

D.3.2.3-4 Analysis of the physical and non-physical bottlenecks in Italy and Croatia

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INTRODUCTION

In this part briefly explain about document, which work package is it part, what is the main goal off the document, and why is it important. A few words about project, work package and deliverable. Explain what is your role and what information you will provide in this report.

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.

This document will follow given methodology for bottleneck collection. The main goal of the document is to give insight in state of the art in the Port of Rijeka and show any possible flaws in traffic flows that occur. PP8 will provide all necessary information asked in methodology, such as data of traffic flows and cargo turnover in the Port of Rijeka, as well as analysed data collected from field research.

ABSTRACT

The Analysis of the physical and non-physical bottlenecks for the Port of Rijeka covers defining and characterising the area of study, the list of all the bottlenecks and undesirable effects present in the area, analysis of those bottlenecks and proposed solutions for resolving the bottlenecks.

EXECUTIVE SUMMARY

This report defines the Port of Rijeka as the area under study. The report lists all the main infrastructural, supply chain and regulatory bottlenecks. The main bottlenecks and the proposed solutions are:

No direct connection of the port with the highway – One solution is 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 solution is replacing the existing single track railway with double track.

Parking space problem - The first solution could be to change unused space for new parking lot, the second solution could be to transfer more cargo flows on railway.

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 can be easily solved by constructing vertical storage spaces. The other solutions would be to construct storage spaces outside the port area.

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, and by using ICT to better organize arrival of the ships.

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

DEFINING THE SCOPE OF STUDY

This part is necessary in correct understanding of what exactly should be researched. So, in this step scope of study will be defined and characterized in order to help us reach next step of research process. The scope of study, covers what, how, when and where the study was done including what data's were taken as inputs, what criteria were used for comparing the data, what was the outcome of the comparison. In this case, main objective of the document investigates traffic flows and bottlenecks in intermodal transportation.

The purpose of this document is to analyse bottlenecks in the Port of Rijeka. That is part of the activity D.3.2. that will analyse physical and non-physical bottlenecks in the Adriatic Area, more precisely, in six ports: 3 Croatian (Rijeka, Ploče, Split) and 3 Italian (Fusina, Bari and Ortona).

This study is done as the part of Charge project, and data about bottlenecks were collected through 2 months period of time. Data concerning freight flows and cargo turnover are collected for the years 2000-2017. This large period of time should show how port evolved in that time and what potential port has, if bottlenecks are reduced and solutions found.

Data were collected from port authority, port operators, custom administration, towing companies, veterinary, phytosanitary and sanitary inspectors, railway operators and shipping agencies and agents.

Data collected are mainly statistical data that shows turnover of cargo. There are also data about terminals and their capacity, other infrastructure and road and railway connections, as well as maritime links. These collected data will be compared with data of other big European ports in near vicinity. Data will be compared in absolute numbers and in percentage to show the development trend of the Port of Rijeka.

DEFINING THE AREA UNDER STUDY AND CHARACTERIZING RESPECTIVE AREA

It is important to define the geographical area where analysis will be conducted in order to determinate volume of data that need to be collected. Also, by characterizing area under study, we can determine the current situation of the area. That enable us to focus our analysis on current problems and help us in finding all potential bottlenecks, as well as proposing solutions for said bottlenecks to enable freight flow system to work efficiently.

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 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 m² with an open storage yard (130.000m²) and with 44.000m² arranged as covered warehouses. The rest of the space is still available for other programs and is waiting for investors.

