport operator;
- Rail Road/Freight Terminals (Dinazzano Freight Terminal, Bologna RRT, Parma RRT, Intermodal Terminal Cremona – Cavatigozzi, Freight Terminal of Piadena, Freight Terminal of Guastalla San Giacomo, Intermodal Terminal Melzo…)
- Multimodal Transport Operators (MTO) (Cargo Clay Logistics, Spinelli…)

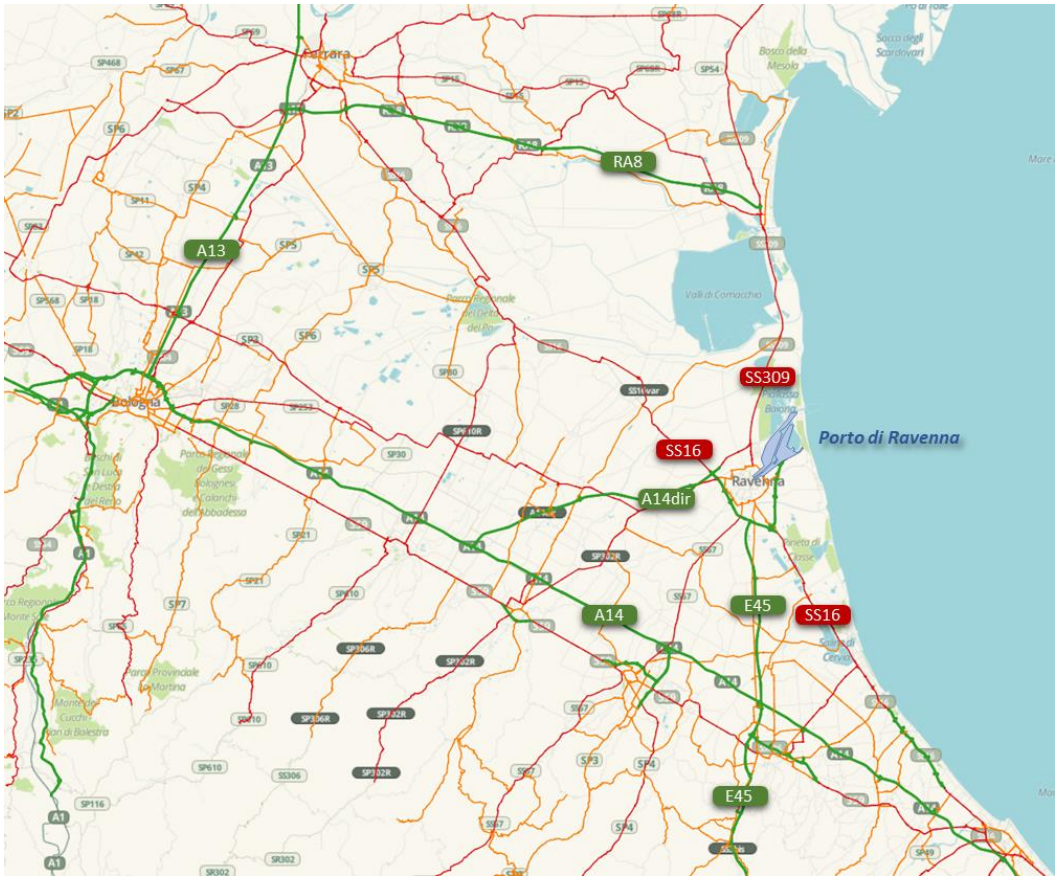
2.2 Port-hinterland chain operations

2.2.1 Existing infrastructure for port-hinterland connections

The Port of Ravenna is interconnected to the main road and rail Italian and European networks.

Concerning road infrastructure, the port and the city of Ravenna are connected to the regional and national road network through the A14 dir motorway (or roads with equivalent characteristics, i.e. the E45) and national highways (SS16 Adriatica and SS309 Romea).

Figure 8 – National and regional road network connecting Ravenna



Source: Port Authority

The so-called 'last mile road accessibility' to the Port is currently guaranteed by the roads that run along the two sides of the Candiano Canal, i.e. Baiona and SS67. The first is a two-lane carriageway, whilst the latter has two carriageways and two lanes per direction. Both road accesses are directly linked to the urban ring road, and through it to the regional and national intercity road network.

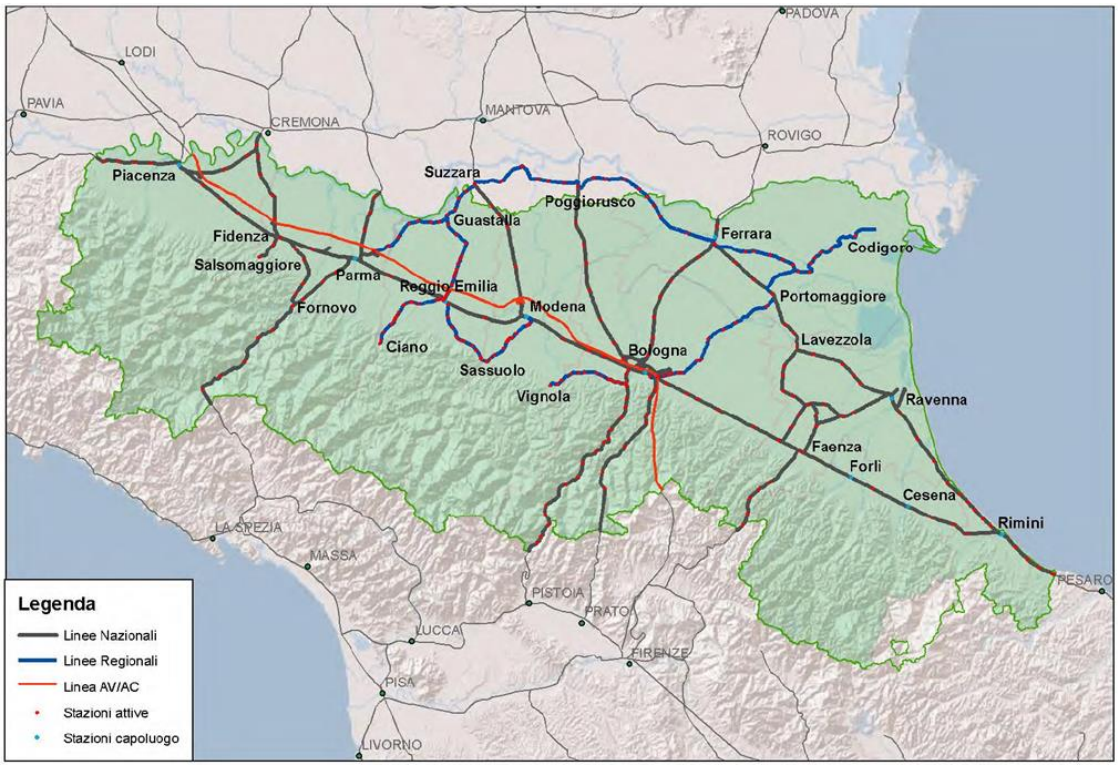
Figure 9 – Local road network connecting the Port of Ravenna

Source: Port Authority

Such layout ensures a road accessibility to the Port that correctly exploit the road system outside the urban centre of Ravenna. This allows the port traffic to respect the functional hierarchy of the roads, thereby avoiding the arise of congestion in the Ravenna's urban network and preventing heavy vehicles from using road infrastructures that are inadequate to their axle load. As a consequence, the ring road experiences very high traffic volumes.

About railway interconnections, the Port of Ravenna is connected to the freight station located in the proximity of the Ravenna train station by two non-electrified rail tracks that run along the sides of the Candiano Canal. From here, four electrified single-track lines allow the connection to the national railway system. Two of these lines (i.e. Ravenna – Granarolo/Faenza and Ravenna – Castelbolognese) are used for freight transport as a double-track line to connect Ravenna with the Adriatic railway line between Bologna and Rimini.

Figure 10 – National and regional railway network in Emilia-Romagna



Source: Emilia-Romagna Region, PRIT2025

The main technical characteristics of the lines are shown in the table overleaf. The railway lines have the typical features to serve the regional passenger transport demand, and they already result to be suitable for freight transport, despite some restrictions concerning axle load and train length, the latter currently limited to 475 m.

Table 6 – Characteristics of railway lines of the national network in the area of Ravenna

Line	Length [km]	No. of tracks	Traction	Max. speed [km/h]	Axle load	Gauge	Max. train length [m]
Ravenna - Rimini	50	1	Electric	130	D4L	P/C32	< 600 m
Ravenna - Ferrara	73	1	Electric	120	D4	P/C32	< 600 m
Ravenna - Granarolo (Faenza)	8	1	Electric	135	D4L	P/C80	< 600 m
Ravenna - Castelbolognese	41	1	Electric	120	D4L	P/C80	< 600 m

Source: RFI

2.2.2 Road traffic

The Port of Ravenna is interested by a meaningful imbalance between the inward and outward road traffic, being the import traffic highly dominant. This means that a large portion of the inward goods vehicles are empty when reaching the port area. This is confirmed by a survey carried out in 2013 by the Emilia-Romagna Region. Results show that 90% of the outward trucks are full, therefore indicating that the traffic generated by the port is basically import traffic.

In 2016, the amount of import goods hauled by road was 19,145,730 tons. The estimated bi-directional traffic generated by the port was 6,962 veh/day (using an annualisation factor of 250 day/year and an average truck load of 22 tons).

