

# D.3.2.5 Final report on physical and non-physical bottlenecks and missing links in Italy and Croatia

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# INTRODUCTION

This document is part of WP3 Elimination or reduction of Bottlenecks through the Harmonization of Data.

The main objective of this work package is the identification of new physical bottlenecks in the Adriatic area as an improvement and a pursuance of the CARICA activity, updating of CARICA reports on bottlenecks and traffic flows.

After collecting inputs from partners on issues on bottleneck collection and analysis, this document will give a brief overview of all collected bottlenecks and main problems in analysed ports, as well as show similarities and differences in Croatian and Italian bottlenecks.

## ABSTRACT

The final report is a document which offers a brief overview of the listing, analysis and proposed solutions of all the collected bottlenecks from the three Italian (Venice, Bari and Ancona) and three Croatian ports (Rijeka, Ploče and Split). Along with serving as an overview of the Analyses of physical and non-physical bottlenecks in Italy and Croatia, this document displays similarities and differences between Croatian and Italian bottlenecks and therefore different approaches on solving them.

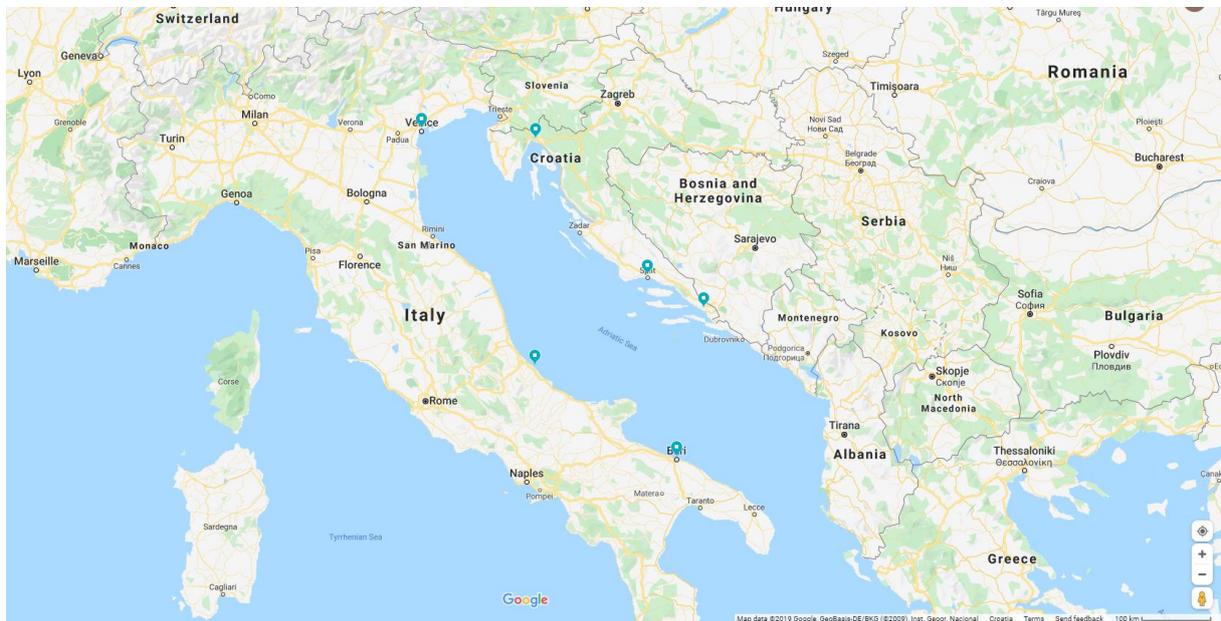
## EXECUTIVE SUMMARY

The final report is a brief overview of the Analyses of physical and non-physical bottlenecks in Italy and Croatia. As such it defines the areas of study of three Italian ports – Venice, Bari and Ancona; and three Croatian ports – Rijeka, Ploče and Split. Italian and Croatian ports analysed in this document have several problems. Croatian ports have mainly same bottlenecks that are infrastructural in nature, Italian ports have issues mostly with the limited depth in the part of their port basins which leads to the problems with large ships that wants to enter their ports. Many problems and bottlenecks were resolved through EU funded projects such as Interreg, CEF and similar programmes. Apart from EU funded projects, partners also resolve bottlenecks through infrastructure and development projects funded from national or own sources.

# DEFINING THE AREA UNDER STUDY AND SCOPE OF STUDY

The main goal of the project is analysis of the main physical and non-physical bottlenecks in the Adriatic Area, more precisely, in six ports: 3 Croatian (Rijeka, Ploče, Split) and 3 Italian (Venice, Bari and Ortona) on the Adriatic Sea.

Figure 1. Analysed ports



Source 1: Google maps

Port of Ploče is one of the main Croatian ports and it is considered a strategic port by the Croatian Government. The port of Ploče is an international commercial port with special economic interest for the Republic of Croatia. As part of the maritime links in the Adriatic Sea,

it represents the main cargo port in the southern part of Croatia. The port is managed by the Port of Ploče Authority which is a public non-profit legal entity.

The port is located on the eastern Adriatic coast at mid-distance between Croatian ports Split and Dubrovnik and is the relevant point of the Pan European corridor V - branch VC (Budapest-Osijek-Sarajevo-Ploče). The port is connected to the road network via the A1 highway as well as the railway communication to neighbouring Bosnia & Herzegovina. Ploče is the start/endpoint of the aforementioned corridor and due to that the port is the most important maritime gateway for Bosnia & Herzegovina. The port is in the list of 328 TEN-T Maritime ports published by the European Commission (REF).

Port of Ploče has a potentially large gravitational area that includes the northeast part of Croatia, part of Serbia, Montenegro, Bosnia and Herzegovina, part of Austria, Hungary, Czech Republic, Slovakia, Romania and Poland.

The port of Split is situated in the central part of the eastern coast in the Adriatic basin. As for its strategic position, it has become one of the most important passenger ports in the Mediterranean, often called as the gateway to the islands. The port is ranked first among Adriatic ports by the number of passengers and vehicles and third among Croatian ports regarding the transport of cargo behind port of Rijeka and port of Ploče. Also, the port of Split is largest port in central Dalmatian region, comprising both passenger and cargo transport as the main port business orientation. According to its purpose, the Port of Split is classified as a port open for international public traffic, while due to its size and importance, it was nominated a port of special (international) economic interest for the Republic of Croatia. The Port of Split has been also classified as a Trans-European Transport Network (TEN-T) comprehensive port for Croatia. In addition to the passenger transport, the port accommodates freight transport mainly to the destinations in the external environment of the port situated in the hinterland creating its gravitational area.

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The port is connected by the International E-road network routes E65 and E71 with a link to the Croatian A1 motorway (Zagreb –Split) and the D1 state road. The existing road connection to the port area is passing throughout city centre which usually causes stoppage on the city roads, regularly during the summer season. The port is also connected with Zagreb by an electrified single-track railway, which runs through Knin and Karlovac. The airport of Split is located 20km from the port of Split and is able to receive any sort of aircraft, including cargo planes.

Strategically located at the top end of the Adriatic Sea, at the intersection of the main European transport corridors and of the Motorways of the Sea (MoS), the Port of Venice is in a position to act as the European gateway for trade flows to and from Asia.

The Port of Venice's position means it can act as the main entry point to a vast area of Central Europe - including amongst others North-Eastern Italy, Austria and Bayern - in addition to Eastern Europe and some of the European Union's most dynamic markets.

The Port of Venice is also located at the intersection of three main European corridors:

- Scandinavian – Mediterranean Corridor;
- Mediterranean Sea Corridor;
- Adriatic – Baltic Corridor.

The Port of Venice is also the northernmost terminal of the Motorways of the Sea that crosses the Eastern Mediterranean and connects Central Europe with North Africa and the Middle East.

The port of Bari is located in the Apulia region in the southeastern part of Italy and stands as a gateway between Italy, the Middle East and Balkan regions. During the last several years the Port Authority of Bari managed strategic, transport, environment and ICT projects funded by SEE, IPA Adriatic and Greece-Italy 2007-2013 Programmes. The city of Bari includes two

separate harbours. Near the old part of town is the Old Port, which is used for smaller vessels and fishing boats, while the New Port is reserved for large passenger ferries, and offers short and long-term parking options.

The city of Ortona is located in the East of Abruzzo Region, on the Adriatic Sea, at the top of a 70 meter-high cape. The area is characterized by a rocky coast with sandy beaches and by the presence of gravel and pebbles. Because of the cape, there are two inlets that have always made the coast area suitable to be a boat shelter. In this context, the Port of Ortona has developed since the Roman period and it has always been a strategic node for the area.

The Port of Ortona is part of the Central Adriatic Ports Authority (Autorità di Sistema Portuale del Mar Adriatico Centrale) which also includes the ports of Pesaro, Falconara Marittima, Ancona, San Benedetto del Tronto and Pescara. The Authority has competence on a 215 km long shore.

The Port of Ortona is the main multi-functional commercial seaport of Abruzzo Region and it is specialized in the handling of bulk, general cargo and project cargo.

Located in the central Adriatic Sea coast, the port stands in a strategic position for the industrial areas of Central Italy and it is suitable for cargo, Ro-Ro and passenger traffic. The port is connected to A14 (North-South) and to A25 (East-West) highways. Furthermore, the port is linked to the railway network by a single track leading to Ortona station, on the Adriatic railway line (North-South).

# BOTTLENECKS AND UNDESIRABLE EFFECTS

Bottlenecks are limiting factors. That can mean any obstruction to port performance such as administrative, operative or legal. Usually, it is a phenomenon that limits the full performance of an entire system due to a problem at a single component of that system. The table that lists potential bottlenecks in the port was created and sent to all partners to be distributed between stakeholders in order to understand problems from more than one perspective. After that, partners were asked to perform an analysis of collected bottlenecks and offer possible solutions.

Croatian ports have mainly same bottlenecks that are infrastructural in nature. Both Rijeka and Split are old ports positioned in the city centre and have problems with space and both road and rail connections. Port of Ploče has a somewhat better position, with lots of space and is currently working on their main infrastructural bottlenecks. There are also some other bottlenecks, non-infrastructural in nature, those are mainly the lack of communication and exchange of information between all actors in the port and stakeholders. That is reason why the Croatian ministry of the Sea, transport and infrastructure is currently working on a system that will enable all actors to exchange information in real time and access all important information through the system without the need to contact different institutions and/or actors.

Italian ports have issues mostly with the limited depth in the part of their port basins. This leads to the problems with large ships that wants to enter their ports. They are working on dredging to increase the draft in order to resolve this bottleneck. Some of the mentioned problems are also with the existing infrastructure that is insufficient for current traffic flow.

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Port of Ortona is resolving this problem with the introduction of Ortona area in the Special Economic Zone – ZES. Ortona is one of the infrastructural nodes pivotal for the regional logistic system due to its key role as link between the Region and the TEN-T Scandinavian – Mediterranean corridor. It is a great opportunity to foster the development of the port activity and interventions aimed to improve the port infrastructure. Port of Venice, on the other hand, have problem with weather conditions, such as fog. It is causing a lack of clear visibility. Such conditions are causing issues in ports with reduced natural accessibility and ports with high traffic compared to their size. Improving the accessibility of the ports will lead to increased amounts traffic and longer periods of port activities. Another solution would be ensuring full functioning at night-time which would extend the port terminals working time. These solutions have to be sought by adopting the “soft measures” promoted by the National Logistics Strategic Plan and suggested by a general management approach that prefers operative and light infrastructures investments to the large infrastructural projects. Beside shallow water problems, the port of Bari also has issues with administrative procedures – they are the first port of call for the cargo from Eastern Asia and because of this, they are required to have a customs area. Another large issue is the impossibility of finding adequate spaces that guarantee high standards of safety and working efficiency, makes it necessary to find important retroport areas that allow the development of the port.

# PROPOSED SOLUTIONS IN THE SCOPE OF CHARGE PROJECT

Although a lot of bottlenecks were collected and their solutions proposed, in the scope of CHARGE project, only some could be resolved.

Croatian partners, especially PP7 Croatian ministry of the Sea, transport and infrastructure are working on the upgrading of the Croatian National Single Window system (NSW).

Croatian NSW will be upgraded in order to ensure:

- The exchange of information from NSW applications and announcements of maritime facilities
- The establishment of port area occupancy records and exchange of AIS data

The exchange involves upgrading the NSW web service in terms of messages, structures and rules for needs ensuring the exchange of information between the NSW system and the information system of the Port Authority of Split through which Port Authority of Split makes financial calculations based on the arrival and departure of ships, in the sections:

- exchange of technical data on domestic and foreign maritime facilities
- position of maritime facilities (statuses, arrival and departure times, ports, berth ...)
- information on cargo, both ordinary and dangerous
- information on the number and type of passengers and vehicles
- crew details
- fuel data (bunker)

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- ship waste notification data
- contact details of the shipping company and the agent

Italian partners, especially PP 2 North Adriatic Sea Port Authority, in recent years have been investing in the Intelligent Transport System to increase the nautical accessibility of the port. For the port of Venice, in fact, one of the main bottlenecks is the low visibility due to weather conditions, that hampers if not prevents the navigation even for few days in a row in case of fog.

For this reason, the Port Authority started several projects with the scope of equipping the lagoon with series of sensors and cameras, gathering their information and elaborating them through its Port Community System in order to give real time information to the commercial ships and cruises on the weather condition in the lagoon (wind, temperature, visibility, special notices). The main scope is to make navigation safer and thus efficient and therefore attract more traffic and business opportunity for the territory.

On the basis of above mentioned, they developed a free mobile application that gives all port user the possibility to have easy and free access to real time data related to:

- georeferencing
- weather condition
- port accessibility (port entry/exit conditions)
- maritime traffic data (presence of other vessels)
- special notice to navigators

## CONCLUSION

Italian and Croatian ports analysed in this document have several problems. However, looking overall, all these ports have also many benefits and are working on improving and resolving their problems. If CARICA reports are compared with new reports made in CHARGE project, it can be seen that ports that were partners in both projects have improved their results in these several years.

Many problems and bottlenecks were resolved through EU funded projects such as Interreg, CEF and similar programmes. Apart from EU funded projects, partners also resolve bottlenecks through infrastructure and development projects funded from national or own sources.

# Annexes

## Port of Rijeka

### DEFINING THE AREA UNDER STUDY AND CHARACTERIZING RESPECTIVE AREA

Port of Rijeka is Croatian largest seaport. It is located on the shore of the Kvarner Gulf in the Adriatic Sea. Luka Rijeka d.d. is a concessionaire of the Port of Rijeka.

Rijeka provides the shortest connection between overseas destinations and Central and Central-Eastern Europe. The most important traffic routes for the Port of Rijeka are the Pan European Corridor 5, Branch B and Corridor 10.

There are several terminals at the port, and they are located on several locations:

Bulk Cargo Terminal – it is situated in the Bakar basin, about 13 km from Rijeka, and is specialized for iron ore and coal handling, as well as other bulk and loose. The main and most important physical characteristics of this terminal is its operational quay and the depth alongside ( 18 metres) which makes it suitable to accommodate deeper drafted vessels up to 15.000 DWT.

Cereal Terminal – it is situated in the Rijeka basin. The Terminal is specially equipped to handle and store grain and oil plants. Terminal is provided with a large operational quay able to accommodate vessels up to 60.000 DWT/h and with loading/unloading bridge crane of a 400 T/h capacity. The terminal is also equipped with all necessary modern facilities for cargo drying operation, ventilation, weighing, disinfection and rat control.

General Cargo Terminal – The general cargo terminal is located within the old port core of Rijeka and in the hinterland area of Škrljevo where its warehouses are installed. The Terminal

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handles conventional cargo and offers many adequate storage facilities close to the operations quay. The depth of the sea varies from 5 m up to 14 m, and annual capacity of the terminal is 2.000.000 tons.

Container and Ro-Ro Terminal – this terminal is located in the eastern part of the Port of Rijeka. Concessionaire for this part is Adriatic Gate j.s.c. This terminal is equipped and prepared for handling and warehousing containers, Ro-Ro trailers and other type of vehicles as well as heavy shipment packages. Two operational piers are equipped with a Ro-Ro platform and four container bridge cranes enabling simultaneous Lo-Lo and Ro-Ro operations.

Terminal Škrljevo – Warehouse Complex – The Škrljevo terminal is a warehouse complex that is intended for the storage of various goods, as well as for the final treatment, processing and packaging. The complex was developed on the surface of 417.413 m<sup>2</sup> with an open storage yard (130.000m<sup>2</sup>) and with 44.000m<sup>2</sup> arranged as covered warehouses. The rest of the space is still available for other programs and is waiting for investors.

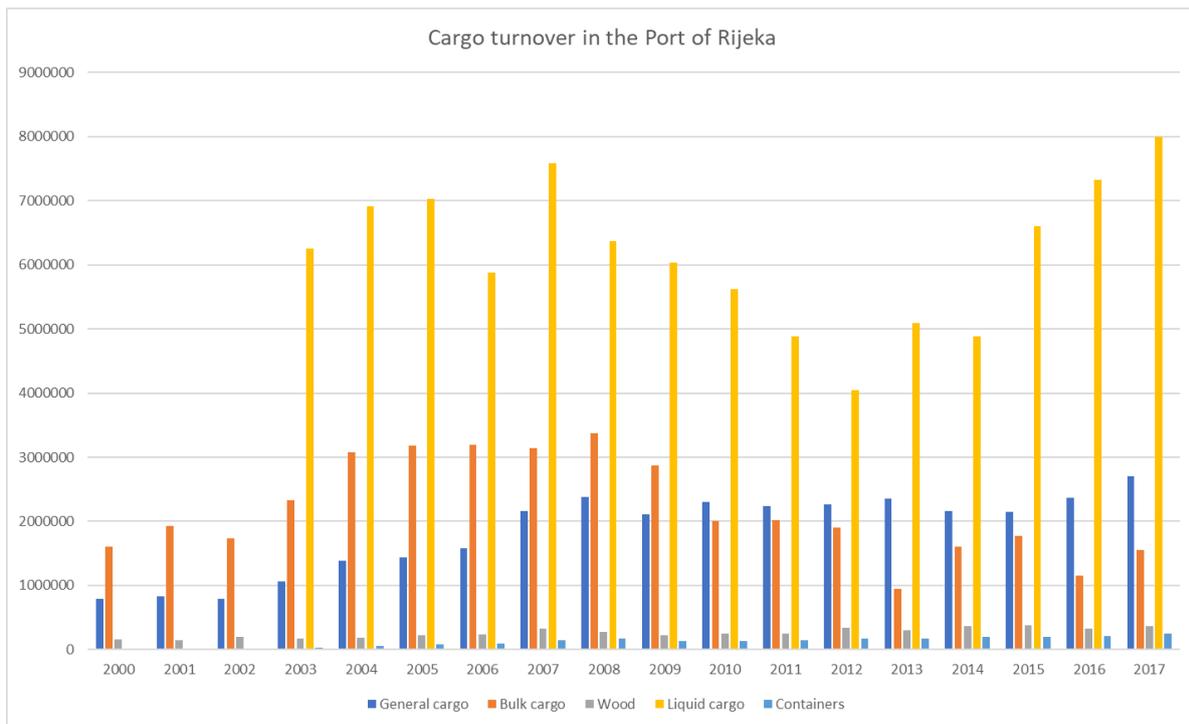
Timber terminal - The Terminal is specially equipped to handle timber and to prepare sawn timber for overseas transport.

Frigo terminal – The terminal is equipped with cooling chambers for tropical fruit and chambers for frozen meat.

Terminal Bršica – This is a multipurpose terminal that is adept for handling of livestock, as well as for timber and bulk cargo. The terminal Bršica is equipped with a suitable infrastructure for loading/discharge of animals, which enables direct movement from one transportation means to another. There is a permanent veterinary inspection available at the terminal. Depth of the sea is 8 m, and storage capacities 510.000m<sup>2</sup>.

Between 2002 and 2010 increased its total turnover by 69%. However, the global economic crisis did leave its mark. From 2008 there is drastic decrease in the turnover of bulk cargo, and

it did not recover to this day. In same year we can see decrease in liquid cargo as well, but in 2013 it starts its recovery and is currently at the highest level. Similar situation is with containers.



Port of Rijeka has strategic geo-traffic position that is a natural and most favourable access to the Adriatic Sea, to the whole Pannonian Plain and the wider European region. Port belongs to the North Adriatic ports that have traditionally gravitational area in central and eastern European countries, which widely includes central and eastern Croatia, Hungary, northern and western part of Bosnia and Herzegovina, northern part of Serbia and Vojvodina, and can include Slovenia, Austria, Slovakia and Romania.

This is mostly transit port for the Hungary (as a traditional partner of the port of Rijeka), Czech Republic, Slovakia and Austria. These Central European countries also represent a strategic transport market for the port of Rijeka. In addition, it should be mentioned that Serbia represents the most important transit market for container traffic from the Port of Rijeka. Unfortunately, current “use” of mentioned gravitational potential for ferry transport almost does not exist.

Port of Rijeka currently have no international ferry lines. Maritime links which is currently operational from port of Rijeka consist of two local lines:

- passenger HSC line to Island of Cres and Mali Lošinj,
- passenger HSC line to island of Rab,

From the aforementioned it can be seen that port of Rijeka currently is not port of big significance for ferry or passenger sea transport including transport of Ro-Ro cargo. The services are local, primarily oriented to passenger traffic.

It should be mentioned, that there were several attempts for introducing regular ferry connection between Italian coast and Rijeka but without success due to relatively low demand in the hinterland and relatively low land distance between Rijeka and Italian ports such as Ravenna (357 km) or Ancona (594 km).

Despite that, Rijeka have a good number of feeder container services that connects Port of Rijeka with ports in Asia and Mediterranean.

The services are:

- Phoenix (MSC) and AE12 (Maersk) - direct weekly service from Far East to Rijeka:

Busan → Shanghai → Ningbo → Chiwan → Singapore → Port Said → Haifa → Koper → Trieste → Rijeka → Gioia Tauro → Port Said → King Abdullah → Salalah → Tanjung Pelepas → Vung Tao → Yantian → Ningbo → Shanghai

- Phoenician Express (CMA CGM), AEM6 (COSCO), BEX2 (Evergreen), AAS (OOCL), ADX (APL) - direct weekly service from Far East to Rijeka:

Shanghai → Ningbo → Busan → Shekou → Singapore → Port Said → Malta → Koper → Trieste → Rijeka → Venice → Koper → Malta → Damietta → Jeddah → Port Kelang → Shekou → Shanghai

- Adriatic Greece Turkey (AGT) - Cosco feeder weekly service to Rijeka via Pireas:

Rijeka → Koper → Venice → Ancona → Pireas → Thessaloniki → Istanbul Ambarli (Kumport) → Istanbul Haydarpara → Yilport Gebze → Izmir → Pireas → Rijeka

- Hapag Lloyd feeder weekly service to Rijeka via Damietta:

Damietta → Piraeus → Ancona → Koper → Rijeka → Venice → Piraeus → Damietta

- Line H (Gioia Tauro to Balkans & Sicily Shuttle Service) - MSC feeder weekly service to Rijeka via Gioia Tauro:

Gioia Tauro → Koper → Rijeka → Ploče → Gioia Tauro

- Maersk feeder weekly service to Rijeka via Algeciras:

Algeciras → Marsaxlokk → Rijeka → Koper → Venice → Ravenna → Ancona → Marsaxlokk → Algeciras

This services mainly used Port of Rijeka as a transit port. The pan European corridor V, namely its leg Vb, is an important traffic route connecting Rijeka port with the European railway and

road network. Equally important are corridor X and the Danubian corridor VII, running through Croatia.

Thanks to them, Rijeka and its port have much better traffic connection with the important markets in their hinterland. The network of Croatian motorways is the fastest and most reliable land connection between Rijeka port and its immediate and extended hinterland. The railway corridor links Rijeka, via Zagreb, with Hungary and Serbia.

If we are comparing Port of Rijeka with neighbouring port of Koper and Trieste, we can see that in the last few years all three ports recorded a rise in container traffic. The statistic shows that these three ports recorded a total growth of about 15% in 2017. The strongest of the three ports in container traffic is convincingly Koper, while the biggest growth has been recorded by the Trieste port.