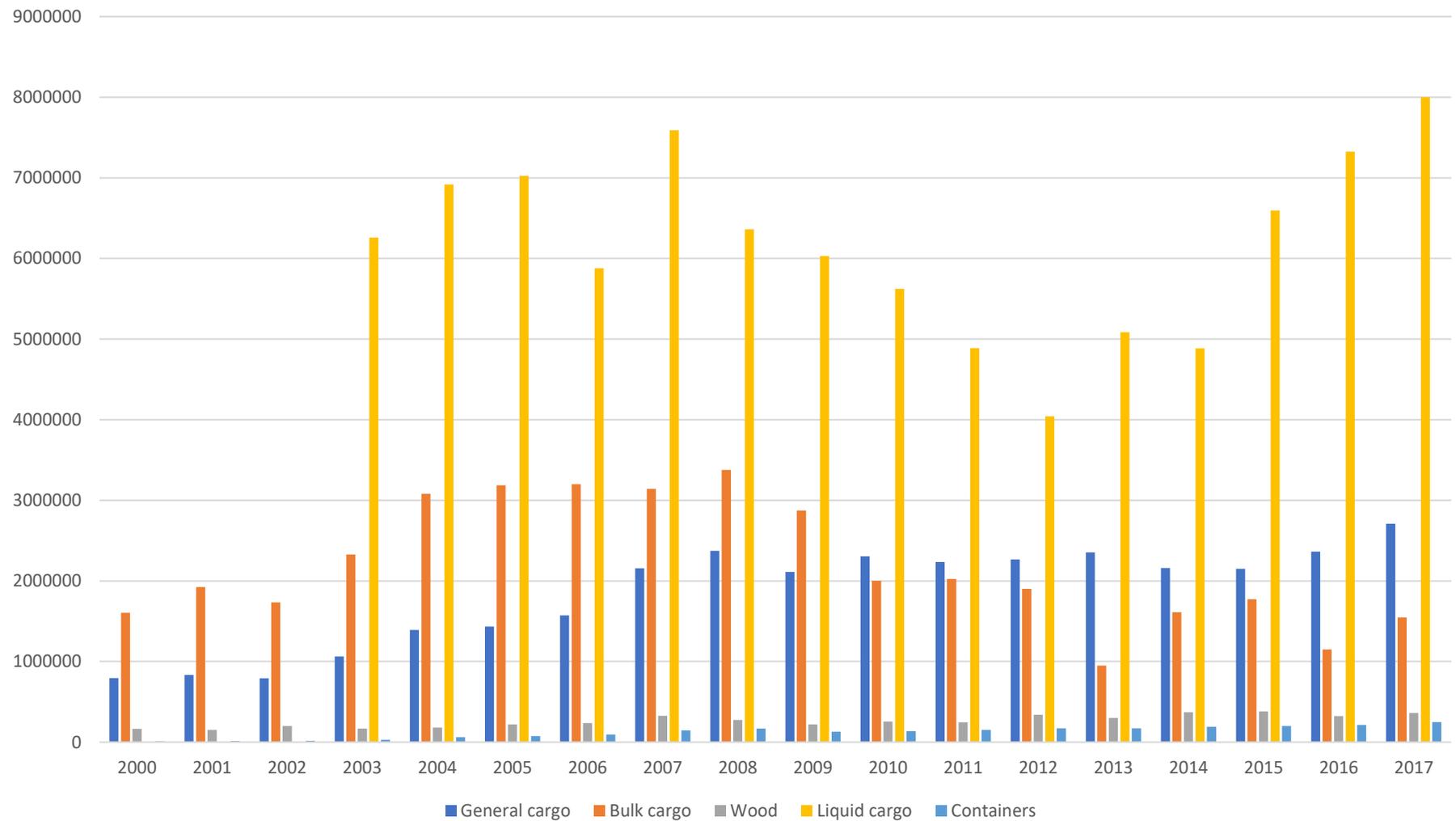
Timber terminal - The Terminal is specially equipped to handle timber and to prepare sawn timber for overseas transport.

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 510.000m².

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 containe

Cargo turnover in the Port of Rijeka



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 Haydarpaşa → 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

Please, use a table that is provided in excel file to identify current state of the art in the ports. A bottleneck is emerging when answers on questions in a table are unsatisfactory for the stakeholders. Please, explain why answers are unsatisfactory and how it is creating bottlenecks. After bottlenecks are found, they should be listed by priority.