Table 7 - Road traffic generated by the Port of Ravenna (heavy vehicles/day, 2016 estimates)

Year	**2016**
Freight road transport [tons]	19,145,730
Annualisation factor [day/year]	250
Average load [tons]	22
Bi-directional traffic generated by the port [veh/day]	6,962

Source: Port Authority

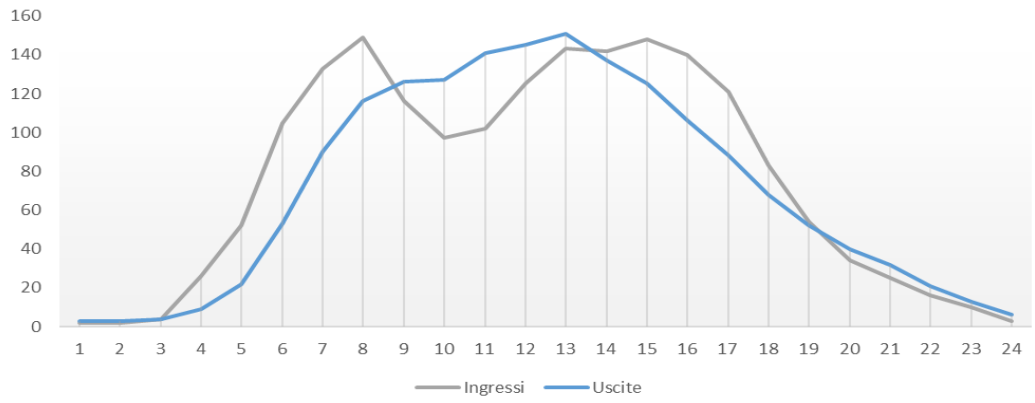
The current amount of daily transits recorded at the Ravenna toll plaza on the A14 dir motorway is almost 17,000, against a road capacity of at least 60,000 veh/day, i.e. 15,000 veh/day per lane. These data show that the motorway has still ample room to host further traffic in the coming years, and hence to support the growth of the Ravenna Port.

Table 8 - Road traffic on the A14Dir Motorway - Toll Plaza of Ravenna (May 2016)

	Vehicle type			**Total**
	Light	**Medium**	**Heavy**	
Transits	12,074	1,576	3,356	16,992
%	71%	9%	20%	-

Source: Port Authority based on Autostrade per l'Italia data

Figure 11 - Hourly transit profile of heavy vehicles at the toll plaza of Ravenna (May 2016)



Source: Port Authority based on Autostrade per l'Italia data

Similar reasonings can be done in relation to the urban and interurban road network of Ravenna, especially if considering the planned doubling of the SS309 highway where it becomes the Ravenna's ring road. During the weekdays, traffic volumes on these road sections are equal or lower than 10,000 veh/day per lane per direction, except for the SS16 highway between Cervia and Cesenatico, where volumes are slightly greater than 13,000 veh/day per lane per direction. The intersections on this road segment has been recently upgraded.

Table 9 – Road traffic on the main ordinary extra-urban network of Ravenna (May 2016)

Section	Lanes x Directions	Total	Vehicle type		Day type	
			Light	Heavy	Weekday	Weekend
SS 3Bis/E 45 between Borello e Mercato Saraceno	2x2	20,992	17,685	3,307	21,019	20,925
SS 16 between Cervia e Cesenatico	2x1	24,510	22,767	1,744	23,752	26,364
SS 309Dir (ringroad of Ravenna) nearby Canalazzo	2x1	22,005	16,187	5,819	23,418	18,551
SS 309 between Comacchio and the provincial borders of Ferrara and Ravenna	2x1	12,570	8,756	3,814	12,887	11,795

Source: Emilia-Romagna Region

2.2.3 Rail traffic and type of cargoes

Rail traffic registered its historical record in 2016, with a total of 3,368,090 (420,406 tons entering and 2,947,684 tons leaving the port). Traffic increased by 10.1% compared to 2015 and represented 13% of the total moved freight to/from the port.

Table 10 – Historical trend of rail traffic at the Port of Ravenna

Year	Port traffic [tons]	Rail traffic [tons]	% of rail traffic	TEUs (excluding transhipment)	TEUs by rail	% of TEUs by rail
2002	17,104,363	1,432,686	8.40	156,908	15,578	9.90
2003	18,704,425	1,924,145	10.30	155,668	20,179	13.00
2004	19,972,835	1,999,032	10.00	157,822	26,649	16.90
2005	23,888,989	2,245,591	11.70	156,336	26,344	16.90
2006	26,777,198	2,563,583	11.90	154,789	24,678	15.90
2007	26,336,232	2,841,657	13.00	185,146	33,347	18.00
2008	25,924,050	3,008,595	14.30	188,176	33,494	17.80
2009	18,718,819	1,936,965	13.80	166,225	29,937	18.00
2010	21,934,241	1,936,965	11.40	160,062	26,789	16.70
2011	23,354,118	2,284,644	12.30	200,741	24,195	12.10

2012	21,469,477	2,076,834	12.30	200,312	23,375	11.70
Year	Port traffic [tons]	Rail traffic [tons]	% of rail traffic	TEUs (excluding transhipment)	TEUs by rail	% of TEUs by rail
2013	22,485,841	1,984,352	11.00	221,128	26,248	11.90
2014	24,460,154	2,959,135	12.10	204,442	22,095	9.90
2015	24,738,959	3,059,970	12.40	210,882	19,966	8.20
2016	25,962,764	3,368,090	13.00	213,617	22,174	9.60

Source: Port Authority

The table above provides historical maritime traffic data of the Ravenna Port and the related distribution in the territory by rail. On average, 12% of the Ravenna's traffic reaches or leaves the port by rail. Rail traffic experienced a reduction regarding the containerized goods over the last few years, whereas conventional traffic increased from 2013 onwards.

Similarly to road traffic, the large majority of goods that are hauled by train departs from the Port of Ravenna (imported goods) reflecting the nature of the port traffic. The evident asymmetry of traffic flows hinders the competitiveness of rail freight transport, as each train has to afford the cost of an empty return.

Metallurgic and raw materials for ceramics represent the main component of rail traffic, followed by containerized goods and chemical products. Compared to 2015, a meaningful increase of cereals (43.2%), metallurgical products (13.3%), ceramic raw materials (7%) and containerized goods (6.7%) was recorded in 2016. TEUs increased by 11% in 2016, reaching 22,174 units (of which 10,659 entering and 11,515 leaving the port).

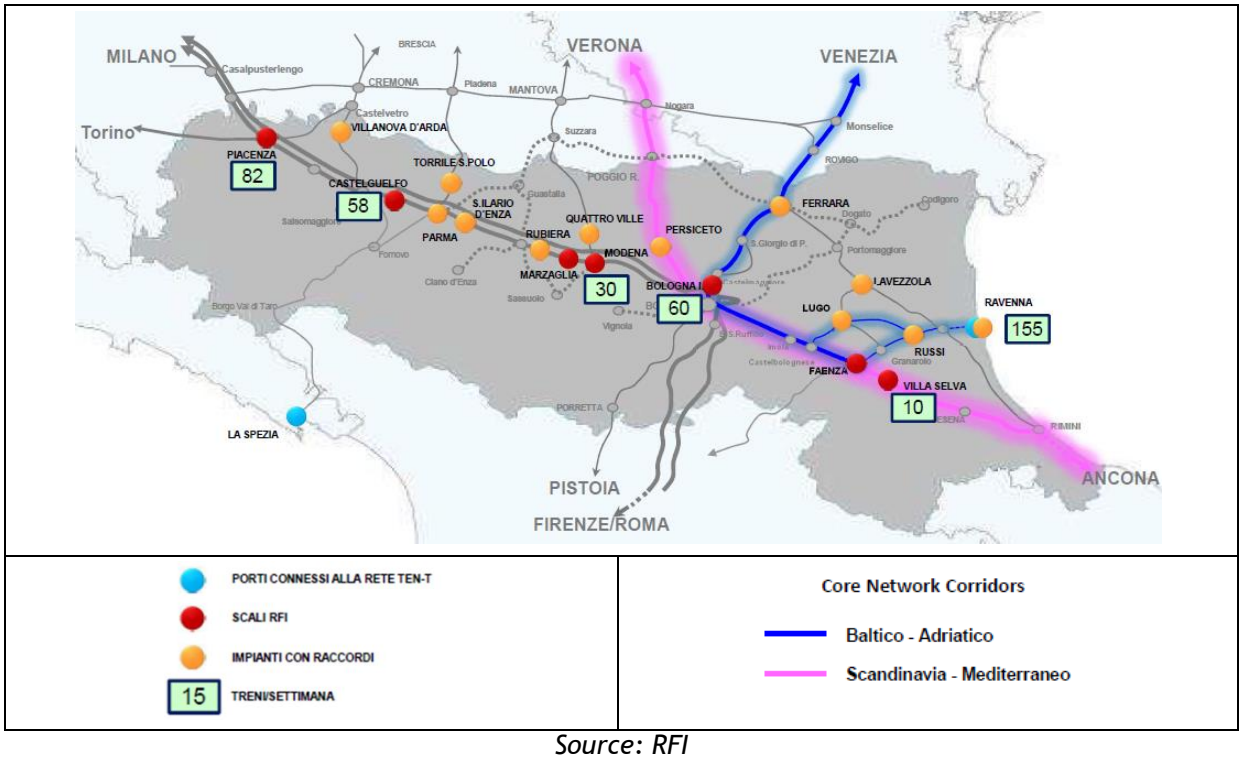
Table 11 – Rail traffic generated by the Port of Ravenna, categorized by type of goods (tons) – 2016 data

Goods type	Incoming [tons]	Outgoing [tons]	Total [tons]
Chemical	106,730	76,132	182,862
Metallurgical	-	1,605,259	1,605,259
Raw material for ceramics	168,231	1,021,569	1,189,800
Cereals	-	161,028	161,028
Ferrous	-	5,308	5,308
Rapeseed oil	4,885	-	4,885
Containerised	140,560	78,388	218,948
Total	420,406	2,947,684	3,368,090
TEUs	10,659	11,515	22,174

Source: Port Authority

In 2016, the Port of Ravenna generated 7,291 trains. This figure is given by the total number of trains entering and leaving the Port of Ravenna, including empty ones. This makes the Ravenna Port the main rail terminal of the Emilia-Romagna region, with an average value of 155 trains per week against 80 in Piacenza and 60 in Bologna.

