Interreg

EUROPEAN UNION

Danube Transnational Programme

DIONYSUS

Integrating Danube Region into Smart & Sustainable Multi-modal & Intermodal Transport Chains

Report on traffic flows in the Danube corridor

Deliverable D.T1.1.4

Version: 1.2

Date: 29/06/2022

Status: FINAL

Project co-funded by European Union Funds (ERDF, IPA, ENI)

Document History

Version	Date	Authorised
0.2	21/01/2022	iC
1.0	25/05/2022	iC
1.1	22/06/2022	iC
1.2	29/06/2022	iC

Contributing Authors

Name	Organisation	Email
Saša Jovanović	iC	s.jovanovic@ic-group.org
Sebastian Steinbrecher	iC	s.steinbrecher@ic-group.org
Werner Auer	EHOO	w.auer@ennshafen.at
Melanie Ebner	EHOO	m.ebner@ennshafen.at
Christina Huber	EHOO	c.huber@ennshafen.at
Karin Voglsam	EHOO	k.voglsam@ennshafen.at
Igor Barna	VPAS	igor.barna@vpas.sk
Martin Goliaš	VPAS	martin.golias@vpas.sk
Miroslav Mađarac	PAV	miroslav.madjarac@luv.hr
Vladislav Maraš	FTTE	v.maras@sf.bg.ac.rs
Danijela Pjevčević	FTTE	danijela@sg.bg.ac.rs
Aleksandar Radonjić	FTTE	a.radonjic@sf.bg.ac.rs
Monica Patrichi	MTI	monica.patrichi@mt.ro
Cristian Dobritoiu	MTI	cristian.dobritoiu@mt.ro

Name	**Organisation**	**Email**
Ion Damian	MTI	ion.damian@mt.ro
Desislava Pencheva	BRCCI	d.pencheva@brcci.eu
Srđa Lješević	PGA	srdja.ljesevic@aul.gov.rs
Živana Luković	PGA	zivana.lukovic@aul.gov.rs

Executive summary

This report brings an overview of traffic flows in the Danube countries participating in the elaboration of this deliverable. Traffic flows in all modes are presented in order to obtain a generic overview of the total quantities of cargoes moved on the transport infrastructure in the Danube region and to obtain a balanced insight into the possibilities to shift a determined share of cargo to the inland waterways transport (IWT).

In addition, project partners have identified a number of gaps and barriers for further development of IWT and inland ports, at the same time proposing a set of recommendations on how to bridge those gaps and mitigate the identified barriers. Gaps and barriers are classified into six basic categories: infrastructure, logistic and transport, political and legal, trade, economic gaps and barriers and socio-economic and environmental gaps and barriers.

In *Austria*, the only identified gaps and barriers for IWT and inland ports development were logistic barriers, manifested in the lack of viable and reliable container transport services along the Danube. Proposed remedies for this barrier included the redesign of the pricing systems for container transports and handling in ports.

In *Slovakia*, most important gaps and barriers in terms of infrastructure, are the legal uncertainties about the ownership of port infrastructure and the lack of an investment plan for the renewal and modernization of the port infrastructure, aging transshipment facilities. Moreover, the political gaps such as lack of sufficient support for the development of inland waterway transport or absence of regulated intra-port competition were also identified.

In *Croatia*, the emphasis of the gap identification was on the problems with the road and rail connection to the port, as well as the lack of physical space for expansion and unhindered and smooth cargo operations.

In *Serbia*, the most important gaps that were identified included, inter alia, outdated and inadequate transport infrastructure, lack of extended RIS services and Port Information Systems, lack of Single Window applications, lack of transport/traffic management platforms, lack of adequate vessels, fleet age, lack of automation in port operations, etc.

In *Romania*, the most important gaps that were identified included the infrastructure, quality of the port connection rail and road infrastructure, lack of port community systems, shortage of the workforce and reaching the climate neutral goal by IWT ships, which implies substantial costs.

In *Bulgaria*, the gaps are centred around the poor condition of port infrastructure, lack of high-speed roads in the north of the country (in the Danube region), poor condition and insufficient density of railroad infrastructure in the Danube Region, poor navigation conditions in the Danube River, inconsistency in the implementation of large-scale projects due to high political dynamics and poor socio-economic conditions in the Danube Region.

No inputs were received from Ukraine due to the ongoing armed conflict.

Finally, the overall gap analysis was performed, including the process of "generalization" of the gaps and barriers. This "generalization" was needed to provide a generalized view of gaps and barriers for further development of IWT in the Danube area, and it included the combination of gaps, reduction of overlapping or duplicated gaps, as well as their adjustment and replacement on the basis of their type and proposed mitigation measures.

Table of Contents

1 Table of Figures

2 Table of Tables

3 Abbreviations

Abbreviation	Explanation
IWT	Inland waterway transportation
DC	Danube Commission

4 Introduction

4.1 Scope of the report

This report summarizes the cargo traffic flows on the transport infrastructure of the Danube region and consequently reflects the market situation i.e. transport demands of all transport modes. The current and future development of transport Infrastructure on the transport corridors in the Danube Region will be considered in terms of gaps. Gaps and barriers impeding further development of inland waterway transportation are identified, such as the lack of cross-border connections, missing links or bottlenecks on other parts of the corridor which have an impact to the overall functioning, absence or insufficient quality of intermodal connections and/or their accessibility (e. g. of ports by railway lines), infrastructure gaps in urban nodes, lack of standards preventing seamless services.

In close collaboration with other reports from Activity T1.1 and T1.2, this report identifies not only infrastructural bottlenecks preventing further development of inland waterway transportation. Instead, it brings into the broader analysis the gaps and barriers of other types, such as political, economic, trade, logistic and transport and socio-economic gaps acting as hindrances for growth of volumes transported on inland waterways.

4.2 Avoidance of duplication with other reports

4.2.1 Report on cargo flows (Status quo and forecast) in Deliverable DT1.2.2

From the description of the Deliverable DT1.2.2[1] in the Application Form, as well as from its contents (submitted in June 2021) it can be seen that it analyses the current cargo flows in the Danube region on a country basis and provides forecasts. The cargo flows are specified by major cargo types. Input data came from statistical offices as well as secondary sources such as national Transport Master Plans, EU-funded studies, or other relevant projects carried out in the near past.

Deliverable D1.1.4 analyses virtually the same, as explained in the Application Form: “This report will investigate the cargo traffic flows on the transport infrastructure of the Danube region and consequently reflects the market situation i.e. transport demands of all transport modes.”

Given the description and contents of the deliverable DT1.2.2 the study team agreed not to fully repeat neither the current cargo statistics nor the forecasts. For detailed cargo statistics the reader is referred to DT1.2.2.

[1] DIONYSUS project, DT1.2.2 Report on cargo transport flows (Status quo and forecasts)

4.2.2 Report on IWT cargo potential in Deliverable DT1.2.3

Deliverable DT1.2.3 Report on IWT cargo potential[2] investigated potential cargo flows using the Danube waterway. In this analysis of IWT cargo potentials, cost comparisons to the other transport modes were elaborated for the most promising types of cargo and transport relations.

On the other hand, the current deliverable (DT.1.1.4), according to the description in the Application Form, also has to investigate the cargo flows and cargo potentials for IWT development. Since this has already been investigated in DT1.2.3 it will not be repeated here and the reader is referred to Deliverable DT1.2.3.

[2] DIONYSUS project, DT1.2.3 Report on IWT cargo potential

5 Traffic statistics in Austria

The following table[3] demonstrates the figures of import/export/transit and inland traffic of waterway transportation in tonnes in Austria from 2015 – 2020.

Year	Values	Import	Export	Transit	Inland Traffic
2015	Tonnes	4,325,020	1,763,975	1,830,025	680,335
	1000 tonne-km Inland	806,253	292,068	640,509	66,764
	1000 tonne-km Foreign Country	3,317,991	1,317,736	1,890,660	-
2016	Tonnes	4,299,854	1,975,592	2,187,190	608,842
	1000 tonne-km Inland	826,415	319,038	765,517	51,505
	1000 tonne-km Foreign Country	3,358,467	1,590,332	2,362,384	-
2017	Tonnes	4,822,231	2,380,773	2,027,367	389,148
	1000 tonne-km Inland	917,935	364,604	709,579	30,194
	1000 tonne-km Foreign Country	3,603,998	2,008,579	2,086,778	-
2018	Tonnes	3,793,364	1,776,694	1,355,564	276,747
	1000 tonne-km Inland	728,942	257,441	474,447	27,696
	1000 tonne-km Foreign Country	2,700,107	1,328,215	1,447,132	-
2019	Tonnes	4,193,339	2,258,611	1,805,896	253,708
	1000 tonne-km Inland	763,913	322,637	606,357	21,742
	1000 tonne-km Foreign Country	3,256,241	1,576,070	1,856,770	-
2020	Tonnes	3,989,282	2,060,982	1,601,604	594,913
	1000 tonne-km Inland	745,690	304,139	537,678	18,356
	1000 tonne-km Foreign Country	2,871,579	1,413,530	1,657,325	-

Table 1: IWW traffic in Austria 2015-5020

[3] Source: Eurostat

Total transportation in thousand tonnes on Inland Waterway Transportation in Austria from 2015 – 2020 is given in the following table[4]:

GEO/TIME	2015	2016	2017	2018	2019	2020
Austria	8,599	9,071	9,620	7,202	8,512	8,247

Table 2: Total IWW traffic in Austria 2015-2020

2020, 8.2 million tonnes (million t) of goods were transported on the Austrian part of the Danube. Compared to the previous year, this corresponds to a decrease of 3.1% or 0.3 million t compared to 2019. This interrupted the upward trend in 2019, which still showed an increase of 18.2% or 1.3 million t.

With a number of 8,071 transports (-0.3% or -23), a total transport performance (domestic and international routes) of 7.5 billion tonne-kilometres (billion tkm) was achieved, which is a decrease of 10.2% or 0 .9 billion tkm. On the domestic route, this decreased by 6.3% to 1.6 billion tkm. The average load factor per loaded kilometre was 57.1% and thus 5.2% below that of the previous year.

In cross-border receipts[5], a decrease in the transport volume of 4.9% or 0.2 million t to 4.0 million t was observed in 2020. Cross-border shipments fell by 8.8% or 0.2 million t to 2.1 million t, and transit traffic saw a drop in transport of 11.3% or 0.2 million t to 1.6 million t. t shown. Domestic traffic, which is less significant in terms of volume, recorded a strong increase of 0.3 million t to 0.6 million t (+ 134.5%), which was primarily due to the increased freight transport in the "stone, earth, mining products; peat" department.

5.1 Summary statistics for railway transportation

The following figure shows the development of transport volume of domestic and foreign companies on the Austrian railway network from 2015 – 2019[6].

[4] Source: Eurostat

[5] Source: http://www.statistik.at/web_de/statistiken/energie_umwelt_innovation_mobilitaet/verkehr/binnenschifffahrt/index.html)

[6] Source: Österreichische Verkehrswirtschaft 2020

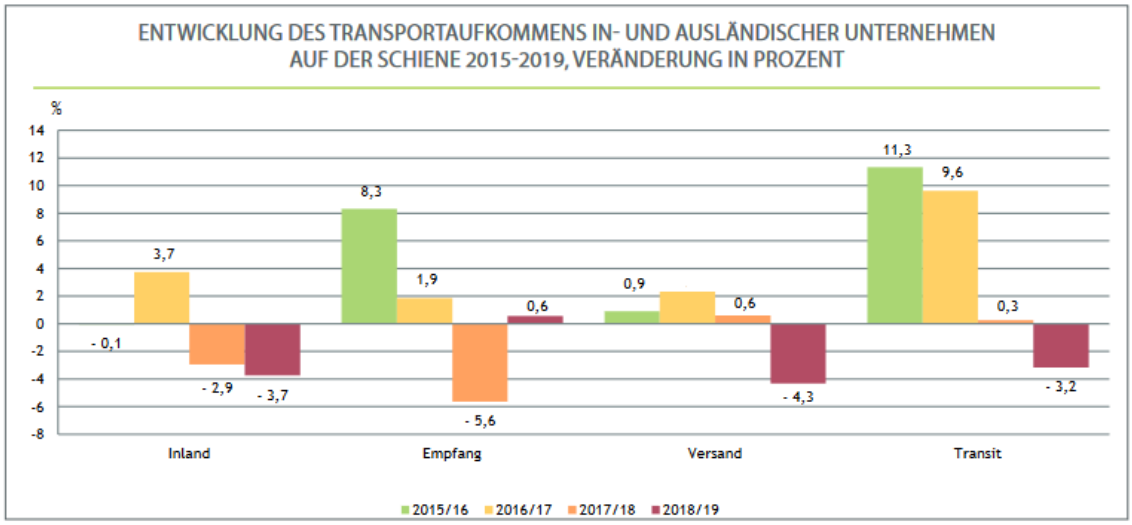

Figure 1: Railway transport statistics Austria 2015-2019

Total transportation in thousand tonnes on Railway Transportation in Austria from 2015 – 2020[7]:

GEO/TIME	2015	2016	2017	2018	2019	2020
Austria	100,163	102,835	107,579	105,271	102,575	97,512

Table 3: Total railway traffic in Austria 2015-2020

The transport volume of domestic and foreign companies on the Austrian railway network is subject to fluctuations over time, partly caused by the economic business cycles. In 2019, there was a slight increase in the reception traffic area compared to the previous year: In detail, the transport of goods in cross-border receipts increased by 0.6%. There is a 4.3% drop in cross-border shipping and it is in transit traffic 3.2% less and domestically 3.7% less goods are transported by rail[8].