The container traffic of Rijeka, Koper and Trieste ports in TEU is shown in the following table:

Year/Port	RIJEKA	KOPER	TRIESTE
2012	171.945	570.744	411.247
2013	169.943	600.441	458.497
2014	192.004	674.033	476.507
2015	200.102	790.736	443.882
2016	214.348	844.767	449.481
2017	249.975	911.528	546.660

The table shows that all three ports have experienced a rise in container traffic over the last few years. In 2017, Rijeka saw a significant increase in container traffic compared to the previous year, about 16%, while Koper port increased by approximately 8%. The highest growth was the Trieste port, approximately 22%.

Although the Port of Rijeka noted a significant increase in container traffic, it is still significantly smaller than neighbouring ports of Koper and Trieste. The reason for this is the poor state of the railway network in the Port of Rijeka, and Croatia as a whole. It is one of the main bottlenecks in the Port of Rijeka.

## LISTING OF ALL BOTTLENECKS AND UNDESIRABLE EFFECTS

In the picture below are shown bottlenecks collected from the field research.

**Questionnaire for CHARGE project - collection of bottlenecks**

Answer: simple yes/no answers  
 Relevance: How important is this part for your port and is this the reason for bottlenecks? Will reduction of this problem solve bottlenecks?

Bottleneck	Question	Answer	Relevance		
infrastructural bottlenecks	road	safety	Is the connection between the terminal and highway network at a satisfactory safety level?	yes	
			Is there a regular maintenance of the terminal roads and connection between the terminal and highway network?	no	
		flow capacity	Are there clearly marked routes for accessing the terminal and leaving the terminal in order to reach the highway network?	yes	
			Is there adequate (satisfactory) lighting on the terminal roads and connection between the terminal and highway network?	yes	
			Are there clearly marked routes to get to the terminal and to the highway network?	yes	
	rail	safety	Is there a direct access to the highway network?	yes	
			Is the current capacity of the road infrastructure sufficient?	no	important
		flow capacity	Is there a sufficient number of lanes on terminal roads and connection between the terminal and highway network?	no	important
			Is the width of the lanes on the terminal roads and connection between the terminal and highway network appropriate (satisfactory)?	yes	
			Is the connection between the terminal and highway network passing through the urban and inhabited area?	yes	
			Is there a road and pedestrian crossing on the railway?	no	
			Is the signalization on a satisfactory level?	no	
			Is there adequate (satisfactory) lighting on the terminal railway infrastructure?	no	
			Is there a regular maintenance of infrastructures relevant for the satisfactory level of security?	no	
			Is there a road and pedestrian crossing on the railway?	no	
	flow capacity	Are the crossings satisfactory marked?	no		
		Is the current capacity of railway infrastructure satisfying?	no	extremely important	
	inland waterways	safety	Is it the connection of railway and road infrastructure at a satisfactory level?	no	extremely important
			Is it possible to dispatch the maximum allowed quantities of the train at once?	no	highly important
		flow capacity	Is there a ramp for the loading/unloading of the trucks on the railway?	no	
Is the safety level of the port access satisfactory?			N/A		
Is the area of the port basin sufficient?			N/A		
terminal	capacity	Is the capacity of the access to the terminal sufficient so the barges shouldn't be separated?	N/A		
		Is there a RO-RO ramp on the terminal?	N/A		
		Are the parking spaces adequately signposted for identification?	yes		
		Is the capacity of a parking lot sufficient?	no	extremely important	
		Is parking space able to accommodate all dimensions of the vehicles / units?	no	important	
		Are the roads at the terminal separated from waiting areas for the loading / unloading cargo?	no	important	
		Is the number of berths for mooring ships sufficient?	yes		
		Are the lengths of berths sufficient for mooring the largest vessels?	no	extremely important	
		Are the sea depth/draft berths enough for the biggest ships?	no	extremely important	
		Is the sea depth in the driveway shore/terminal satisfactory for the biggest ships?	yes		
		Is there a storage space near the berth?	yes		
		safety	Does the space for storage of goods have sufficient capacity?	no	extremely important
	Does the terminal (individual bindings) have conditions of secure mooring?		no	highly important	
weather	Is the sea access to the terminal sufficient (maritime safety requirements)?	yes			
	How much time a year is the terminal out of function for bad weather?	2 days	important		
a supply chain bottlenecks	work shifts	Is it guaranteed cargo handling 24 hours a day every day of the year?	yes		
		Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading?	no	highly important	
	information exchange	Is there a system which allows the electronic exchange of documents and communications between the driver unit and the terminal?	yes		
		PILOTS - Is it the time required from the request to reaction at a satisfactory level?	yes		
	time response	TUGS - Is it the time required from the request to reaction at a satisfactory level?	yes		
		Is the cooperation between the terminal and the agent at a satisfactory level?	yes		
cooperation	Is the administrative co-operation of the terminal and Ship at a satisfactory level?	yes			
	Is the cargo handling capacity of the terminal sufficient?	yes	extremely important		
	Does the shore cranes terminal have sufficient performance / capacity?	no	important		
technology	Does the mobile cranes terminal have sufficient performance / capacity?	no			
	Is there in the function the VTMS system?	yes			
	Is the cooperation between the Customs Authority and Ships at a satisfactory level?	yes			
	Is the time required for inspection (veterinary, phytosanitary, etc.) at a satisfactory level?	yes			
regulatory bottlenecks	customs inspections	Are there any cabotage restrictions?	yes		
		Is there an exemption obligations pilots for ships in service, which regularly touch the port?	no		
	other	Is there an exemption obligations tugs for ships in service, which regularly touch the port?	no		

### D.3.2.5 Final report on physical and non-physical bottlenecks and missing links in Italy and Croatia

**Questionnaire for CHARGE project - collection of bottlenecks**

Answer: simple yes/no answers  
 Relevance: How important is this part for your port and is this the reason for bottlenecks? Will reduction of this problem solve bottlenecks?

Bottleneck	Question	Answer	Relevance		
infrastructural bottlenecks	road	safety	Is the connection between the terminal and highway network at a satisfactory safety level?	yes	
			Is there a regular maintenance of the terminal roads and connection between the terminal and highway network?	yes	
			Are there clearly marked routes for accessing the terminal and leaving the terminal in order to reach the highway network?	yes	
		flow capacity	Is there adequate (satisfactory) lighting on the terminal roads and connection between the terminal and highway network?	no	important
			Are there clearly marked routes to get to the terminal and to the highway network?	yes	
			Is there a direct access to the highway network?	yes	
	rail	safety	Is the current capacity of the road infrastructure sufficient?	yes	
			Is there a sufficient number of lanes on terminal roads and connection between the terminal and highway network?	yes	
			Is the width of the lanes on the terminal roads and connection between the terminal and highway network appropriate (satisfactory)?	yes	
			Is the connection between the terminal and highway network passing through the urban and inhabited area?	yes	
			Is there a road and pedestrian crossing on the railway?	no	
			Is the signalization on a satisfactory level?	no	
			Is there adequate (satisfactory) lighting on the terminal railway infrastructure?	no	
		flow capacity	Is there a regular maintenance of infrastructures relevant for the satisfactory level of security?	no	
			Is there a road and pedestrian crossing on the railway?	no	
			Are the crossings satisfactory marked?	no	
			Is the current capacity of railway infrastructure satisfying?	no	
			Is it the connection of railway and road infrastructure at a satisfactory level?	no	
			Is it possible to dispatch the maximum allowed quantities of the train at once?	no	
			Is there a ramp for the loading/unloading of the trucks on the railway?	no	
inland waterways	safety	Is the safety level of the port access satisfactory?			
	flow capacity	Is the area of the port basin sufficient?			
terminal	capacity	Is the capacity of the access to the terminal sufficient so the barges shouldn't be separated?			
		Is there a RO-RO ramp on the terminal?			
		Are the parking spaces adequately signposted for identification?	no	important	
		Is the capacity of a parking lot sufficient?	no		
		Is parking space able to accommodate all dimensions of the vehicles / units?	no		
		Are the roads at the terminal separated from waiting areas for the loading / unloading cargo?	no		
	safety	Is the number of berths for mooring ships sufficient?	yes		
		Are the lengths of berths sufficient for mooring the largest vessels?	no	important	
		Are the sea depth/draft berths enough for the biggest ships?	no	important	
		Is the sea depth in the driveway shore/terminal satisfactory for the biggest ships?	yes		
		Is there a storage space near the berth?	yes		
		Does the space for storage of goods have sufficient capacity?	yes		
weather	Does the terminal (individual bindings) have conditions of secure mooring?	yes			
	Is the sea access to the terminal sufficient (maritime safety requirements)?	yes			
a supply chain bottlenecks	work shifts	How much time a year is the terminal out of function for bad weather?	yes	4-5 days	
	information exchange	Is it guaranteed cargo handling 24 hours a day every day of the year?	yes		
	time response	Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading?	no	important	
		Is there a system which allows the electronic exchange of documents and communications between the driver unit and the terminal?	yes		
	cooperation	PILOTS - Is it the time required from the request to reaction at a satisfactory level?	yes		
		TUGS - Is it the time required from the request to reaction at a satisfactory level?	yes		
technology	Is the cooperation between the terminal and the agent at a satisfactory level?	yes			
	Is the administrative co-operation of the terminal and Ship at a satisfactory level?	yes			
regulatory bottlenecks	customs	Is the cargo handling capacity of the terminal sufficient?	yes		
		Does the shore cranes terminal have sufficient performance /capacity?	no	important	
	inspections	Does the mobile cranes terminal have sufficient performance /capacity?	yes		
		Is there in the function the VTMS system?	yes		
	cabotage restrictions	Is the cooperation between the Customs Authority and Ships at a satisfactory level?	yes		
Is the time required for inspection (veterinary, phytosanitary, etc.) at a satisfactory level?		yes			
other	Are there any cabotage restrictions?	no			
	Is there an exemption obligations pilots for ships in service, which regularly touch the port?	yes			
	Is there an exemption obligations tugs for ships in service, which regularly touch the port?	yes			

D.3.2.5 Final report on physical and non-physical bottlenecks and missing links in Italy and Croatia

Questionnaire for CHARGE project - collection of bottlenecks

Answer: simple yes/no answers  
 Relevance: How important is this part for your port and is this the reason for bottlenecks? Will reduction of this problem solve bottlenecks?

Bottleneck	Question	Answer	Relevance		
infrastructural bottlenecks	road	safety	Is the connection between the terminal and highway network at a satisfactory safety level?	no	
			Is there a regular maintenance of the terminal roads and connection between the terminal and highway network?	no	
		flow capacity	Are there clearly marked routes for accessing the terminal and leaving the terminal in order to reach the highway network?	yes	
			Is there adequate (satisfactory) lighting on the terminal roads and connection between the terminal and highway network?	yes	
			Are there clearly marked routes to get to the terminal and to the highway network?	yes	
	rail	safety	Is there a direct access to the highway network?	no	very important, will solve bottlenecks when completed.
			Is the current capacity of the road infrastructure sufficient?	no	
			Is there a sufficient number of lanes on terminal roads and connection between the terminal and highway network?	no	
			Is the width of the lanes on the terminal roads and connection between the terminal and highway network appropriate (satisfactory)?	yes	
			Is the connection between the terminal and highway network passing through the urban and inhabited area?	yes	
		flow capacity	Is there a road and pedestrian crossing on the railway?	yes	
			Is the signalization on a satisfactory level?	yes	
			Is there adequate (satisfactory) lighting on the terminal railway infrastructure?	yes	
			Is there a regular maintenance of infrastructures relevant for the satisfactory level of security?	no	
			Is there a road and pedestrian crossing on the railway?	yes	
	inland waterways	safety	Are the crossings satisfactory marked?	yes	
			Is the current capacity of railway infrastructure satisfying?	no	very important, will solve bottlenecks when completed.
		flow capacity	Is it the connection of railway and road infrastructure at a satisfactory level?	no	
			Is it possible to dispatch the maximum allowed quantities of the train at once?	no	
			Is there a ramp for the loading/unloading of the trucks on the railway?	no	
terminal	inland waterways	safety	Is the safety level of the port access satisfactory?		
			Is the area of the port basin sufficient?		
		flow capacity	Is the capacity of the access to the terminal sufficient so the barges shouldn't be separated?		
			Is there a BQ-BQ ramp on the terminal?		
	capacity	Are the parking spaces adequately signposted for identification?	yes		
		Is the capacity of a parking lot sufficient?	yes		
		Is parking space able to accommodate all dimensions of the vehicles / units?	yes		
		Are the roads at the terminal separated from waiting areas for the loading / unloading cargo?	yes		
		Is the number of berths for mooring ships sufficient?	no		
		Are the lengths of berths sufficient for mooring the largest vessels?	no		
		Are the sea depth/draft berths enough for the biggest ships?	no		
		Is the sea depth in the driveway shore/terminal satisfactory for the biggest ships?	no		
		Is there a storage space near the berth?	yes		
		Does the space for storage of goods have sufficient capacity?	no		
		safety	Does the terminal (individual bindings) have conditions of secure mooring?	yes	
Is the sea access to the terminal sufficient (maritime safety requirements)?	yes				
weather	How much time a year is the terminal out of function for bad weather?	almost never			
a supply chain bottlenecks	work shifts	Is it guaranteed cargo handling 24 hours a day every day of the year?	yes		
		Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unload?	yes		
	information exchange	Is there a system which allows the electronic exchange of documents and communications between the driver and the terminal?	no	very important, will solve bottlenecks when completed.	
		PILOTS - Is it the time required from the request to reaction at a satisfactory level?	yes		
	time response	TUGS - Is it the time required from the request to reaction at a satisfactory level?	yes		
		Is the cooperation between the terminal and the agent at a satisfactory level?	no		
		Is the administrative co-operation of the terminal and Ship at a satisfactory level?	yes		
technology	Is the cargo handling capacity of the terminal sufficient?	yes			
	Does the shore cranes terminal have sufficient performance /capacity?	yes			
	Does the mobile cranes terminal have sufficient performance /capacity?	yes			
	Is there in the function the VTMS system?	yes			
regulatory bottlenecks	customs inspections	Is the cooperation between the Customs Authority and Ships at a satisfactory level?	no		
		Is the time required for inspection (veterinary, phytosanitary, etc.) at a satisfactory level?	no		
	cabotage restrictions	Are there any cabotage restrictions?	no		
		Is there an exemption obligations pilots for ships in service, which regularly touch the port?	no		
other	Is there an exemption obligations tugs for ships in service, which regularly touch the port?	no			

As can be seen from pictures, different actors of intermodal transportation gives different answers. However, it can be concluded that main problems are:

There is no direct connection with highway – this is problem for part of the port, since the old part is located in the city centre. Although there is good road through the centre, it will be beneficial if port have direct access to the highway network. Container terminal, on the other hand, have connection with Rijeka bypass, that is part of Croatian highway, and, as such, have a good connection with highway.

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The current capacity of the road infrastructure is insufficient, as well as number of lanes on terminal roads and connection between the terminal and highway network. Terminal is limited in space, and have small number of lanes that is crossing through the terminal.

Railway infrastructure is also a bottleneck:

The signalization is unsatisfactory – this can be bottleneck because it can cause problems in safety of operations on terminals.

There is no adequate lightening on the terminal railway infrastructure. Same as before, it is connected with the safety of operations on terminal.

Capacity is unsatisfactory, as well as connection of railway and road infrastructure. With unsatisfactory capacity and poor connection, it is very hard to increase flow capacity in the port, since that would mean congestion of road traffic.

It is not possible to dispatch the maximum allowed quantities of the trains at once

There is no ramp for the loading/unloading of the trucks on the railway

On the terminal, parking space is the main problem:

The capacity of the parking lot is insufficient

Parking space is not able to accommodate all dimensions of the vehicles/units

The roads at the terminal are not separated from waiting areas for the loading/unloading of cargo

The lengths of berths are not sufficient for mooring the largest vessels and sea depth/draft is not enough for the biggest ships

Space for storage does not have sufficient capacity

There is no guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading/unloading services

Shore cranes and mobile cranes on the terminal do not have sufficient performance/capacity

The most important bottlenecks are those related to railway infrastructure and parking space capacity.

By building new motorways in the Republic of Croatia, a large part of freight traffic is diverted to road transport. For example, in the 1990s, Rijeka has taken part in rail freight transport with about 90%, while today it accounts for about 25%, which means that the realized freight traffic fell to one third compared to thirty years ago.

The problem arises because the development and modernization of the port is not accompanied by the development of the railway infrastructure in the hinterland of Rijeka. The capacity of the railway infrastructure is about 6.5 million net tons per year, mainly due to the poor transport characteristics of the Rijeka-Lokve section.

Also, the general condition of the railway fleet does not correspond to the current traffic requirements. Investments in railway infrastructure are not accompanied by the modernization of the fleet, and the operating characteristics of the old fleet have a negative impact on infrastructure in the form of faster decay of the upper track layout, and also inadequate maintenance of the track affects the lower tier and towed vehicles. One of the main problems is the lack of compatibility between the fleet and railway infrastructure.

#### **ANALYSING OF LISTED BOTTLENECKS AND THEIR CAUSATIVE RELATIONS**

In the Port of Rijeka, there are mostly two types of bottlenecks: infrastructural and supply chain bottlenecks. Main infrastructural bottlenecks are railway capacity and available parking space. If railway capacity would be solved, it would help solve the problems with congestion

on road infrastructure and even some problems with parking space, since more cargo would be sent away through railway, thus reducing the need for a large number of trucks in the port.

A supply chain bottlenecks problems mostly lay in work shifts of stevedoring crew. There is no guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading services. Also, problem lays in insufficient performance/capacity terminal mobile and shore cranes. This problem could be solved by better planning shifts according to the demands in loading/unloading services.

### PROPOSING SOLUTIONS OF BOTTLENECKS AND ANALYSING HOW IT WILL AFFECT FUTURE FREIGHT FLOWS

Once all bottlenecks are listed and analysed, it is time for proposing solutions and analysing how it will affect future freight flows. There should be proposed solutions for all bottlenecks. For some bottlenecks, more than one solutions could be proposed. Then, the one that have the most desirable outcome should be chosen. Also, all solutions should be analysed to show us if proposed activity actually eliminate bottleneck and how it affect freight flow in whole.

The current capacity of the road infrastructure is insufficient, as well as number of lanes on terminal roads and connection between the terminal and highway network. Terminal is limited in space, and have small number of lanes that is crossing through the terminal. One solution to this problem could be to increase the flow capacity through the railway and decrease the need for road vehicles. The other solutions could be in better organizing vehicles flow through the terminal.

Railway bottlenecks:

The signalization is unsatisfactory. There is no adequate lightening on the terminal railway infrastructure. Capacity is unsatisfactory, as well as connection of railway and road

infrastructure. It is not possible to dispatch the maximum allowed quantities of the trains at once. There is no ramp for the loading/unloading of the trucks on the railway.

All this can be classified as one big bottleneck. This is not a problem only in Rijeka, but in the entire territory of the Republic of Croatia. The length of the railway network in the Republic of Croatia is 2604 km, which makes a good ratio of the railway tracks and the number of inhabitants of the country. The problem is because the network is not maintained enough. The data show that within the next 5 to 8 years it is possible to maintain only 45.6% of the total length of the line, on the remaining 54.4% of the total length in the same period it is necessary to carry out investment works or major interventions within the maintenance.

Solution to the problem is construction of the so called “Nizinska pruga” that would connect Rijeka, Zagreb and Botovo with the state border to Hungary. That way, Rijeka would receive the required railway infrastructure which is missing for intermodal transport. It is planned to replace the existing single track railway with double track. The capacity of this new railway is estimated to be about 25 to 30 million tonnes per year, unlike the current 5 million tons. To achieve this project, it is necessary to build about 380km of new tracks in four sectors.

Parking space problem:

The capacity of the parking lot is insufficient. Parking space is not able to accommodate all dimensions of the vehicles/units. The roads at the terminal are not separated from waiting areas for the loading/unloading of cargo.

The solution to this problem can be twofold:

The first one could be to change unused space for new parking lot. Since there is not really enough space, one of proposed solutions could be to make a space better used – by constructing vertical parking lot – like garage.

The other solution could be to transfer more cargo flows on railway. That way, Port of Rijeka can attract more cargo with the offer of possibility of intermodal transportation, and at the same time, it will reduce the needs for a large number of road vehicles in the Port area.

The lengths of berths are not sufficient for mooring the largest vessels and sea depth/draft is not enough for the biggest ships. This problem is not easily solved. The problem is because of the nature of shore. Some of the problem could be solved by deepening of the sea, but mostly it is bottleneck that cannot be easily solved. The proposed solution can be in construction of new terminal. This solution is something that is spoken of in last couple of years. However, with current traffic flows in the Port of Rijeka, there is no justification for such investment. In the event that cargo flows increase in the future, this solution will be available.

Space for storage does not have sufficient capacity. This problem can be easily solved by constructing vertical storage spaces. The other solutions would be to construct storage spaces outside the port area – in industrial zone Kukuljanovo, and to transport goods there by rail.

There is no guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading/unloading services. This problem could be solved by better planning shifts according to the demands in loading/unloading services. Also, problem can be solved by using ICT to better organize arrival of the ships.

Shore cranes and mobile cranes on the terminal do not have sufficient performance/ capacity. The only solution for this problem is to invest in new technologies.

## CONCLUSION

This chapter should be summary of all that is already said and conclusions that are reached during the research should be elaborated.

Port of Rijeka is Croatian main cargo port. After the economic crisis in 2008, port started its recovery. In 2017, Rijeka saw a significant increase in container traffic compared to the

previous year, about 16%, which is a good indicator. In the same year, we can also see slight increase in the railway cargo turnover from and to the port of Rijeka. The number of containers transported by rail increased to 30%, while in the years before, that number was around 15% to 20%. The representatives of the Port of Rijeka states that the reason for the increase in traffic is an important part of the more accessible and better service on the railways, which only confirms the importance of the railway's efficiency for a more significant increase in traffic.

## Port of Ploče

### DEFINING THE AREA UNDER STUDY AND CHARACTERIZING RESPECTIVE AREA

Port of Ploče is one of the main Croatian ports and it is considered as a strategic port by the Croatian Government. The port of Ploče is international commercial port with special economic interest for the Republic of Croatia. As part of maritime links in the Adriatic Sea, it represents the main cargo port in the southern part of Croatia.

The port is managed by the Port of Ploče Authority which is a public non-profit legal entity established by the decision of the Government of the Republic of Croatia on 13th February 1997, as a port authority with national significance. The port services are operated by the private companies which act as concessionaires of the PPA. The main operator/concessionaire in the port is stevedoring company Port of Ploče (Luka Ploče d.d. ).

The port is located on the eastern Adriatic coast at mid-distance between Croatian ports Split and Dubrovnik and is the relevant point of the Pan European corridor V - branch VC (Budapest-Osijek-Sarajevo-Ploče). From the port there is road connection to the A1 highway and railway communication to neighboring Bosnia & Herzegovina. Ploče is the start/endpoint of the aforementioned corridor and due to that the port is the most important maritime gateway for Bosnia & Herzegovina. The port is in the list of 328 TENT Maritime ports published by the European Commission (REF).

Port of Ploče has potentially large gravitational area that includes the northeast part of Croatia, part of Serbia, Montenegro, Bosnia and Herzegovina, part of Austria, Hungary, Czech Republic, Slovakia, Romania and Poland.