Figure 12 – Main rail terminals for freight transport in the Emilia-Romagna region (2016)



Source: RFI

The main rail connections are significantly influenced by the typologies of goods that are hauled by rail. In fact, the two most important relations involve Mantova for metallurgical products, through the Piadena terminal, and Reggio Emilia for ceramic raw materials, through the Dinazzano Po terminal. Other relevant terminals are Melzo, Cremona, and Parma. It is worth noting the existence of regular rail services on the rail lines directed

towards Germany, Poland and France on the itineraries of the relevant EU core network and RFC corridors.

Figure 13 – Rail flows from/to the Port of Ravenna (total number of trains, 2016)

Source: Authors based on RFI data

Regarding to the rail access to the port, the two fundamental lines are hence the Ravenna-Ferrara Northbound and the Ravenna-Faenza/Castelbolognese Westbound, where rail traffic is almost evenly distributed. Traffic towards Rimini is much lower compared to the abovementioned.

Figure 14 – Rail flows on the lines accessing the Port of Ravenna (total number of trains, 2016)

Source: Authors based on RFI data

Despite the relevance of rail transport, the Port of Ravenna cannot benefit from an optimal connection to the national network, which causes long train operating times. These are further penalized by the interferences occurring in the urban areas, especially on the line south of the Candiano Canal and due to the need of trains to transit through the city station.

The services between Ravenna Port and the main hinterland intermodal terminals are listed and described below.

Table 12 – Rail services between Port of Ravenna and intermodal terminals (2014)

Promoter	Route	Type of Traffic	Yearly tonnes transported
Dinazzano Po	Ravenna – Guastalla S.Giacomo	Traditional	203,237
Siderlogistics Consorzio /ASTL	Ravenna - Cava Tigozzi	Land intermodal	214,270
Terminal Nord	Ravenna - Dinazzano	Land intermodal	458,529
SAPIR - Porto Intermodale Ravenna	Ravenna - Dinazzano	Land intermodal	362,040
Spinelli	Milano Smistamento - Ravenna	Maritime Intermodal	59,584
Marcegaglia Carbon Steel	Ravenna - Piadena	Traditional	800,422
Cargo Clay Logistics	Ravenna - Dinazzano	Traditional	251,147
CePIM - Centro Padano Interscambio	Ravenna - Castelguelfo	Land intermodal / Tradional	76,434

Source: Emilia-Romagna Region, Monitoraggio 2017, Capitolo 9, La logistica e il trasporto merci e il porto di Ravenna[1]

Figure 15 – Rail network within the Port of Ravenna

Source: Port Authority

At the port, the internal rail network, whose layout is represented in the figure above, allows the direct connection of the plants listed below.

[1] https://mobilita.regione.emilia-romagna.it/allegati/pubblicazioni/monitoraggio/monitoraggio_2017/monitoraggio2017_cap9_logistica.pdf

Table 13 – Plants with rail connection at the Port of Ravenna

Connected plants – North track:	Connected plants – South track:
Polynt (liquid chemicals)	Docks Cereali (cereals/flour)
Versalis (liquid chemicals)	Sapir (clay/vegetable oils/minerals)
PIR - La Petrolifera Italo-Rumena (liquid chemicals)	Setramar (steel coils/clay/cereals/flour)
Marcegaglia (steel coils)	TC Ravenna (containerized goods)
IFA (clay/flour)	
Terminal Nord (clay)	

Source: RFI

At the Port of Ravenna, the shunting service is provided by the following companies:

- Serfer SpA;
- Dinazzano Po SpA.

2.2.4 Services provided by the main actors involved in port-hinterland connections operations

The table below defines type of service provided by each actor of the port-hinterland logistic chain.

Table 14 – Services provided by each of the main actors

Agent	Type of service
Port Authority;	Administrative services
Customs Agency;	Administrative services
Harbor Masters Office;	Administrative services
Maritime Health Office;	Administrative services
Phytosanitary Office;	Administrative services
Financial Police;	Administrative services
State Police;	Administrative services
State Prefecture;	Administrative services
Freight forwarders;	Freight commercial services
Shipping agents;	Freight commercial services
Terminal operators	Freight handling at port terminals
Rail transport operators	Rail transport and shunting operations
Road transport operator	Road transport operations
Rail Road/Freight Terminals	Freight handling at inland terminals
Multimodal Transport Operators (MTO)	Freight transport and terminal operations

Further to the terminals located at the Port of Ravenna, the rail road terminals and intermodal/freight terminals listed in the table below are worth mentioning which are involved in the hinterland logistics chain of the port.

Table 15 - Main actors involved

Logistic centre	Characteristics
CePIM (Parma RRT)	Rail terminal: **35,000 m²**
	Warehouse: **2,500,000 m²**
	Intermodal terminal: **6,000,000 m²** (12,000 m² refrigerated)
	7 rail tracks for loading/unloading
	Terminal services: handling, picking, container maintenance, goods transhipments
Dinnazzano Po	Rail terminal: **300,000 m²**
	8 rail tracks plus **13** rail tracks for loading/unloading
	Highway connections: **A22, A1**
	Specialized services: containers, palletts and bulk goods in particular for ceramics district
Interporto Bologna	Total surface: **4,100,000 m²**
	Warehouse: **580,000 m²**
	17 loading and unloading rail track
	Container terminal: **130,000 m²**
	Intermodal terminal: **140,000 m²**
	Bulk terminal: **50,000 m²**
	Terminal services: handling, heating and cooling, picking, wagons maintenance and reparing, container and swap bodies maintenance, treatment of dangerous goods
Piadena	Total surface: **180,000 m²**
	Warehouse: **10,000 m2** (with internal rail track)
	Equipped workshop: **3,000 m²**
	Additional warehouse: **500 m²** (which can be extended by 20,000 covered m2).
	Facility for recovery of equipment, maintenance, cleaning, supplies and permits, plus a governance office
	6 electrified tracks with direct connection to Piadena railway station (2 of 900 metres, of which 1 for storage and manoeuvres and 1 for internal movement of materials; 2 of 600 metres length for external movement of materials; 2 of 600 metres for intermodal use).
Milano Melzo	**5** electrified tracks (total length of 1300 m)
	Total surface: **160,000 m²**
	Terminal services: handling, custom, handling of dangerous goods, trucking, container repair, container maintenance
Intermodal Terminal Cremona – Cavatigozzi (Port of Cremona + Rail Freight Terminal Cavatigozzi)	**10** electrified tracks (total length of 3645 m) in Cavatigozzi
Guastalla S.Giacomo	Freight terminal managed by Dinazzano Po

Source: Authors based on several sources including Emilia-Romagna Region, The logistic platform in the heart of Europe[2]

[2] http://mobilita.regione.emilia-romagna.it/presentazioni-convegni-seminari/iniziative-2014-2018/transport-logistic-2017

2.3 Port-hinterland chain governance

2.3.1 Responsibilities of each port-hinterland actor

Most of the transport related terminal activities occurring at ports and further along their hinterland logistics chains involve a relevant number of stakeholders. These activities can be generally grouped into the following categories of operations:

- customs and additional administrative clearance and inspection procedures; cargo and logistics operations;
- nautical services.

The table below provides a list of the main types of services and operations within each of the above categories, together with the stakeholders involved in their provision/use.