5.2 Summary statistics for road transportation

The following table contains the figures of import/export/transit and inland traffic of road transportation in tonnes in Austria from 2015 – 2020[9].

Year	Values	Domestic transport	Import	Export	Transit	Other foreign traffic
2015	Tonnes	325,615,685	9,869,587	10,538,555	1,702,157	3,266,120

[7] Source: Eurostat

[8] Source: Österreichische Verkehrswirtschaft 2020

[9] Source: Statistik Austria

Year	Values	Domestic transport	Import	Export	Transit	Other foreign traffic
	1000 tonne-km Inland	14,842,993	974,554	1,153,459	189,807	-
	1000 tonne-km Foreign Country	641,404	2,534,192	2,973,940	1,100,943	1,046,233
2016	Tonnes	350,208,525	10,727,028	10,410,476	1,519,479	3,460,293
	1000 tonne-km Inland	15,766,401	1,028,624	1,118,722	176,886	-
	1000 tonne-km Foreign Country	740,694	2,540,327	2,781,517	861,169	1,123,330
2017	Tonnes	360,295,806	10,725,085	10,886,942	1,183,324	3,765,885
	1000 tonne-km Inland	16,214,139	986,985	1,075,258	123,461	-
	1000 tonne-km Foreign Country	590,364	2,492,858	2,756,050	622,221	1,117,030
2018	Tonnes	367,576,259	10,335,650	10,623,659	977,779	3,801,786
	1000 tonne-km Inland	16,393,030	971,335	1,122,707	106,536	-
	1000 tonne-km Foreign Country	521,244	2,386,269	2,624,348	560,729	1,076,671
2019	Tonnes	377,349,621	9,943,427	9,878,527	1,203,886	3,812,927
	1000 tonne-km Inland	16,693,136	1,000,051	1,063,819	148,135	-
	1000 tonne-km Foreign Country	525,383	2,403,233	2,654,649	749,560	1,263,839

Table 4: Road transport in Austria 2015-2019

Total transportation in thousand tonnes on Road Transportation in Austria from 2015 – 2020[10].

GEO/TIME	2015	2016	2017	2018	2019	2020
Austria	351,068	376,399	386,858	393,313	402,083	373,064

Table 5: Total road transport in Austria 2015-2020

The development of road freight transport in recent years has been characterised by ups and downs. In the survey year 2019, trucks with a payload of two tonnes or more and semitrailer tractors transport a total of 402 million tonnes of goods, an increase of 2.3% compared to the previous year complies.

Domestic transport is experiencing increased transport services. In detail, the change in transport volume is distributed as follows: domestically, the volume of transport

[10] Source: Eurostat

increases by 2.7%, cross-border reception is reduced by 3.8%, cross-border shipping is down 7.0% and transit is up 23.1%[11].

5.3 Summary statistics for maritime transportation

Ennshafen port is an inland port therefore no statistics for maritime transportation is available.

5.4 Gaps and barriers for IWT development

5.4.1 Infrastructure gaps and barriers

In Austria a lot of projects are on-going or planned in order to remove identified gaps and barriers. So far there are no real gaps within the ports known, which are not covered by these projects. Some of these important projects are listed below (only short form examples as these projects have been discussed in detail previous deliverables).

Project: Modernisation of transhipment facilities in Ennshafen port

Project: Construction of a port gate at Port of Vienna

Project: Neuland in port of Linz

Project: Upgrade Asten-Linz

Project: Upgrade Parndorf – Kittsee (border AT/SK)

Project: Link between Vienna Airport-Bruck/Leitha

Project: S1 Vienna Outer Ring Expressway part 1

Project: S1 Vienna Outer Ring Expressway part 2

Project: Integrated River Engineering Project Danube East of Vienna, Implementation 2016-2030

Project: FAIRway works in the RD-corridor

Project: Preparing FAIRway2 works in the RD-corridor

Project: further development of hinterland connection of Ennshafen port

Project: Alternative fuel project in Ennshafen port

Project: Feasibility study for free space zones in Ennshafen port

Project: Expansion of the existing infrastructure in the Port of Vienna

Project: Provision of *Good Navigation Status* on the Danube in Austria

Project: FAIRway Danube – Follow-up activities

[11] Source: Österreichische Verkehrswirtschaft 2020

The most important "gap" or project of great relevance on the inland waterway Danube in Austria, which should be considered here, is the section Straubing-Vilshofen in Germany. Even if measures and projects are ongoing or planned within the TEN-T-lists, this problem will remain further for the whole inland waterway, especially in Austria as traffic from or to the west will be hindered by the shallow water problems leading to lightening, stop of traffic, etc. As experienced from the last 5 years it can be expected that – even if the planned projects will be realized – this problem will stay alive for the future and makes ongoing problems for Austria even for the time after 2025. It will need ongoing international discussion to solve this problem.

5.4.2 Logistic and transport gaps and barriers

The really important barrier on the Danube, not only on the Austrian Danube section, is the absence of container business on the inland waterway. Even if there are some initiatives and a lot of political targets for modal split towards IWW there has been no establishment of permanent cargo traffics of loaded containers. A solution may be found in rethinking of transport cost in total (maybe CO2-pricing) and changings in benefits and founding principles to foster waterway business. This means an international approach and cannot be solved by one country alone – maybe and integrated CEF-project for the whole Danube region can develop a new system for the future, which can survive on the cargo market.

5.4.3 Political and legal gaps and barriers

At present, there are no specific political and legal gaps and barriers identified.

5.4.4 Trade gaps and barriers

At present, there are no specific trade gaps and barriers. But there are huge problems now in European trade systems due to current crisis in the region of Ukraine-Russia. But it is too early to describe in detail what this situation will bring to Austria within the next months/years and what solutions can be developed to overcome these barriers. We have to monitor within the next months what will come out of this crisis, maybe that afterwards some serious gaps and barriers will remain and solutions for this have to be developed urgently.

5.4.5 Economic gaps and barriers

At present, there are no specific economic gaps and barriers. The item of container business on the Danube has been mentioned above (chapter 5.5.2), probably this item can partly align under "economic gaps" – e.g., lack of competitiveness.

5.4.6 Socio-economic and environmental gaps and barriers

At present, there are no specific NEW socio-economic and environmental gaps and barriers identified, except those which are "work in progress" (means OPS, AFID, targets for 2030-2050)

5.4.7 Other gaps and barriers

At present, there are no specific other gaps and barriers identified.

5.4.8 Summary of gaps and proposed solutions

Overview of identified gaps and proposed solutions is given in the table below.

Type of gap or barrier	Gaps and barriers	Proposed solutions
railway	Connection of the Danube Region with OBR initiative	ongoing international discussions
inland waterway	Navigational bottleneck at Straubing Vilshofen section on the Danube in Germany	Ongoing international discussion
Inland waterway	No regular container business on IWW	Rethinking of cargo pricing or changings in funding systems

Table 6: Summary of gaps and barriers for IWT development in Austria

6 Traffic statistics in Slovakia

6.1 Summary statistics for inland waterway transportation

Table (below) shows that the total volume of transported commodities on the Danube River in Slovakia is between 6 and 7 million tonnes. It is the fourth highest in terms of neighbouring countries. The structure of transport suggests that Slovakia is mainly an export and transit country. Approximately 2.1 million tonnes of commodities reflect export from Slovakia on the Danube River. Transit through Slovakia, without loading or unloading in the Slovak ports, accounts for around 4 million tonnes.The transport in the "Middle Danube" is dominated by cereals and agricultural products, as it is an agriculturally strong region of Central Europe. This segment is characterized by strong seasonality depending on the harvest. At the same time, the transport heads mainly to the North Sea and short distances. That is the reason why this segment competes with road transport. The segment of iron ore and metallurgy and metals is strongly interconnected, and both show a stable tendency. Transhipment in individual ports depends on the proximity of the ironworks and steelworks.

Transport of goods total (thous. tonnes)		**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
		1 683	***1 796***	***1 780***	***1 240***	***1 509***	***1 599***
international transport total		1 664	1 733	1 765	1 210	1 481	1 580
of which	import	34	27	21	19	36	63
	export	1 313	1 402	1 551	1 057	1 112	1 168
	transit and cross trade transport	317	304	193	134	333	349
national transport		19	36	15	30	30	19

Table 7: Inland waterway freight transport Slovakia

6.2 Summary statistics for railway transportation

The railway lines in the Slovak Republic are standard built with a gauge of 1435 mm, and there are two broad-gauge lines linking Slovakia with Ukraine built between the towns of Čop and Čierna nad Tisou and the Ukrainian city of Uzhhorod and the municipality of Haniska in Slovakia.

The public port of Bratislava is connected to the TEN-T transnational railway network through the Central Freight Station. There are three railway corridors running directly through this station:

- Baltic-Adriatic Corridor in section Austria - Slovakia - Poland

• Orient - East Mediterranean Corridor in section Hungary - Slovakia - Czech Republic

• The Rhine - Danube Corridor in section Austria - Slovakia - Hungary

By rail transport mode, approximately 30% of the freight is transported in Slovakia. In terms of quality of railway infrastructure, the Slovak Republic, according to the World Economic Forum survey in 2016-2017, was above the EU average with 4.43 out of total 7 points and ranked 12th out of 26 countries. From the point of view of the completeness of the conventional rail network, Slovakia ranked on the 18th place with a total completeness of 20.17%.

Transport of goods total (thous. tonnes)		2015	2016	2017	2018	2019	2020
		47 358	**50 727**	**47 790**	**50 931**	**47 869**	**43 443**
of which transport of goods by operators of transport with the number of employees 20 and more							
Transport of goods total (thous. Tonnes)		**37 841**	**47 982**	**42 846**	**45 927**	**46 218**	**41 606**
international transport total		32 202	42 419	37 601	40 817	3 968	37 579
of which	import	14 218	16 440	16 736	17 645	14 985	13 296
	export	9 358	12 694	11 912	11 430	10 857	1 041
	transit	8 626	13 285	8 953	11 742	13 838	13 873
national transport		5 639	5 563	5 245	5 110	6 538	4 027

Table 8: Railway freight transport Slovakia

6.3 Summary statistics for road transportation

Trucks transported 42.6 million in the 2nd quarter of 2021 tons of goods. 75.7% of goods were transported in domestic transport and 24.3% in international transport. The transport of goods for own needs (to ensure its own production process) accounted for 22.2% of the total transport and the transport of goods for foreign needs (for a fee) 77.8%. Compared to the 2nd quarter of 2020, freight transport increased by 0.9%, of which in domestic transport it decreased by 4.3% and in international transport it increased by 21.1%. Performance in tonne-kilometers increased by 19.5% compared to the 2nd quarter of 2020. Of the total services, 21.6% were realized in domestic transport and 78.4% in international transport. Outputs for own needs (to ensure its own production process) accounted for 6% of total outputs and for external needs (for a fee) 94%. Compared to the 2nd quarter of 2020, performance in domestic transport increased by 4.5% and in international transport by 24.4%.