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	
			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?	yes	
	Is the current capacity of the road infrastructure sufficient?		no	important	
	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		
	rail	safety	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	
		flow capacity	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	
	inland waterways	safety	Are the crossings satisfactory marked?	no	extremely important
			Is the current capacity of railway infrastructure satisfying?	no	extremely important
			Is it the connection of railway and road infrastructure at a satisfactory level?	no	extremely important
		flow capacity	Is it possible to dispatch the maximum allowed quantities of the train at once?	no	highly important
			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		
terminal	capacity	Is the area of the port basin sufficient?	N/A		
		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	
	work shifts	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		
a supply chain bottlenecks	information exchange	Is there a 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?	yes	highly important	
	time response	Is there a system which allows the electronic exchange of documents and communications between the driver unit and the terminal?	no		
		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	extremely important		
regulatory bottlenecks	customs	Does the shore cranes terminal have sufficient performance /capacity?	no	important	
		Does the mobile cranes terminal have sufficient performance /capacity?	no		
	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 tugs for ships in service, which regularly touch the port?	no			

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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	
			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	
		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?	yes	
	rail	safety	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	
			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?			
		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 RO-RO ramp on the terminal?			
terminal	capacity	Are the parking spaces adequately signposted for identification?	no		
		Is the capacity of a parking lot sufficient?	no	important	
		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		
		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		
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?	yes	4-5 days		
a supply chain bottlenecks	work shifts	Is it guaranteed cargo handling 24 hours a day every day of the year?	yes		
	information exchange	Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading?	no	important	
	time response	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			
	Is the cargo handling capacity of the terminal sufficient?	yes			
	Does the shore cranes terminal have sufficient performance /capacity?	no	important		
regulatory bottlenecks	customs	Does the mobile cranes terminal have sufficient performance /capacity?	yes		
		Is there in the function the VTMS system?	yes		
	inspections	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?	yes			
		Is there an exemption obligations tugs for ships in service, which regularly touch the port?	yes		

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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?	yes		
			Are there clearly marked routes for accessing the terminal and leaving the terminal in order to reach the highway network?	yes		
		flow capacity	safety	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	very important, will solve bottlenecks when completed.
	flow capacity		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		
	rail	safety	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		
			Is there adequate (satisfactory) lighting on the terminal railway infrastructure?	yes		
		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?	yes		
			Are the crossings satisfactory marked?	yes		
			Is the current capacity of railway infrastructure satisfying?	no	very important, will solve bottlenecks when completed.	
	inland waterways	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		
	terminal	safety	Is there a ramp for the loading/unloading of the trucks on the railway?	no		
Is the safety level of the port access satisfactory?						
capacity		flow 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?	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		
safety	flow capacity	Is there a storage space near the berth?	yes			
		Does the space for storage of goods have sufficient capacity?	no			
weather	flow capacity	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?	almost never			
		Is it guaranteed cargo handling 24 hours a day every day of the year?	yes			
	information exchange	time response	Is there a guaranteed flexibility in the composition of stevedoring crews and handling equipment to absorb demand peaks in loading / unloading?	yes		
			Is there a system which allows the electronic exchange of documents and communications between the driver unit and the terminal?	no	very important, will solve bottlenecks when completed.	
	cooperation	technology	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		
			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		
regulatory bottlenecks	customs	Is the cargo handling capacity of the terminal sufficient?	yes			
		Does the shore cranes terminal have sufficient performance /capacity?	yes			
	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?	no			
		Is the time required for inspection (veterinary, phytosanitary, etc.) at a satisfactory level?	no			
other	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			

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

This step help us understand real problems in freight transportation chains, and how one bottleneck can cause more than one problem, and can affect one another. In this step, all bottlenecks should be divided in categories to help us in better understanding. Also, relations between bottlenecks should be drawn, so we can see how solving of one bottleneck can help us solve the other.

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.

D.3.2.3-4 Analysis of the physical and non-physical bottlenecks in Italy and Croatia

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.