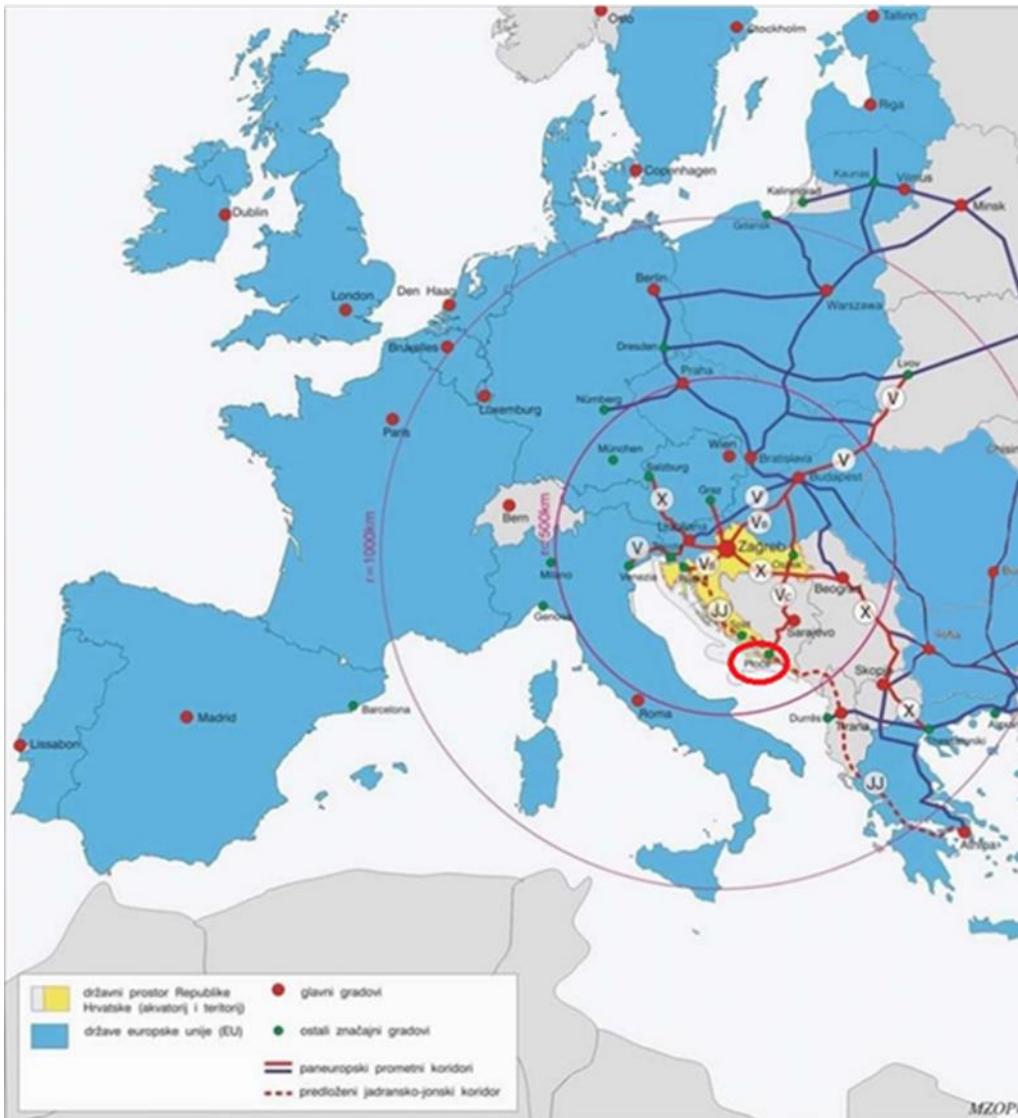


Figure 1 Source: <https://strukturnifondovi.hr>

### Location of the port of Ploče

The Port of Ploče is situated at the Central Adriatic coast line, approximately 120 km south from the city of Split and 100 km North from Dubrovnik. The ports central-Adriatic location, as well as its position in the south of Croatia (HR) leads to an international hinterland, covering

the Dalmatian coastline, as well as Bosnia and Herzegovina (BiH), Serbia (SR), Montenegro (MNE) and Hungary (HU).

Through a 24 km railway line and road, the port is linked with its immediate hinterland of BiH and further to the North-East of Croatia and Central Europe. Further, it is the end/starting point of the Corridor Vc (Budapest-Osijek-Sarajevo-Ploče). Through the Adriatic Highway (as part of the European route E65), it is connected to the Northern cities of Split, Rijeka and Trieste; and to Montenegro in the South.

The Pelješac peninsula to the South and West of the port provides for a natural breakwater.

Equally important is the connection to Corridor X via Corridor Vc, connecting the Port of Ploče also with Serbia to the East and even Austria to the North-West.

The nearest international airports are located in Dubrovnik (120 km) and Split (150 km).

The port is an EU port and open to domestic and international traffic.

Other ports in the eastern Adriatic region and with similar catchment areas, in particular landlocked Serbia, and therefore potential competitors are:

- Port of Durres (Albania)
- Port of Bar (Montenegro)
- Port of Rijeka (Croatia)
- Port of Koper (Slovenia)

Outside the Adriatic regions, the Greek and Black sea ports can also be considered competitors when it comes to markets of the land-locked Serbia and Macedonia.

An integral part of the Port of Ploče is the Port of Metković. Situated 25 km upstream on the banks of river Neretva in the town of Metković, situated along the BiH-HR border. The terminal

disposes of a connections to the rail and road systems and provides facilities for the transshipment of cement (silo), cinder and granulized stone.

The following figure gives a schematic overview of the location of the port along the Adriatic coast and a more detailed view of the location of the port facilities and the major transport connections.

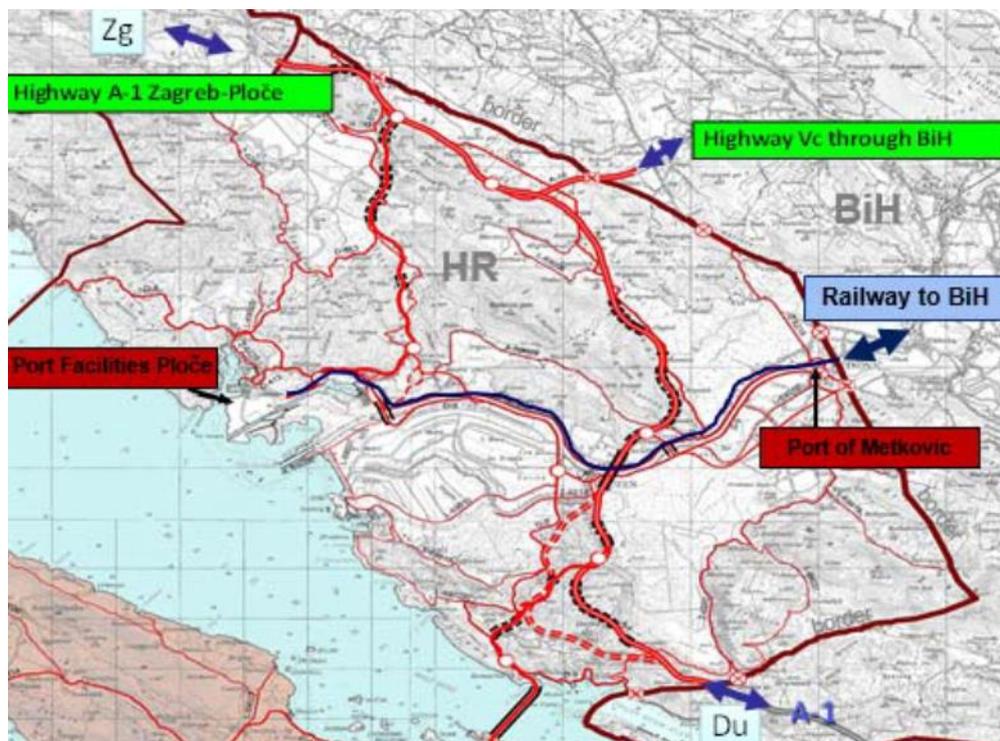


Figure 2 - Location of the Port and major rail and road connections

#### Port facilities and related processes

Port of Ploče is the second largest port in Croatia, after Rijeka. Port of Ploče total annual transshipment capacity is estimated at 6.2 million tonnes of bulk and general cargo, while the total annual storage capacity for the liquid cargo is 1.2 million tons. Container traffic capacity

is estimated at 60.000 TEU per year. In 2017 there was transhipped 418.000 tons of general cargo, 1.973.000 tons of bulk cargo and 804.000 tons of liquid cargo. There was also 24.307 TEUs .

The most container's origin is Far East, and 95% of containers is in transit to Bosnia and Herzegovina.

From this statistical data, it could be seen that Port of Ploče is not using its full capacity. Since Port of Ploče is situated as a main cargo port for the Bosnia and Herzegovina, as well as very favourable port for Serbia, Montenegro, part of Austria, Hungary, Czech Republic, Slovakia, Romania and Poland, it is obviously that port have potential, but it is not utilized.

The following table gives an overview on the general capacities of the port.

<b>Area (land part)</b>	<b>2.340.000 m<sup>2</sup></b>
<b>Area (sea part)</b>	<b>1.406.430 m<sup>2</sup></b>
<b>Area of external anchorage</b>	<b>23.000.000 m<sup>2</sup></b>
<b>Open storage area</b>	<b>315.000 m<sup>2</sup></b>
<b>Sheltered storage area</b>	<b>9.400 m<sup>2</sup></b>
<b>Indoor storage area</b>	<b>50.540 m<sup>2</sup></b>
<b>Total number of quays</b>	<b>7</b>
<b>Length of quays</b>	<b>1.815 m</b>
<b>Depth</b>	<b>5-13,5 m</b>
<b>The length of rails within the port area</b>	<b>19.944 m</b>
<b>Length of crane tracks</b>	<b>1.545 m</b>

Table 1 - general capacities of the port

The major concessionaire is Luka Ploče d.d., which has undergone a privatization in recent years. Luka Ploče d.d. operates several facilities for reloading and storage of various types of cargo located on seven shores with a draught of up to 14m. These are:

General cargo terminal:

- Quay with a length of 705 m and a draught of 9.2 m,
- Warehouses with an area of about 300,000 m<sup>3</sup>,
- Equipped with:
  - 8 shore cranes,
  - 9 auto cranes with capacity of 15-60 tons,
  - 100 fork lifters with a capacity of 2-28 tons,
  - 16 electric fork lifters of a capacity of 1,2-2,5 tons,
  - Floating crane with a 100 tons capacity,
  - Railway tracks with a length of 5,600 m.

Dry bulk cargo warehouse:

- Quay with a length of 510m and a draught of 14 m,
- Storage capacity of 300,000 tons,
- Mooring possible for ships of up to 75.000 DWT,
- Reloading capacity 15.000 tons/ day,
- Equipment with:
  - 14 loaders,
  - 2 bulldozers,
  - 5 Shore cranes with a capacity of 10 tons,

- 1 mobile crane with a capacity of 63 tons,
- 1 mobile crane with a capacity of 140 tons.

Alumina and petrol coke terminal:

- Quay with a length of 180m and a draught of 9,8m,
- Alumina silo with a storage capacity of 20,000 tons,
- Petrol coke storage of 10,000 tons.

Timber transit terminal:

- Quay with a length of 110m,
- Covered warehouse of 2000 m<sup>2</sup>,
- Open storage area of 153,925 m<sup>2</sup>,
- Equipped with 10 fork lifters.

Two liquid cargo terminals:

- Storage capacity of 160,000 tons in total separated for different kinds of liquid bulk.

Cold store and other phytosanitary equipment

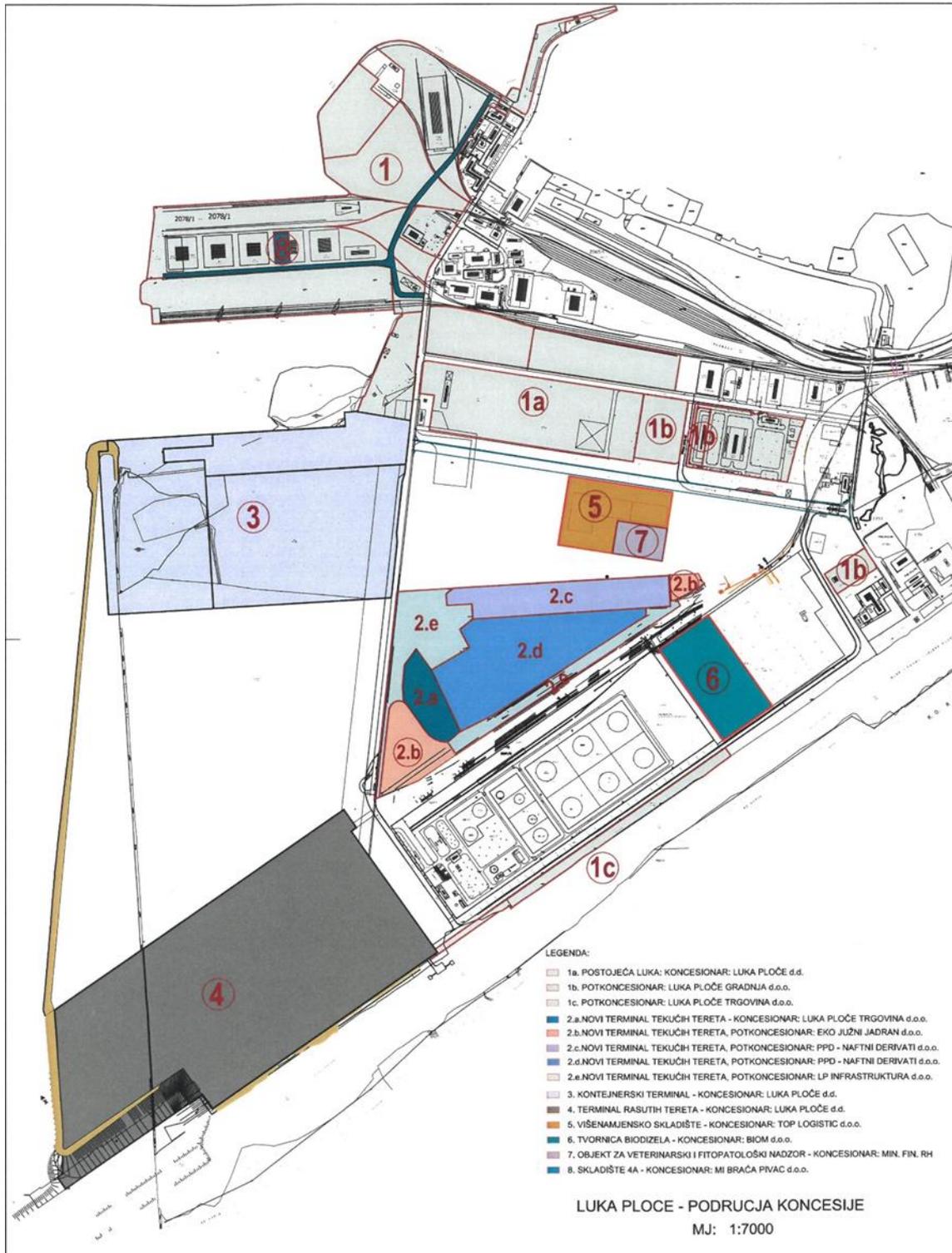
New container terminal

New dry bulk cargo terminal

The following figure gives an overview of the port, the concessionaires and sub-concessionaires and the facilities operated by them.

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D.3.2.5 Final report on physical and non-physical bottlenecks and missing links in Italy and Croatia

The Port of Ploče geographical location leads to the fact that it has a rather small immediate inland catchment area along the Dalmatian Coast line. It is only connected to the larger northern regions of Slavonia and Croatia properly via Bosnia and Herzegovina or lengthy detours. Thus, the international hinterland is of an even greater importance with BiH, Serbia, Montenegro, Hungary, Slovakia and Slovenia. The hinterland countries are only to a small extend congruent with the markets. The Port of Ploče is currently active in BiH, HR and SRB. To a bigger extent, they constitute the potential catchment area.



Figure 3 - Port of Ploče's hinterland

While not even 1% of the goods leaving the port are directed towards the southern neighboring state of Montenegro (MNE) and roughly 8% are distributed directly to the Croatian surroundings (HR), 91% of the goods are heading towards BiH.

This is not to say that BiH constitutes the final destination of these goods in their entirety. However, it underlines the importance of the transport route along Corridor Vc through BiH.

Since exact numbers on the final destinations of goods leaving the port are not available, a comparison with the ports of similar catchment/destination areas and thus posing as competitors to the Port of Ploče deems to be wise – always keeping in mind the slightly different geographical positions. Looking at the destinations of goods handled by the Port of Rijeka for example, it becomes clear that of the 70% of the total throughput of Rijeka nearly all goes to Hungary and Slovakia, countries of destination which the Port of Ploče can claim to be its hinterland as well.

### LISTING OF ALL BOTTLENECKS AND UNDESIRABLE EFFECTS

Bottleneck		Question	Answer	Relevance	
infrastructural bottlenecks	road	safety	Is the connection between the terminal and highway network at a satisfactory safety level?	yes	
			Is there a regular maintenance of the terminal roads and connection between the terminal and highway network?	yes	
			Are there clearly marked routes for accessing the terminal and leaving the terminal in order to reach the highway network?	yes	
			Is there adequate (satisfactory) lighting on the terminal roads and connection between the terminal and highway network?	yes	
			Are there clearly marked routes to get to the terminal and to the highway network?	yes	
		flow capacity	Is there a direct access to the highway network?	yes	
			Is the current capacity of the road infrastructure sufficient?	yes	
			Is there a sufficient number of lanes on terminal roads and connection between the terminal and highway network?	yes	
			Is the width of the lanes on the terminal roads and connection between the terminal and highway network appropriate (satisfactory)?	yes	
			Is the connection between the terminal and highway network passing through the urban and inhabited area?	no	
	rail	safety	Is there a road and pedestrian crossing on the railway?	no	
			Is there a road and pedestrian crossing on the railway?	no	
			Is the signalization on a satisfactory level?	yes	
			Is there adequate (satisfactory) lighting on the terminal railway infrastructure?	yes	
			Is there a regular maintenance of infrastructures relevant for the satisfactory level of security?	yes	
		flow capacity	Is there a road and pedestrian crossing on the railway?	yes	not important
			Are the crossings satisfactory marked?	yes	
			Is the current capacity of railway infrastructure satisfying?	yes	
			Is it the connection of railway and road infrastructure at a satisfactory level?	yes	
			Is it possible to dispatch the maximum allowed quantities of the train at once?	yes	
inland waterways	safety	Is there a ramp for the loading/unloading of the trucks on the railway?	yes		
	flow capacity	Is the safety level of the port access satisfactory?	yes		
terminal	capacity	Is the area of the port basin sufficient?	yes		
		Is the capacity of the access to the terminal sufficient so the barges shouldn't be separated?	yes		
		Is there a RO-RO ramp on the terminal?	yes		
		Are the parking spaces adequately signposted for identification?	yes		
		Is the capacity of a parking lot sufficient?	yes		
		Is parking space able to accommodate all dimensions of the vehicles / units?	no	not important	
		Are the roads at the terminal separated from waiting areas for the loading / unloading cargo?	no	not important	
		Is the number of berths for mooring ships sufficient?	yes		
		Are the lengths of berths sufficient for mooring the largest vessels?	yes		
		Are the sea depth/draft berths enough for the biggest ships?	yes		
safety	Is the sea depth in the driveway shore/terminal satisfactory for the biggest ships?	yes			
	Is there a storage space near the berth?	yes			
weather	Does the space for storage of goods have sufficient capacity?	yes			
	Does the terminal (individual bindings) have conditions of secure mooring?	yes			
a supply chain bottlenecks	work shifts	Is the sea access to the terminal sufficient (maritime safety requirements)?	yes		
		How much time a year is the terminal out of function for bad weather?	n/a	not important	
	information exchange	Is it guaranteed cargo handling 24 hours a day every day of the year?	yes		
		Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading services?	yes		
	time response	Is there a system which allows the electronic exchange of documents and communications between the driver unit and the terminal?	yes		
		PILOTS- Is it the time required from the request to reaction at a satisfactory level?	yes		
	cooperation	TUGS- Is it the time required from the request to reaction at a satisfactory level?	yes		
		Is the cooperation between the terminal and the agent at a satisfactory level?	yes		
	technology	Is the administrative co-operation of the terminal and Ship at a satisfactory level?	yes		
		Is the cargo handling capacity of the terminal sufficient?	yes		
regulatory bottlenecks	customs	Does the shore cranes terminal have sufficient performance /capacity?	yes		
		Does the mobile cranes terminal have sufficient performance /capacity?	yes		
	inspections	Is there in the function the VTMS system?	yes		
		Is the cooperation between the Customs Authority and Ships at a satisfactory level?	yes		
	cabotage restrictions	Is the time required for inspection (veterinary, phytosanitary, etc.) at a satisfactory level?	yes		
Are there any cabotage restrictions?		no			
other	Is there an exemption obligations pilots for ships in service, which regularly touch the port?	no			
	Is there an exemption obligations pilots for ships in service, which regularly touch the port?	no			

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Bottleneck		Question	Answer	Relevance	
infrastructural bottlenecks	road	safety	Is the connection between the terminal and highway network at a satisfactory safety level?	yes	
			Is there a regular maintenance of the terminal roads and connection between the terminal and highway network?	yes	
			Are there clearly marked routes for accessing the terminal and leaving the terminal in order to reach the highway network?	yes	
			Is there adequate (satisfactory) lighting on the terminal roads and connection between the terminal and highway network?	yes	
		flow capacity	Are there clearly marked routes to get to the terminal and to the highway network?	yes	
			Is there a direct access to the highway network?	yes	
			Is the current capacity of the road infrastructure sufficient?	yes	
			Is there a sufficient number of lanes on terminal roads and connection between the terminal and highway network?	yes	
	rail	safety	Is the width of the lanes on the terminal roads and connection between the terminal and highway network appropriate (satisfactory)?	yes	
			Is the connection between the terminal and highway network passing through the urban and inhabited area?	no	
		flow capacity	Is there a road and pedestrian crossing on the railway?	no	
			Is the signalization on a satisfactory level?	yes	
	inland waterways	safety	Is there adequate (satisfactory) lighting on the terminal railway infrastructure?	yes	
			Is there a regular maintenance of infrastructures relevant for the satisfactory level of security?	yes	
		flow capacity	Is there a road and pedestrian crossing on the railway?	yes	not relevant
			Are the crossings satisfactory marked?	yes	
	terminal	capacity	Is the current capacity of railway infrastructure satisfying?	yes	
			Is it the connection of railway and road infrastructure at a satisfactory level?	yes	
			Is it possible to dispatch the maximum allowed quantities of the train at once?	yes	
			Is there a ramp for the loading/unloading of the trucks on the railway?	no	not relevant
Is the safety level of the port access satisfactory?			yes		
Is the area of the port basin sufficient?			yes		
safety		Is the capacity of the access to the terminal sufficient so the barges shouldn't be separated?	yes		
		Is there a RO-RO ramp on the terminal?	yes		
		Are the parking spaces adequately signposted for identification?	yes		
		Is the capacity of a parking lot sufficient?	no	not relevant	
		Is parking space able to accommodate all dimensions of the vehicles / units?	no	not relevant	
		Are the roads at the terminal separated from waiting areas for the loading / unloading cargo?	no	not relevant	
weather	Is the number of berths for mooring ships sufficient?	yes			
	Are the lengths of berths sufficient for mooring the largest vessels?	yes			
	Are the sea depth/draft berths enough for the biggest ships?	yes			
	Is the sea depth in the driveway shore/terminal satisfactory for the biggest ships?	yes			
	Is there a storage space near the berth?	yes			
	Does the space for storage of goods have sufficient capacity?	yes			
a supply chain bottlenecks	work shifts	Does the terminal (individual bindings) have conditions of secure mooring?	yes		
		Is the sea access to the terminal sufficient (maritime safety requirements)?	yes		
	information exchange	How much time a year is the terminal out of function for bad weather?	n/a	not relevant	
		Is it guaranteed cargo handling 24 hours a day every day of the year?	yes	could be improved	
	time response	Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading services?	yes		
		Is there a system which allows the electronic exchange of documents and communications between the driver unit and the terminal?	yes	in further development	
	cooperation	PILOTS- Is it the time required from the request to reaction at a satisfactory level?	yes		
		TUGS- Is it the time required from the request to reaction at a satisfactory level?	yes		
	technology	Is the cooperation between the terminal and the agent at a satisfactory level?	yes		
		Is the administrative co-operation of the terminal and Ship at a satisfactory level?	yes		
	regulatory bottlenecks	customs	Is the cargo handling capacity of the terminal sufficient?	yes	
			Does the shore cranes terminal have sufficient performance /capacity?	no	could be faster
inspections		Is there in the function the VTMIS system?	yes		
		Is the cooperation between the customs Authority and Ships at a satisfactory level?	yes		
cabotage restrictions		Is the time required for inspection (veterinary, phytosanitary, etc.) at a satisfactory level?	yes		
		Are there any cabotage restrictions?	no		
other	Is there an exemption obligations pilots for ships in service, which regularly touch the port?	no	could be avoided		
	Is there an exemption obligations tugs for ships in service, which regularly touch the port?	no	could be avoided		

### An infrastructural bottlenecks:

- In the port of Ploče related to rail one an safety shortcoming is existing road and pedestrian crossing on the railway. There is one intersection with roads and pedestrian lines which, although satisfactory marked and thus meeting safety requirements, can still be seen as a bottleneck because pedestrians always represent safety risk.
- There is a lack in terminal capacity because parking spaces are not able to accommodate all dimensions of the vehicles. There are no provided parking lots for trucks, nor available facilities for drivers. This is one of main problems in the Port of Ploče. Port of Ploče has enough surface which should soon be organised as a parking space.
- The roads and the terminals are not separated from waiting areas for the loading/unloading cargo.