		2015	2016	2017	2018	2019	2020
Transport of goods total (thous. tonnes)		147 275	156 279	17 679	177 222	187 161	168 652
international transport total		46 581	50 432	47 951	48 317	44 268	40 719
of which	import	9 958	11 474	11 168	12 461	12 262	101
	export	12 506	12 671	12 496	14 522	13 764	13 086
	cross trade transport and international cabotage	24 117	26 287	24 287	21 334	18 242	17 533
national transport		100 694	105 847	128 839	128 905	142 893	127 933

Table 9: Road freight transport Slovakia

6.4 Gaps and barriers for IWT development

6.4.1 Infrastructure gaps and barriers

Generally inadequate technical state of the infrastructure

After creating an ownership relationship to the infrastructure, an investment plan for repairs and reconstruction of the transport infrastructure in the port is required. For these purposes, there is potential for using external resources (e.g. EU funds), provided that the port operator is able to declare/prove ownership of the subject of modernization.

It is recommended to develop an investment plan for the renewal of the infrastructure and the reserve fund for its ongoing maintenance

It is recommended to implement and evaluate measurable performance indicators - investments in infrastructure modernization [mil. EUR]; length of upgraded road and rail infrastructure [km].

Inadequate technical state of the transshipment technologies

The transshipment technologies in the port are at the final stage of their lifecycle and require a substantial upgrading to secure the transshipment standards.

It is recommended to implement operational standards in the Operating rules of public ports aimed at the minimal technical level of transshipment technologies

It is recommended to implement and evaluate measurable performance indicators - the speed of transshipment of one ton of bulk goods [s]; loading speed of one container [s]; number of transshipment technologies meeting standards [n]

Insufficient parking space for trucks

Construction of new parking capacities in the port for truck parking. This is particularly necessary in order to increase the volume of traffic and associated port traffic.

It is recommended to define parking spaces for trucks in the port and in the Operating rules

It is recommended to establish and evaluate measurable performance indicators - area for truck parking [m2]

Problematic railway system in the port

In view of the dangerous crossing of road and rail infrastructure at several points in the port, as well as the inappropriate shifting of trains to certain tracks, it is necessary to consider reconstruction of existing railway system.

It is recommended to assess the possibility of a technical solution for alternative railway system in the port.

6.4.2 Logistic and transport gaps and barriers

Inability to use the Váh waterway for freight transport

Several strategically important enterprises that produce commodities exported abroad are situated in the north-western part of Slovakia in the catchment area of the Váh waterway. The Váh river has a proven international transport significance, but several power plants are built along its flow without sailing chambers, thus preventing the passage of vessels. Coordination of energy, water-use and transport interests, as well as unambiguous support from the state is necessary in order to enable the use of Váh waterway for the purpose of water freight transport.

It is recommended to develop definitive concept focusing on the future use of the Váh waterway.

It is recommended to allocate financial resources to remove critical bottlenecks according to the action plan

It is recommended to establish and regularly assess measurable performance indicators to monitor the navigability of the Váh river - number of navigable kilometers [km]

Absence of necessary data (VPAS)

It is necessary to establish a record of data concerning the transport and transshipment of goods. Consequently, it is recommended to introduce a data control and evaluation system that will allow continuous optimization of port operations.

It is recommended to maintain a relationship and implement data interfaces with tenants in the port for the collection and statistical evaluation of relevant data.

6.4.3 Political and legal gaps and barriers

Insufficient support for the development of inland waterway transport

Inland waterway transport represents an interesting potential for the Slovak Republic at the time of increasing ecological and economic requirements. One problem, however, is insufficient state support in the area of its development.

It is necessary to promote water transport as a sustainable mode of transport, which has the potential to bring economic benefits, e.g. due to the high capacity of the goods transport.

It is necessary to develop a long-term concept of inland waterway development, establishing action plans and allocating sufficient resources

It is recommended to establish and ongoingly evaluate measurable performance indicators - investments in inland waterway transport [mil. EUR]; number of promotional materials produced [n].

No internal competition in the port

Resolving property rights within the port aiming to create an open market environment allowing entry of new transshipment operators into ports of Bratislava and Komárno.

It is recommended create a formal contractual ownership relationship to port infrastructure

It is recommended search proactively for new operators for unused port capacities.

6.4.4 Trade gaps and barriers

Decrease in iron ore transshipment segment

Number commodity transshipped port of Bratislava is iron ore, that is mined in Ukraine, then transported by rail to the port. Ports serves the purpose as the hub where iron ore is loaded to vessels that continue to Austria. Current development in Ukraine will have negative impact on the volume of transshipped iron ore.

To solve this issue, mines must be fully operational again.

6.4.5 Economic gaps and barriers

Unstable navigability on the Danube River

A necessary step for the development of transport and transshipment activities in the Bratislava port is to improve the quality of water transport and to ensure the fulfillment of international conditions and obligations requiring the navigability of the Danube waterway at 300 days / year. To that end, it is necessary to clearly define competences in the field of care for waterway maintenance and to allocate sufficient funds to solve the bottlenecks. In addition, it is also essential to address the critical

points together with the border states on the other side of the Danube River (Hungary and Austria).

Develop a bilateral agreement with border countries on technical solutions to remove critical points and improve the Danube navigability.

It is recommended to develop an action plan to address navigability at national level.

It is recommended to allocate financial resources to remove critical bottlenecks according to the action plan.

It is recommended to implement and evaluate measurable performance indicators to monitor Danube navigability - number of full navigation days in year [n / year].

6.4.6 Socio-economic and environmental gaps and barriers

Human resources and technical skills

It is clear from the above data that the number of inland waterway workers has been rapidly decreasing, with a decrease of almost 30% between the years 2013 and 2016. This fact poses a significant problem to the public port of Bratislava.

There is no precise statistics on the number of employees of individual companies operating in the port of Bratislava, but it is generally possible to estimate that it currently employs approximately 220 to 270 workers. The project partner, VPAS, employs approximately 20 to 30 employees, with the majority of activities being of administrative nature, which is mainly focused on port management and land lease.

The dominant port operator and transport operator in the public port of Bratislava is SPAP, whose history dates to 1922, when its legal predecessor was company called Czechoslovakian Danube Shipping. The specific scope of knowledge and skills of staff in this private company is not available, however from the long history it can be estimated that SPAP has deep technological know-how in the transshipment activities and transportation of goods. The tri-modal container terminal at the Pálenisko basin, which is owned and operated by SPAP, was built at the end of the 1970s, which also highlights the long experience in transshipment and transport of containers. SPAP has an established quality management system in line with the ISO 9001: 2015 standard applicable to river transport of goods, transshipment, and warehouse operation, as well as operation of container terminal and customs services.

To maintain the critical skills, it is necessary, inter alia, to promote the training of water transport workers, in particular crew members. Currently, there is a shortage of skilled workers, with a large proportion of them retiring soon. This is mainly due to lack of professional learning opportunities in education, as well as the critical employment situation in this sector.

6.4.7 Summary of gaps and proposed solutions

Overview of identified gaps and proposed solutions is given in the table below.

Type of gap or barrier	Gaps and barriers	Proposed solutions
Infrastructure gaps and barriers	Generally inadequate technical state of the infrastructure	• develop an investment plan for the renewal of the infrastructure and the reserve fund for its ongoing maintenance • implement and evaluate measurable performance indicators - investments in infrastructure modernization [mil. EUR]; length of upgraded road and rail infrastructure [km].
	Inadequate technical state of the transhipment technologies	• implement operational standards in the Operating rules of public ports aimed at the minimal technical level of transshipment technologies • implement and evaluate measurable performance indicators - the speed of transshipment of one ton of bulk goods [s]; loading speed of one container [s]; number of transshipment technologies meeting standards [n]
	Insufficient parking space for trucks	• define parking spaces for trucks in the port and in the Operating rules • establish and evaluate measurable performance indicators - area for truck parking [m2]
	Problematic railway system in the port of Bratislava	• assess the possibility of a technical solution for alternative railway system in the port
Logistic and transport gaps and barriers	Several strategically important enterprises that produce commodities exported abroad	• to remove critical bottlenecks according to the action plan • It is recommended to establish and regularly assess measurable performance indicators to monitor the navigability of the Váh river - number of navigable kilometres [km]
	Absence of necessary data (VPAS)	• maintain a relationship and implement data interfaces with tenants in the port for the collection and statistical evaluation of relevant data.

Type of gap or barrier	Gaps and barriers	Proposed solutions
Political and legal gaps and barriers	Insufficient support for the development of inland waterway transport	• promote water transport as a sustainable mode of transport, which has the potential to bring economic benefits, e.g. due to the high capacity of the goods transport. • develop a long-term concept of inland waterway development, establishing action plans and allocating sufficient resources • establish and ongoingly evaluate measurable performance indicators - investments in inland waterway transport [mil. EUR]; number of promotional materials produced [n]
	No internal competition in the port	• create a formal contractual ownership relationship to port infrastructure • search proactively for new operators for unused port capacities.
Trade gaps and barriers	Decrease in iron ore transhipment segment	• mines to be fully operational again.
Economic gaps and barriers	Unstable navigability on the Danube River	• develop an action plan to address navigability at national level. • allocate financial resources to remove critical bottlenecks according to the action plan. • implement and evaluate measurable performance indicators to monitor Danube navigability - number of full navigation days in year [n / year].
Socio-economic and environmental gaps and barriers	Human resources and technical skills	• promote the training of water transport workers, in particular crew members.

Table 10: Summary of gaps and barriers for IWT development in (Slovakia)

7 Traffic statistics in Croatia

7.1 Summary statistics for inland waterway transportation

Below figure reflects total transhipment of good in Croatian inland ports, in Vukovar, Osijek, Slavonski Brod and Sisak. Moreover, the major amount of goods transhipment is recorded in Danube port, more precisely in Port of Vukovar which is 50% of total transhipment. When we look into distribution on international and national goods transhipment, most of transhipment goods is from international transhipment and it covers 80% of total transhipment, while the share between unloaded and loaded cargo is almost the same where unloaded cargo is slightly higher with 54% of total cargo.

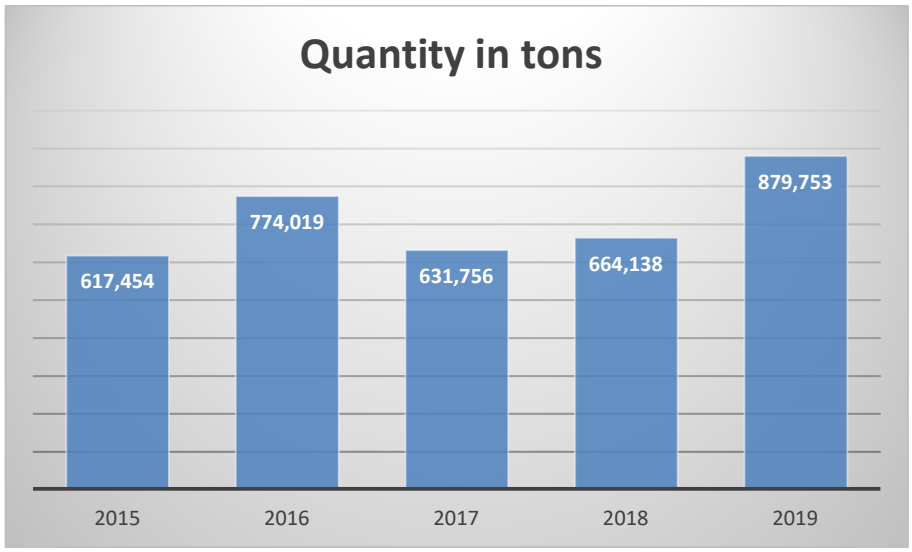

Figure 2: Statistics of goods transshipment in inland ports

7.2 Summary statistics for railway transportation

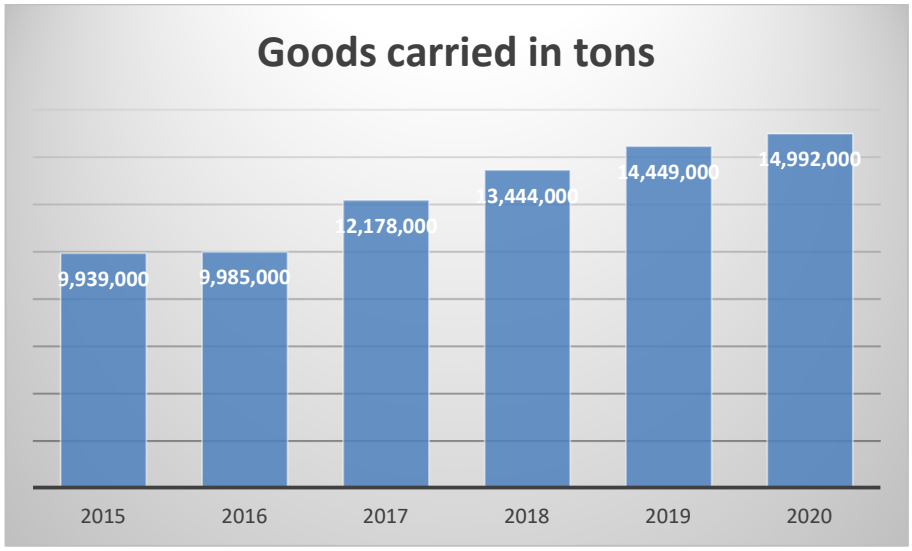

Figure 3: Statistics of goods carried in railway transport

From the above figure which shows total cargo carried by railways, it is visible slightly but continuously increasing of cargo volume in railway transport. Furthermore, when we look at exchange of the goods in railway transport with Danube countries, it covers 25% of total carried goods, while the higher amount refers to unloading cargo from Danube countries with covers of 75% of total cargo exchange between Danube countries. Nevertheless, it worth indicated that a low quantity of cargo transhipment in port of Vukovar is carried by railway in yearly average amount of 235.000,00 tons.