Table 16 – Hinterland logistics chain services matrix

Categories	Services	Stakeholder involved
CUSTOMS AND ADDITIONAL ADMINISTRATIVE CLEARANCE AND INSPECTION PROCEDURES	Customs declaration	• Shipper • Freight Forwarder • Shipping Agent • Shipping Company • Road Transport • Rail Transport • Terminal Operator • Port Authority • Customs Agency • MTO • Rail Road/Freight Terminals • Official Administrative Bodies
	Declaration export manifest	
	Declaration import manifest	
	Notification of arrival	
	Notification of departure	
	Notification transhipment	
	Other administrative clearance procedures	
CARGO & LOGISTICS	Booking transport	• Shipper • Freight Forwarder • Shipping Agent • Shipping Company • Road Transport • Rail Transport • Terminal Operator • Port Authority • MTO • Rail Road/Freight Terminals • Official Administrative Bodies
	Container release	
	Electronic invoicing	
	Electronic payments	
	Inland transport order	
	Loading/discharge order breakbulk (inland transport)	
	Loading/discharge order breakbulk (maritime transport)	
	Notification booking containers	
	Pre-announcement container	
	Delivery and collection (road, rail)	
	Shipping instructions (B/L)	
	Stowage position information	
	Track & trace containers	

Categories	Services	Stakeholder involved
NAUTICAL	Berth reservation	• Shipper • Freight Forwarder • Shipping Agent • Shipping Company • Road Transport • Rail Transport • Service Provider • Terminal Operator • Port Authority • Customs Agency • MTO • Rail Road/Freight Terminals • Waste Collectors • Official Administrative Bodies
	Consult port stay numbers	
	Consult dock planning	
	Declaration berthing dues	
	Declaration waste collection	
	Electronic invoicing	
	Disposal notification	
	Order piloting, tug and mooring services	
	Pre-announcement	

2.3.2 Coordination among port-hinterland stakeholders

Also due to the relevant number of stakeholders involved in port and hinterland chain logistics operations, travel times and economics of maritime and short sea shipping, including of motorways of the sea solutions are significantly harmed by the times associated with the fulfilment of administrative and clearance procedures. Paper based procedures and the involvement of multiple stakeholders make the processes lengthy and with potential delays due to availability of personnel and possible accumulation of practices at certain steps of the procedures. This has affected and still affects the competitiveness of this transport mode in comparison to rail and particularly road transport. In the past decades the gradual development of ICT technologies and their application to administrative procedures has set the basis for the improvement of processes and coordination among the different stakeholders involved in port operations and hinterland logistics chains, particularly about administrative and clearance aspects of maritime transport. Due to the importance of promoting paperless procedures eMaritime and ICT solutions are being gradually implemented and refined which in addition to changes in the legal requirements and regulations are gradually supporting the digitalisation of transport. The most important step in this direction is represented by the development of ICT-based Port Community Systems (PCS) to be integrated in wider national single windows if not international digital communities.

A Port Community System is already in place and operational at the Port of Ravenna. This consists of the following modules:

- Customs procedures and formalities;
- Port call process, i.e. management of information about port calls and processes related to:
    - goods management;
    - gate-in/gate-out;
    - submission of formalities to the Port Authority.

The PCS in operation at the Port of Ravenna integrates all the agents involved in the logistics operations that take place in the port and provides an effective solution to their coordination by means of electronic data exchange. The wide range of functions available allows to cover the operative cycles typical of a port. Thanks to PCS, the Port of Ravenna has been one of the first to implement innovative solutions such as pre-clearing and Fast Corridor.

About the integration of the PCS at the Port of Ravenna with wider initiatives at the national scale, the activities currently under implementation by UIRNet are worth mentioning, aiming at the integration the port operations in the wider National Logistic Platform (*Piattaforma Logistica Nazionale*). This is a ITS system (i.e. Intelligent Network System) for the integrated interface of intermodal actors and for the optimal management of flows to / from the node of the supply chain. At the present stage the system is under-development and UIRNet is also implementing solutions for the integration of their platform with the PCS of the main ports in Italy. The availability in the future of integrated multi-user and multi-nodal platform is expected to streamline in the future all the port-hinterland operations comprehensively, allowing all involved partners in the supply chain to be coordinated in their day-to-day administration and operations.

The table overleaf provides a matrix of the PCS system in place at the Port of Ravenna, including the different type of stakeholders coordinated by this ICT tool.

Table 17 – PCS matrix

	Shipping agents	Terminal operators	Freight Forwarders	Haulage companies	Shippers	Depots	Port Authority	Official Bodies
Maritime Transport								
Departure & Arrivals	x						x	x
Bookings								
Shipping Instructions								
Port operations								
Port Calls Management	x	x					x	
Dangerous Goods Management								
Loading & Discharge Orders	x	x	x	x				
Inland Transport								
Inland Transport		x	x	x				
Road Transport Management								
Rail Transport Management								
Customs Authorities								
Customs			x					
Goods Declaration	x		x					x
Customs Information	x	x						x
Track & Trace								
Cargo Tracking			x	x				
Equipment Status								

2.3.3 Networking activities with other ports

The Port of Ravenna is member of the North Adriatic Ports Association – NAPA. This association also involves the port of Koper, Rijeka, Trieste, Venezia. The goal of the association is to combine their strengths in order to promote the Northern Adriatic route and present themselves as an alternative to the North-European ports, face the development of the One Belt One Road initiative between Europe, the Middle East and China. In addition, the association anticipates cooperation in the development of maritime and hinterland connections, visits from cruise lines, environmental protection, safety and information technology.

In line with the activities under implementation as part of the development of the Core Network Corridors and particularly the Mediterranean and Baltic-Adriatic axes and Motorways of the Sea related operations, NAPA aims at investing efforts into the coordinated planning of road, rail and maritime infrastructure, as well as the harmonisation of regulations and procedures in the field of port service provision, with a focus on the development of hinterland connections and transport digitalisation.

3 BOTTLENECKS TOWARDS BECOMING AN INTEGRATED HUB

3.1 Market bottlenecks

As also described at the previous section above, the Port of Ravenna is a terminal serving the excellence industry located in the Emilia Romagna Region and Northern Italy. It is a leading port particularly in the dry bulk sector for the provision of raw materials to these industries. The strength of this port in this segment is also confirmed by the recent trends in traffic which are positive and overall higher than the EU average.

The position of the Port of Ravenna in other segments of the maritime transport market i.e. container traffic and Ro-Ro, is less supported by the industry excellence in the catchment area of the port, whereas these markets are in any case seen as an opportunity for development of the port operations.

As further detailed in the following sections the port is nowadays harmed by the low draft of the Candiano Canal, this representing a significant infrastructure bottleneck that is however expected to be solved by ongoing and future planned investments. Parallel to the deepening of the canal the Port Authority is also planning the realization of areas to be allocated to hinterland logistics operations. The lack of such infrastructure and facilities can be considered as of today a barrier to the competitiveness of the port in market terms. The space currently available at the port or in its immediate vicinity to be used to develop value added logistics services is very limited. Accordingly, thanks to the acquisition of areas interested by the "Port of Ravenna Hub" project, the Port Authority will have a suitable surface to develop, through forms of public-private partnership, modern and efficient integrated logistic places as interchange centres between the different transport modes (road - rail - water) and service delivery centres for goods. Production facilities may be also located in the mentioned areas, according to the general urban planning strategies, and in line with the provisions of the Strategic National Plan for Ports and Logistic (*Piano Strategico Nazionale dei Porti e della Logistica*, PNSPL) and with the strategic transport infrastructure plans of the Italian Government (i.e. *Connecting Italy*).

Considering the relatively high specialisation of the port and its strong integration with the manufacturing and industrial sectors of the local and national economy availability of new areas for the development of logistics centers as well as production sites in the hinterland of the port is deemed to impact on the attractiveness of this port. The possibility for the port to accompany the development of the regional industry at the same time providing more places for highly specialised and added value logistics operations along the logistic chain, may generate more traffic in the future.

Creating conditions for innovating and improving the performance of the port and of its hinterland connections as well as logistics operations, is just one of the fields where the Port of Ravenna is investing. Another important element of high sensitivity in the freight transport and logistics sector is the development of green solutions, for the impact this can have in the image of the effects transport can have on final customers of several products. In this regard the project of the construction of a coastal storage facility and LNG supply for land transport vehicles and ships in the Port of Ravenna is worth to be mentioned which has been already authorized by the competent ministry and is going to be constructed in the short term. This is an important element, having the characteristics of an infrastructural intervention that can be linked to the selective increase of capacity, as well as to the

valorisation of the port assets (quays and the private areas just behind), with both the active involvement and the substantial investments of private entities.

In this regard, the Directive 2014/94/EU obliges each Member State to ensure an adequate number of supply points in the sea ports to allow the movement of LNG-powered ships in the TEN-T central network, as well as publicly accessible supply points along the central TEN-T network to allow the circulation of heavy vehicles powered by LNG.

The availability of such alternative clean fuel that may be used in the future for the greening of both road and maritime transport operations allows the Port of Ravenna to be in line with the relevant policies for the greening of freight transport. This may enable the port keeping its competitiveness in the market or even generate marginal traffic increases in the future.

3.2 Infrastructural bottlenecks

Maintaining an efficient and effective infrastructure capable of serving the needs of the market and accompany the evolution of the port and maritime industry is still a key element to keep a port competitive, especially in the mid- and long-term timeframe.

At present the main infrastructure bottlenecks affecting the freight transport and logistics operations at the Port of Ravenna and its hinterland are related to the deepening of the draft of the port canal, expansion of the existing terminals and areas dedicated to logistics operations, as well as improvement of the last mile connections. Transport digitalisation related infrastructure and ICT solutions are also relevant priorities for development particularly in the mid term, which are considered in the following section dedicated to innovation bottlenecks.

Starting with the port infrastructure development and expansion projects, activities are already ongoing which relate to the deepening of the Candiano Canal. The past 20 years have seen a constant growth of the load capacity of the world fleet. A decisive impact was given by the contemporaneous growth of the average ship size, in terms of length, width and draft. Accordingly, vessels with a draft higher than 10 m entering the Port of Ravenna have been gradually increasing in their size between 2010 and 2016.

The port is currently constrained by a low draft of the harbour which limits the efficiency of the terminal operations to all types of cargo, and particularly dry bulks. Considering that the Port of Ravenna is the first in Italy and in the Adriatic basin for dry bulks and that it is one of the main ports in Europe for this typology of cargo, the need to solve this critical issue is paramount.