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- There is no ramp for the loading/unloading of the trucks on the railway.
- Railway line Ploče-Sarajevo-Doboj does not have full interoperability. All companies which operate certain parts of the line change their locomotives in Čapljina and Doboj even though they use same types of locomotives. The change of locomotives is imposed by political will which is backed by legislative issues. Changing locomotives increases costs, uses time and therefore additionally limits the lines already very limited capacity.
- There is no direct access to road motorway, and the road that connects the terminal gates and motorway has two intersections with the city road network. Following reasons makes this bottleneck problem; congestion on the road infrastructure in the area of the Port of Ploče and the road is passing through the urban and inhabited area.
- The congestion is present only in summer months with influx of tourists, since city of Ploče is not big touristic destination, congestion is a minor problem.

#### A supply chain bottlenecks:

- Cargo handling is guaranteed 24 hours a day every day of the year but it could be improved.
- Regarding to information exchange the existing system of electronic exchange of documents and communications between the driver unit and the terminal is in phase of development and improving in order to achieve more satisfactory level.
- The shore crane terminal should have faster performance and sufficient capacity.
- There is no available bottleneck management system so Port of Ploče is involved in a lot of project that deals with the problem of improving capacity of entire system.
- There is no available waste management system – the ports should have plans for effective means of minimising ship pollutions and avoiding operational and illegal discharges of oil and garbage from ships into the marine environment.

Regulatory bottlenecks:

- There is no exemption in obligations for ships pilots service which regularly enter the port.
- There is no exemption in obligations for ships tugs service which regularly enter the port.
- At the railway line Ploče-Sarajevo-Doboj all companies which operate certain parts of the line change their locomotives in
- Čapljina and Doboj even though they use same types of locomotives. The change of locomotives is imposed by political will which is backed by legislative issues. This increases costs, uses time and limits the lines with already very limited capacity.

### ANALYSING OF LISTED BOTTLENECKS AND THEIR CAUSATIVE RELATIONS

In the Port of Ploče three types of bottlenecks can be find: infrastructural, supply chain and regulatory bottlenecks.

Main infrastructural bottlenecks are a lack in terminal capacity, no existing direct access to motorway, and the road that connect the terminal gates and motorway has two intersections with the city road network.

The construction of an enter terminal will solve all infrastructure problems and part of the supply chain bottlenecks as well, as all operations will be connected and all documents will be exchanged electronically which will improve communication.

A supply chain bottlenecks problems mostly lay in a lack of available bottleneck management system and existing system of electronic exchange of documents and communications between the driver unit and the terminal that should be improved.

Regarding the regulatory bottlenecks there is no exemption in obligations for ships pilots and tugs services which regularly enter the port.

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One more bottleneck is of operational nature – railway line Ploče-Sarajevo-Doboj does not have full interoperability. All companies which operate certain parts of the line change their locomotives in Čapljina and Doboj even though they use same types of locomotives. The change of locomotives is imposed by political will which is backed by legislative issues. Changing locomotives increases costs, uses time and therefore additionally limits the lines already very limited capacity.

## PROPOSING SOLUTIONS OF BOTTLENECKS AND ANALYSING HOW IT WILL AFFECT FUTURE FREIGHT FLOWS

New entrance to terminal in the port of Ploče should provide a direct access from main port gate to motorway. It will include an overpass above rail tracks so the intersections will be avoided.

New clearly marked parking lots are planned in the parking that is currently in the construction. New parking lots will offer drivers different facilities for example restaurants, rest rooms and showers, bars which could minimise sleeping in the trucks.

Enabling clearly marked parking space should avoid irregularly trucks parking in the city and on the streets.

Lack of available bottleneck management system and existing system of electronic exchange of documents and communications between the driver unit and the terminal is currently in phase of improving.

The regulatory bottlenecks could be avoided by reducing the ships pilots and tugs services obligations for only necessary and not every enter in the port. The employees of Port of Ploče expect opening the new terminal and improving information management system will increase the port transport in following few years.

## CONCLUSION

In the Port of Ploče three types of bottlenecks can be found: infrastructural, supply chain and regulatory bottlenecks.

The main physical infrastructural bottleneck of the Port of Ploče is lack of direct access to motorway. Also, at the moment, the road that connects the terminal gates and motorway has two intersections with the city road network, which is a safety bottleneck. This problem is being solved with the construction of the new Entrance terminal. This terminal will provide direct access from the main port gate to the motorway. It will also include an overpass above the rail tracks so there will be no more intersections.

Also, the problem is at the border with Bosnia and Herzegovina, where congestion manifested, especially in peak touristic season. This problem cannot be easily solved, but one of the possible solutions is to send as much goods as possible using the railway mode of transport.

Second physical bottleneck is lack of parking space, as well as unavailability of facilities for drivers. Port of Ploče has enough surface for a parking lot, but it is still not exploited. This problem is in the process of solving.

The main non-physical bottleneck is lack of information exchange between all stakeholders.

The non-physical bottlenecks of Port of Ploče are the unavailability of the bottleneck management and waste management system.

Port of Ploče has a PCS information system for information exchange. The main operator (concessionaire) – Luka Ploče d.d. did not integrate its system into PCS. Other operators are integrated and data exchange is satisfactory. Finally, it could be concluded that the most of the bottlenecks are not of an infrastructural nature, nor do they occur in the port isolated from the other bottlenecks. They are in areas where the port and port authority do not have any impact and cannot do anything. Port of Ploče is mostly oriented to the area of Bosnia and Herzegovina

where bottlenecks origin from. The problem of information exchange of all involved stakeholders and operators exist as well as a gap caused by no exchange of information between sea part and port part of the systems in port areas. Inadequate connectivity and data exchange have impact on transport of cargo and port positioning in world of modern technological ports.

## Port of Split

### DEFINING THE AREA UNDER STUDY AND CHARACTERIZING RESPECTIVE AREA

The port of Split is situated in the central part of the eastern coast in the Adriatic basin. As for its strategic position it has become one of the most important passenger ports in the Mediterranean, often called as the gateway to the islands. The port is ranked first among Adriatic ports by the number of passengers and vehicles and third among Croatian ports regarding the transport of cargo behind port of Rijeka and port of Ploče. Also, the port of Split is largest port in central Dalmatian region, comprising both passenger and cargo transport as the main port business orientation. According to its purpose, the Port of Split is classified as a port open for international public traffic, while due to its size and importance, it was nominated a port of special (international) economic interest for the Republic of Croatia. The Port of Split has been also classified as a Trans-European Transport Network (TEN-T) comprehensive port for Croatia. Except the passenger transport, the port accommodates freight transport mainly to the destinations in the external environment of the port situated in the hinterland creating its gravitational area.



Source: Luka d.d. Split, 2017

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The port is connected by the International E-road network routes E65 and E71 with link to the Croatian A1 motorway (Zagreb – Split) and the D1 state road. The existing road connection to port area is passing throughout city centre which usually cause stoppage on the city roads, regularly during summer season. The port is also connected with Zagreb by an electrified single track railway, which runs through Knin and Karlovac. Airport of Split is located 20km from port of Split and is able to receive any kind of planes, including planes for carrying cargo.

### Infrastructure

The port is divided into seven docking areas as follows: City port basin (passenger, ferry and cruise port), Vranjic - Solin basin (cargo port), Kaštela basin A, Kaštela basin B, Kaštela basin C, Kaštela basin D - Resnik and Komiža basin for fishing needs. The total surface of docking areas is amounted to 81.679051 km<sup>2</sup>, of which 0.672263 km<sup>2</sup> is related to land surface and 81.006788 km<sup>2</sup> of surface of the sea, while the total length of operational docks amounts to 6,239 km. The whole port area of the port of Split is under jurisdiction of the Port Authority Split, a non-profit legal person established according to Decree of the Government of the Republic of Croatia on the establishment of Port Authority Split („Official Gazette“ number 45/97, 155/98 and 72/11, 114/14) for the purpose of managing, building and using the Port of Split.

City port basin – is situated in the city central zone. It comprises area from the west breakwater to the junction of Obala Lazareta and Obala hrvatskog narodnog preporoda, primarily offering the transport of passengers and vehicles (private cars, trucks, buses) in national and international traffic. The City port basin is equipped with 3,643 km length of operational docks, four piers (Sveti Nikola, Sveti Petar, Sveti Duje and Lukobran), three quays and 27 berths being able to provide mooring to vessels having maximum length of 320 meters on berth. The cruise terminal situated in the city port basin is along ferry (RO-RO passenger

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and vehicle), passenger and catamaran vessels essential part of the port business, representing the strategic orientation of the port development indicated in the National Transport Development Strategy of the Republic of Croatia (2017 - 2030). The city port is a main connection to the central and south Dalmatian islands and destinations along the coast of central Dalmatia while also maintaining the weekly and daily traffic flows with Italy, where the frequency depends on the period of the tourism season. Considering that port is situated in the city central zone, all forms of the transport system, road, railway and maritime transport are integrated in the port area, enabling the use of intermodal services but also creating difficulties especially in the summer periods. The road infrastructure in the City port basin has limited throughput.

Vranjic-Solin basin - traditionally nominated as the “North port”, is the cargo port. The port possesses 1,854 km of operational docks, eight berths with maximum draft of 10.3 meters. The berths from 1 to 5 are intended for vessel transshipment operations of all types of cargo in accordance with legal provisions. The berth number 5 is equipped with RO-RO ramp with a maximum draft of 7.2 meters. The berth number 6 is intended for loading and unloading of grain commodity. Berths number 7 and 8 are located on the Obala Vranjic, intended for berthing vessels by the decision of the Split Port Authority. Shore to ship bunkering operations, referring to fuel transfer, are made on berths number 1,2,3,4 and 5. Ship to ship bunkering operation is possible only on berths number 1 and 2. The main activities of the cargo port are transport and transshipment of diverse commodities, of which the most common dry bulk products are iron ore, coal, cement and grain for key regular clients in the direct hinterland, with various seasonal commodities like sugar, salt, fertilizer and others depending on the demand. Also, there is a high demand in quartzite and slag for industries in Bosnia and Herzegovina. The key general cargo commodities are metal products and wood. Transport of yachts and small vessels especially in the summer periods and special cargo like wind turbines intended for projects in the port hinterland should also be emphasized. The

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cargo port is also a center for import and distribution of petroleum products for INA concessionaire in Kaštela Basin C intended to supply the regional economy with oil derivatives. The container terminal is located in the Vranjica-Solin Basin, and is operated by the “Port of Split Ltd.” Company. It consists of one berth dedicated for container transshipment, with depth of 10,5 meters which allow berthing of larger container ships. The container terminal is connected with Zagreb by a highway, and is thus linked with European traffic corridors. Other connections include the road to larger cities of the Republic of Bosnia and Hercegovina, and Adriatic highway toward Rijeka and Dubrovnik., and the railway which connects the Port of Split with the Croatian market (rail of Lika) and with the market of the Bosnia and Hercegovina (rail of Una).

Transport of containers recorded a continuous increase in recent years as well as the truck cargo transport to destinations on Croatian islands.

Kaštela basin A - The operational dock is 0.08 km long, equipped with one berth having length of 80 m, maximum depth of 8.5 m being able to accommodate a vessel with maximum length on berth of 100 m. The berth is intended for berthing of vessels at the discretion of Port Authority Split with the consent of Harbor master's office.

Kaštela basin B - On the 0,532 km of operational docks, divided on Sv. Juraj I and Sv. Juraj II shores, five (5) berths are located. Berths are used for manipulation of liquefied gas cargo for industry purposes, for berthing of vessels while performing loading processes of cement and cement products and slag unloading for complementary industry located on the shore, for vessels performing unloading operations of coal, for vessels loading and unloading of fuel and gas trucks for the purpose of supply of islands with fossil fuels, and also for shore to ship bunkering operations.

Kaštela basin C - has 0,311 km<sup>2</sup> of sea surface. It has eight berths divided into three areas, quay of Sv. Kajo, INA tanker terminal and Brižine coast. Berth no. 1 on the quay of Sv. Kajo is

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used for vessels in domestic and international transport performing loading operations of cement and cement products and unloading of slag. Berths no. 1 and 2 on the quay INA are intended for loading and unloading operations of oil and petroleum products. Berth no. 3 is used for berthing of smaller tanker vessels. There are four berths on the Brižine coast. Berth no.1 is temporary used for berthing ships in lay-up (out of service), ships carrying out deratization and other needs at the Port Authority Split decision with the approval of the Harbor master's office. Berth no. 2 and no.3 on the Brižine coast are used for berthing of fishing vessels and other vessels at the Port Authority Split decision with the approval of the Harbor master's office. Berth no. 4 also on the Brižine coast is intended exclusively for unloading fish and loading of fishing gear and supplies for fishing purposes. The maximum vessels length of stay is limited to two hours.

Kaštela basin D - consists of 0,040 km of operational docks equipped with one 45 meter long berth being able to accommodate vessels with maximum draft of four (4) meters. The primarily function of Kaštela basin D – Resnik is in integrating the air and maritime transport modes creating an intermodal node, providing the direct passenger transport services from Split airport to destinations along the coast and islands with tourist or fast boats, evading the use of often congested road towards maritime passenger terminal in the city port basin.

Komiža basin - basin is dislocated basin on the island of Vis with 0,001086 km<sup>2</sup> of land area and 0,062538 km<sup>2</sup> of sea surface, having the main purpose of provision of fishing services.

## Services

Maritime links from port of Split includes.

- International ferry (RO-RO passenger) line to Ancona, Italy
- Several local passenger and ferry and HSC lines to neighbouring islands (Brač, Šolta, Hvar, Vis,..)

The ferry line from Split to Ancona is operated by several Ro\_Ro passenger vessels. Currently the service is maintained by two ferry operators. Local lines are operated by ferries, passenger high speed crafts and classical passenger vessels.

Ferry lines to Ancona are primarily oriented to transport of cargo on trucks and trailers during winter time and to transport of passenger (tourists) during summer season.

There are five state ferry lines operating from and to the port of Split towards islands of Vis, Lastovo, Korčula, Hvar, Brač and Šolta on an all year turnaround trip. There is also one state passenger line connecting the port with island of Čiovo and city of Trogir. The Port of Split has five state high speed craft (HSC) (catamaran) line connections with central and southern Dalmatian islands, increasing the quality of additional services to passengers while reducing the time of the voyage. All the above mentioned state ferry, passenger and catamaran lines have public service obligations. There are seven catamaran lines without public service obligations, connecting Split with various destinations on islands and destinations on the coast

The port also has a one direct turnaround international passenger line with Italy enabling the efficient transport of passengers, vehicles (busses, trucks etc.) in the international trade. Two companies Jadrolinija and SNAV are operating on the route Split – Ancona, of which Jadrolinija operates all year on turnaround voyage, calling the port of Stari Grad on Hvar Island in the high season, while SNAV operates only during the high season period.

Port of Split is increasingly recognized as a cruise destination, evident in the yearly increase of number of port of calls and passengers, where the port is usually a transit port on the scheduled itineraries and connected with other Mediterranean cruise destinations.

The northern part of the port is dedicated to the transport of cargo, equipped with cargo terminals being able to accommodate all types of vessels, depending on the typology of freight, typically including dry bulk products such as iron ore, coal, cement and grain as well as liquid products. Imported cargo is primarily intended for local markets of various industries in port hinterland, but also by supplying the steel industry in Bosnia and Herzegovina. In addition, various goods are exported to the Middle East, including wooden products. General cargo terminals are used to provide trade services to worldwide destinations depending on the demand for commodities, while the container terminal is connected with Mediterranean hub ports predominantly in the Adriatic. The port is directly connected with Freeport container terminal in Malta on the Adriatic X-PRESS 1 (ADX 1) service route jointly operated by CMA-CGM and Maersk on a weekly basis. The potential of the Port of Split for the development in the freight segment was confirmed with the adoption of the Transport Development Strategy of the Republic of Croatia (2017 – 2030) in 2017, indicating the appropriate specialization and proper development of the railway freight infrastructure as the development measures.

## LISTING OF ALL BOTTLENECKS AND UNDESIRABLE EFFECTS

In the picture below are shown bottlenecks collected from the field research

Bottleneck		Question	Answer	Relevance	
infrastructural bottlenecks	road	safety	Is the connection between the terminal and highway network at a satisfactory safety level?	NO	HIGH, YES
			Is there a regular maintenance of the terminal roads and connection between the terminal and highway network?	NO	HIGH, YES
			Are there clearly marked routes for accessing the terminal and leaving the terminal in order to reach the highway network?	NO	HIGH, YES
		flow capacity	Is there adequate (satisfactory) lighting on the terminal roads and connection between the terminal and highway network?	YES	HIGH, YES
			Are there clearly marked routes to get to the terminal and to the highway network?	NO	HIGH, YES
			Is there a direct access to the highway network?	NO	HIGH, YES
	rail	safety	Is the current capacity of the road infrastructure sufficient?	NO	HIGH, YES
			Is there a sufficient number of lanes on terminal roads and connection between the terminal and highway network?	NO	HIGH, YES
			Is the width of the lanes on the terminal roads and connection between the terminal and highway network appropriate (satisfactory)?	NO	HIGH, YES
		flow capacity	Is the connection between the terminal and highway network passing through the urban and inhabited area?	NO	HIGH, YES
			Is there a road and pedestrian crossing on the railway?	YES	HIGH, YES
			Is the signalization on a satisfactory level?	NO	HIGH, YES
	terminal	safety	Is there adequate (satisfactory) lighting on the terminal railway infrastructure?	NO	HIGH, YES
			Is there a regular maintenance of infrastructures relevant for the satisfactory level of security?	YES	HIGH, YES
			Is there a road and pedestrian crossing on the railway?	YES	HIGH, YES
		flow capacity	Are the crossings satisfactory marked?	NO	HIGH, YES
			Is the current capacity of railway infrastructure satisfactory?	NO	HIGH, YES
			Is it the connection of railway and road infrastructure at a satisfactory level?	NO	HIGH, YES
inland waterways	safety	Is it possible to dispatch the maximum allowed quantities of the train at once?	NO	MEDIUM, NO	
		Is there a ramp for the loading/unloading of the trucks on the railway?	NO	MEDIUM, NO	
		Is the safety level of the port access satisfactory?	NO	HIGH, YES	
	flow capacity	Is the area of the port basin sufficient?	NO	HIGH, YES	
		Is the capacity of the access to the terminal sufficient so the barges shouldn't be separated?	NO	MEDIUM, NO	
		Is there a RO-RO ramp on the terminal?	NO	HIGH, YES	
a supply chain bottlenecks	capacity	Are the parking spaces adequately signposted for identification?	NO	HIGH, YES	
		Is the capacity of a parking lot sufficient?	NO	HIGH, YES	
		Is parking space able to accommodate all dimensions of the vehicles / units?	NO	HIGH, YES	
		Are the roads at the terminal separated from waiting areas for the loading / unloading cargo?	YES	MEDIUM, NO	
		Is the number of berths for mooring ships sufficient?	NO	HIGH, YES	
		Are the lengths of berths sufficient for mooring the largest vessels?	YES	HIGH, YES	
	weather	Are the sea depth/draft berths enough for the biggest ships?	YES	HIGH, YES	
		Is the sea depth in the driveway shore/terminal satisfactory for the biggest ships?	YES	HIGH, YES	
		Is there a storage space near the berth?	NO	MEDIUM, NO	
	work shifts	Does the space for storage of goods have sufficient capacity?	NO	MEDIUM, NO	
		Does the terminal (individual bindings) have conditions of secure mooring?	YES	HIGH, YES	
		Is the sea access to the terminal sufficient (mainly safety requirements)?	YES	HIGH, YES	
How much time a year is the terminal out of function for bad weather?		NO	MEDIUM, NO		
Is it guaranteed cargo handling 24 hours a day every day of the year?		YES	MEDIUM, NO		
Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading services?		YES	MEDIUM, NO		
information exchange	Is there a system which allows the electronic exchange of documents and communications between the driver unit and the terminal?	NO	MEDIUM, NO		
	PILOTS - Is it the time required from the request to reaction at a satisfactory level?	YES	HIGH, YES		
	TUGS - Is it the time required from the request to reaction at a satisfactory level?	YES	HIGH, YES		
	Is the cooperation between the terminal and the agent at a satisfactory level?	YES	MEDIUM, NO		
	Is the administrative co-operation of the terminal and Ship at a satisfactory level?	YES	MEDIUM, NO		
	Is the cargo handling capacity of the terminal sufficient?	YES	MEDIUM, NO		
technology	Does the shore cranes terminal have sufficient performance / capacity?	NO	MEDIUM, NO		
	Does the mobile cranes terminal have sufficient performance / capacity?	NO	MEDIUM, NO		
	Is there in the function the VTMIS system?	YES	HIGH, YES		
	Is the cooperation between the Customs Authority and Ships at a satisfactory level?	YES	HIGH, YES		
	Is the time required for inspection (veterinary, phytosanitary, etc.) at a satisfactory level?	YES	HIGH, YES		
	Are there any cabotage restrictions?	NO	HIGH, YES		
regulatory bottlenecks	inspections	Is there an exemption obligations pilots for ships in service, which regularly touch the port?	NO	MEDIUM, NO	
	cabotage restrictions	Is there an exemption obligations tugs for ships in service, which regularly touch the port?	NO	MEDIUM, NO	
	other				

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Interreg Italy - Croatia CHARGE		Questionnaire for CHARGE project - collection of bottlenecks					
European Regional Development Fund		EUROPEAN UNION		Answer: simple yes/no answers			
		Relevance: How important is this part for your port and is this the reason for bottlenecks? Will reduction of this problem solve bottlenecks?					
Bottleneck	Question	Answer	Relevance				
infrastructural bottlenecks	road	safety	Is the connection between the terminal and highway network at a satisfactory safety level?	YES			
			Is there a regular maintenance of the terminal roads and connection between the terminal and highway network?	YES			
			Are there clearly marked routes for accessing the terminal and leaving the terminal in order to reach the highway network?	YES			
		flow capacity	Is there adequate (satisfactory) lighting on the terminal roads and connection between the terminal and highway network?	YES			
			Are there clearly marked routes to get to the terminal and to the highway network?	YES			
			Is there a direct access to the highway network?	NO			
	rail	safety	Is the current capacity of the road infrastructure sufficient?	YES			
			Is there a sufficient number of lanes on terminal roads and connection between the terminal and highway network?	YES			
			Is the width of the lanes on the terminal roads and connection between the terminal and highway network appropriate (satisfactory)?	YES			
		flow capacity	Is the connection between the terminal and highway network passing through the urban and inhabited area?	YES			
			Is there a road and pedestrian crossing on the railway?	YES			
			Is the signalization on a satisfactory level?	YES			
	inland waterways	safety	Is there adequate (satisfactory) lighting on the terminal railway infrastructure?	YES			
			Is there a regular maintenance of infrastructures relevant for the satisfactory level of security?	YES			
			Is there a road and pedestrian crossing on the railway?	YES			
		flow capacity	Are the crossings satisfactory marked?	YES			
			Is the current capacity of railway infrastructure satisfying?	YES			
			Is it the connection of railway and road infrastructure at a satisfactory level?	YES			
terminal	capacity	Is it possible to dispatch the maximum allowed quantities of the train at once?	YES				
		Is there a ramp for the loading/unloading of the trucks on the railway?	NO				
		Is the safety level of the port access satisfactory?	YES				
		Is the area of the port basin sufficient?	YES				
		Is the capacity of the access to the terminal sufficient so the barges shouldn't be separated?	YES				
		Is there a RO-RO ramp on the terminal?	YES				
	safety	Are the parking spaces adequately signposted for identification?	YES				
		Is the capacity of a parking lot sufficient?	YES				
		Is parking space able to accommodate all dimensions of the vehicles / units?	YES				
		Are the roads at the terminal separated from waiting areas for the loading / unloading cargo?	NO				
		Is the number of berths for mooring ships sufficient?	YES				
		Are the lengths of berths sufficient for mooring the largest vessels?	NO				
weather	Are the sea depth/draft berths enough for the biggest ships?	NO					
	Is the sea depth in the driveway shore/terminal satisfactory for the biggest ships?	NO					
	Is there a storage space near the berth?	YES					
	Does the space for storage of goods have sufficient capacity?	YES					
	Does the terminal (individual buildings) have conditions of secure mooring?	YES					
	Is the sea access to the terminal sufficient (maritime safety requirements)?	YES					
work shifts	How much time a year is the terminal out of function for bad weather?	Never out of function					
	Is it guaranteed cargo handling 24 hours a day every day of the year?	YES					
	Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading services?	YES					
	Information exchange	Is there a system which allows the electronic exchange of documents and communications between the driver unit and the terminal?	YES				
	time response	PILOTS - Is it the time required from the request to reaction at a satisfactory level?	YES				
	cooperation	TUGS - Is it the time required from the request to reaction at a satisfactory level?	YES				
regulatory bottlenecks	inspections	Is the cooperation between the terminal and the agent at a satisfactory level?	YES				
		Is the administrative co-operation of the terminal and Ship at a satisfactory level?	YES				
		Is the cargo handling capacity of the terminal sufficient?	YES				
	cabotage restrictions	Does the shore cranes terminal have sufficient performance /capacity?	YES				
		Does the mobile cranes terminal have sufficient performance /capacity?	YES				
		Is there in the function the VTMS system?	YES				
other	Is the cooperation between the Customs Authority and Ships at a satisfactory level?	YES					
	Is the time required for inspection (veterinary, phytosanitary, etc.) at a satisfactory level?	YES					
	Are there any cabotage restrictions?	NO					
	Is there an exemption obligations pilots for ships in service, which regularly touch the port?	NO					
	Is there an exemption obligations tugs for ships in service, which regularly touch the port?	NO					