7.3 Summary statistics for road transportation

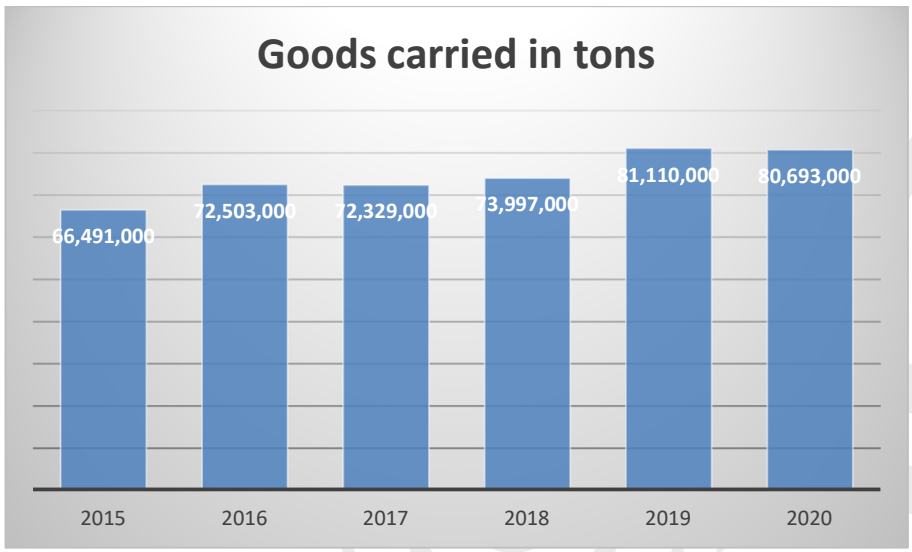

Figure 4: Statistics of goods carried in road transport

Above graph shows total cargo carried by road it is visible slightly but continuously increasing of cargo volume in road transport. Compering with other modes of transport road transport covers a major amount of carried goods, while shown in precent it covers 64% of total goods carried by all modes of transport.

7.4 Summary statistics for maritime transportation

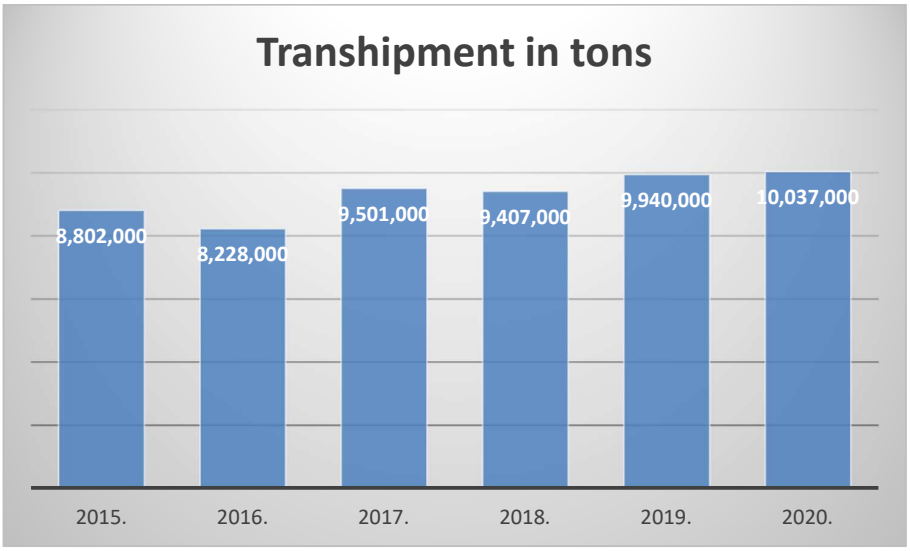

Figure 5: Annual transshipment of cargoes in Croatian seaports 2015-2020

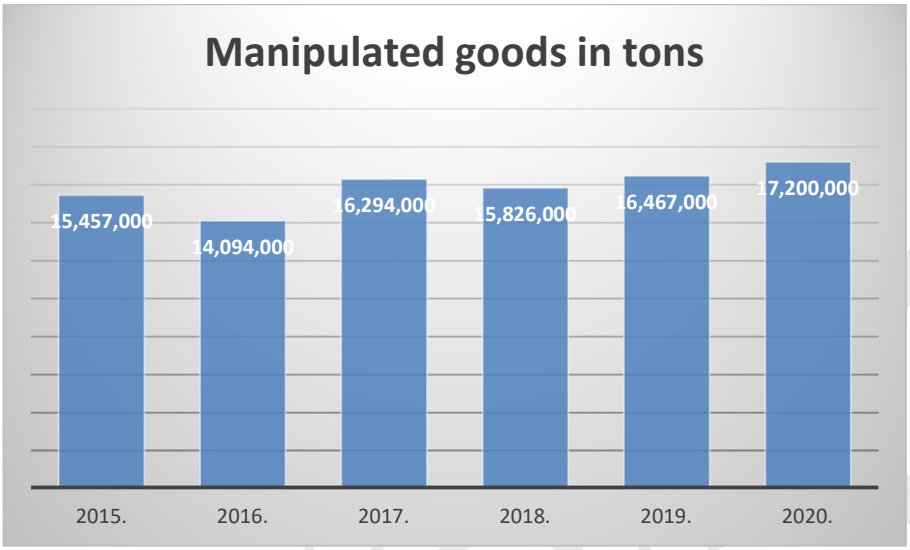

Figure 6: Annual handling of goods in Croatian seaports 2015-2020

Comparing transhipment of goods in the seaports with inland ports it is significant difference, while at the yearly basis it is average higher more than ten times regarding

transhipment in inland ports. Furthermore, manipulated tons in seaport are almost twice as higher as transhipment in seaports.

7.5 Gaps and barriers for IWT development

7.5.1 Infrastructure gaps and barriers

Railway connection with the port

The M601 Vinkovci -Vukovar railway serves as a railway connecting the RH1 and the only Croatian inland port of the basic TEN-T network on the Danube, Vukovar. This line is important for freight traffic and must meet the minimum technical criteria in terms of axle load and useful length of receiving and dispatching tracks, therefore the line is currently in the process of reconstruction and modernization. The M601 railway is used for cargo traffic, as well as for passenger traffic in the total length of 18,71 km. In its total length the railway is a single-track unelectrified railway and has allowed axle load up to 20 tons per axle. Current speed that trains can be driven is from 20 up to 50 km/h, while maximum length of the train composition is from 416 up to 784 m.

Upgrading and electrification of the railway line from Vinkovci to Vukovar, 18.71 km long, sections important for international traffic, will enable an increase in the volume of railway traffic and transhipment of goods in the port of Vukovar and better connection of railway passenger transport of Vukovar-Srijem County with main transport corridors and other counties, and will have a particularly positive impact on the comfort and safety of travel as part of daily passenger migrations.

With the modernization, the Vinkovci - Vukovar section will be capable of train speeds of a maximum of 120 km/h, which will reduce travel time by about 50 percent and the journey in passenger transport will last 20 minutes, and in freight 30 minutes. Electrification of the section will ensure more economically and energy-efficient and environmentally sustainable railway transport. The capacity of the section will be increased and the access to the port of Vukovar will be improved, which will make it, located on the TEN-T corridor Rhine - Danube, well connected with Corridor RH1, the former X. Pan-European Corridor. The modernization of the railway from Vinkovci to Vukovar will contribute to the economic development of the local community and the recovery of the eastern part of Slavonia.

Road connection with the port

Cities Ilok, Otok, Vinkovci, Vukovar and Županja are interconnected by state roads, while other populated places within the county are connected by local and county roads and also some of them with state roads. Due to the relocation of heavy freight traffic, faster flow of vehicles in transit and increase in traffic safety segment, bypasses are needed around the towns of Vinkovci, Vukovar and Ilok (e.g., corridor of the state road D2 passes through the center of the city of Vukovar).

The projects are currently being prepared while some of the construction projects have already started, and some sections have already been built and are in use within the operations performing on public road networks. Corridor X has well-built highways. In addition, connections to the corridor X are well-built federal roads, so

along Corridor X one can speak of good transport network. Corridor Vc is also a motorway, so a high standard and quality is ensured here as well. The Port of Vukovar is located near the intersection of Corridor X and Corridor Vc and thus benefits from well-built road infrastructure.

There are good transport connections with the neighboring countries of Bosnia and Herzegovina, Hungary and Serbia. Vukovar is 16 km away from the town of Vinkovci which is the largest railway hub in Croatia. It is well connected by the state road D55 via Vinkovci with the 39 km distant junction Županja on the highway A3 Zagreb-Lipovac. It is connected to Osijek, 33 km away, by the state road D2, via which Vukovar is connected to the Vc corridor (A6 motorway).

The position of Vukovar will become even more favorable with the implementation of regional spatial plans that include investments in regional transport infrastructure. Construction of a four-lane Vukovar bypass as part of a multimodal junction (railway-road-river), construction of expressways that will connect Vukovar with corridors X and Vc on the one hand, and with border crossings on these corridors on the other.

Port area lack of space

The Port of Vukovar is very well situated on the Danube, which makes it possible for the Port to be accessible during the whole year regardless of the water level. There is an acute shortage of space, especially regarding the manipulative space between the water side and the rails, as well as traffic areas for arrival and departure. The layout of the Port area, particularly the access to railway tracks and the quay operational area, are technologically inappropriate and not compatible. Altogether, it affects the quality of the service which can be provided in the Port and thus decreases the competitiveness of the Port.

The Port area is of a very specific shape, with several natural obstacles that restrict Port activities. The Port of Vukovar extends to a total of 38.53 ha, of which the land part occupies 22.10 ha and the water part occupies 16.42 ha. It is evident that there is a lack of space to expand the Port. In the port area there is located unused part of the Port in which it is possible to construct port structures and thus put into operation a space that is not currently operational. Unused space could be used for accommodation of the vertical quay and associated tracks and port roads, storage, and manipulative areas. Furthermore, the solution is in the construction of port roads, storage, and manipulative areas within unused port area, with main goal to provide a better and more reliable road connection between the two parts of the port and to increase the storage capacities, which are insufficient due to the structure of the goods in the Port. With the implementation of the construction project, an area of approximately 3 hectares is put into operation.

7.5.2 Logistic and transport gaps and barriers

Port Community system

Currently all port users use their own electronic platforms for different kind administration activities related to vessels docking, control of entry / exit of freight vehicles, as well as rail wagons and cargo. Furthermore, administrative procedure is

different in all authority which are actively involved in port community. To achieve fastest flow of traffic and cargo within port area all information related to port activities and administrative procedure should be visible at in the same and in the real time to all administrative bodies involved in port activities, as well as to initials of activities, such as port users, logistic companies, port agents... However, to achieve the afore mentioned goals, a harmonization of port administration procedure should be done through creation of unique electronic platform such as the Port Community System.

7.5.3 Political and legal gaps and barriers

Cross sector strategic documents validity period harmonization and Methodology for sector specific projects coordination

Water Management Strategy (Official Gazette 91/2008) (further: WMS) was prepared in 2009 and it covers period until 2038. It is a long-term strategic document which gives the vision, mission, goals, and assignments of the State policy in the field of water management. It gives strategic commitments and directions towards water management development. It gives the framework for strategies and zoning plans preparation, environmental protection, nature protection and other sectors which depend on waters. Water management relates to socio-economic environment.