The relatively limited depth of the access canal, whose maximum draught is 10.5 m, and of the quays, in some of which (some of the mains) the draft is limited to just above 9 m, is suitable to those ships whose dead-weight tonnage (DWT) is lower than 20-25 thousand tons (approximatively the segment of the Handysize ships), corresponding to around 30% units (10% if measured in DWT) of the world fleet. The use of bigger ships is subjected to a reduction of the maximum permissible load, which can be achieved through a prior unload to a different port. Such constraint reduces the transport efficiency and increases the related costs, with a negative impact on the competitiveness of the Ravenna Port.

The realization of the Ravenna Port Hub project will allow to keep the port competitive and overcome the possible progressive marginalization of the seaport due to the increasing

vessel size of the word fleet and the existence of higher drafts available in other European ports that register dry bulks traffic volumes higher than 10 million tons.

The First Stage of the Ravenna Port Hub project, is already under implementation which includes dredging the canals (marine, Candiano and Baiona) and the front port area, reaching a maximum draft of 11.8 m. This improvement will allow the access of full loaded ships with 30-35 thousand tons of DWT (Handymax or sub-Panamax), which corresponds to load capacity that is 50% higher than the current limit. This stage also envisages the upgrade of the existing quays and the construction of the New container/multipurpose terminal quay, as well as the re-use of dredged materials to raise the level of areas located in the proximity of the port, in order to develop them as logistics platforms.

The Second Stage of the Ravenna Port Hub initiative includes additional dredging works in several parts of the canal harbour up to -12,50 / -14,50 meters in the inner parts, and up to -15,00 m in the approaching canal. Such an upgrade will enable the access of fully loaded ships with a DWT of 40-50 thousand tons (Panamax and post-Panamax) thus covering about 60-70% of the world fleet (40-50% if measured in DWT), namely almost the totality of the ships that transited through the Ravenna Port in 2016. Further development of multimodal platforms are also planned in this stage.

In addition to the deepening of the port canal, investments are already planned, which are related to the further expansion of the existing port infrastructure, including development of new quays for a multimodal platform, a container terminal and the upgrading of the existing Ro-Ro and Ro-Pax terminals. Implementation of telematics applications is also planned, including advanced PCS ICT based services as well as e-Maritime applications.

Finally, projects have been already identified some of which are also already under implementation for the improvement of last-mile connections in the wider context of the initiatives related to the development of the Core Network Corridor road and particularly rail infrastructure in line with the standards required by the Regulation EU 1315/2013. To achieve this latter objective, the investments planned by the Italian national railway infrastructure manager, RFI, foresee numerous interventions relating to the adjustment of the gauge, the length and the axle load of the railway lines interconnecting the port with the main logistics nodes located in the Emilia Romagna Region and more generally in the catchment area of the port. In the following figures an overview of the expected developments in the Emilia Romagna Region and Italy is provided for the main parameters affecting freight transport operations by railway: train length, axle load, rail gauge.

Figure 16 – Development of the national railway network in Italy: upgrade of the maximum train length

Source: RFI

The program for the infrastructural upgrade to allow the transit of 750 m-long trains is structured as follow:

- 2018 Brennero – Bologna (PM Tavernelle and San Felice sul Panaro) upgrade of the Marzaglia and Villa Selva terminal;
- 2021: Padova I. – Bologna I. (Castelmaggiore, Polesella e S.Elena d'Este), Bologna – Piacenza – Milano, Bologna – Firenze (Monzuno e Vaiano), Bologna - Faenza – Ravenna/Bari Lamasinata;
- 2026: Piacenza/Codogno – Cremona – Mantova – Verona/Monselice.

Figure 17 – Development of the national railway network in Emilia-Romagna: upgrade of the maximum train length

Current scenario

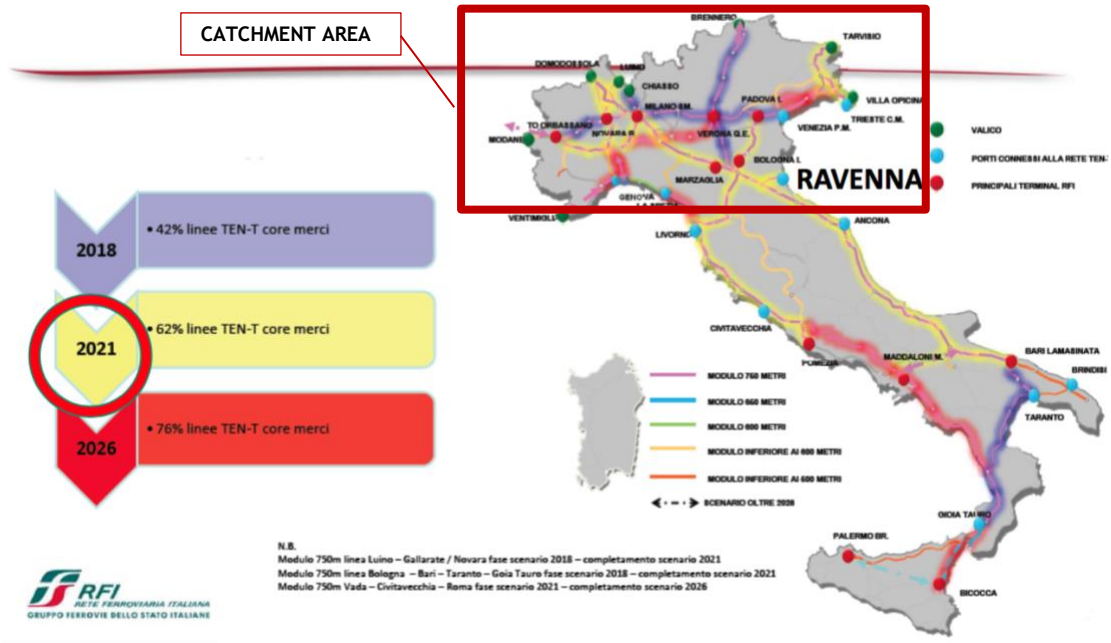
2018 scenario

2026 scenario

Source: RFI

The adjustment of the axle load (D4) is expected to be done in 2018 on the Bologna – Ravenna line, by removing the existing limitations to the D4 axle category, and on the Piacenza/Codogno – Cremona – Mantova line.

Figure 18 – Development of the national railway network in Italy: upgrade of the axle load



Source: RFI

Figure 19 – Development of the national railway network in Emilia-Romagna: upgrade of the axle load

Current scenario

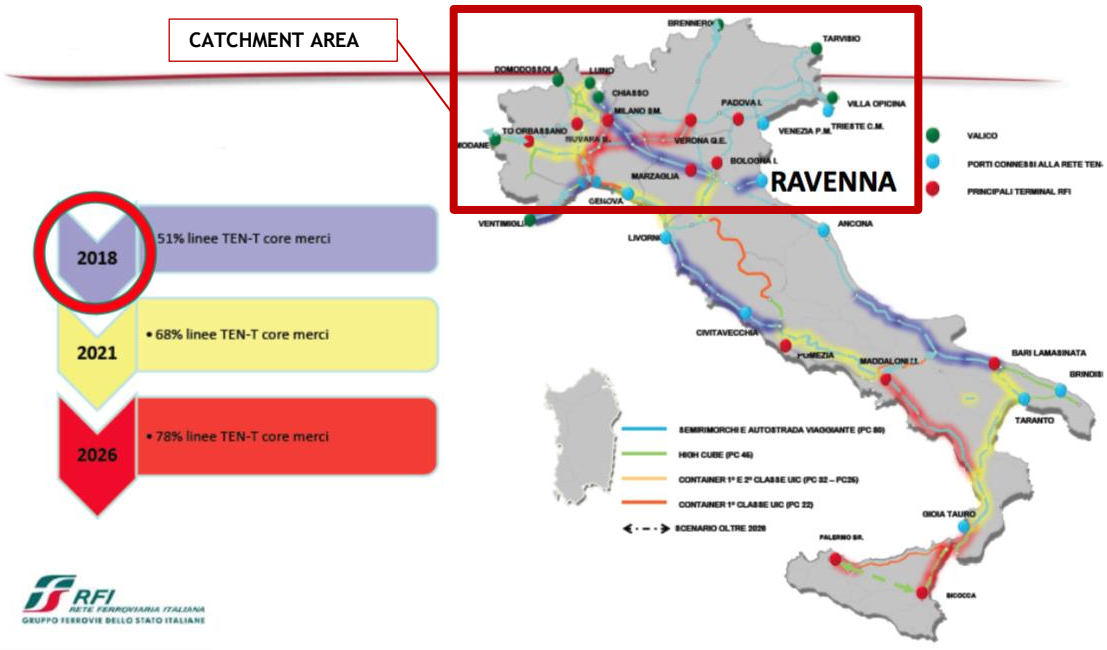
2018 scenario

Source: RFI

The upgrade to the P/C80 gauge will allow to provide rolling motorway services (Ro-La trains). Interventions on the following lines are planned as follows:

- 2018: Milano – Piacenza – Bologna and connection to the Ravenna Port;
- 2021: Bologna – Firenze;
- 2026: Piacenza/Codogno – Cremona – Mantova.