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Bottleneck		Question	Answer	Relevance	
infrastructural bottlenecks	road	safety	Is the connection between the terminal and highway network at a satisfactory safety level?	NO	
			Is there a regular maintenance of the terminal roads and connection between the terminal and highway network?	YES	
			Are there clearly marked routes for accessing the terminal and leaving the terminal in order to reach the highway network?	YES	
		flow capacity	Is there adequate (satisfactory) lighting on the terminal roads and connection between the terminal and highway network?	YES	
			Are there clearly marked routes to get to the terminal and to the highway network?	YES	
			Is there a direct access to the highway network?	NO	
	rail	safety	Is the current capacity of the road infrastructure sufficient?	NO	
			Is there a sufficient number of lanes on terminal roads and connection between the terminal and highway network?	NO	
			Is the width of the lanes on the terminal roads and connection between the terminal and highway network appropriate (satisfactory)?	NO	
		flow capacity	Is the connection between the terminal and highway network passing through the urban and inhabited area?	YES	
			Is there a load and pedestrian crossing on the railway?	YES	
			Is the signalization on a satisfactory level?	YES	
terminal	inland waterways	safety	Is there adequate (satisfactory) lighting on the terminal railway infrastructure?	YES	
			Is there a regular maintenance of infrastructures relevant for the satisfactory level of security?	YES	
			Is there a load and pedestrian crossing on the railway?	YES	
		flow capacity	Are the crossings satisfactory marked?	YES	
			Is the current capacity of railway infrastructure satisfactory?	NO	
			Is it the connections of railway and road infrastructure at a satisfactory level?	NO	
	terminal	safety	Is it possible to dispatch the maximum allowed quantities of the train at once?	N/A	
			Is there a ramp for the loading/unloading of the trucks on the railway?	N/A	
			Is the safety level of the port access satisfactory?	YES	
		capacity	Is the area of the port basin sufficient?	YES	
			Is the capacity of the access to the terminal sufficient so the barges shouldn't be separated?	N/A	
			Is there a RO-RO ramp on the terminal?	YES	
a supply chain bottlenecks	terminal	capacity	Are the parking spaces adequately signposted for identification?	YES	
			Is the capacity of a parking lot sufficient?	NO	
			Is parking space able to accommodate all dimensions of the vehicles / units?	YES	
		safety	Are the roads at the terminal separated from waiting areas for the loading / unloading cargo?	N/A	
			Is the number of berths for mooring ships sufficient?	YES	
			Are the lengths of berths sufficient for mooring the largest vessels?	YES	
	information exchange	weather	Are the sea depths/drafts enough for the biggest ships?	NO	
			Is the sea depth in the driveway shore terminal satisfactory for the biggest ships?	NO	
			Is there a storage space near the berth?	NO	
		time response	Do the spaces for storage of goods have sufficient capacity?	NO	
			Do the terminal (individual buildings) have conditions of secure mooring?	YES	
			Is the sea access to the terminal sufficient (maritime safety requirements)?	YES	
regulatory bottlenecks	work shifts	How much time a year is the terminal out of funds on for bad weather?	N/A		
		Is it guaranteed cargo handling 24 hours a day every day of the year?	YES		
		Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading services?	YES		
	technology	Is there a system which allows the electronic exchange of documents and communications between the driver unit and the terminal?	YES		
		PILGTS - Is it the time required from the request to reaction at a satisfactory level?	YES		
		TUGS - Is it the time required from the request to reaction at a satisfactory level?	YES		
other	customs	Is the cooperation between the terminal and the agent at a satisfactory level?	YES		
		Is the administrative cooperation of the terminal and ship at a satisfactory level?	YES		
		Is the cargo handling capacity of the terminal sufficient?	NO		
	cabotage restrictions	Do the shore cranes terminal have sufficient performance / capacity?	NO		
		Do the mobile cranes terminal have sufficient performance / capacity?	NO		
		Is there in the function the VTMIS system?	YES		
other	Is the cooperation between the Customs Authority and Ships at a satisfactory level?	YES			
	Is the time required for inspection (veterinary, phytosanitary, etc.) at a satisfactory level?	YES			
	Are there any cabotage restrictions?	N/A			
Is there an exemption obligations pilots for ships in service, which regularly touch the port?	N/A				
Is there an exemption obligations tugs for ships in service, which regularly touch the port?	N/A				

As seen from tables above, different stakeholders give different answers. It can be concluded that main problems are:

The connection between the terminal and highway network is not at satisfactory safety level, since the City port is located in the city centre. Although there is regular maintenance of the terminal roads and connections within the port, done regularly by Port Authority, it would be more beneficial if port would have direct access to the highway network.

Main infrastructural bottlenecks are found in flow capacity of the roads. There is no direct access to the highway network and the current capacity of the road infrastructure is not sufficient. – the part of the port area, which is mainly intended for passenger traffic, City Port is located in the city centre. The road through the centre is not good, and the traffic flow of

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the vehicles which are coming to port is during the summer season and especially at weekends is large – the City Port handles up to 35.000 passenger per day and more than 100.000 passengers and around 16.000 vehicles at weekends. The average vehicle speed is 500 meters per hour at that time. Terminal is limited in space and have small number of lanes that is crossing through the terminal. Also, there isn't a sufficient number of lanes on roads which are heading to the port form highway network. The width of the lanes on the terminal roads and connection between the terminal and highway network are not at satisfactory level.

#### Railway bottlenecks:

Signalization is not at satisfactory level, as well as the crossings' marking – this can cause problems in safety operations at terminal.

Lighting is not adequate on the terminal railway infrastructure – this can also cause problems in safety operations at terminal.

The current capacity of railway infrastructure is not satisfying, as well as the connection of railway and road infrastructure. This is causing limiting flow capacity in the port, and limited ability to receive more cargo.

There is no ramp for the loading/unloading the trucks on the railway.

#### Terminal bottlenecks:

The capacity of a parking lot is not sufficient.

The parking space is not able to accommodate all dimensions of the vehicles/units.

The number of berths for mooring ships are not sufficient.

The lengths of berths are not sufficient for mooring the largest vessels.

The sea depth/draft berths is not enough for the biggest ships.

The sea depth in the driveway shore/terminal is not satisfactory for the biggest ships.

A supply chain bottlenecks:

The shore and mobile cranes terminal does not have sufficient performance /capacity.

### ANALYSING OF LISTED BOTTLENECKS AND THEIR CAUSATIVE RELATIONS

The Port of Split has mostly one type of bottlenecks: infrastructural bottlenecks, which occurs in road, rail and terminal infrastructure.

Main road infrastructural bottlenecks are referred to the safety and flow capacity. Connection between the terminal and highway network is not at a satisfactory level in both port areas – City Port and North/Cargo Port. Also, there is not direct access to the highway network, and the current capacity of the road infrastructure is not sufficient. If this bottleneck would be solved, it would have helped to solve problems with congestion when approaching the port and within the port, especially in summer season in City Port when traffic (both passenger, vehicle and cargo trucks) flow is very high and it has tendency to rise every year.

A rail infrastructural bottlenecks problem is mostly not sufficient current capacity of railway infrastructure and connection of railway and road infrastructure. These bottlenecks are referring mostly on North/Cargo Port, and if it would be solved, it would allow cargo traffic to increase, because more cargo would be sent away through railway and not by trucks.

As main terminal bottleneck is not enough sea depth/draft for the biggest ships, the biggest ships must be at the anchor, which causes problems with operationalization within the port system. This problem could be solved by transferring those ships in North Port.

## PROPOSING SOLUTIONS OF BOTTLENECKS AND ANALYSING HOW IT WILL AFFECT FUTURE FREIGHT FLOWS

With existing road, terminal and rail infrastructure insufficiencies and with number of passengers and vehicles on the increase in the Port of Split it will not be possible in the future to manage the flow of passengers and vehicles effectively. There is a berthing capacity deficit resulting in vehicle congestion, long time needed to embark and disembark, low energy efficiency etc. Also, there is not direct access to the highway network, and at the main terminal not enough sea depth/draft for the biggest ships, as well as not sufficient current capacity of railway infrastructure and connection of railway and road infrastructure

This infrastructural bottlenecks could be solved by investing into the new infrastructure in the City Port and in the North Port.

One solution is the modernization of infrastructure of the Berth of Sv. Petar in the City Port. It assumes the extension in a way that will create a new manipulative area for boarding passengers and vehicles together with new berthing capacities that will be able to accommodate larger vessels. The second solution is constructing new port infrastructure in the North Port- Vranjic-Solin Basin- Stinice area, by creating a new manipulative area for Ro-Ro ships to berth and thus relocate cargo trucks to the newly constructed infrastructure in order to disburden the traffic within the City Port Basin and the centre of the City of Split. This newly constructed infrastructure will be constructed in a way to be able to accommodate both cargo and passenger vessels in future.

Also, one of the solution would be construction of New Passenger Terminal in the City Port Basin. The proposed construction would revitalise worn out former industrial facilities in the City Port through reconstruction, as well as former warehouses, workshops, and office space through demolishing and reconstruction. New terminal would accommodate maritime passenger transport related content, various commercial content as well as conference centre and parking building.

By investing into the new infrastructure, the Port of Split Authority would reduce the congestion within both the Port of Split and the centre of the City of Split. Realization of this planned investments will help to solve main bottlenecks in the City Port Basin, as well as in the North/Cargo Port. In this way that entering the Port will be simplified, as well as cargo handling, and at the end congestion of vehicles in the old city centre, where the City Port Basin is located, will be partly avoided and passenger guidance and security increased

## CONCLUSION

Port of Split as for its strategic position has become one of the most important passenger ports in the Mediterranean and it is part of the comprehensive TEN-T network. The port is ranked first among Adriatic ports by the number of passengers and vehicles and third among Croatian ports regarding the transport of cargo behind port of Rijeka and port of Ploče. Also, the port of Split is largest port in central Dalmatian region, comprising both passenger and cargo transport as the main port business orientation. After the economic crisis in 2006., Split Port has a constant growth of traffic both passenger, vehicle and cargo, and today more than 5 million passengers and 800.000 vehicles were transported through cruise and ferry transport, and 3 million tons of cargo were handled in Cargo port.

Besides the favorable location and acceptable connection with other transport modes, the state of access roads and rail infrastructure as one of the indicators of further port development is

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unsatisfactorily, having limited capacity and throughput, where the points of congestion mainly occur. Therefore, the investments in infrastructure are needed to maintain competitiveness in both passenger and cargo transport in Adriatic and Mediterranean. Investments in infrastructure would eliminate and reduce existing bottlenecks and due to the expected growth potentially new points of congestion in port area and accompanying traffic infrastructure.

## Port of Venice

### DEFINING THE AREA UNDER STUDY AND CHARACTERIZING RESPECTIVE AREA

The identified area is the Lagoon of Venice in particular the navigation channels that are coloured in blue.



### LISTING OF ALL BOTTLENECKS AND UNDESIRABLE EFFECTS

For the port of Venice one of the main bottlenecks is the low visibility due to weather conditions, that hampers if not prevents the navigation even for few days in a row in case of fog. The delays and route changes cause loss of productivity for the port. This bottleneck is not bound to infrastructural improvement, but rather to an organizational/management solution.

A further problem is caused by the mix of commercial and private/leisure maritime traffic. To maintain a safe navigation implies again delays, loss of efficiency and thus productivity.

## ANALYSING OF LISTED BOTTLENECKS AND THEIR CAUSATIVE RELATIONS

Besides the common and well-known accessibility restrictions determined by shallow waters, for many ports there are other conditions that, de facto, are impediments to a smooth and continuous navigation in the port and within the port areas. Fog and lack of clear visibility, are two examples of weather conditions that may heavily affect the port functioning, reducing its attractiveness for vessels to call. This is particularly true for ports with reduced natural accessibility (e.g. river or lagoon ports) or for those ports with high traffic compared to their size.

While in some other transportation means such as road or air transport, technology made several steps forwards in term of digital application and self-driving, the maritime sector is still rather conservative. Although some technological solution are already tested and available, there is not an international data exchange standard to connect ship to ports and to guarantee a communication between them, as it is for example from airplane to airport.

The concept consists in overcoming the vision of a single user needs considering instead the overall needs, in particular in the scheduling of port arrival/departures.

Improving the nautical accessibility of the port, means removing both physical and operational constraints that reduce the port full functionality and thus increase port effectiveness, reliability for the market and reducing operation costs. This goal may be achieved by deploying in ports technologies and tools that allow a better and continuous communication between port and vessels, as to ensure a safe navigation within the port areas in every weather conditions. This would definitely strengthened the relations among port operators and would allow a more efficient use of the port infrastructures.

## PROPOSING SOLUTIONS OF BOTTLENECKS AND ANALYSING HOW IT WILL AFFECT FUTURE FREIGHT FLOWS

Improving the port accessibility and, in turn, its efficiency should lead to an increased vessel traffics and to longer periods of port activities. Ensuring full functioning at night-time would extend the port terminals working time, determining a more intense use of port equipment and requiring a smoother integration with other port operators, both at sea and inland. Port functioning effectiveness has to guarantee cost-effective solutions that require an extensive use of management tools that to optimize port operational issues and reduce their costs

The solution has to be sought by the adoption of “soft measures” as promoted by the National Logistics Strategic Plan and suggested by a general management approach that prefers operative and light infrastructures investments to the large infrastructures projects.

The Charge pilot Activity is recognize as crucial for the development of the maritime traffic in the port of Venice for the overall management of the port and to increase port efficiency and safety.

Through the development of the Charge pilot activity, a solution of the above explained bottleneck is tackled.

The pilot foresees a data exchange focused on the seaside and on the navigation channels system in the port area. It has a maritime accessibility insights and a much broad extension of fruition.

The result of the pilot consist in a “free mobile application” that will give to all port users the possibility to have easy and free access to real time data related to:

- weather condition
- port accessibility (port entry/exit conditions)
- maritime traffic data (presence of other vessels)

- special notice to navigators

It is a new system to share maritime data among all port users that will bring innovation to the project and that can easily be replicated.

## CONCLUSION

Considering the accessibility difficulties in the port of Venice, considering the fact that the traffic is of a mix nature (commercial ships and private/leisure boats) and having assessed the lack of ports technologies and tools that allow a better and continuous communication between port and vessels, as to ensure a safe navigation within the port areas in every weather conditions, the development of a “free mobile application” that will give to all port users the possibility to have easy and free access to real time data that allow a safe navigation and thus an increase of port efficiency.

It is a new system to share maritime data among all port users that will bring innovation to the project and that can easily be replicated.

The mobile application is developed among other light infrastructure investments co-financed by INTESA project (ITALIA-CROATIA), and GreenC project (CEF Programme).

## Port of Ortona

### DEFINING THE AREA UNDER STUDY AND CHARACTERIZING RESPECTIVE AREA

The city of Ortona is located in the East of Abruzzo Region, on the Adriatic Sea, at the top of a 70 meter-high cape. The area is characterized by a rocky coast with sandy beaches and by the presence of gravel and pebbles. Because of the cape, there are two inlets that have always made the coast area suitable to be a boat shelter. In this context, the Port of Ortona has developed since the Roman period and it has always been a strategic node for the area.



Figure 1: Map of Ortona area. (SOURCE: [www.buonefra.com](http://www.buonefra.com))

## Central Adriatic Ports Authority

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The Port of Ortona is part of the Central Adriatic Ports Authority (Autorità di Sistema Portuale del Mar Adriatico Centrale) which also includes the ports of Pesaro, Falconara Marittima, Ancona, San Benedetto del Tronto and Pescara. The Authority has competence on a 215 km long shore. Central Adriatic Ports Authority has been instituted following the publication of the national legislative decree D.Lgs.169/2016, i.e. the reform of the national port systems. The national decree D.Lgs.169/2016 and the **National Strategic Plan for the Logistics Port 2015** (Piano Strategico Nazionale della portualità e della logistica) have defined the main objectives of Port Authorities mainly requesting:

- To guide, plan, coordinate, regulate, promote and control port services and operations as well as all the commercial and industrial activities carried out by the ports and their territorial districts;
- To manage the ordinary and extraordinary maintenance of common parts in the port areas, including the maintenance of seabed;
- Commitment and control of the activities aimed to give a supplying upon payment to port users of general interest services;
- Coordination of administrative activities carried out by public bodies and organizations within the ports and in the public maritime areas included in the territorial district;
- Exclusive administration of areas and assets of the maritime state property under his own responsibility;
- To promote forms of connection with the different types of logistics systems in the port areas.

In 2018 the ports of Central Adriatic Ports Authority registered a 1.163.720 passenger traffic. Freight traffic reached 11.832.439 tonnes<sup>1</sup> (empties included), of which 5.037.748 tonnes are liquid goods (crude oil and refined oil products) while 6.794.691 tonnes are solid goods (both

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<sup>1</sup> ESPO data ("Rapporto Statistico 2018", Central Adriatic Ports Authority).

bulk and unitized). A significant amount of 6.731 new vehicles exported (12.789 tonnes), was registered in 2018 in the Ports of Ancona and Ortona.

#### Special Economic Zones (ZES)

The development of the Port of Ortona can be positively influenced by the institution of the Special Economic Zones (Zone Economiche Speciali = ZES). Abruzzo Region has approved the Regional Government Deliberation **DGR 122/2019** regarding the ZES framework and the Port of Ortona – included in one ZES – has been considered one of the infrastructural nodes pivotal for the Regional logistic system due to its key role as link between the Region and the TEN-T Scandinavian-Mediterranean corridor.

According to the Deliberation, the **Strategic Development Plan of Abruzzo Region 2019** (Piano Strategico di Sviluppo della Regione Abruzzo) has been issued. The plan regards the characteristics, the analysis and strategies of the Region areas included in the ZES.

In the national legislative decree **D.Lgs.91/2017** (Misure di sostegno alla nascita e alla crescita delle imprese nel Mezzogiorno) a ZES is defined as a delimited and identified geographical area formed by different zones with functional economic relations. The decree points out that every ZES must include a port area which respects the characteristics established by the **European Regulation n. 1315 (11/12/2013)**, issuing the revised TEN-T network.

The aim of including the Port of Ortona in the ZES is to create better economic, financial and administrative conditions in the port area in order to improve the development of the already operative companies as well as the settlement of new companies.

Moreover, Abruzzo Region aims to exploit the relevance of the ports of Ortona and Vasto as key nodes for import, in order to create favourable conditions for a new development of the area. The institution of the ZES allows the area to be eligible for investment funding and other

benefits such as the simplification of administrative procedures, tax exemption policy and the insertion in the already existing infrastructures.

### The Port of Ortona – characteristics and traffic

The Port of Ortona is the main multi-functional commercial seaport of Abruzzo Region and it is specialized in the handling of bulk, general cargo and project cargo.

Located in the central Adriatic Sea coast, the port stands in a strategic position for the industrial areas of Central Italy and it is suitable for cargo, Ro-Ro and passenger traffic. The port is connected to A14 (North-South) and to A25 (East-West) highways. Furthermore, the port is linked to the railway network by a single track leading to Ortona station, on the Adriatic railway line (North-South).

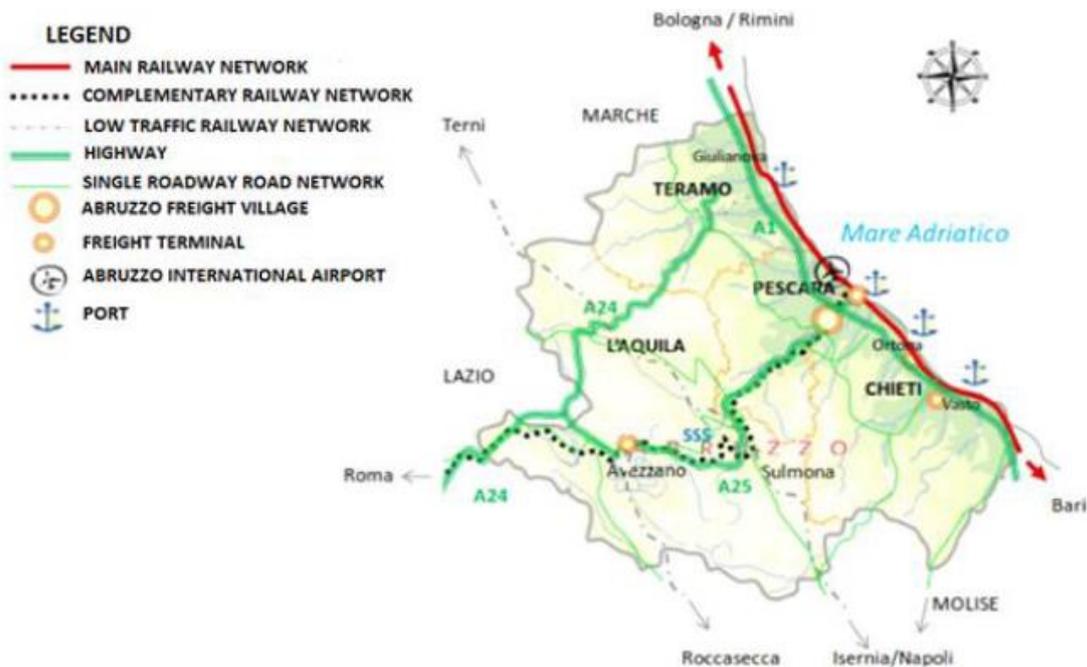


Figure 2: The railway network and the road network of Abruzzo Region (SOURCE: Proposal for identifying a ZES in Abruzzo Region, 31/10/2018)

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*Figure 3: The connection between the Port of Ortona and the railway network. (SOURCE: Google maps)*

The Port of Ortona is neither part of the TEN-T network up to date nor it is included in the Scandinavian-Mediterranean (ScanMed) Corridor. Currently, the reference railway of the Port of Ortona (Ortona-Fossacesia line) is part of the Comprehensive Network, on the branch of the Adriatic line (Ancona-Bari) which is not part of the ScanMed Corridor.



Figure 4: Ortona area, the ScanMed Corridor and the TEN-T Comprehensive Network. (SOURCE: TENTec)

The Port of Ortona is fully integrated in the Regional policy and framework of the ZES. The following maps show the level of integration of the Port within the ZES and the exact border of the ZES within the harbour area.