The contents of the WMS are water condition, water management condition, objectives and determinants and implementation.

Inland waterways are included in the water management part, they are covered with the Chapter 3.4.5. This Chapter describes inland waterways in Croatia, gives the statistics about the transshipment volumes mentioning relevant national Inland Navigation and Ports Act and international documents. It is stated that waters and hydro-constructions projects in the frontier region on inland waterways on Drava, Sava and Danube are done in close cooperation with neighbouring countries, except Serbia, in line with international bilateral agreements.

Inland waterways development should be based on mid-term development plans for the inland waterways and ports which are to be in line with water area management plans.

WMS should support and enable inland waterways and ports development and it also should give the main directions considering the water management that is the field covered with Water Act (Official Gazette 66/19, 84/21) and is under competence of Croatian Waters. Ministry of Sea, Transport and Infrastructure, inland port authorities and Croatian Waters should all benefit from the divided jurisdiction and from cooperation.

Strategic documents from water and inland sector should be harmonized in the period of their validity. Projects that are of interest for both, water and inland navigation sector should be up to date and coordinated.

7.5.4 Trade gaps and barriers

Not identified at this moment.

7.5.5 Economic gaps and barriers

Not identified at this moment.

7.5.6 Socio-economic and environmental gaps and barriers

Improving the energy efficiency of the transport system

According to the guidelines for the development of the trans-European transport network, encouraging the efficient and sustainable use of infrastructure is one of the priorities in infrastructure development. In this regard, it is necessary to raise the level of energy efficiency and identify low-carbon energy sources and propulsion systems as a priority. Development of future studies should aim to analyze specific requirements.

7.5.7 Summary of gaps and proposed solutions

Overview of identified gaps and proposed solutions is given in the table below.

Type of gap or barrier	Gaps and barriers	Proposed solutions
Infrastructure gaps and barriers	Railway connection with the port	Upgrading and electrification of the railway line from Vinkovci to Vukovar
Infrastructure gaps and barriers	Road connection with the port	Implementation of regional spatial plans that include investments in regional transport infrastructure
Infrastructure gaps and barriers	Port area lack of space	Construction of port roads, storage, and manipulative areas within unused port area
Logistic and transport gaps and barriers	Port Community system	Harmonization of port administration procedure through unique electronic platform
Political and legal gaps and barriers	Cross sector strategic documents validity period harmonization	Strategic documents from water and inland sector should be harmonized in the period of their validity
Political and legal gaps and barriers	Methodology for sector specific projects coordination	Projects that are of interest for both, water and inland navigation sector should be up to date and coordinated.
Improving the energy efficiency of the transport system	Improving the energy efficiency of the transport system	Development of future studies with aim to analyse specific requirements for energy efficiency in IWT

Table 11: Summary of gaps and barriers for IWT development in (Croatia)

8 Traffic statistics in Serbia

8.1 Summary statistics for inland waterway transportation

The data on cargo transport by inland waterways refer to transport activities realized by companies and organizations registered for transport activities, regardless of whether the transport was performed inside or outside the national boundaries and for domestic or foreign users. The inland waterway transport operations are shown in ton-kilometres and reflect operations in transport carried out inside as well as outside the territory of the Republic of Serbia.

Domestic inland waterway cargo transport carried out by vessels under national or foreign flag covers the overall traffic at Serbian river ports, including other loading and unloading places out of ports.

Cargo loading or discharging at river ports and places out of ports refers only to realization of activities performed by companies responsible for cargo handling on the operational quays. It is mainly smaller than the overall throughput at river-ports by its volume.

Registered fleet in inland waterway transport refers to the capacity of cargo vessels over 50 tons or vessels with main engines exceeding 37 kW.

The data on cargo transport by inland waterways are presented in the following tables.

Years		2016	2017	2018	2019	2020
Navigable inland waterways (km)		1613	1613	1613	1613	1613
Cargo vessels	Total number	152	152	123	110	116
	Carrying capacity (1000 tons)	171	171	141	118	122
Self-propelled vessels, barges (number)	Self-propelled vessels	17	17	12	12	12
	Barges	111	111	88	78	78
Self-propelled vessels, barges, by carrying capacity (tons)	Self-propelled vessels	14948	14947	12264	12161	12161
	Barges	155666	155666	128351	106078	106078

Table 12: Summary of navigable inland waterways and cargo vessels registered in Serbia

Years			2016	2017	2018	2019	2020
Ton-kilometers, million			927	725	580	727	558
Cargo transport (1000 tons)	National transport		1142	720	1045	970	1090
	Exports		121	133	151	195	221
	Imports		749	591	297	458	276
	Transit		2	4	60	64	15
	Traffic between foreign ports		–	–	–	10	–
Cargo loading or discharging (1000 tons)	Total cargo	Total	8411	7112	8570	10821	9368
		Loading	3594	2638	3432	4676	4957
		Unloading	4817	4474	5138	6145	4411
	National cargo	Total	2284	1440	2236	2170	2410
		Loading	1142	720	1118	1085	1205
		Unloading	1142	720	1118	1085	1205
	International cargo	Total	6127	5672	6334	8651	6958
		Exports	2452	1918	2314	3591	3752
		Imports	3675	3754	4020	5060	3206
	Transit cargo	Total	3812	3351	2844	3629	3436
		Upstream	1827	1660	1739	2274	1927
		Downstream	1985	1691	1105	1355	1509

Table 13: Summary of cargo transport in Serbia

Data presented in the above reveals that twice the actual transport volume could have been accommodated by almost all waterways and that the capacity reserves of the fleet can be assumed to be about 30%.

8.2 Summary statistics for railway transportation

The data on cargo transport by railways refer to transport activities realized by companies and organizations registered for transport activities, regardless of whether

the transport was performed inside or outside the national boundaries and for domestic or foreign users. The railway transport operations are shown in ton-kilometres and reflect operations in transport carried out inside as well as outside the territory of the Republic of Serbia.

The data on cargo transport by railways are presented in below table.

		2016	2017	2018	2019	2020
Type of tracks	Single gage	3471	3441	3436	3428	3044
	Double gage	295	323	288	296	289
	Electrified	1279	1278	1272	1272	1290
Locomotives (number)		306	226	211	239	255
Freight wagon stock (number)		7227	6781	6843	5661	5661
Goods carried	Ton-kilometers, million	3087	3288	3932	2861	2612
	1000 tons	11896	12352	13449	11475	10118
Employees in railway transport (number)		13641	11328	10226	10703	10587

Table 14: Summary of railway transportation

8.3 Summary statistics for road transportation

The data on cargo transport by roads refer to transport activities realized by companies and organizations registered for transport activities, regardless of whether the transport was performed inside or outside the national boundaries and for domestic or foreign users. The road transport operations are shown in ton-kilometres and reflect operations in transport carried out inside as well as outside the territory of the Republic of Serbia.

		2016	2017	2018	2019	2020
Roads by types of surfacing and economic importance (kilometers)	National roads, Class I	4644	4142	3890	3864	3865
	National roads, Class II	11392	10743	10040	9651	9662
	Provincial (municipal)	29374	29346	30037	30402	30453

		2016	2017	2018	2019	2020
	roads					
Freight Vehicles (number)		5219	5555	7281	8223	10064
Cargo	carried (1000000 tons)	10,0	10,2	13,1	15,9	15,6
	Ton kilometers, million	4299	4980	6443	8175	7741
Employees in road transport (number)		16266	16307	20648	21296	23707

Table 15: Summary of road transportation

Taking into account road congestion and bottlenecks along the main routes of the railway network, the question of the reserve capacity of inland waterway transport has gained prior importance.

8.4 Gaps and barriers for IWT development

8.4.1 Infrastructure gaps and barriers

Investigating the development of safety of navigation, flexibility of loading and unloading in ports and sustainability of IWT over other modes of transport helps identify the following gaps and barriers: navigation restrictions in critical sectors of fairways in Serbia, dependence of transport from current climatic factors and climate changes, dynamic changes of hydro-morphological regime, old handling equipment in ports, low connectivity of port area with national railway and access roads, lack of port storage facilities and short length of operational quay.

In order to find solution for restrictions in critical sectors of fairways in Serbia, dependence of transport from current climatic factors and climate changes, dynamic changes of hydro-morphological regime it is possible to make the following actions: hydrographic riverbed monitoring and surveying, water level measurements and monitoring, fairway dredging and marking the fairway. The outcome of the actions should be mid-to-long term evaluations of the changes in the morphology of the riverbed, flood alerts and water level prognosis models and improvement of safety and navigability of inland waterways.

Solutions for gaps and barriers related to ports include improvement of pertaining port infrastructure and superstructure like expanding the port area, building a new quay and port roads, building open-space storage facilities, building more operational

railway tracks which can connect ports to the national railway network and acquisition of new handling equipment.

8.4.2 Logistic and transport gaps and barriers

Logistic and transport gaps and barriers play an important role in moving physical resources across the globe. We identified and analyzed gaps and barriers in logistic and transport which are associated with IWT development. Several gaps and barriers were selected from the literature and they are: lack of RIS and Port Information Systems, lack of Single Window applications, lack of transport/traffic management platforms, lack of adequate vessels, fleet age , lack of automation in port operations , missing of ship operations and capacity reserves of fleet.

RIS and Port Information Systems enable the digital supervision of fairway marks and thus much faster detection of dislocated buoys and provision of precise information to navigation users through electronic charts. They enable gathering of up-to-date riverbed data required for efficient marking and dredging interventions and improve dynamic fairway marking approach. River information system must also be instituted to promote sharing of information between ports and also enable cargo tracking by customers.

Ports and other loading and unloading centres, border crossings as well as their custom procedures are one of the major gaps and barriers in logistic and transport. Delays at border crossings and ports caused by lengthy, complex procedures and excessive paperwork could create a negative impact on trade mainly in terms of time and cost. A Single Window application allows exchange of information between all parties involved in trade in order to reduce the complexity, time and costs. However, the most critical challenges of Single Window application are lack of government support, inadequate coordination between stakeholders and organization and human resistance to change. The solution to those challenges requires government and high-level strategic decision makers to actively take their parts in the creation of political will and inter part collaboration.

The existence of transport/traffic management platforms may encourage operational exchange of transport/traffic data related to cross-border information services. It can also preserve a good navigation status and increase commitment of various stakeholders attracting new transport flows.

The majority of today fleet does not reflect the real situation in terms of freight transport needs, reduction of harmful emissions and fuel consumption.

Gaps and barriers like fleet age has the greatest impact on the increased harmful emissions, intensified consumption of fossil fuels while the inadequate vessels influence current demands for transport.

It can be overcome with innovations in propulsion plants and fuels (including innovative energy sources and innovative propulsion systems) and modern design concept of ships. According to Grendel project innovative energy sources include hydrogen in combustion engines, innovative energy storage solutions, new diesel fuels, dual fuel hydrogen diesel combustion engines, fuel cells, hydrogen fuel cell technology and drop-in fuels. Innovative propulsion systems include electric

propulsion, ambient water transmission, side-by-side propeller, gas and gas-electric propulsion, diesel-electric propulsion and stage v emissions engines. Modern design concept of ships focuses on the promotion of new types of hull forms that can reduce wave-making resistance, on hull-propeller interaction as well as on type of a ship, speed and cargo-carrying capacity.

Lack of automation in port operations as a gap can lead to supply-chain woes which is closely related to terms called "inefficient ports".

Ships idling on the anchorages and waiting to offload cargo impose serious costs which are reflected in: shortages bind to retailers, slowed production of manufacturers, spoiled cargoes and eventually loss of customers.

A crucial factor for overcoming lack of automation is to organize labor which covers introduction of workers with their interests and possible gains. Other actions involve automation of port operation although it won't make sense at every port, but its potential benefits are almost unthinkable. It could make shipping cargoes faster, safer, greener and cheaper. It could ease congestion, boost economic growth and reduce consumer prices.

Missing of ship operations have a special place as a gaps and barriers as they trim the efficiency and productivity of port logistics and causes possible damage to cargos equipment failure, accidents during cargo handling, mishandling of equipment and could cause tremendous damage and loss to cargo. All of that is a result of inadequate, defective and over-aged cargo handling equipment in ports. Accidents and mishandling of cargo at ports, decrease the overall efficiency and incur other costs such as handling costs, accident costs, transport costs, etc. To overcome the problems, it is recommended to install new equipment that will overcome the existing shortcomings.