Figure 20 - Development of the national railway network in Italy: upgrade of the gauge

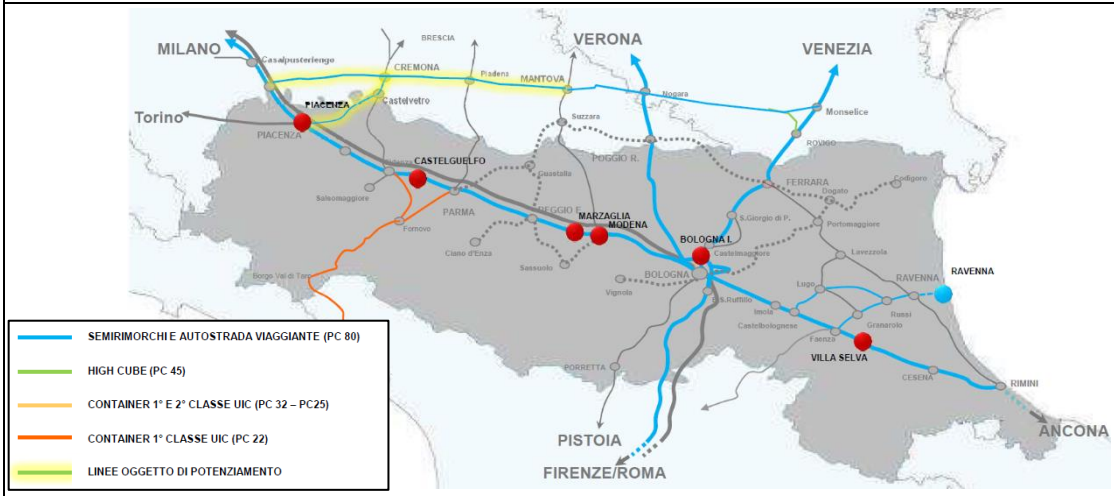


Source: RFI

Figure 21 – Development of the national railway network in Emilia-Romagna: upgrade of the gauge

Current scenario

2018 scenario



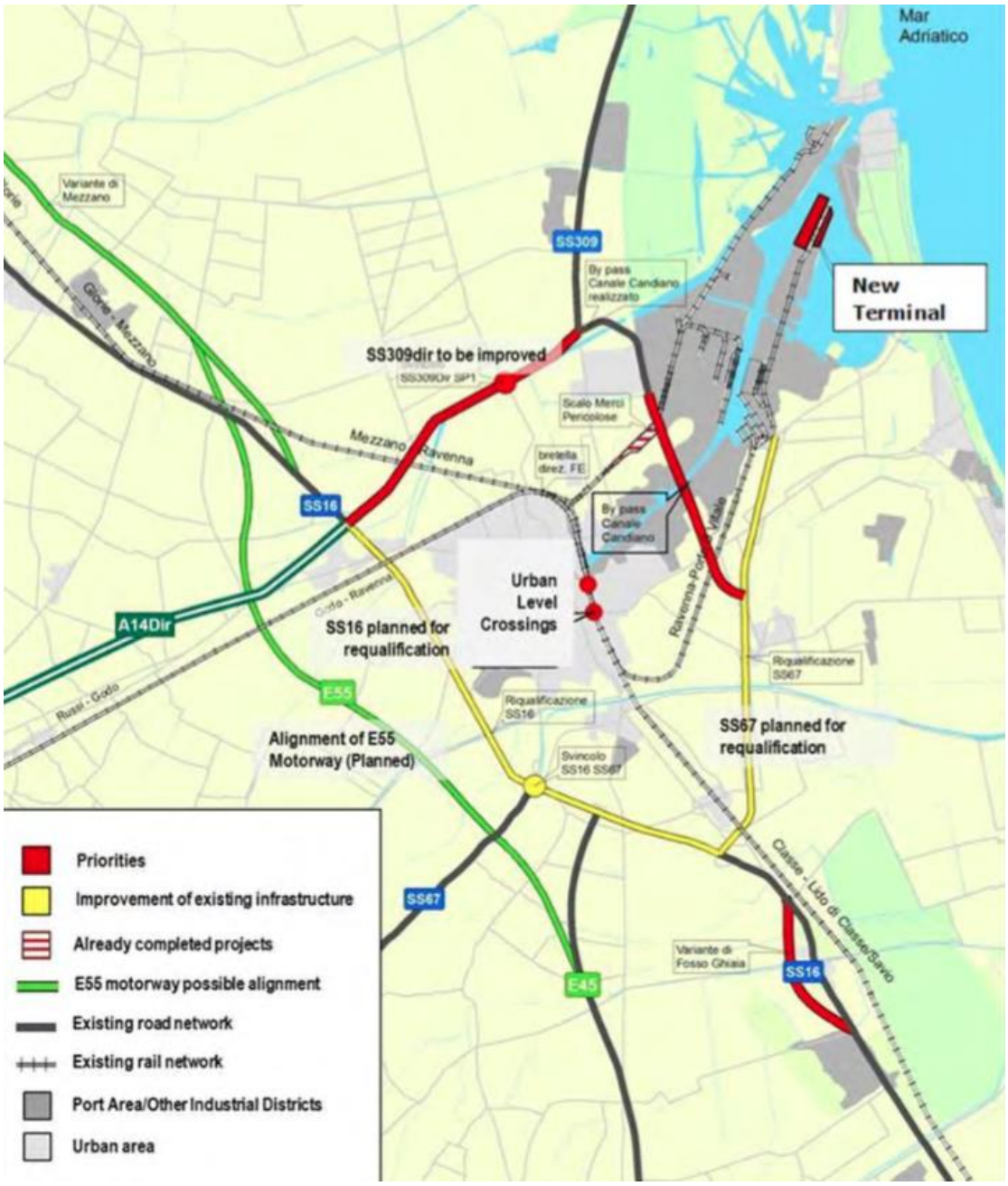
2026 scenario

Source: RFI

Focussing on last mile improvement initiatives, currently, the last mile railway/port interconnections issues are deemed to limit the development of Ravenna Port. Dedicated interventions are already a priority for the new TEN-T policy, the Work Plan of the Baltic-Adriatic corridor, the Deployment Plan for the Motorways of the Sea as well as the Con-

necting Italy (*Connettere l'Italia*) strategy, and the Strategic National Plan for Ports and Logistics (*Piano Strategico Nazionale dei Porti e della Logistica*).

Figure 22 – Port last mile connections



Source: Port Authority

Concerning rail last mile connections, the objective is again to ensure the ports and their terminals respect as far as possible the technical standards in terms of:

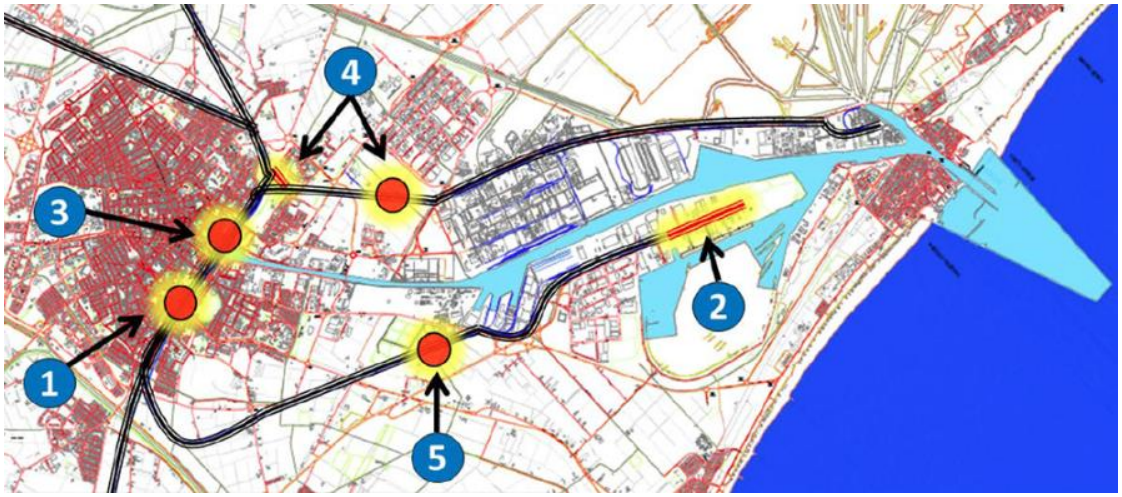
- electrification;
- gauge;
- axle load;
- train length.

Furthermore, there is the need to upgrade and further develop the existing rail infrastructure within and in the immediate surroundings of the port areas. Improvements are required also in view of future traffic increase. The following issues have been recognised:

- freight terminal close to its capacity limit;
- interference with passenger train station;
- low speed and long travel time to port terminals;
- road – rail interference: level crossings (no barriers);
- unavailability of hazardous cargo yards.

The planned works aim to eliminate one level crossing on the line interconnecting the port to the Baltic-Adriatic corridor network as well as to upgrade to P/C80 standard the link on the Teodorico bridge and extend the existing infrastructure on the right side of the port canal by 2021, reaching the new container terminal. Additional upgrading and improvements of the existing infrastructure are also planned to be implemented by 2026 (70 million euros for all the above rail related projects).