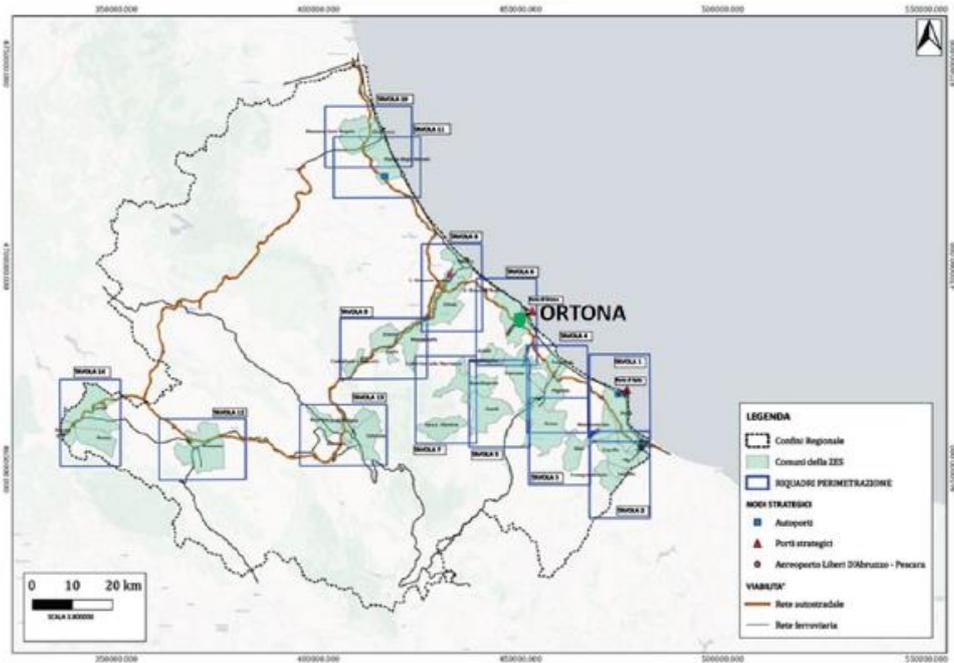
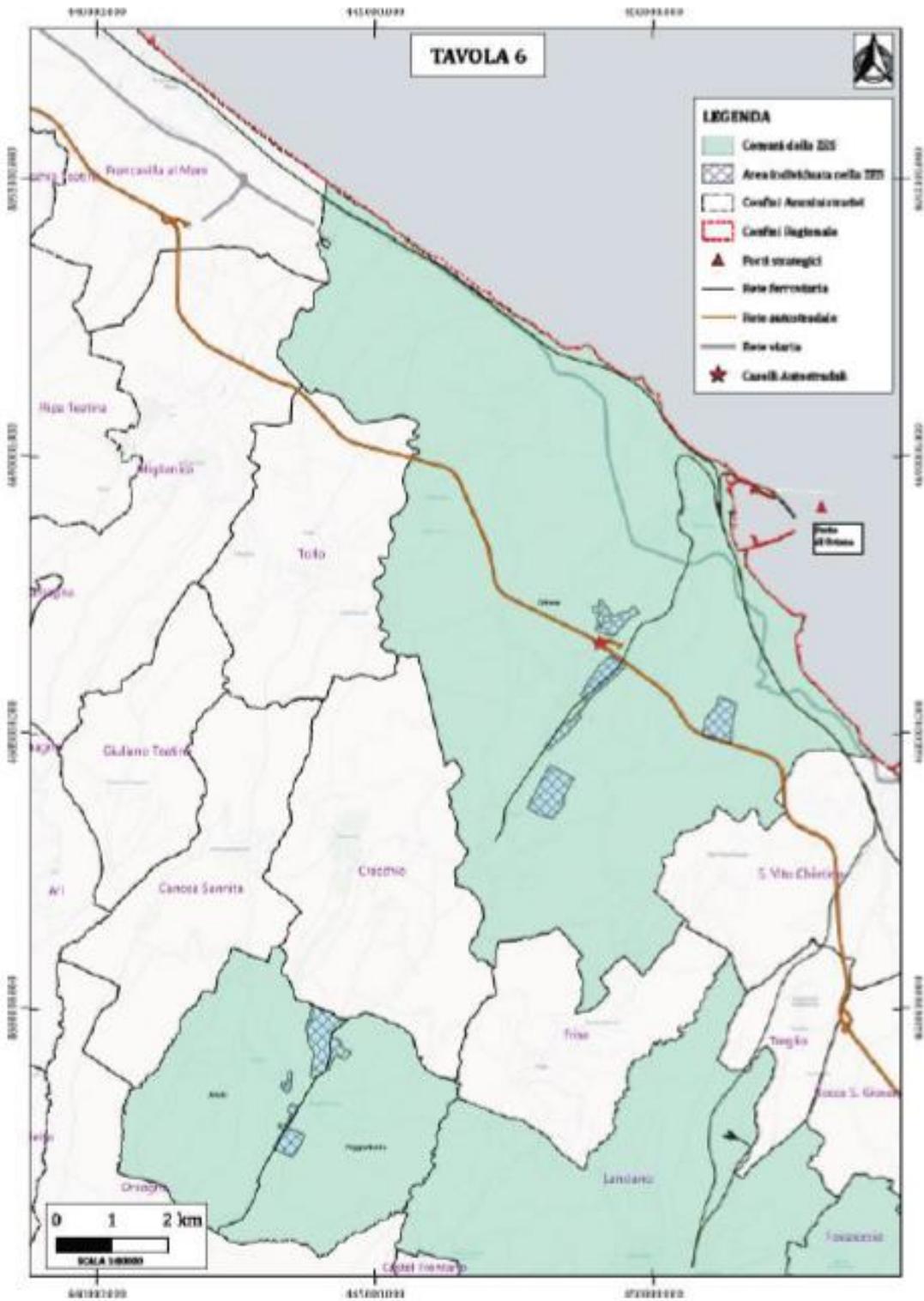


Figure 5: ZES in Abruzzo Region, included Ortona area. (SOURCE: Strategic Development Plan of Abruzzo Region 2019)



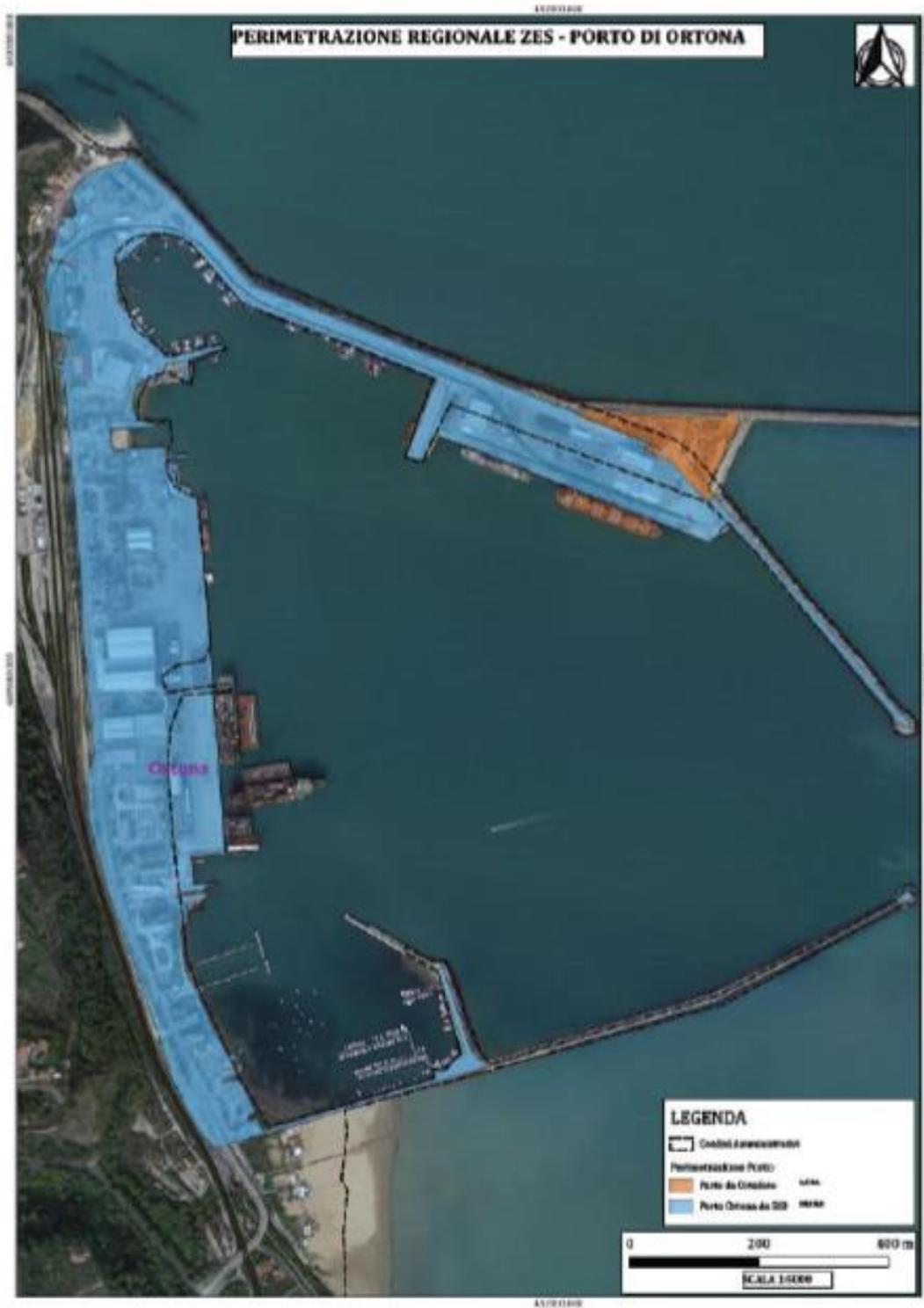


Figure 7: The ZES within the Port of Ortona area. (SOURCE: Strategic Development Plan of Abruzzo Region 2019)

Focusing on the specific port characteristics, Ortona shows a significant water and land surface, warehouses and national depots, customs services, docks equipped with port cranes and it is possible to receive Handymax Panamax ships. The port is characterized by two breakwaters that delimit the harbour entrance. The total extension of the North Pier is about 1.500 meters, while the South Pier one is about 1.100 meters. According to the Port Regulatory Plan (Piano Regolatore Portuale - PRP), the main technical features of the port are:

- Water surface: 1.000.000 sqm (100 hectares);
- Maximum depth of the natural seabed (at the harbour entrance): 8,0/8,5 meters above sea level;
- Average depth of the access canal: 7,0/7,5 meters above sea level;
- Average depth of the internal dock: -6.5 meters above sea level;
- Land surface: about 260,000 sqm (26 hectares);
- Overall development of the operational quays: more than 1.350 meters.

The operative quays are:

- NORD NUOVA: 457 meters length, max 6.80 meters draught, 200 meters max ship length allowed, total area 50.000 sqm;
- MARTELLO PIER: 130 meters length, max 5.70 meters draught, 130 meters max ship length allowed, total area 2.500 sqm;
- RIVA – RIVA NUOVA: 496 meters length, max 5.70 meters draught, 180 meters max ship length allowed, total area 50.000 sqm;
- NORD: 474 meters length, max 5.70 meters draught, 70 meters max ship length allowed, total area 20.000 sqm;
- MANDRACCHIO PIER: 90 meters length, max 5,70 meters draught, 60 meters max ship length allowed, total area 600 sqm

- SARACENI AND TOURISTIC PIER: 182 meters length, max 3 meters draught, 8 meters max ship length allowed, total area 2.500 sqm;

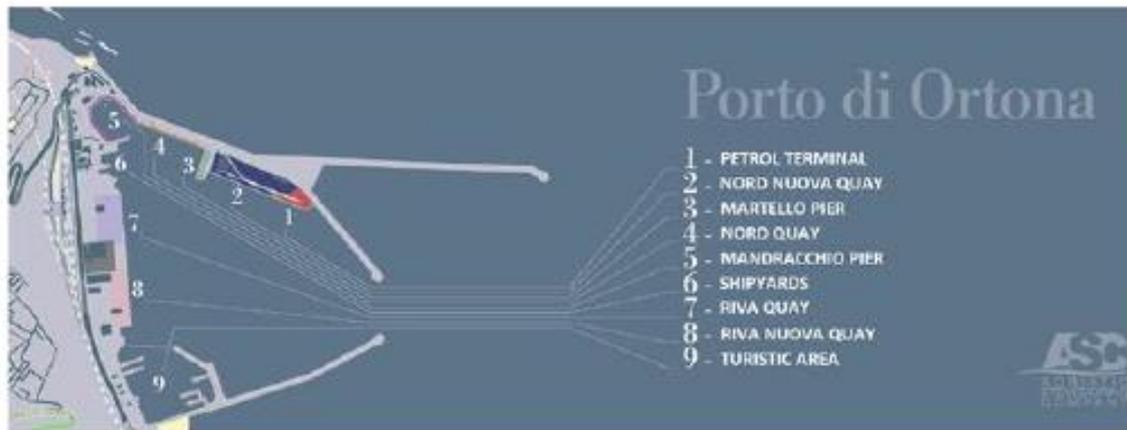


Figure 8: The main sections of Port of Ortona. (SOURCE: Adriatic Stevedoring Company)

The main services offered by the port are:

- Goods weighing;
- Goods accounting;
- Package reconditioning;
- Filling, emptying and maintenance of containers;
- Vehicles stacking.

Other relevant services offered are: national customs warehouses, national and international shipments, fire prevention services, slipway, crane, travel lift, engine repair, electrical slide and repairs, reserved areas for leisure boats at the 100 meters long southern pier managed by the Maritime District and at the 70 meters long dock managed by the Navy League.

The structure of the management offices consists in the Harbor Master's Office, an Office Maritime District and a Customs Office. Moreover, about the administrative competences:

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- Abruzzo Region is in charge of programming, administrative management and planning of the State Property together with SIT (formerly Civil Engineers Maritime Works);
- Municipality of Ortona and the A.S.I. (consortium for the industrial development) take care of the general planning;
- Maritime Directorate, State Police, Financial Police, Coast Guard and the Customs deal with the State Property and Security.

The Port of Ortona has been classified as a port of national economic importance with the national law 84 of 1994. Currently, the port performs multiple functions:

- industrial and commercial traffic, specifically the transport of dry bulk goods, liquid bulk goods and containerized goods;
- Shipbuilding (construction / renovation and storage of pleasure boats);
- Fishing;
- Yachting and nautical tourism.

The following table shows the clustering of goods by categories.

	2016	2017	2018			2017/2018
	TOTAL	TOTAL	LOADED	UNLOADED	TOTAL	%
LIQUID GOODS* (Tonnes)	430.337	409.460	0	430.294	430.294	5 %
SOLID GOODS** (Tonnes)	616.486	614.617	100.597	469.718	570.315	-7%
NEW VEHICLES EXPORTED (Tonne)	-	10.897	12.721	22	12.743	17%
TOTAL GOODS (Tonnes)	1.019.041	1.034.974	113.318	900.034	1.013.352	-2%
VEHICLES EXPORT (#)	-	4.707	6.695	0	6.695	42%
PASSENGERS (#)	638	642	-	917	917	43%

*Table 1: Port of Ortona: freight traffic 2016 by goods categories<sup>2</sup> (SOURCE: Statistical report 2018) \*: including liquid bulk (refined oil products); \*\*: including dry bulk (438.014 Tonne in 2016) and dangerous goods (298 Tonne). Data are split into such sub-categories for 2016 only.*

In 2016 the Port of Ortona registered a traffic of 653 passengers to/from Croatia and 1.019.041 tonnes of goods. Specifically, the total amount achieved by liquid goods and solid goods was respectively 430.337 tonnes and 616.486 tonnes. In 2017 409.460 tonnes of liquid goods and 614.617 tonnes of solid goods were recorded, with a slight negative variation of 5% and 0,3%. However, the total goods increased of 1,6% thanks to 10.897 tonnes of new vehicles exported (4.707 vehicles in total). The number of passengers registered was 642, quite steady with the previous year. In 2018 1.013.352 tonnes<sup>2</sup> were handled in the Port of Ortona, split into 430.294 tonnes of liquid goods and 579.315 tonnes of solid goods. The new vehicles exported were 6.695, for a total amount of 12.743 tonnes, whereas the passenger traffic significantly increased to 917 (+43%). Between 2017 and 2018 the traffic of solid goods decreased by 7%, while liquid goods increased by 5%. The new vehicles exported, instead, increased by 17%, with the number of vehicles enhanced by 42%. In 2018 the unloaded amounts were always higher than the ones loaded, except for the vehicles exported.

## Scenarios and programming documents for the Port of Ortona

The most relevant document for the planning of the future port development is the Port Regulatory Plan (Piano Regolatore Portuale - PRP). Originally approved in 1969, the updated version of 2010 has been adopted with the decree n. 75/2015 of Ortona Coast Guard, even if it is waiting for the last approval by the Regional Council (which still has to receive the new national legislation on port management). The plan includes a complete overview of the characteristics of Ortona area and the port. Furthermore, it foresees new capacities and functions for the port thanks to the investments related with the Abruzzo Masterplan, which aims to achieve higher accessibility, wider manoeuvring spaces, better ground operations and links with the hinterland. The future operational availabilities for the port are:

- 5 moorings for ro-ro and Ro-pax ships 220 m long (with 10m depths);
- 4 multi-purpose docks of 650m, 440m, 550m, 250m length;
- 600m long quays adjacent to oil docks;
- 3 berths for oil tankers.

A further relevant document for the strategies regarding the Port of Ortona is the Three-year Operational Plan 2017-2020 (Piano Operativo Triennale) of Central Adriatic Ports Authority.

The plan lists the main operational actions programmed for the development of Ortona port and area.

The importance of the Port of Ortona is evidenced in the Regional Integrated Transports Plan (Piano Regionale Integrato dei Trasporti – PRIT). Indeed, the Port is classified as a local port of national interest and it is considered a strategic node for the future development of the area, key to develop logistic and integrated mobility in the Region. The plan foresees a central role of Ortona in the development of maritime traffic in Adriatic Sea, due to its strategic and unique location as the only relevant commercial port between Ancona and Apulian ports. Moreover,

in the Regional Plan a relevant role of Ortona port is expected in the short-distance trans-Adriatic passenger lines, whilst a possible role in container transport among Mediterranean, the Black Sea and the hub port of Taranto (Ionian Sea) is foreseen.

Finally, the Strategic Development Plan of Abruzzo Region 2019 (Piano Strategico di Sviluppo dell Regione Abruzzo), already mentioned as a framework document for the ZES, reports the actions planned for Ortona Port and area. The document foresees a future scenario in which the port assumes a pivotal role in the freight land corridor between Thyrrhenian and Adriatic Sea (Civitavecchia-Ortona/Pescara). Indeed, thanks to the steady-to-increasing commercial exchanges between Italy and the Mediterranean countries and the increasing growth rates of Turkey, East Europe and Middle East, the development of a combined maritime-land transport corridor - and the planning of new commercial routes between the Iberia peninsula and the Balkan countries through Italy as a landbridge - has to be taken into account. This would enhance the role of Ortona as a key node for Ro-Ro traffic, linking Adriatic routes with the Italian landbridge within the corridor. This scenario evidences the opportunity of including Ortona in the Scandinavian-Mediterranean (ScanMed) Corridor, and the necessity for the port to fulfil the infrastructure requirements necessary for the inclusion in the Comprehensive Network. This goal is strictly connected to the necessity to improve the infrastructural endowment of the Port of Ortona, as concerns both port infrastructure and road/rail connections.

## LISTING OF ALL BOTTLENECKS AND UNDESIRABLE EFFECTS

The results of the bottleneck survey have been collected through the questionnaire below. The questionnaires have been filled by the most relevant stakeholders of the Port of Ortona (see ANNEX 1), namely:

- The Port Authority;
- The Coast Guard;

- The Custom administration;
- Representatives of maritime agencies.

The template used for the survey is the following.

Bottleneck		Question	Answer	Relevance	
infrastructural bottlenecks	road	safety	Is the connection between the terminal and highway network at a satisfactory safety level?		
			Is there a regular maintenance of the terminal roads and connection between the terminal and highway network?		
			Are there clearly marked routes for accessing the terminal and leaving the terminal in order to reach the highway network?		
			Is there adequate (satisfactory) lighting on the terminal roads and connection between the terminal and highway network?		
			Are there clearly marked routes to get to the terminal and to the highway network?		
	flow capacity	Is there a direct access to the highway network?			
		Is the current capacity of the road infrastructure sufficient?			
		Is there a sufficient number of lanes on terminal roads and connection between the terminal and highway network?			
		Is the width of the lanes on the terminal roads and connection between the terminal and highway network appropriate (satisfactory)?			

			Is the connection between the terminal and highway network passing through the urban and inhabited area?			
			Is there a road and pedestrian crossing on the railway?			
	rail	safety		Is the signalization on a satisfactory level?		
				Is there adequate (satisfactory) lighting on the terminal railway infrastructure?		
				Is there a regular maintenance of infrastructures relevant for the satisfactory level of security?		
				Is there a road and pedestrian crossing on the railway?		
				Are the crossings satisfactory marked?		
		flow capacity		Is the current capacity of railway infrastructure satisfying?		
				Is it the connection of railway and road infrastructure at a satisfactory level?		
				Is it possible to dispatch the maximum allowed quantities of the train at once?		
				Is there a ramp for the loading/unloading of the trucks on the railway?		
	inland waterways	safety		Is the safety level of the port access satisfactory?		
		flow capacity		Is the area of the port basin sufficient?		
				Is the capacity of the access to the terminal sufficient so the barges shouldn't be separated?		
			Is there a RO-RO ramp on the terminal?			
	terminal	capacity		Are the parking spaces adequately signposted for identification?		
				Is the capacity of a parking lot sufficient?		
				Is parking space able to accommodate all dimensions of the vehicles / units?		
				Are the roads at the terminal separated from waiting areas for the loading / unloading cargo?		
			Is the number of berths for mooring ships sufficient?			
			Are the lengths of berths sufficient for mooring the largest vessels?			
			Are the sea depth/draft berths enough for the biggest ships?			
			Is the sea depth in the driveway shore/terminal satisfactory for the biggest ships?			

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			Is there a storage space near the berth?		
			Does the space for storage of goods have sufficient capacity?		
		safety	Does the terminal (individual bindings) have conditions of secure mooring?		
			Is the sea access to the terminal sufficient (maritime safety requirements)?		
weather	How much time a year is the terminal out of function for bad weather?				
a supply chain bottlenecks		work shifts	Is it guaranteed cargo handling 24 hours a day every day of the year?		
			Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading services?		
		information exchange	Is there a system which allows the electronic exchange of documents and communications between the driver unit and the terminal?		
		time response	PILOTS - Is it the time required from the request to reaction at a satisfactory level?		
			TUGS - Is it the time required from the request to reaction at a satisfactory level?		
		cooperation	Is the cooperation between the terminal and the agent at a satisfactory level?		
Is the administrative co-operation of the terminal and Ship at a satisfactory level?					
regulatory bottlenecks		technology	Is the cargo handling capacity of the terminal sufficient?		
			Does the shore cranes terminal have sufficient performance /capacity?		
			Does the mobile cranes terminal have sufficient performance /capacity?		
			Is there in the function the VTMS system?		
		customs	Is the cooperation between the Customs Authority and Ships at a satisfactory level?		
		inspections	Is the time required for inspection (veterinary, phytosanitary, etc.) at a satisfactory level?		
		cabotage restrictions	Are there any cabotage restrictions?		
		other	Is there an exemption obligations pilots for ships in service, which regularly touch the port?		
Is there an exemption obligations tugs for ships in service, which regularly touch the port?					

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Despite the different answers, a list of the commonly identified key bottlenecks affecting the Port of Ortona can be drafted. The key bottlenecks are listed below by priority and clustered in three categories: infrastructural, supply chain and regulatory bottlenecks. The most significant bottlenecks will be commented in detail in the following section.

The **infrastructural bottlenecks** identified from the questionnaires are:

- Insufficient sea depth/drafts for bigger ships;
- Insufficient sea depth in the driveway shore of the port for the biggest ships;
- Absence of Ro-Ro ramp in the port;
- Absence of a direct access to the highway in the Ortona area;
- Low capacity of railway infrastructures;
- Low efficiency in dispatching the maximum allowed quantities of the train at once;
- Absence of a ramp for loading/unloading of the tracks in the railway;
- Lack of adequate parking lots and parking spaces not well signposted for identification;
- Insufficient number of berths for mooring ships;
- Low capacity of road infrastructures;
- Unsatisfactory Crossing marks in the railway infrastructures;
- Low level of safety of the access to the port in accordance with the Maritime requirements;
- Insufficient number lanes in the road infrastructures;
- Lack of regular maintenance of roads in the port;
- Unsatisfactory width of lanes in the road infrastructures;
- Lack of regular maintenance of railway infrastructures;
- Unsatisfactory signalization in the railway network;
- No separation between port roads and waiting areas for loading/unloading;
- Parking space no able to accommodate all dimensions of the vehicles / units.