The capacity reserves of the fleet in the logistic chain depends on several factors and can be assumed to be about different percentages. If the operational rationalization potentials like reduction of port waiting times, reduction of non-productive empty trips, extension of lock-operating periods and use of modern communication technology are activated capacity reserves of the fleet can be significantly reduced allowing an increase of economic benefits of IWT for Serbia.

8.4.3 Political and legal gaps and barriers

Four gaps and barriers are identified and analysed in this subchapter. They are: lack of harmonization of national legislation with the EU legislation, administrative restrictions, complicated border procedures for crossing into/out of EU and outdated regulations.

In order to overcome the lack of harmonization, Republic of Serbia opened Cluster 4 in which Chapter 14 – Transport Policy and Chapter 21 - Trans-European Networks – Green Agenda and Sustainable Connectivity are found. However, problems are not solved, in fact they are just deepened with a bad implementation of laws and regulations and with the way the laws are adopted. The solution is in courageous political decisions that will be in line with Strategy for sustainable and smart mobility in the western Balkans.

Fighting against administrative restrictions as well as regulatory complexity include administrative simplification as the most effective method on the political and policy agenda in most countries and improvement of administrative capacities. Administrative simplification involves cutting filling out unnecessary paperwork, and complying with excessive administrative procedures and requirements such as licenses. Improvement of administrative capacities starts as a cooperation with all competent authorities and organizations in the fields of civil engineering, transportation, infrastructure, water management and environment protection. It is crucial for proper planning of the waterway infrastructure projects and development of inland waterway traffic in the Republic of Serbia.

In its entirety border procedures for crossing into/out of EU comprise of decisions and measures which are taken along the borders. Officials carry out inspection services, in accordance with European Union and national law. Special importance should be given to improvement and standardization of the inspection services in charge of navigation safety control procedures for all types of foreign and local vessels. The procedures in emergency situations on the waterways need to be standardized and improved, especially for hazardous cargo transportation.

The problem with outdated regulations may arise when rules in regulations are not in accordance with the development of new technology and new safety knowledge and performance criteria are only applied to a limited degree. This has two main drawbacks: technical solutions specified may become obsolete even before it enters into force, and the lack of focus on performance criteria does not stimulate the researcher to find or invent better solutions. The solution is to change rules and amend resolutions enough times in order to be in accordance with the development of new technology. There is also need for resolutions to become effective and therefore be translated into the official national language and be formally adopted by the government branch. The example is SOLAS Convention.

8.4.4 Trade gaps and barriers

The following trade gaps and barriers are identified: lack of trade agreements, lack of diversity of transported goods and large share of agricultural products.

Serbia is not a member of the WTO, but it has taken steps to approximate the practice of compliance with WTO requirements. It has addressed some tariff and non-tariff barriers, including eliminating import quotas, reducing import licenses and prohibitions, and simplifying customs procedures. However, barriers remain, largely in the form of high tariffs for some products, lack of transparency and best value considerations in public procurement, and frequent implementation of legislative and regulatory measures without proper impact analysis and private sector consultation. The solution is to lower tariffs, make legislative and regulatory measures with detail analysis and consultation with private sector. As for the inland waterway transport in Serbia, this solution could bring an increase of containerization on major waterways.

Comparing the Danube with the Rhine countries, it can be concluded that freight transport in the Rhine region is more diversified. It means that vessels on the Rhine River transport more heterogeneous freight than on the Danube River. It also means that there is a gap between Danube and Rhine transport and also there is difference

in fleet appearing on these two rivers. This diversity is partly due to container transport, which accounts for 13% in Rhine countries, while it is almost inexistent in the part of Danube River in Serbia. In order to increase use of container on the Danube River in Serbia mid-term development plan would be the construction of new container terminals, but with securing their own container flows.

The large share of agricultural products in Danube shipping makes it quite vulnerable to bad harvest results. Last summer has shown that distinction between overall production volume of agricultural crops can be even higher than the highest recorded distinctions over the past several decades. Although an influence of modern technology to producing agricultural crops can mitigate the effects of climate changes to volume of agricultural products it cannot neutralize them. It can be concluded that transport on the Danube should include as many types of cargos as possible in order to reduce the impact of the lack of one type of cargo (agricultural products in this case) on the overall volume of transport.

Unfortunately, inland waterway transport in Serbia is mainly reduced to the transport of gravel, sand and grain by barges, while in developed countries the structure of transport of freights by river have the largest share of coal, coke, ore, wood, cereals, gas, oil and petroleum product. Apart from the limited possibilities of TEU handling in the ports of Belgrade, Pančevo, Novi Sad and Prahovo, there is no RO-RO terminal. At the moment, it is not possible to load or unload road vehicles by Ro-Ro platform on the territory of the Republic of Serbia in order to transport them by rail (Hucke pack).

8.4.5 Economic gaps and barriers

Economic gaps and barriers include *shipping costs*, lack of competitiveness of IWT, insufficient investments in ports and waterway maintenance and lack of competitiveness of IWT enterprises.

Lack of competitiveness of IWT is reflected in inefficient navigation and traffic management, inefficient integration of IWT in logistics processes and high administrative burden for complying with legislation. It all increases the entire transport costs due to lower impossibility of using IWT and due to widen usage of road and railway units of transport. The consequences of those deficiencies can therefore indirectly affect not only the IWT, but the entire economic growth of a country in several ways. From the consumer's point of view the most critical part of movement an item from the factory to the customer is price. Price is calculated on the basis of shipping costs which are directly related to transport costs. The higher the transport costs are, the lower the rent from exports of primary products is. An outcome is one of the possible results which include push up import prices of capital goods, thus directly reducing real investments. Higher transport costs are likely to devote a smaller share of output to trade. Since trade and foreign direct investment are key channels of international knowledge diffusion, higher transport costs may lead an economy of Serbia to be farther removed from the world technology frontier and slow its rate of productivity growth. The solution is to invest in marketing which could provide profitable freight contracts in IWT, bring skilled personnel and select cost-effective service providers.

Insufficient investments in ports and waterway maintenance in Serbia leads to:

- Old equipment based on outdated technical and technological solutions which can be traced to the middle of the last century. Cranes are more than 50 years old, are inadequately maintained due to lack of original spare parts and lack of professional services.
- Productivity of equipment does not meet today's technical norms and standards which increases waiting times of transport units in ports. It consequently affects the amount of indirect and direct transport costs in total shipping costs as well as final price of the goods.
- Operational costs are high and thus do not make port competitive and as a result of that customers pay high handling prices.

Solution for this gap includes investments in mobile equipment and superstructures, such as new quay cranes and safety and security of handling processes. Modernizing old equipment and installation of aid units could also increase the port efficiency and decrease operational costs.

IWT enterprise structure is characterized by a notable bipartition. There are small scale enterprises disposing of one to three ships and large scale enterprises with several to dozen of ships. Only a few of small scale enterprises operate on the market individually and by freight stock exchange. Most of them are members of shipping cooperatives or are employed by shipping firms, forwarders and chartering companies. Most of the large scale enterprises are linked by capital interlocking with industrial, trading and other transport enterprises, or they are engaged in transshipment, forwarding, trading, and transport activities by other modes.

It is necessary for the small scale enterprises to establish their own unions in order to be more competitive on transport market and to avoid further dependence on shipping firms, forwarders and chartering companies.

Since the 1990s, the number of inland waterway transport enterprises in Serbia has diminished drastically due to withdrawals of various types of cargo on ships and fusions with other shipping firms. The decrease of bulk cargo transports (coal, ore, cereals, and feed) which traditionally make up the main field of activity of inland waterway transport could not be compensated by introducing new types of cargos (e.g. containers) on Serbian ships.

8.4.6 Socio-economic and environmental gaps and barriers

Socio-economic and environmental gaps and barriers in ship operations, business environment and inequalities in labour market that still exist in Serbia are some of the chief obstacles for further development in IWT. The key socio-economic and environmental gaps and barriers are safety aspect of ship operations, uncertain business environment and IWT labour market attractiveness.

Shipowners in Serbia have a number of different objectives related to safety aspect of ship operations that need to be balanced. These objectives include balancing between business, marketing, service, efficiency, employer, subcontracting and availability.

The overall aim is to maximize safety issues subject to the satisfaction of the following activities: return on investment, win well-paying freight contracts, minimize damage on cargo, keep on schedule, operate and maintain vessel, attract competent personnel, select efficient service providers and minimize unplanned off-hire. It is important that shipowners have a clearly defined policy that always gives priority to safety issues. On the other hand, the shipowners can base their business on a balance between cost, efficiency and safety.

IWT enterprises in Serbia are not able to work systematically and continuously without matters such as training of personnel, developing better technical standards and improving management routines. As a consequence of that income and revenues of IWT enterprises in Serbia fluctuate over time which creates a rather uncertain business environment. There is no easy solution, but some recommendations could be done. This gap should be analysed through the new Strategy on waterborne transport development of the Republic of Serbia in cooperation with the relevant EU organizations.

With an uncertain business environment in IWT sector in Serbia and fluctuations of the profits and the amount of transported cargo within the IWT enterprises, IWT sector became less attractive in the labour market. As a consequence of that there is a shortage of qualified personnel on board of ships working longer and therefore increasing risks of accidents. IWT enterprises have a cost advantage enabling them to attract more business.

In order to increase attractiveness of IWT sector to the labours, joint cooperation between employers and trade unions need to be realized. Employers and workers should find mutual interest like organizing longer periods of rest after longer periods of work. Workers should join trade unions which can enable them understanding of the sector's developments and range of job opportunities for workers.

8.4.7 Summary of gaps and proposed solutions

Overview of identified gaps and proposed solutions is given in the table below.

Type of gap or barrier	Gaps and barriers	Proposed solutions
Infrastructure gaps and barriers	Navigation restrictions in critical sectors of fairways in Serbia	Carry out hydrographical riverbed monitoring and surveying
	Dependence of transport from current climatic factors and climate changes	Conduct water level measurements and monitoring
	Dynamic changes of hydro-morphological regime	Carry out fairway dredging and marking the fairway
	Old handling equipment in ports	Improvement of pertaining port infrastructure and superstructure like expanding the port area, acquisition of new handling equipment
	Low connectivity of port area	Building a new quay and port roads,

Type of gap or barrier	Gaps and barriers	Proposed solutions
	with national railway and access roads	building more operational railway tracks which can connect ports to the national railway network
	Lack of port storage facilities and short length of operational quay	Building open-space storage facilities
Logistic and transport gaps and barriers	Lack of RIS and Port Information Systems	Installing to promote sharing of information about navigation
	Lack of Single Window applications	Create political will and inter part collaboration with activities of government and high-level strategic decision makers
	Lack of transport/traffic management platforms	Installation of transport/traffic management platforms in order to encourage operational exchange of transport/traffic data related to cross-border information services
	Lack of adequate vessels, fleet age	Innovations in propulsion plants and fuels (including innovative energy sources and innovative propulsion systems) and modern design concept of ships
	Lack of automation in port operations	Organizing labor which covers introduction of labormen with their interests and possible gains
	Missing of ship operations	Installing new equipment that will overcome the existing shortcomings
	Capacity reserves of fleet	Introducing operational rationalization potentials like reduction of port waiting times, reduction of non-productive empty trips, extension of lock-operating periods and use of modern communication technology
Political and legal gaps and barriers	Lack of harmonization of national legislation with the EU legislation	Courageous political decisions that will be in line with Strategy for sustainable and smart mobility in the western Balkans
	Administrative restrictions	Improvement of administrative capacities and administrative simplification
	Complicated border procedures for crossing into/out of EU	Improvement and standardization of the inspection services in charge of navigation safety control procedures for all types of foreign and local vessels