Figure 23 – Locations of the planned improvements of the rail network within the Port of Ravenna



Source: RFI

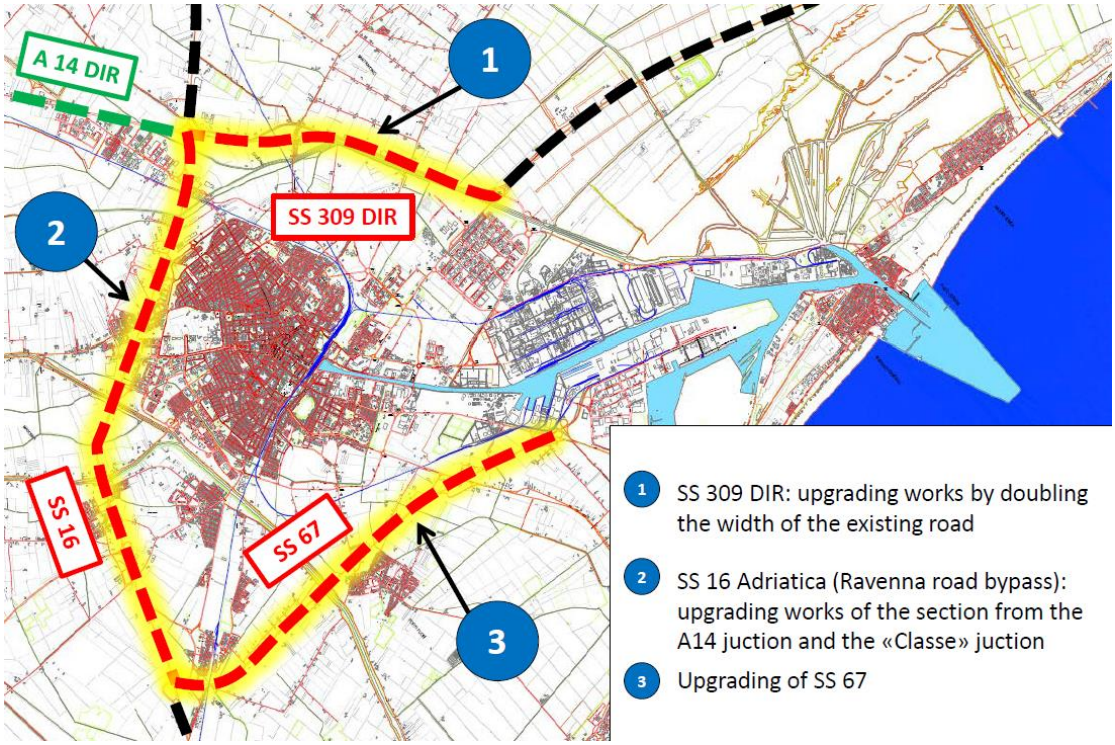
Table 18 – Planned improvements of the rail network within the Port of Ravenna

Number	Description
1	Elimination of a level crossing (Via Canale Molinetto) 15M€ - 2018
2	Teodorico Bridge: Upgrading to P/C80 5M€ - 2018
3	Extension of the shunting track to the new container terminal
4	Strengthening of the North shunting track: • upgrade of the rail yard to freight terminal; • direct link to North bound main line into operation.
5	Strengthening of the South shunting track: • electrification and equipment of the track; • upgrade of the rail yard to freight terminal.

Source: Port Authority

Regarding road last mile connections, the road infrastructure requires modernization. With this regard, the national planning envisages interventions for the upgrade of the Ravenna's ring road, which shows criticalities in relation to the peak traffic volumes in summer months, particularly on those sections that distribute the traffic coming from the A14 dir between the North and the South area of Ravenna. Moreover, solutions to mitigate the impact of road transport on the respective urban areas are also needed.

Figure 24 – Road sections interested by the planned upgrades



Source: Port Authority

Works for the improvement of road accessibility to the port are also planned for the upgrade of the SS 309 dir and its interconnection to the SS 16, expected to be completed by 2020 (175 million euros), and for the upgrade of the SS 16 (72 million euros).

Another relevant infrastructure development project for the Port of Ravenna, as well as for the Port of Venezia, is the improvement of the Cesena-Ravenna-Mestre highway interconnecting Venezia to Ravenna, to Rome. This project is currently under consideration, assumed to be possibly developed under a PPP scheme.

As demonstrated by studies recently undertaken by the Port Authority, the solution of the infrastructure bottlenecks are expected to keep the port competitive and maintain its functions in the future, also generating benefits to the European society. The planned port expansions at the existing and future terminals is expected to generate an increase in traffic. Finally, the improvement of last mile connections together with the development of ICT solutions are foreseen to support modal shift and contribute to the greening of freight transport and logistics operations involving the Port of Ravenna and the logistics centres located in its catchment area.

3.3 Operational bottlenecks

One important group of actions that has been also identified among the analyses and the work activities for the freight and multimodal European corridors at the European level is related to the administrative barriers or to the obstacles to the operation of the services, particularly railway operations across borders. In fact, existing bureaucratic and administrative problematics related to the operation rail transportation have been found to reduce and, in some cases, even nullify the benefits generated by the infrastructural developments in terms of time savings. This amplifies the need to support and develop actions also towards the improvement of transport operations, particularly across borders, to overcome existing barriers. The analysis of the Port of Ravenna seems to show that at present the port has a predominant strategic market position in the Emilia Romagna Region and in Northern Italy. However its catchment area is also going beyond the Alps, which emphasises the importance of solving operational barriers affecting cross border operations of long distance traffic flows between European Member States.

In recent years the Rail Freight Corridors in coordination with RailNetEurope – RNE have started a number of initiatives aimed at assessing and possibly solving procedural and organisational issues or legal aspects affecting the functioning of international transport services. In the view of the rail freight corridors a disturbance is defined as operational bottleneck when it relates to:

- communication between Infrastructure Managers (IMs') Traffic Control Centres (TCCs) or among Railway Undertakings (RUs) or between RUs and IMs at the borders;
- or to operational rules between RUs and IMs at the borders.

The main categories of operational bottlenecks and possible solutions have been identified accordingly to the above definitions:

- Bottlenecks related to communication:
  a) Inadequate communication in situations of big disturbances. One of the preliminary results of the analysis is about malfunction in communication between IMs TCCs in situations of big disturbances on the network.
  This kind of operational bottleneck could be eliminated when all IMs of the RFC use the RNE tool TCCCom and have English fluent staff available 24/7 at TCCs in the future.

b) Faulty communication of delays and arrival sequence of trains. Untimely inter-system communication of delays and arrival sequence of freight trains at some border crossings represents an operational bottleneck.
Solving of this bottleneck requires the deployment of TAF-TSI messages for data communication in train planning & operations and of TAF-TSI compliant interfaces between national IT tools and the RNE tools like Train Information System (TIS) and Path Coordination System (PCS), whose deployment is already ongoing.
TIS usage as a RFC-wide tool is an important measure as well, but it is vital that IMs feed it on time with accurate data and that international trains running with different numbers are linked in the system.

c) Long dwelling times at cross-border sections. Insufficient communication between railway undertakings in takeover of trains leads to prolonging dwelling times on cross-border sections, which are particularly sensitive to congestion.
Communication between cooperating RUs for international traffic should be improved to reduce the trains dwelling times at the border crossings. Particularly for the ad hoc traffic, often the path is requested separately to each IM at a different time in not coordinated way. The use of path coordination tools like RNE PCS for ad hoc international trains would contribute to the solutions of this communication barrier.

- Bottlenecks related to operational rules:
  a) Technical inspection of rolling stocks. Among operational rules leading to extensive dwelling times at international border crossings, the technical inspection of rolling stocks has been identified. For that, a better trust/cooperation scheme among RUs would be beneficial.
  b) Necessity to change locomotives. In addition, to reduce idle times at the border crossings, RUs should extend the use of multi-system locomotives and/or fasten the operations of changing the locomotives. Higher punctuality of freight traffic would largely be beneficial as well.

In order to solve the above communication and operational barriers RailNetEurope started developing tools and processes that would enable a more effective and efficient operation of international rail traffic. By such approach many processes, templates, handbooks and guidelines were already developed which together with the developed Information Technology (IT) tools might provide a solution to the barriers affecting long-distance international transport by railway. In this regard the following IT tools, already mentioned in the paragraphs above are worth describing, which are considered the most relevant ones by the RFC5 and RNE:

- Path Coordination System (PCS) - which is an international path request coordination system for path applicants, e.g. Railway Undertakings (RUs), Infrastructure Managers (IMs) and Allocation Bodies (ABs). This internet-based application optimises international path coordination by ensuring that path requests and path offers are harmonised by all involved parties. Input for international path requests needs to be placed only once into one system – either into the domestic application or directly into PCS. For the efficient use the PCS or an interface between the national systems and the PCS has to be installed or developed.
- Train Information System (TIS) – which is a web-based application that supports international train management by delivering real-time train data concerning inter-

national passenger and freight trains. The relevant data is obtained directly from the Infrastructure Managers' systems.

- Traffic Control Centres Communication "TCCCom" tool – is a multilingual information exchange tool, working in 21 different languages to facilitate necessary communication between the Traffic Control Centres.

As also mentioned in the Rotterdam Sector Statement on Rail Freight Corridors titled *Boosting International Rail Freight* the further development and deployment of these IT tools is considered essential by the railway sector in order to solve the existing operational barriers and improve the performance of the European railway network, which shall also be financially supported by EU funds to accelerate the development of a Single Railway Area.

About multimodal and combined transport operations of freights at the Port of Ravenna and rail road terminals located in its catchment area, the following aspects can be noticed which may generally affect the development of multimodal freight and combined transport.