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The **supply chain bottlenecks** identified from the questionnaires are:

- Absence of a VTMISS (Vessel Traffic Management Information System) in the port;
- No cargo handling 24 hours a day every day of the year;
- Lack of flexibility in the composition of stevedoring crews and handling equipment.

The **regulatory bottlenecks** identified from the questionnaires are:

- No restrictions to cabotage;
- Insufficient time for inspection (veterinary, phytosanitary, etc.);
- Low level of exemption obligations of pilots and tugs.

## ANALYSING OF LISTED BOTTLENECKS AND THEIR CAUSATIVE RELATIONS

The survey performed through the questionnaires reveals that the Port of Ortona shows relevant bottlenecks to be overcome, both infrastructural and supply chain.

The outcome of the survey mirrors the same conclusions reported in the Port Regulatory Plan, in particular as regards the bottlenecks related to the connection between the city and the Port:

- **Separation due to the orography:** the port and the city of Ortona are divided by steep and unstable slopes which hamper the efficient connection between the two places of interest;
- **Separation due the lack of infrastructures:** the connection between the city and the port is limited by the low efficiency level of the Adriatic railway line and the Via della Cervana road used both for urban mobility and for freight traffic to and from the port;
- **The port size:** the port is a large infrastructure with a relevant role with respect to the medium size of the City of Ortona. Therefore, the interventions needed for the port risk to have not sufficient political support (e.g. compared to ports located in big cities), with the connected risk to focus investment priorities in more dense port areas. The

insertion of Ortona in the current port cluster managed by Central Adriatic Ports Authority is an effective alleviating measure against the above-mentioned risk.

Moreover, the Port Regulatory Plan reports a deep territorial discontinuity caused by the following problems:

- **Low level accessibility of coastal areas;**
- **Physical barrier constituted by the railway line** (discontinuous coastal territories with visual and physical impediment to direct access to the state-owned areas);
- **Rural and agricultural use of private lots** between the state-owned area and the railway line to the detriment of the tourist potential on the coast;
- **Morphological and orographic conformation of the territory**, with the coast and the mountainous area near to each other and with spread infrastructural networks.

Afterwards, the Port Regulatory Plan focuses on the problems directly related to the Port of Ortona:

- **Maritime and navigational problems because of a lack of an outer harbor**, which causes wave agitations and reduction of the operation of the quays.
- **Lack of continuity between the Riva and Nord quays**, which are physically separated by the fishing area and by the proximity in the use of spaces and docks.

Finally, the Plan mentions the Regional Integrated Transports Plan for further problems related to the Port of Ortona:

- **Limited sea depth in the port entrance and internal docks;**
- **High level of wave motion inside the port;**
- **Insufficient sea depth available at the beginning of existing docks;**
- **Difficult usage of Riva quay due to the physical constraint constituted by a planimetric and altimetric discontinuity.**

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According to quantity of problems reported in the questionnaires and the problems indicated in the Port Regulatory Plan, it is evident that **infrastructural bottlenecks** are the most critical ones, concerning road and railway accessibility, as well as seaside infrastructure and terminal capacity.

**Road:** the absence of a direct access to the highway and the low capacity of the road infrastructures may cause traffic congestion in case of a constant increase of the maritime traffic. The insufficient number of lanes and the absence of efficient connections between the port and the highway are critical issues as well. Moreover, the unsatisfactory width of lanes affects the general capacity of the area and the lack of regular maintenance of roads represent an issue for the safety of the area. The improvement of the road accessibility may increase the cargo traffic in the Port thanks to a congestion reduction and a higher capacity.

**Railway:** the current rail connection from the port to Ortona station shows many infrastructural shortcomings, causing severe limitations to the capacity of transporting goods by rail to Ortona inland catchment area. Among limitations, the low maximum train weight allowed on the track, the presence of many crossings (since the track is built on a road), and the lack of a loading/unloading ramp. Those are the key identified bottlenecks concerning rail connection. They contribute in reducing the attractiveness of the Port for the stakeholders organising inland repositioning services (terminal managers, logistics operators, etc.). Furthermore, the obsolete signalling and the lack of regular maintenance of the rail branch gives the perception of low safety standards. Because of such inadequacy factors, future substantial improvements of the rail connection become fundamental to achieve acceptable safety levels and to increase the opportunities to organise intermodal transport relations from/to the Port of Ortona. Currently, the railway split of inland transport from Ortona is zero.

**Seaside:** the capacity and the efficiency of port operations are hampered by the insufficiency of sea depth/drafts, the low level of sea depth in the driveway shore for bigger ships, the

insufficient number of berths for mooring ships are perceived as the most important bottlenecks concerning the seaside characteristics of the port.

**Terminal:** the main bottleneck concerning the terminal – and thus the capability of the port to host efficient solutions of intermodal transport – is the absence of a Ro-Ro ramp. The construction of the main key facility for Ro-Ro is fundamental to develop this kind of traffic in the Port of Ortona. Moreover, other bottlenecks related to the terminal and landside area of the port are the lack of adequate parking lots, parking spaces not well signposted for identification. In particular, the absence of separation between roads and waiting areas for loading/unloading heavily affect the efficiency of port operations.

The improvement of Port infrastructure is fundamental for the future growth of the Port of Ortona, to ensure, higher efficiency, capacity and safety. The main objective of Central Adriatic Ports Authority is to solve the infrastructural bottlenecks of Port of Ortona in order to aim at the inclusion in the TEN-T Comprehensive Network.

As concerns **supply chain bottlenecks**, the most critical issue is represented by the lack of a VTMISS system. The implementation of this ICT tool has a high relevance in order to achieve a better and faster data sharing as well as to increase the effectiveness of port and maritime activity operations. Further reported bottlenecks are the lack of 24/7 cargo handling service and by the scarce flexibility in the composition of stevedoring crews and handling equipment. Although these are not considered as critical issues, their resolution could increase the organizational efficiency of the port in terms of less time needed for ordinary operations.

## PROPOSING SOLUTIONS OF BOTTLENECKS AND ANALYSING HOW IT WILL AFFECT FUTURE FREIGHT FLOWS

The introduction of Ortona area in the ZES is a great opportunity to foster the development of the port activity and interventions aimed to improve the port infrastructure. Indeed, the creation of the ZES succeeded to attract the attention of decision makers on the importance

for Ortona area to be served by a competitive port, with the ultimate goal to include it in the TEN-T Comprehensive Network. Therefore, ZES has generated a positive impact on planning actions of the Port of Ortona, placing Ortona among strategic priorities of Abruzzo Region and Central Adriatic Ports Authority.

In order to face the problems related with the bottlenecks analysed in the previous chapters, relevant solutions have been already identified in the programming documents issued by the Central Adriatic Ports Authority for the Port of Ortona (see ANNEX 2).

The most relevant planned infrastructure actions to overcome the bottlenecks of the Port of Ortona are the following:

- **Excavation and deepening of the seabed of Ortona harbour basin;**
- **Connection with the A14 highway;**
- **Completion of railway infrastructures serving the Port of Ortona;**
- **South Pier Extension.**

The main programming level and state of the art of such interventions are summarised in the following table. As depicted there, the most important regional programming documents, as well as the Three-year Port Operational Plan and the Programming Contract between the Ministry and the National Rail Infrastructure Manager, include all of these priority measures. However, the revamping of the rail connection to the harbour is just foreseen as element of possible collaboration between RFI and the Port Authority (in the three-year Operational Plan), although not planned nor financed.

INTERVENTION	PLANNING DOCUMENTS	PROGRESS
Excavation and deepening of the seabed of Ortona harbour basin	<ul style="list-style-type: none"> <li>Strategic Development Plan of Abruzzo Region 2019</li> <li>Three-year Operational Plan 2017-2020</li> </ul>	Implementation phase (9.400.000 €)
Connection with the A14 highway	<ul style="list-style-type: none"> <li>Strategic Development Plan of Abruzzo Region 2019</li> <li>Port Regulatory Plan</li> </ul>	Implementation phase (2.000.000 €)
Completion of railway infrastructures serving the Port of Ortona	<ul style="list-style-type: none"> <li>The Programming Contract 2017-2021 between Ministry of Infrastructure and Transport and RFI</li> <li>Three-year Operational Plan 2017-2020</li> <li>Strategic Development Plan of Abruzzo Region 2019</li> <li>Port Regulatory Plan</li> </ul>	Implementation phase (1.700.000 €)
South Pier Extension	<ul style="list-style-type: none"> <li>Strategic Development Plan of Abruzzo Region 2019</li> <li>Port Regulatory Plan</li> </ul>	Implementation phase (40.500.000 €)

Table 2: Main interventions planned in the Port of Ortona (SOURCE: "Completamento interventi sul Porto di Ortona" Masterplan Abruzzo Region, 2018)

In conclusions, the solutions planned aim to increase the relevance of Port of Ortona. **The improvement of port infrastructure and facilities is the necessary condition to increase the port traffic and competitiveness.** Indeed, taking in account the strategic position as a pivotal link along the Mediterranean, in the middle of an ideal land-sea corridor between the Iberian Peninsula and the Balkan countries, **the Port of Ortona may be included in the TEN-T Comprehensive Network.** To achieve this objective, the solutions aimed to improve the road and railway connections, together with the dredging of the sea basin, become fundamental to verify the minimum conditions to achieve this goal.

## CONCLUSIONS

The Port of Ortona is the main multifunctional commercial seaport of Abruzzo Region and it is part of Central Adriatic Ports Authority. After the institution of the Abruzzo Region ZES areas, the port has been considered a pivotal infrastructural node and a development planning has been started for the Ortona area.

The main problems related to the Port of Ortona regard the infrastructural bottlenecks. Particularly, the insufficient sea depth of the seabed, the lack of road and railway infrastructures as well as the low development of port infrastructure (e.g. absence of Ro-Ro ramp, insufficient number of berths) hamper the enhance of the capacity, security and efficiency of the Port of Ortona. Consequently, the overall surrounding area is negatively affected by these issues and its development is slowed down.

In order to solve these problems, several solutions are foreseen. Indeed, different interventions of dredging are planned, despite bureaucracy and political problems occurred between Central Adriatic Ports Authority, Ortona Coast Guard and Abruzzo Region have affected the procedure causing delays in the procedure<sup>2</sup>. Moreover, a direct connection between the highway and the port, an improvement of railway infrastructures (double-track implementations) and port infrastructure thanks to the construction of new quays, berths docks, Ro-Ro ramp and other facilities are planned.

Others infrastructural interventions as well as solutions for supply chain and regulatory bottlenecks are needed in order to increase the capacity, the security and the efficiency of Port of Ortona. Despite such interventions are not foreseen in the short run, the inclusion of Ortona Area in the ZES can be an important incentive to foster the starting of planning phases and their realization in the long run. Therefore, the aim to achieve is the exploitation of Port and Ortona area potentialities and the possibility for all stakeholders and citizens to take advantage of the correlated benefits.

The improvement of port infrastructure is fundamental for the future growth of traffic of the Port of Ortona, ensuring higher efficiency, capacity and safety. The main objective of Central Adriatic Ports Authority is to solve the infrastructural bottlenecks affecting the Port of Ortona. Indeed, port infrastructure and safety must be implemented to enable the increase of freight

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<sup>2</sup> *Dragaggio del porto: lavori fermi e polemiche*, 03/03/2019, A. Sitti, [www.ilcentro.it](http://www.ilcentro.it)

traffic flows, to make the request for the inclusion of Ortona in the TEN-T Comprehensive Network possible. Central Adriatic Ports Authority will foster the cooperation among all the Ortona area stakeholder in order to speed up the achievement of this objective.

## ANNEX 1 – Questionnaires

Bottleneck		Question	Answer	Relevance	Answer	Relevance	Answer	Relevance	Answer	Relevance	Answer	Relevance	Answer	Relevance			
			ADSPMAC		COAST GUARD		CUSTOM		MARITIME AGENCY 1		MARITIME AGENCY 2		MARITIME AGENCY 3				
infrastructural bottlenecks	road	safety	is the connection between the terminal and highway network at a satisfactory safety level?	NO	MEDIUM	NO	MEDIUM	NO		NO	HIGH	NO	HIGH	YES	HIGH		
			is there a regular maintenance of the terminal roads and connection between the terminal and highway network?	YES	MEDIUM	NO	MEDIUM	NO		NO	MEDIUM	NO	HIGH	NO	HIGH	YES	HIGH
			Are there clearly marked routes for accessing the terminal and leaving the terminal in order to reach the highway network?	YES	LOW	YES	LOW	YES		YES	LOW	YES		YES		YES	HIGH
		is there adequate (satisfactory) lighting on the terminal roads and connection between the terminal and highway network?	YES	LOW	YES	LOW	YES		YES	LOW	YES		YES		YES	HIGH	
		Are there clearly marked routes to get to the terminal and to the highway network?	YES	LOW	YES	LOW	YES		NO	LOW	YES		YES		YES	HIGH	
		is there a direct access to the highway network?	NO	MEDIUM	NO	MEDIUM	NO		NO	HIGH	NO		NO		NO	MEDIUM	
	flow capacity	is the current capacity of the road infrastructure sufficient?	NO	MEDIUM	NO	MEDIUM	YES		NO	HIGH	NO		YES		YES	HIGH	
		is there a sufficient number of lanes on terminal roads and connection between the terminal and highway network?	NO	MEDIUM	NO	MEDIUM	YES		NO	LOW	NO		YES		YES	MEDIUM	
		is the width of the lanes on the terminal roads and connection between the terminal and highway network appropriate (satisfactory)?	YES	HIGH	NO	HIGH	NO		NO	LOW	NO		YES		YES	HIGH	
		is the connection between the terminal and highway network passing through the urban and inhabited area?	YES	MEDIUM	YES	MEDIUM	NO		YES	MEDIUM	YES		NO		NO	MEDIUM	
		is there a road and pedestrian crossing on the railway?	YES	LOW	YES	LOW		One track section exists. However, it is not used	YES	MEDIUM	NO		NO		NO	HIGH	

Bottleneck			Question	Answer	Relevance	Answer	Relevance	Answer	Relevance	Answer	Relevance	Answer	Relevance	Answer	Relevance	
				ADSPMAC		COAST GUARD		CUSTOM		MARITIME AGENCY 1		MARITIME AGENCY 2		MARITIME AGENCY 3		
rail	safety	Is the signalization on a satisfactory level?	YES	LOW	YES	LOW				NO	LOW	NO		NO	HIGH	
		Is there adequate (satisfactory) lighting on the terminal railway infrastructure?	YES	LOW	YES	LOW				YES	MEDIUM	YES		NO	HIGH	
		Is there a regular maintenance of infrastructures relevant for the satisfactory level of security?	YES	MEDIUM	YES	MEDIUM				NO	LOW	NO		NO	HIGH	
		Is there a road and pedestrian crossing on the railway?	YES	LOW	YES	LOW				YES	MEDIUM	YES		NO	HIGH	
		Are the crossings satisfactory marked?	NO	MEDIUM	NO	MEDIUM				NO	MEDIUM	YES		NO	HIGH	
	flow capacity	Is the current capacity of railway infrastructure satisfying?	NO	MEDIUM	NO	MEDIUM				NO	LOW	NO		NO	HIGH	
		Is it the connection of railway and road infrastructure at a satisfactory level?	NO	MEDIUM	NO	MEDIUM				NO	LOW	NO		NO	HIGH	
		Is it possible to dispatch the maximum allowed quantities of the train at once?	NO	LOW	NO	LOW				NO	LOW	NO		NO	HIGH	
		Is there a ramp for the loading/unloading of the trucks on the railway?	NO	LOW	NO	LOW				NO	LOW	NO		NO	HIGH	
	inland waterways	safety	Is the safety level of the port access satisfactory?	YES	LOW	YES	LOW				/	LOW	NO		YES	HIGH
		flow capacity	Is the area of the port basin sufficient?	YES	MEDIUM	YES	MEDIUM				/	LOW	NO		YES	HIGH
			Is there a RO-RO ramp on the terminal?	NO	HIGH	NO	HIGH				NO	HIGH	NO	HIGH	NO	HIGH
	terminal	capacity	Are the parking spaces adequately signposted for identification?	NO	MEDIUM	NO	MEDIUM	NO			NO	LOW	NO		NO	MEDIUM
			Is the capacity of a parking lot sufficient?	NO	MEDIUM	NO	MEDIUM	NO			NO	LOW	NO		YES	MEDIUM
Is parking space able to accommodate all dimensions of the vehicles / units?			YES	MEDIUM	YES	MEDIUM	NO			NO	LOW	NO		YES	MEDIUM	
Are the roads at the terminal separated from waiting areas for the loading / unloading cargo?			YES	LOW	YES	LOW	NO			NO	LOW	NO		NO	MEDIUM	
Is the number of berths for mooring ships sufficient?			NO	HIGH	NO	HIGH	NO			NO	HIGH	NO	HIGH	YES	HIGH	
Are the lengths of berths sufficient for mooring the largest vessels?			YES	LOW	YES	LOW	YES			NO	HIGH	NO	HIGH	YES	HIGH	
Are the sea depth/draft berths enough for the biggest ships?	NO	HIGH	NO	HIGH	NO			NO	HIGH	NO	HIGH	NO	HIGH			

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Bottleneck			Question	Answer	Relevance	Answer	Relevance	Answer	Relevance	Answer	Relevance	Answer	Relevance	Answer	Relevance
				ADSPMAC		COAST GUARD		CUSTOM		MARITIME AGENCY 1		MARITIME AGENCY 2		MARITIME AGENCY 3	
a supply chain bottlenecks	safety		Is the sea depth in the driveway shore/terminal satisfactory for the biggest ships?	NO	HIGH	NO	HIGH			NO	HIGH	NO	HIGH	NO	HIGH
			Is there a storage space near the berth?	YES	LOW	YES	LOW	YES		YES	MEDIUM	YES		YES	HIGH
			Does the space for storage of goods have sufficient capacity?	YES	MEDIUM	YES	MEDIUM	YES		YES	MEDIUM	YES		YES	HIGH
		Does the terminal (individual bindings) have conditions of secure mooring?	YES	MEDIUM	NO	MEDIUM	////		YES	MEDIUM	YES		YES	HIGH	
		Is the sea access to the terminal sufficient (maritime safety requirements)?	NO	HIGH	NO	HIGH	////		NO	HIGH	NO		YES	HIGH	
	weather		How much time a year is the terminal out of function for bad weather?	NO (less than 1 week)	LOW	NO	LOW	////		NO		NONE		20 DAYS	
			Is it guaranteed cargo handling 24 hours a day every day of the year?	NO	LOW	NO	LOW	////		YES	MEDIUM	YES		NO	MEDIUM
	work shifts		Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading services?	NO	LOW	NO	LOW	////		YES	HIGH	YES		YES	MEDIUM
			Is there a system which allows the electronic exchange of documents and communications between the driver unit and the terminal?	YES	MEDIUM	YES	MEDIUM	////		NO	LOW	NO		YES	MEDIUM
	information exchange		PILOTS - Is it the time required from the request to reaction at a satisfactory level?	YES	MEDIUM	YES	MEDIUM	////		YES	HIGH	YES		YES	HIGH
TUGS - Is it the time required from the request to reaction at a satisfactory level?			YES	MEDIUM	YES	MEDIUM	////		YES	MEDIUM	YES		YES	HIGH	
time response		Is the cooperation between the terminal and the agent at a satisfactory level?	YES	MEDIUM	YES	MEDIUM	////		YES	HIGH	YES		YES	HIGH	
		Is the administrative co-operation of the terminal and Ship at a satisfactory level?	YES	LOW	YES	LOW	////		YES	HIGH	YES		YES	HIGH	
cooperation		Is the cargo handling capacity of the terminal sufficient?	YES	MEDIUM	YES	MEDIUM	////		YES	HIGH	YES		YES	HIGH	
		Does the shore cranes terminal have sufficient performance /capacity?	YES	MEDIUM	YES	MEDIUM	////		YES	HIGH	YES		YES	HIGH	
technology		Does the mobile cranes terminal have sufficient performance /capacity?	YES	MEDIUM	YES	MEDIUM	////		YES	MEDIUM	YES		YES	HIGH	
		Is there in the function the VTMS system?	NO	HIGH	NO	HIGH			NO		NO		NO	MEDIUM	

Bottleneck			Question	Answer	Relevance	Answer	Relevance	Answer	Relevance	Answer	Relevance	Answer	Relevance	Answer	Relevance
				ADSPMAC		COAST GUARD		CUSTOM		MARITIME AGENCY 1		MARITIME AGENCY 2		MARITIME AGENCY 3	
regulatory bottlenecks	customs		Is the cooperation between the Customs Authority and Ships at a satisfactory level?	YES	HIGH	YES	HIGH	YES		YES	HIGH	YES		YES	HIGH
			Is the time required for inspection (veterinary, phytosanitary, etc.) at a satisfactory level?	NO	MEDIUM	NO	MEDIUM	NO	Improvement's needed. Offices outside the port area; the release of certificates is slow	YES	MEDIUM	YES		YES	HIGH
	inspections		Are there any cabotage restrictions?	NO	LOW	NO	LOW	NO		YES	MEDIUM	YES		NO	HIGH
			Is there an exemption obligations pilots for ships in service, which regularly touch the port?	YES	LOW	SI	LOW	////		NO		NO		NO	LOW
other		Is there an exemption obligations tugs for ships in service, which regularly touch the port?	YES	LOW	YES	LOW	////		NO		NO		NO	LOW	

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## ANNEX 2 - Programming documents of the Port of Ortona

The present annex section reports on the infrastructural actions relevant for the development of the Port of Ortona, as included in the main programming documents. The first part of the section concerns the “main interventions”, as listed in Table 2 as prioritaires. The second part concerns all other infrastructure actions included in the main programming documents.

### Main interventions

The **Port Regulatory Plan**, as concerns seaside and terminal infrastructure, identifies the **Extension of the South Pier** as fundamental intervention in order to improve the capacity of Port of Ortona and then allowing higher traffic flows in the future. As concerns roads and railway, the Port Regulatory Plan foresees the **doubling of the Pescara - Ortona railway line** as well as **the completion of the direct connection between the highway and the port** in order to allow higher intermodality and make possible a future growth of port traffics.

The **Three-year Operational Plan 2017-2020** (Piano Operativo Triennale 2017-2020) mentions the interventions planned in order to solve the main bottlenecks of the Port of Ortona. The actions already in progress are:

- The **dredging of seabed** (dredging of the port basin to the depth of -10 meters): an important intervention of dredging is foreseen in order to allow the port to receive higher class ships in the container sector as well as in general cargo and cruise;
- **Completion of the railway infrastructures** for the last mile and for the main network: a collaboration between the Central Adriatic Ports Authority and the Italian Railway Network (Rete Ferroviaria Italiana) will provide the empowerment of the station of Ortona (increase of the size of railway tunnels, restoration and improvement of the railway access to the port).