Type of gap or barrier	Gaps and barriers	Proposed solutions
	Outdated regulations	Changing rules and amending resolutions enough times in order to be in accordance with the development of new technology; making resolutions effective and translating them into the official national language; adopting resolutions by the government branch
Trade gaps and barriers	Lack of trade agreements	Lowering tariffs, making legislative and regulatory measures with detail analysis and consultation with private sector
	Lack of diversity of transported goods	Increasing the use of container on the Danube river; construction of new container terminals, securing own container flows
	Large share of agricultural products	Including as many types of cargos as possible in transport by IWT fleet
Economic gaps and barriers	Lack of competitiveness of IWT	Invest in marketing which could provide profitable freight contracts in IWT, bring skilled personnel and select cost-effective service providers
	Insufficient investments in ports and waterway maintenance	Investments in mobile equipment and superstructures, such as new quay cranes and safety and security of handling processes; modernizing old equipment and installation of aid units
	Lack of competitiveness of IWT enterprises	Establishing unions of small enterprises in order to be more competitive on transport market; avoiding further dependence on shipping firms, forwarders and chartering companies
Socio-economic and environmental gaps and barriers	Safety aspect of ship operations	Return on investment, wining well-paying freight contracts, minimizing damage on cargo, keeping on schedule, operating and maintaining vessel, attracting competent personnel, selecting efficient service providers and minimizing unplanned off-hire
	Uncertain business environment	Solution through the new Strategy on waterborne transport development of the Republic of Serbia in cooperation with the relevant EU organizations
	IWT labour market attractiveness	Joint cooperation between employers and trade unions; employers and workers to find mutual interest like organizing longer periods of rest after longer periods of work; workers to join

Type of gap or barrier	Gaps and barriers	Proposed solutions
		trade unions which can enable them understanding of the sector's developments and range of job opportunities

Table 16: Summary of gaps and barriers for IWT development in Serbia

9 Traffic statistics in Romania

The overall traffic statistics, according to INS (Romanian National Institute for Statistics) is provided in the next table.

						k tone
	2015	**2016**	**2017**	**2018**	**2019**	**2020**
Rail transport	**55.307**	**52.618**	**56.083**	**55.429**	**58.808**	**49.671**
national	43.431	41.762	44.261	44.210	48.747	41.454
international	11.048	10.210	10.818	10.308	9.092	7.273
tranzit	827	646	1.004	911	969	944
Road transport	**198.638**	**216.085**	**226.320**	**237.132**	**256.616**	**266.523**
national	167.447	172.957	174.134	181.831	200.180	217.168
international	31.191	43.128	52.186	55.301	56.436	49.355
Maritime transport	**44.485**	**46.288**	**46.126**	**49.032**	**53.098**	**47.220**
national	48	7	56	75	3	0
international	44.437	46.281	46.070	48.957	53.095	47.220
IWT	**30.020**	**30.484**	**29.043**	**29.714**	**33.261**	**30.518**
national	13.246	14.697	14.632	16.140	17.191	13.978
international	11.216	10.399	9.153	8.540	11.283	13.329
tranzit	5.558	5.388	5.258	5.034	4.787	3.211
Air transport	**34**	**40**	**45**	**49**	**47**	**40**
national	0	1	1	2	1	1
international	34	40	44	47	46	39

Table 17: Traffic statistics in Romania (according to INS), per mode of transport

In terms of market share the situation is the following:

	2015	**2016**	**2017**	**2018**	**2019**	**2020**
Rail	16.84%	15.23%	15.68%	14.93%	14.64%	12.61%
Road	60.47%	62.54%	63.29%	63.86%	63.86%	67.65%
Maritime	13.54%	13.40%	12.90%	13.20%	13.21%	11.99%
IWT	9.14%	8.82%	8.12%	8.00%	8.28%	7.75%
Air	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%
	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 18: Share of each transport mode in Romania

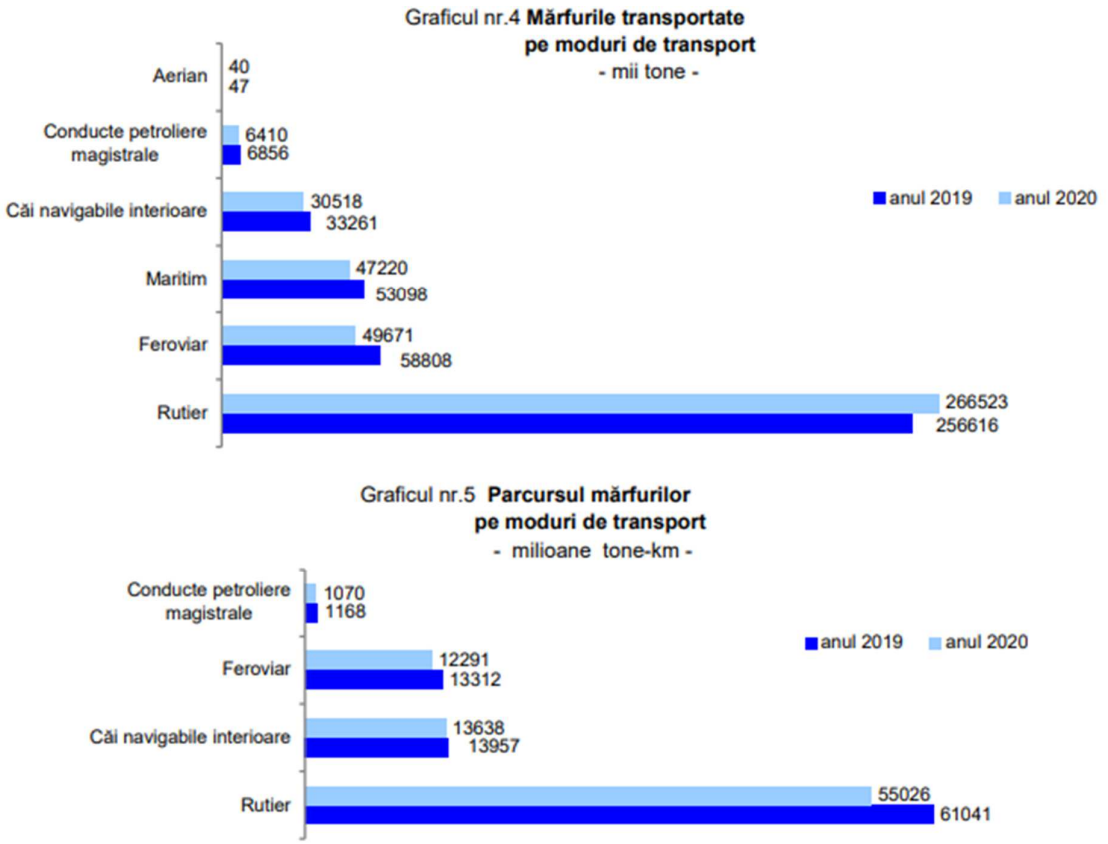

Figure 7: Cargo transported on different modes of transport in 2019 and 2020, in k tones and and millions tones-km

9.1 Summary statistics for inland waterway transportation

Inland waterway transport remains constant in the transport market share in Romania and has around 8%. Our conclusion is that IWT serve the same markets and clients in the Danube region and remained the traditional partner for them.

In 2020 the total IWT traffic values decreased by 8.2%, as a result of decrease of the national transport by 18.7% and of transit by 32.9%, while international transport recorded an increase of 18.1%.

The ports where the most goods were operated in 2020 were: Constanţa, with a share of 47.5% in 2020 and Galati, with shares of 14.8%.

For several years Serbia has the largest share in international inland waterway transport, in origin and destination of goods transported with a level of 5681 thousand tons in 2020. The share of the partners in international transport, registered in 2020 is the following:

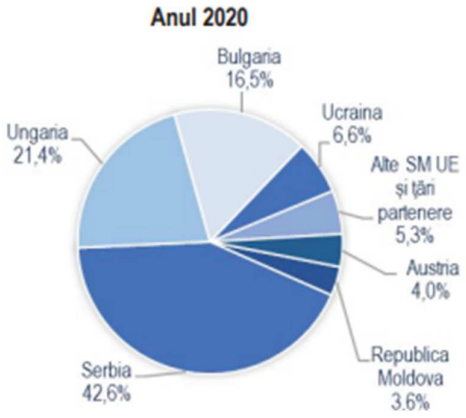

Figure 8: IWT international traffic in 2020, per countries

The most significant types of goods in international traffic in 2020 were the agricultural products with a share of 44.7%. During the same period, there were predominantly transported ore and mining products with a share of 63.1% in national transport, respectively, 71.0% in transit by inland waterways.

Data published by European Commission – Eurostat for 2019 places Romania on the third place in the EU, related to the values for tonnes – km and on the fifth place in the EU related to the values for tonnes transported on inland waterway transport.

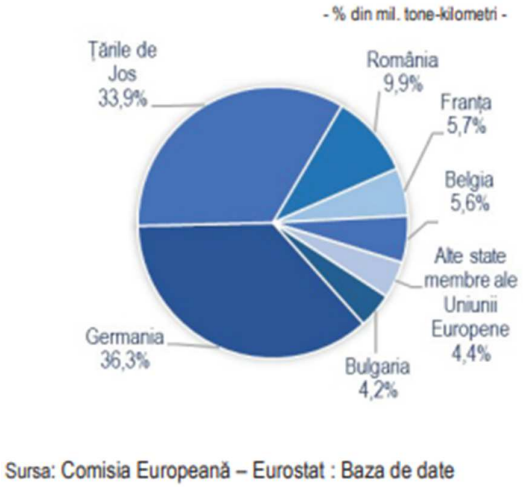

Figure 9: EU IWT traffic in 2019, performance in million tones – km

9.2 Summary statistics for railway transportation

The market share for the rail transport decreased from 16.84% in 2015 to 12.61 % in 2020.

The volume of goods decreased by 15.5% in 2020 compared to the previous year, caused by the negative developments of all components. 49671 thousand tons of

goods were transported, of which 83.5% in national transport. Rail freight transport in the EU declined in 2020 by 5.9 % compared to 2019, according to Eurostat.

In 2020, in railway transport, significant shares in the total transported goods were registered for the divisions: coke, refined petroleum products (23.0%) and coal and lignite; crude oil and natural gas (17.8%). Regarding rail freight transport performance in tkm performed, 28.9% of the total is represented by the division of coke, refined petroleum products and 18.0% agricultural products, hunting and forestry; fish and other fishery products.

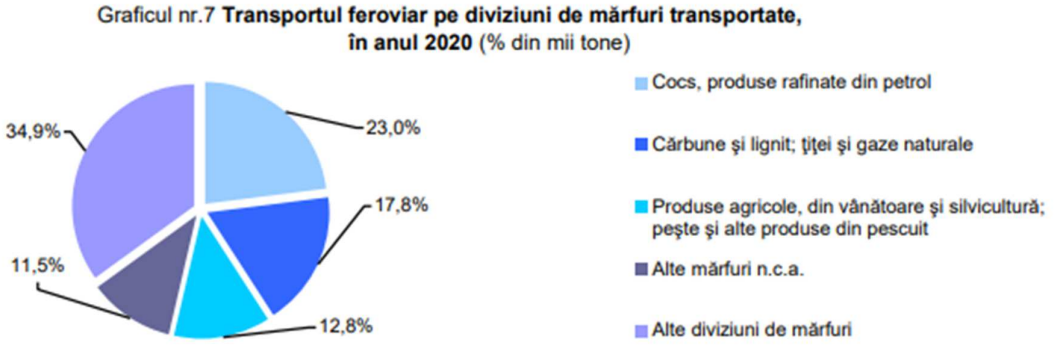

Figure 10: Rail traffic in 2020, per cargo categories, in k tones

In our conclusion the decrease of the rail transport is due to the slow speed on rail, further on caused by the old infrastructure.

9.3 Summary statistics for road transportation

Road transportation has the largest share of transport market and increased from 60.47% in 2015 to 67.65 % in 2020. The largest share of the market can be justified on the fact that road transportation is fast, can reach every destination and the road infrastructure is dense (compared with rail or IWT infrastructure).

Road freight transport increased in 2020 by 3.9% in terms of the volume of goods transported, compared to 2019. Of the total of 266523 thousand tons of goods transported, 81.5% were registered in national transport, increasing by 8, 5% compared to the previous year. The performance in tones – km decreased by 9.9% compared to 2019, even though there was a 3.6% increase in national transport.

In 2020, in road transport, the divisions of goods with the highest shares in the total transported goods were: metal ores and other mining and quarrying products; peat; uranium and thorium (32.0%) and other non-metallic mineral products (19.3%). In terms of tonnes – km the divisions that held the largest shares in total were: grouped goods: a mixture of types of goods transported together (30.5%) and food and beverages 18.6%.