The 2014 study "Analysis of the EU Combined Transport" by the European Commission notices that further to the interoperability issues associated with the characteristics of the rail infrastructure and national systems (also including train weight, axle weight, loading gauge not allowing 4m high semi-trailers or transport of 9'6" high-cube containers) the development of rail combined traffic is currently hindered by total handling costs. This applies to a higher extent to continental shipments with at least two additional handlings compared to road transport. Substantial cost savings on the rail leg are required for the feasibility of combined services, given also the additional cost of the pre- and post- carriage legs by road. In this respect, the availability of inland terminals within a short road distance is a main prerequisite for users of combined transport services to ensure competitive door-to-door costs. In fact, disproportionately high last-mile costs arise if terminals are located off the main line. Also, efficient last mile rail connections and rail logistics terminals in the main ports are essential to support the growth in the maritime-based rail combined transport.

Overall the improvement of the operation of freight transport by railway and more generally of combined and multimodal transport operations in the catchment area of the Port of Ravenna is expected to increase the competitiveness of transport by railway, with positive benefits of society particularly in terms of reduced externalities and costs for railway and multimodal transport operators.

3.4 Institutional bottlenecks

Freight transport and logistics similarly to most of the modern industry systems are multi-governance ones. This requires the set up and functioning inter-institutional cooperation processes and agreements. The coordination and integration of different stakeholders, their competences and skills in a single logistics chain whose operation is determined by the availability of infrastructure components as well as machinery, productive as well as procedural and administrative elements under the responsibility of different entities may present problems of institutional nature. This type of issues usually occurs with reference to planning, development and implementation of infrastructure and technological solutions that imply approval processes by different public entities or national infrastructure man-

agers; or that may require the disclosure of information and data between private operators and commercial bodies.

With this regard, in the case of the Port of Ravenna important measures have been already put in place including a protocol for the improvement of the rail last mile infrastructure, which involves the interested institutional stakeholders (i.e. Emilia-Romagna Region, RFI, City Council) in order to develop agreed tools for the design, financing and implementation of the required infrastructural works.

Furthermore, on the basis of the above protocol, the Port Authority has also started promoting "Supply Chain Partnership Agreements" ("*Accordi di Partenariato di Filiera*") among port systems stakeholders, logistic platform managers and possibly connecting services, in line with the strategic guidelines also identified in the Strategic National Plan for Ports and Logistic (*Piano Strategico Nazionale dei Porti e della Logistica*) for the development of an "integrated logistics system".

Concerning rail operations, in the context of the new regulation in place for managing the rail operations (deliberation 18/2017 of the Transport Regulatory Authority), agreements were already reached that envisage at the local scale level the interconnection of ten plants, also involving two shunting companies for the operation of terminal services.

As part of the action promoted by the National Agency for Rail Safety (*Agenzia Nazionale per la Sicurezza Ferroviaria*) and the Ministry of Infrastructures and Transport, as well as Assoporti, the required procedures have been started to make the safety standards of the links connecting the national rail network to ports equal to those of the national rail network itself, thereby enhancing the safety levels on the connecting lines between shunting yards and freight stations and the network managed by RFI.

Concerning the application of ICT solutions to freight transport and terminal operations in the wider logistics chain (see also section on innovation below), also in line with the guidelines set in the *Piano Strategico Nazionale della Portualità e della Logistica* on this subject, the AdSP has decided to assign to UIRNet as of July 2017 the management of their SeaGate PCS and its further development. This will significantly facilitate the integration, interface and interoperability of the local PCS with the other systems in use by the other stakeholders operating at the national level, i.e. PMIS (Coast Guard), Servizi Ferroviari (RFI), Autostrade, AIDA (Custom), and other entities involved at different levels in the development of the national logistics platform PLN. Since October 2017 the PCS of the port Ravenna is located in the server of the Italian Ministry of Transport and Infrastructure.

3.5 Innovation bottlenecks

About multimodal and combined transport operations of freights at the Port of Ravenna and rail road terminals located in its catchment area, the following aspects can be noticed which may generally affect the development of multimodal freight and combined transport and which fall within the domain of the implementation of VTMIS and e-Maritime services and solutions aimed at promoting Single Window initiatives to access ports, track flows of vessels and transported intermodal vehicles, rolling stock and goods entering and exiting port areas; and/or simplifying administrative procedures associated to custom, safety and security processes. Activities and initiatives in these fields are already operative and under constant development/evolution also at the Port of Ravenna.

Initiatives including pilot projects are also ongoing which relate to safety and security aspects of multimodal transport at rail road terminals. Telematics solutions are furthermore in place or going to be implemented aimed at simplifying the administrative procedures related to multimodal transport. ICT real time information initiatives are in place or are being implemented even between nodes to monitor and increase the effectiveness and efficiency of the logistics chain and its basic operations. Still, these seem to be more local or in any case associated to the network of operations of single Multimodal Transport Operators rather than "open" and integrated at the wider national and European transport system scale. About these aspects the above mentioned 2014 study "Analysis of the EU Combined Transport" by the European Commission notices how combined transport seems lacking an "open data" ICT platform for exchanging booking, operational and tracking and tracing data between relevant companies involved in the combined transport supply chain. "Open data" means that the system has standardised interfaces and is not determined or controlled by a single actor.

The Port of Ravenna is committed in actions to optimise the port operational cycle and to decrease the stationing time of goods at the port. With this aim, the Port aims at improving the *SeaGate* Port Community System (PCS) which, as previously described, makes available to the entities involved in the import and export processes of goods a group of functionalities, that improve the efficiency of the port operations and processes.

Such functionalities cover an ample spectrum of operations related to the operational cycle of the port. Moreover, various interoperability services that are made available by the *National Maritime Single Window* and are used to provide services in the PCS scope.

In addition to the PCS and ICT services associated to *SeaGate*, based on the use of Internet for the exchange of information and data between the involved stakeholders, other types of services are in use and under development which foresee the exchange of information more at the local level for safety and security purposes, i.e. the agreement with the General Head of the Coast Guards for the integration of the VTS system and radars as well as video camera HCR already installed at the port.

The impact of the solution of innovation related bottlenecks particularly in the fields of transport digitalisation and ICT solutions for multimodal transport operations is expected to reduce the times associated to the terminal activities of maritime transport thus increasing its competitiveness in favour of modal shift from road to short sea shipping. This is the reason why transport digitalisation together with improvement of last mile connections are together key pillars for the promotion of the Motorways of the Sea. The positive effects associated with transport digitalisation ICT and e-Maritime services are related to a possible increase in traffic as well as reduction of the externalities with road transport.

4 MEDIUM-TERM SCENARIOS

4.1 Main factors to influence future development

In line with the local context analysis developed in the previous Chapters, the future development at the Port of Ravenna is expected to be influenced by several elements which relate to infrastructure, innovation as well as market and industry developments. These factors are summarised below with reference to two different time-horizons: short term, up to 2025, and mid term afterwards, up to 2030:

- **Infrastructure**:
  - ***Short term***: Implementation of the first stage of the Ravenna Hub Project as well as improvement of the rail last mile connections to the ports' terminals, new container/multipurpose quay available for operation;
  - ***Mid term***: Implementation of the second stage of the Ravenna Hub Project, as well as improvement of the road last mile connections, new Ro-Ro terminal developed.
- **Transport digitalisation and ICT**:
  - ***Short term***: further development of PCS and ICT solutions at the local scale level, including improvement of Fast Corridor Concept solutions towards more logistics platforms;
  - ***Mid term***: PCS and ICT solutions in the ports' catchment area integrated in the national logistics platform (PLN) and possibly at the NAPA or EU regional scales.
- **Market and Industry developments**:
  - ***Short term***: Possible consolidation and improvement of the existing operations thanks to new commercial agreements and strategies by the commercial stakeholders involved in the maritime and hinterland logistics chain;
  - ***Mid term***: Development of logistics areas in the immediate vicinity of the ports' terminals for the introduction/expansion of value added logistics services and operations.

4.2 Scenarios' formulation and expected impacts

The following tables combine the above described factors influencing the future development of the port and hinterland connections, providing two possible development scenarios for the short and mid term, respectively. For each scenario the expected impacts are also commented.

Table 19 – Planned improvements of the rail network within the Port of Ravenna

	Short term	***Mid term***
Infrastructure	Implementation of the first stage of the Ravenna Hub Project as well as improvement of the rail last mile connections to the ports' terminals, new container/multipurpose quay available for operation	Implementation of the second stage of the Ravenna Hub Project, as well as improvement of the road last mile connections, new Ro-Ro terminal developed
Transport digitalisation and ICT	Further development of PCS and ICT solutions at the local scale level, including improvement of Fast Corridor Concept solutions towards more logistics platforms	PCS and ICT solutions in the ports' catchment area integrated in the national logistics platform (PLN) and possibly at the NAPA or EU regional scales
Market and industry developments	Possible consolidation and improvement of the existing operations thanks to new commercial agreements and strategies by the commercial stakeholders involved in the maritime and hinterland logistics chain	Development of logistics areas in the immediate vicinity of the ports' terminals for the introduction/expansion of value added logistics services and operations
Expected impacts	Increase in the total traffic throughput of the port and hinterland logistics chain with reference to total traffic and internodal traffic, including an increase in the modal share of rail traffic accessing the ports' terminals. Reduction of transport externalities and of operating costs for transport operators due to a dematerialisation process of the terminals related procedures and further development and applicability of the fast Corridor Concept solution	Further increase in the traffic volume at the port as part of its hinterland logistics chain with reference to total traffic and internodal traffic, including an increase in the modal share of rail traffic accessing the ports' terminals. Reduction of transport externalities and of operating costs for transport operators due to a dematerialisation process of the terminals related procedures and further integration of the logistics operations in the national and EU regional/corridor wide logistic platforms/networks