The **Strategic Development Plan of Abruzzo Region 2019**, published in the framework of the ZES, includes also the actions identified:

- **Port of Ortona connection with the tollbooth of highway A14:** the intervention aims to link directly the port with the highway in order to accomplish the “last mile” policies and consequently improve the capacities of the infrastructural node;
- **Completion of interventions in the Port of Ortona (Deepening dredging, south dam extension):** these actions aim to extend the south pier of the port in order to reach a total length of 800 meters and to reach a seabed depth of 10 meters;
- **Excavation and deepening of the seabed of Ortona harbour basin:** this intervention aims to reach a higher depth for all the Ortona harbour basin;
- **Completion of railway infrastructures serving the Port of Ortona:** these interventions foresee the construction of a “catch and deliver” rail track, in addition of the one normal single track already in operation, in order to improve the store capacity of the railway wagons for the freight service. The railway infrastructures improvement has the objective to achieve the modernization, strengthening and development of the port area respect to the entire freight transport network at national and international level. Further interventions include the actions reported in the Programming Contract 2017-2021 (double-track in the north section of Ortona station, infrastructural and technological upgrading as well as completion of managerial performance adjustment of the Adriatica-Ionica section, specifically the TEN-T corridor Scandinavian-Mediterranean ports Adriatic and Southern Italy);

The **Programming Contract 2017-2021 between Ministry of Infrastructure and Transport and RFI (Italian Railway Infrastructure Manager)** (*Contratto di Programma 2017-2021 tra il Ministero delle Infrastrutture e dei Trasporti e Rete Ferroviaria Italiana*) includes two actions involving Ortona area:

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- **The completion of the second-track rail in the section Ortona-Casalbordino** (southbound): the action is part of the wider project aimed at doubling the Adriatic line between Pescara and Bari. The doubling has a total cost of 299 M€, already financed by the Ministries of Economy and Infrastructure. The second track Ortona-Casalbordino is already in operation.
- **The construction of the second-track northbound from Ortona station:** the action foresees the construction of an extra new tunnel of 1 km with single-track. The action is included in the Pescara-Bari line doubling project as well. The second track is currently in construction.

These interventions will allow to achieve a higher capacity, a better traffic management and the possibility for HIGH CUBE semi-trailers and containers to use this railway section.

#### Other actions

Beyond the main interventions previously discussed, the **Port Regulatory Plan** illustrates further possible actions to improve the capacity and requalify the Port of Ortona. As concerns seaside and terminal infrastructure, the Central Adriatic Ports Authority identifies the following actions:

- Redevelopment of the North Pier;
- Construction of a new North dock for dangerous goods;
- Redevelopment of the North quay;
- Redevelopment of the Riva quay;
- Redistribution of areas of the existing basin;
- Redevelopment and redistribution of land spaces;
- Docking of the north breakwater;
- Construction of a slipway and a ferry dock;

- Purchase of a self-moving crane for handling containers.

Furthermore, the Port Regulatory Plan listed other interventions aimed to improve the main road system and to achieve an adequate interchange between public and private transport through the making of an adequate parking system. Therefore, these actions identified on the road network ensuring accessibility to the port are:

- The improvement of the provincial roads SS16 “Adriatica” and SS538 “Marruccina”;
- The realization of the Postilli - Riccio road connection.

In order to create an agenda for the short and long run, the Port Regulatory Plan splits the intervention needs in two Scenarios.

The “reference scenario” includes some planned key actions to be implemented by the Authorities (Province and ANAS) responsible for the road network maintenance and improvement:

Improvement of the SS16 section North of Ortona as a continuation of the section already improved between Pescara and Francavilla al Mare;

- Realization of the connection viaduct between Ortona and the hospital area located in “contrada Sant’Andrea” along the A14 towards Ortona center town and the coast;
- Construction of a link between Via Don Arturo Morlupi and Via della Fontesanta and construction of a viaduct capable of connecting this ring road with Via De Ritis;
- Construction of the new road link between Ortona tollgate A14 and the SS16;
- Restoration of the “mid-coast” road that connects via Marina with the SS16 north of the railway line.

The “project scenario” includes interventions for which the Central Adriatic Ports Authority may have at least partial competence:

- Adaptation and expansion of the tracks to serve the North Pier, with consequent expansion of the railway area and repositioning of the border;
- Resetting and refunctionalization of via della Cervana road axis;
- Construction of a new road section connecting the port and via della Cervana near the lighthouse of Ortona with the Provincial Roads San Tommaso and the SS16.

The **Three-year Operational Plan 2017-2020** (Piano Operativo Triennale), lists the actions planned which can help to solve the bottlenecks of the Port of Ortona. The actions already in progress are:

- The **modernization of public lighting system**;
- **Renovation of forecourts superstructures**, particularly the improvement of the area and the quality of the spaces used for the goods storage and for the passengers handling;
- Construction of **new commercial quays**;

Further solutions are listed in the Three-year Operational Plan 2017-2020. As concerns **ICT**, in order to accomplish an efficient integration, Central Adriatic Ports Authority has made available to Ortona the **Port Community System** in use: **PCS LISy**. The PCS is able to interact with the AIDA system of the Custom Agency, with the by PMIS system of Port Authorities Corp and with the TRAMAR system of ISTAT. The new PCS is fully interoperable with the software used by shipping agents and customs agents and it allows the exchange of data relating to the customs process.

Some programming documents of the national and regional transport system include actions with relevant impact on the accessibility of the Port of Ortona. The above mentioned **Regional Integrated Transport Plan (PRIT)** foresees some key interventions on the railway network:

- The improvement of the Adriatic railway Pescara-Ortona;

- The modernization and improvement of the Adriatic Sangritana Railway, to strengthen the industrial areas of Ortona.

Besides the main Adriatic line (managed by the national Infrastructure Manager RFI), the railway network of Ortona area is managed by Sangritana railway, which also manages a significant part of the railway network in Abruzzo. The figure 8 shows the railway network of Ortona Area. A further intervention related to Ortona area regards the renovation of the section “Ortona-Caldari” (short light blue line), which links Ortona with the Hinterland.

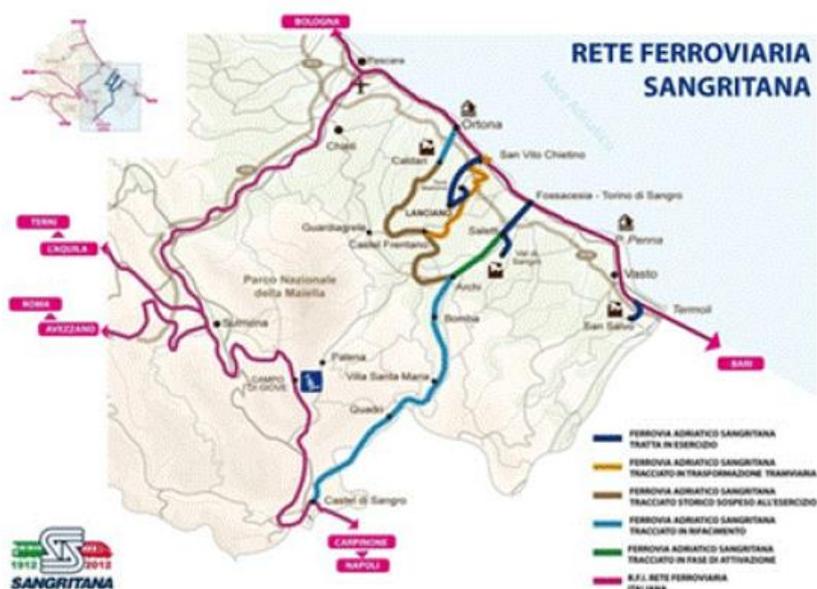


Figure 9: The current railway network and the works in progress in Ortona area by Sangritana Railway (evidenced in blue and light blue. RFI network is showed in purple). (SOURCE: Strategic Development Plan of Abruzzo Region 2019)

## Port of Bari

### DEFINING THE AREA UNDER STUDY AND CHARACTERIZING RESPECTIVE AREA

Apulia is a region in Southern Italy bordering the Adriatic Sea to the east, the Ionian Sea to the southeast, and the Strait of Otranto and Gulf of Taranto to the south. The region comprises 19,345 square kilometers (7,469 sq mi), and its population is about four million. Puglia is the easternmost region of Italy and one of those with the greatest coastal development with an extension of the coasts of about 865 km. Its territory is flat for 53%, hilly for 45% and mountainous only for 2%, which makes it the least mountainous region of Italy, and has a typically Mediterranean climate.

This naturalistic context is also linked to the production and enhancement of agri-food products, including 39 DOP and 13 IGP (cheeses, oils, wines, fruit and vegetables and bakery products). A added value is represent to the presence of numerous presidium Slow Food and the presence of the "Plain of centennial olive trees", inscribed on the National Register of Historic Rural Landscapes of the National Rural Network.

The last ten years have seen a transformation of the shipping world and of the port SYSTEM absolutely not comparable with that which occurred in previous years, this certainly following the "frenzy" due to the evolution of technology and the speed with which changes have occurred to global level, both in political and economic and infrastructural terms. It was thus possible to witness the phenomenon that is called "dimensional, material and immaterial stopover".

As indicated in the PNSLP, "the different speed of growth of the geographic areas of the world has created new traffic opportunities, in fact well defined in terms of directions but by not simple quantification as well as not easy "capture " by Italian ports.

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There is also an overlap of macroeconomic effects at different speeds of impact; for example, the trend of exchange ratios between currencies - which can trigger phenomena of export growth in fairly narrow time intervals - overlaps with substantial structural changes in the country's industrial fabric, with important closures and weakening of factories and production facilities, with more than long-term effects on traffic. In addition, the effects of industrial policy actions and support for internationalization, which can have positive effects on the flow of goods, must also be remembered.

At the infrastructural level the element that has most affected and is affecting traffic is the doubling of the Suez Canal and the Panama Canal with the consequence of the modification, in numerical terms, of the ships and the speeding up of the passage itself; this has meant that the Mediterranean Sea assumes even more its role of centrality in the exchange and global maritime traffic.

The second phenomenon that has strongly affected the mutation of the scenario is to be found in the so-called "Naval gigantism" which saw the setting up and entry of 18 / 20,000 TEUs with an increase in cargo hold of about 25-30% compared to previous-generation container carriers.

The Southern Italy, favors maritime traffic which is 60% of the entire transport chain, with a value significantly higher than the national average. The overall movement of solid (46%) and liquid (47%) bulk represents on average 43% of the entire national movement, with a positive impact on the presence of maritime enterprises equal to 33% of the national figure.

The productive system of Puglia and its positioning in the Italian economy.

The production equipment of Puglia have for many years taken on particular importance not only for the economy of southern Italy, but for the entire country. The overall dimensions of the total added value of economic and industrial activities in the region in 2015 were the following:

- Total economic activities (€ million) 64,665.3
- Value added industry (€ million) 11,253.3

The existence of a massive infrastructure system serving the movement of goods and passengers in the region - six major ports in Puglia (Bari, Brindisi, Manfredonia, Barletta, Monopoli, Taranto), four citizen airports in Bari, Brindisi, Grottaglie, Foggia and three military airports operating in Gioia del Colle (BA), Amendola (FG) and Galatina (LE), the Interporto of Bari, logistic platforms, railway networks of FS and Railways under concession, highways and state roads). This system needs completions, technological improvements, functional connections, 'last mile' interventions, but it is already endowed with a significant consistency, thanks to massive investments made over the last thirty years, underway for some time or just started, in ports and on roads, airports and railways - and of intermodal articulations of increasing use. Most of the movement of goods produced in Basilicata, moreover, gravitates on port and railway nodes of Puglia, while a smaller part - but no less significant for some goods, such as cars built in S. Nicola di Melfi and destined for export to the United States - gravitates towards the ports of Civitavecchia, Naples and Salerno.

The Southern Adriatic Sea Port Authority gathers together the Ports of Bari, Brindisi, Manfredonia, Barletta and Monopoli all along the west Adriatic coast of Italy. The five-port infrastructure includes 57 quays of approximately 10km of total quay length, all connected to the rail and road network and served by two major international airports. The newly formed Southern Adriatic Sea Port Authority is a public body having as its primary task to direct, plan,

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The port of Bari is located in the city center, covers about 260 thousand square meters, and is between the historic city center and the San Cataldo area. Historical port and rich in historical and cultural relevance including the Bourbon dock.



The main features of the port of Bari are the following:

- 285 hectares of basin.
- Docks equipped for all types of commercial traffic (dry and liquid bulks, containers, goods in packages, steel products, etc.)
- Docks serving ro-ro and ro-pax ferry boats (Albania, Greece, Croatia and Montenegro)
- Docks serving cargo (from/to Mediterranean Sea and Black Sea)
- Docks serving cruise ships and related accommodation
- Port Core along the Helsinki-Valletta corridor

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- Services of mooring, pilotage, security, and other services related to passengers
- Port Community System (GAIA)
- PMIS - Port Management Information System
- Collection and disposal service for ship-generated waste and cargo residues

#### Infrastructural analysis

The port of Bari is located north-west of the old city and its boundaries are included to the west by the dock San Cataldo and to the east from the new Foraneo dock. Due to its location, in the south-east of Italy, it is traditionally considered the gateway to Europe to the Balkan Peninsula and the Middle East. The current configuration of the Port of Bari is the result of a series of interventions that have followed over time as new needs arose or particular trends emerged in the sector maritime transport. The port area extends for about 285 hectares with a total development of operational docks of approximately 3,800 ml, affected by different and heterogeneous types of traffic in transit, which have the exchange both of goods (conventional, black and white bulk, Ro-Ro and cars and steel products), both of passengers (cruises and ferries), increased in recent years thanks to the new Terminal structure Cruises, and ferry traffic with Croatia, Montenegro, Albania and Greece. The port area is separated from the rest of the city by a perimeter fence, which delimits the basin.

The stretch of water of the Port of Bari of approximately 209 hectares is artificially protected by the Molo Foraneo dam (breakwater), which opposes the actions generated by the marine weather climate of the neighborhood, and in particular by the waves coming from the main wind. In the Port of Bari the following docks are identified in Darsena di Levante, Darsena di Ponente, Darsena Interna and Darsena Vecchia.

It is possible to make a brief description of the port area starting from the Internal Dock with the " Molo S. Vito " which allows the mooring of ferries for extra-Schengen destinations and the " Vecchio Molo Foraneo " used for the mooring of nautical vessels, tug boats, moorers and firefighters (docks 1 to 9). Next is the Darsena di Ponente used for mooring ferries with Schengen destination and cruise ships (docks 10 and 11). Continuing in the Darsena di Levante, the docks "Deposito Franco" and "Molo di Ridosso" are used for the mooring of cruise ships and ferries to Schengen, while on the Mezzogiorno quay there are grain silos (docks 12 to 15).

Also in the Darsena di Levante, close to the I and II arm of the new outer dock, there is an area divided into two areas, the first of which is rectangular in shape and the second towards the east in the shape of a "crescent" which houses the large part of the port's commercial activities (docks 16 to 23). Proceeding counter clockwise there is the third arm of the new breakwater which is used to stop no operational ships (docks from 24 to 31a) and the IV and V arm of the new breakwater which currently have the exclusive function of defending the port. The Marisabella area follows, where the fill provided by the Port Master Plan. partially built, it is currently used for parking vehicles awaiting boarding on ferries while work is in progress to complete the aprons of the entire Pizzoli-Marisabella area.

The Port of Bari is not connected to the national railway network, so its modal share is represented by 100% of road transport. Yet, the Port of Bari is located close to the RRT of Apulia (Interporto Regionale della Puglia), which is situated less than 5 km from the nearest highway exit, the port of Bari and the international airport of Bari Palese. To encourage rail transport, the Interporto Regionale della Puglia offers to logistics companies and freight forwarders the opportunity to use its intermodal terminal. This comprises of 4 tracks used to organize trains to transport all types of containers, swap bodies and semi-trailers on national

and international routes. The terminal also offers a storage area for containers and other facilities (groupage, maintenance, etc.).

The Interporto is directly accessible from the Bari highway ring road (exit n°5 Bari San Paolo/ Interporto) and is connected to the central railway station through the subway line Bari-San Paolo.

### LISTING OF ALL BOTTLENECKS AND UNDESIRABLE EFFECTS

infrastructural bottlenecks	road	safety	Is the connection between the terminal and highway network at a satisfactory safety level?	YES	MEDIUM
			Is there a regular maintenance of the terminal roads and connection between the terminal and highway network?	YES	MEDIUM
			Are there clearly marked routes for accessing the terminal and leaving the terminal in order to reach the highway network?	YES	MEDIUM
			Is there adequate (satisfactory) lighting on the terminal roads and connection between the terminal and highway network?	YES	MEDIUM
			Are there clearly marked routes to get to the terminal and to the highway network?	YES	MEDIUM
		flow capacity	Is there a direct access to the highway network?	NO	HIGH REASON FOR BOTTLENECK
			Is the current capacity of the road infrastructure sufficient?	NO	HIGH REASON FOR BOTTLENECK
			Is there a sufficient number of lanes on terminal roads and connection between the terminal and highway network?	NO	HIGH REASON FOR BOTTLENECK
			Is the width of the lanes on the terminal roads and connection between the terminal and highway network appropriate (satisfactory)?	YES	MEDIUM
			Is the connection between the terminal and highway network passing through the urban and inhabited area?	YES	HIGH REASON FOR BOTTLENECK
	inland waterways	safety	Is the safety level of the port access satisfactory?	YES	HIGH
			Is the area of the port basin sufficient?	NO	HIGH
		flow capacity	Is the capacity of the access to the terminal sufficient so the barges shouldn't be separated?	NO	HIGH
	Is there a RO-RO ramp on the terminal?		YES	MEDIUM	
	terminal	capacity	Are the parking spaces adequately signposted for identification?	YES	MEDIUM
Is the capacity of a parking lot sufficient?			YES	MEDIUM	

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		Is parking space able to accommodate all dimensions of the vehicles / units?	YES	MEDIUM
		Are the roads at the terminal separated from waiting areas for the loading / unloading cargo?	YES	MEDIUM
		Is the number of berths for mooring ships sufficient?	YES	MEDIUM
		Are the lengths of berths sufficient for mooring the largest vessels?	YES	MEDIUM
		Are the sea depth/draft berths enough for the biggest ships?	YES	MEDIUM
		Is the sea depth in the driveway shore/terminal satisfactory for the biggest ships?	YES	MEDIUM
		Is there a storage space near the berth?	YES	MEDIUM
		Does the space for storage of goods have sufficient capacity?	YES	MEDIUM
	safety		Does the terminal (individual bindings) have conditions of secure mooring?	YES
		Is the sea access to the terminal sufficient (maritime safety requirements)?	YES	HIGH
weather		How much time a year is the terminal out of function for bad weather?	3 DAYS /YEAR	DEPENDING
a supply chain bottlenecks	work shifts	Is it guaranteed cargo handling 24 hours a day every day of the year?	YES	MEDIUM
		Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading services?	YES	MEDIUM
	information exchange	Is there a system which allows the electronic exchange of documents and communications between the driver unit and the terminal?	YES	MEDIUM
	time response	PILOTS - Is it the time required from the request to reaction at a satisfactory level?	YES	MEDIUM
		TUGS - Is it the time required from the request to reaction at a satisfactory level?	YES	MEDIUM
	cooperation	Is the cooperation between the terminal and the agent at a satisfactory level?	YES	MEDIUM
		Is the administrative co-operation of the terminal and Ship at a satisfactory level?	YES	MEDIUM
	technology	Is the cargo handling capacity of the terminal sufficient?	YES	MEDIUM
		Does the shore cranes terminal have sufficient performance /capacity?	YES	MEDIUM
		Does the mobile cranes terminal have sufficient performance /capacity?	YES	MEDIUM
		Is there in the function the VTMS system?	YES	MEDIUM
regulatory bottlenecks	customs	Is the cooperation between the Customs Authority and Ships at a satisfactory level?	YES	MEDIUM

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	inspections	Is the time required for inspection (veterinary, phytosanitary, etc.) at a satisfactory level?	YES	MEDIUM
	cabotage restrictions	Are there any cabotage restrictions?	NO	DEPENDING
	other	Is there an exemption obligations pilots for ships in service, which regularly touch the port?	NO	MEDIUM
		Is there an exemption obligations tugs for ships in service, which regularly touch the port?	YES	DEPENDING

## ANALYSING OF LISTED BOTTLENECKS AND THEIR CAUSATIVE RELATIONS

The first weakness is difficult to overcome, even if an efficient "last mile" connection with the nearby interport that should include the Ferruccio airport could mitigate this criticality.

As for the second aspect, the focus on the port of Bari shown below identifies the possible and partial solution to the problem in a fill outside the outer pier. In any case, the impossibility of finding adequate spaces that guarantee high standards of safety and working efficiency, makes it necessary to find important retroport areas that allow the development of the port.

As already mentioned, the port of Bari has sufficiently adequate loading / unloading and storage facilities, even if the mooring dock is too short for the ships currently in operation.

On the other hand, while proceeding with a better optimization of the use of sylos, the airport does not allow to significantly increase traffic in this sector. Among other things, we must reflect, with the current configuration of the port, on the possible conflict between the grain traffic and the necessary adaptation of the structures intended for cruises and on the lack of a real agri-food center, capable of allowing the movement of perishable goods

From an infrastructural point of view, the main weakness of the port of Bari is made up of more than modest spaces both for loading and unloading operations and for customs controls.

This slows down the boarding / disembarking operations considerably. Furthermore, the lack

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of dedicated and fast connections with the road / railway network creates many conflicts with city traffic and makes access to the port extremely slow. In contrast, the port has adequate reception facilities for passengers.

In the context of the detailed analysis of the individual ports, the POT, especially with reference to the priorities to be given to the infrastructure investment policy, has been able to grasp some specificities / critical issues that are intended to be presented below, albeit in addition.

For Bari:

- Lack of dedicated berths for container ships.
- Insufficient state-owned areas for temporary custody of containers.
- Impossibility of handling containerized dangerous goods.
- Critical issues in the simultaneous management of traffic flows, lengthening of control times on passengers (extra schengen), insufficiency and inadequacy of the pre - boarding areas, insufficient reception facilities for cruise passengers.

## Roadway and Railway



### Rail transport

The priority objectives of the investments of the fundamental railway structure, contained in the PON Infrastructures and Networks (Priority Axis I, with 1.094 billion Euros by 2023) or in the MIT-RFI Program Contract, contribute directly and primarily to the improvement of the Area Integrated Logistics Puglia Basilicata, as they represent the main corridors of communication of the ALI for exchanges outside the region. The priority investments are for:

1. Strengthening and improvement of the High Speed / High Capacity of the Naples-Bari ridge (TEN-T network and main hub for the Tyrrhenian ridge);
2. Efficiency of the Adriatic backbone aimed at increasing capacity and overcoming the limitations of shape and module for freight transport

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## Road transport

Particular attention must be paid to terrestrial integration with the railway network in order to intercept long-distance traffic that currently mainly uses the road system consisting of the Adriatic highway backbone linking Lecce, Brindisi, Bari, Foggia with northern Italy but also that towards Naples , Rome, Florence.

## PROPOSING SOLUTIONS OF BOTTLENECKS AND ANALYSING HOW IT WILL AFFECT FUTURE FREIGHT FLOWS

As regards the structural adjustments, AdSP inherited from the former Port Authority numerous projects e contracts in progress which, due to administrative continuity and contractual commitments undertaken, were managed in continuity. From the needs analysis already carried out, possible structural adjustments have already been defined which require the modification of existing regulatory plans. The final choice of the necessary adjustments and the feasibility and sustainability study of the same will be carried out downstream of the discussion with stakeholders and with local authorities, in order to metabolize and share the choices and development objectives.

- infrastructure adaptation to keep pace with the rapid evolution of the needs of the carriers (dredging of the backdrops, strengthening of the docks, rearrangement of rear - dock spaces, improvement reception of passengers, raising of intermodality.
- integration, development and accessibility of support services through the use of new technologies.
- strategic and operational marketing for the cruise and sea highways sectors.
- joining with energy and environmental planning

The road interventions, in correspondence with the access to the port in the Marisabella area, for the connection to the "Camionale di Bari", a strategic work on infrastructure and transport, in order to connect the port to the retroport areas, to the intermodal logistic nodes as well as to the main road system by facilitating the movement of passengers and vehicles and eliminating the critical issues currently existing in some, albeit limited areas of the city, for the transit of heavy vehicles in large quantities.



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## CONCLUSION

To sum up, the following conclusions that should be taken into consideration for the future activities:

Ports are among the main elements of territorial competitiveness. This is the reason why we expect to improve the services offered to the users, for increasing security and quality of life to those who daily or occasionally interact with the Port. Furthermore, we will necessarily try to overcome the challenge of quality and territorial integration with a model of governance based on innovation and institutional cooperation:

- new opportunities for port growth
- expansion of intermodal transport services and solutions for passengers
- develop the sustainable mobility and strengthen the collaboration with all possible stakeholders improve
- extend the pre-existing services to other ports of Southern Adriatic Ports Authority

Therefore necessary to have a clear picture of the convergent objectives

- Development and safety of city-port link infrastructures.
- Improvement of reception and transport services for passengers.
- Realization of an integrated information / enhancement system
- Improvement of the competitiveness of economic activities