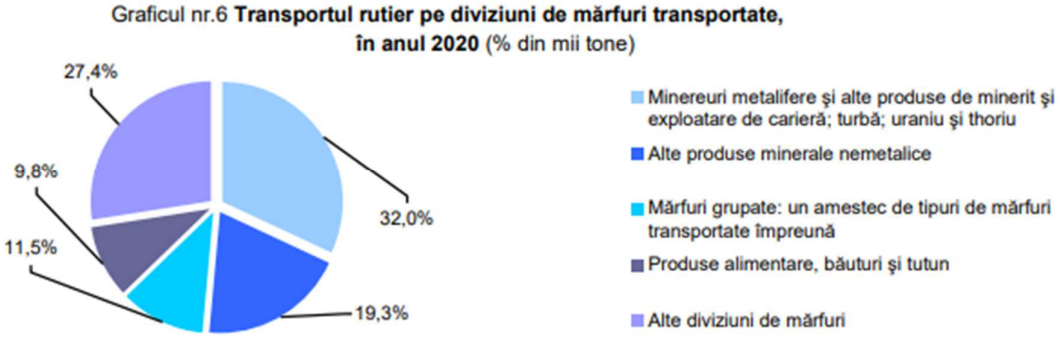

Figure 11: Road traffic in 2020, per cargo categories, in k tones

In 2020, in national road transport, 64.2% of the volume of goods was transported over distances between 1-49 km, 19.8% over distances between 50-149 km and 13.2% over distances between 150-499 km.

In international road transport, 92.9% of all unloaded goods came from EU member states and 91.8% of all loaded goods were destinated for EU member states. The largest quantities of goods came from Germany (21.8%), Hungary (15.7%) and Italy (10.2%), and in terms of loadings, 20.1% of the volume of goods were for Germany, 14.8% Italy and 11.9% Hungary.

9.4 Summary statistics for maritime transportation

In Romania, maritime transport has a market share of 13%, constant, as well as IWT. A decrease of the market share was in 2020 (11.99%), and can be assumed that this was due to the COVID pandemic which started in 2020 and affected world economy (in terms of production), as well as the transport chains.

The maritime transport in Romania is registered in the Port of Constanta and in smallest shares in the ports of Galati and Braila.

In 2020, in maritime transport, the most important shares in total transported goods were registered in the following cargo divisions (NST): agricultural products, hunting and forestry; fish and other fishery products (35.1%); coal and lignite; crude oil and natural gas (17.9%).

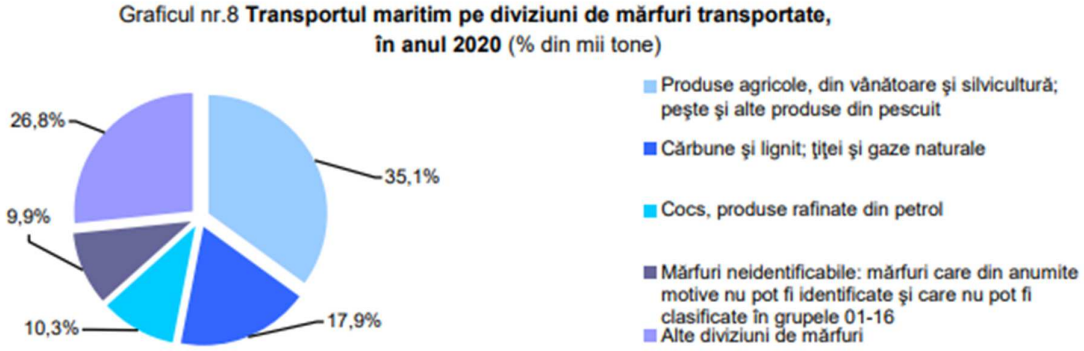

Figure 12: Maritime traffic in 2020, per cargo categories, in k tones

9.5 Gaps and barriers for IWT development

The gaps and barriers for IWT development are related to:

- Infrastructure
- Logistics
- Economic nature
- Social and environmental gaps

9.5.1 Infrastructure gaps and barriers

Traffic flows on the Danube River depends significantly on the water levels and on the port facilities.

Danube River has a free flowing in Romania and in some periods of the year, summer–autumn, the water flows are decreasing considerably, resulting critical points affecting the navigation conditions. The reasons for this very unfavourable navigational situation are mainly related to morphological and hydrological phenomena.

In order to ensure the conditions for navigations measures are identified for short time as well for the medium and long term. In the short term, the measures are related to the performance of maintenance work (measurements, maintenance dredging). Ministry of Transport and Infrastructure allocated in 2022 funding for dredging works, financing being at the level of last year and has concluded (through AFDJ – River Administration of the Lower Danube) framework dredging contracts, which allows the start of maintenance dredging whenever necessary. The capacity of AFDJ for doing maintenance works was improved through the acquisition of 3 dredgers (one in operation, constructed under the SWIM project, financed from CEF and 2 dredgers, financed from the state budget will be in operation util the end of 2022).

The FAST Danube project - the revision of the feasibility study for the improvement of navigation conditions on the common Romanian-Bulgarian sector of the Danube is a measure that will be implemented in the long term. The feasibility study for the common sector is in the stage of developing environmental impact assessment.

Regarding the port infrastructure, there are ongoing projects for the modernization of the infrastructure of the ports of Constanța, Drobeta Turnu Severin, Calafat, Bechet, Giurgiu, Brăila, Galați and Tulcea. Port infrastructure modernization projects include elements for the provision of utilities to ships.

The port of Constanța is a priority for Romania, it is the eastern gateway for goods to enter the European Union and has ongoing projects for the modernization of road infrastructure, electrical infrastructure, modernization of quays. In 2021, a project to deepen the port of Constanța to the quota of the project was completed.

Additionally, the transshipment technologies in the ports are old and require replacement with equipment having higher standards in terms of transshipment productivity and improved resource efficiency. Equipment improvement is a responsibility of the port operators, which are private companies.

Core Danube ports are connected to the rail and road infrastructure. All the rest of the ports have at least road infrastructure connections (exception the port of Sulina, due to its geographical position). A successful port must provide multimodal connections, and since the EU flows the concept of sustainability and the creation of a carbon neutral continent over the next three decades, and encourages rail and inland waterway transport, seaports, as well as inland ports must have reliable connections to the railway networks. The speed on the rail is slow and improvements should be done.

Since February 2022, when started the events in Ukraine, the bottlenecks and limitations of the rail infrastructure were more visible. The Romanian government adopted urgent measures to improve the railway infrastructure and operations in the port of Constanta and the port of Galati, the only port having large and standard gauge. The measures aim at increasing the rail transport capacity at the port. Maintenance activities for rail infrastructure are done annually but the necessities are higher than the actual performance, in terms of financing. Also, there are works ongoing on the TEN-T rail corridors in order to meet the TEN-T standards.

Related the road infrastructure, some ports face bottlenecks related to the quality of infrastructure. Access to the ports is done using cities infrastructure and there is room for a better collaboration between port administration and local authorities to improve the last mile connection to the ports.

9.5.2 Logistic and transport gaps and barriers

Port Logistics consists of a wide range of operations like cargo handling, loading/unloading, custom paperwork, surveillance and so on. Therefore, the effective operation of port logistics is required for having excellence in global trade and

transactions. Port logistics in Industry 4.0[12] era consists of global trade, environment and sustainability, automation and optimization, supply chain, smart technologies, port and terminal shipping lines. According to McKinsey & Company, Industry 4.0 implementation has the potential to increase the efficiency of ports by 15 to 20%[13]

Custom procedures are one of the major gaps and barriers in logistic and transport. Delays at border crossings and ports caused by lengthy, complex procedures and excessive paperwork could create a negative impact on trade mainly in terms of time and cost. Implementation of port community systems and an increased number of custom officers can be possible solutions.

Port community systems (PCS) handles electronic communication in ports between the private transport operators (shipping lines, agents, freight forwarders, stevedores, terminals, depots), the private hinterland (pre- and on-carriage by road, rail and inland waterways), the importers and exporters, the port authorities, Customs and other authorities.

9.5.3 Political and legal gaps and barriers

There are no political gaps or barriers. In terms of legal issues there is room for further improvements.

9.5.4 Trade gaps and barriers

No trade gaps were identified.

9.5.5 Economic gaps and barriers

IWT market, as well as maritime transport, depend on the economy which generates the cargo to be transported. An overview on the IWT market is realized by CCNR and Danube Commission[14].

In Romania the main commodities that are transported by IWT are ores (13228 k tones in 2020), cereals (9847 k tones in 2020), chemical products (2574 k tones in 2020), oil products (1498 k tones in 2020) and basic metals (1200 k tones in 2020). It results that the IWT depends on the mining sector, agriculture, oil and production sectors. Any disturbance in these sectors will affect the IWT cargo flows. It is worth to mention that IWT is an international transport, so the transport operators/ shipowners will look carefully to the economic situation of other Danube riparian countries from the region.

[12] Industry 4.0 - an overview | ScienceDirect Topics

[13] https://www.sciencedirect.com/science/article/pii/S2667096821000240

[14] https://inland-navigation-market.org/archives/?lang=en

9.5.6 Social environmental gaps and barriers

IWT sector is facing challenges in terms of labour mobility and labour shortage, issues identified in several EU documents (NAIADES, DG MOVE – IWT – Social dimension) [15]. Shortages in labour workforce are registered as well in Romania. A possible solution is the promotion of the sector among the young people and investing in them from earlier ages. Also, better salaries will attract skilled force to the sector. Dedicated education systems must be kept and promoted.

9.5.7 Environmental gaps and barriers

The European Green Deal sets ambitions targets in terms of emission reduction. In the domain of transport, the European Green Deal calls for a 90% reduction in greenhouse gas emissions from transport in order for the EU to become a climate-neutral economy by 2050, while working towards the zero-pollution ambition.

NAIADES III mention the relatively high degree of aging of the inland waterway fleet. Most ships are built before 2000 and inadequately equipped to cope with the transition to zero-emission mobility. Romania has a large inland waterway transport fleet. Renewing inland waterway transport fleets and improving access to low-carbon and alternative fuels will require substantial investment.

For the introduction of ship propulsion systems using alternative fuels and the provision of appropriate infrastructure, support measures for alternative fuel infrastructure should be exempted from the State aid rules laid down in European legislation. In order to encourage the actions of port operators and shipowners for the development of sustainable zero-emission shipping, some coordinated measures at European level are needed, such as:

- stimulating investments in port infrastructure, both in basic infrastructure and in the provision of alternative fuels;

- Identification of financing schemes for the development of sustainable alternative energy sources for ship supply and propulsion systems, for the construction of ships with modern technologies (zero emissions), but also for increasing their energy efficiency.

A certain flexibility should be kept, taking into account as far as possible national particularities.

[15] https://transport.ec.europa.eu/transport-modes/inland-waterways/social-dimension_en

9.5.8 Summary of gaps and proposed solutions

Overview of identified gaps and proposed solutions is given in the table below.

Type of gap or barrier	Gaps and barriers	Proposed solutions
Infrastructure	Good navigation status - Critical points on the Danube where 2.5 m depths are not ensured all over the year	Financing and execution of maintenance activities of the fairway Projects to ensure the good navigation status on long term
	Port infrastructure and old equipment	Implementation of projects for the modernization of port infrastructure Improving or replacing the transhipment equipment
	Quality of road and rail infrastructure connecting ports with the hinterland	Financing of rail infrastructure Stronger collaboration between ports administration and local / national authorities in order to improve the access to the Danube River ports
Logistics and transport	Delays in custom procedures	Increase number of custom officers Implementation of port community system
Economy	Cargo to be transported	Stability of the economic sectors
Social	Shortage of labour workforce	Better salaries for the crew members Investing from earlier stages (from schools) in personnel
Environmental	Reaching the climate neutral goal by IWT ships	Innovations in ships propulsion systems based on alternative fuels State aid schemes on EU level

Table 19: Summary of gaps and barriers for IWT development in ROMANIA

10 Traffic statistics in Bulgaria

Transport in Bulgaria has been developing at a generally high rate throughout the last several years.

The following table[16] provides data (thousand tonnes) considering the overall amount of cargo transported within the country through different modes of transport for the period from 2016 to 2020.

Transport mode	2016	2017	2018	2019	2020	Average (2016-2020)
IWW	3993	3705	3547	4038	3815	3820
Railway	14226	16030	14796	14948	16373	15275
Road	147136	151802	143337	114957	136451	138737
Maritime	28685	30953	27868	30997	25258	28752

Table 20: Bulgaria – transportation of goods through different modes of transport

Summary statistics regarding each mode of transport are presented in the next sections of the report.

10.1 Summary statistics for inland waterway transportation

As it is seen from information provided in the previous section of the report, the share of cargo transported via inland waterway routes in Bulgaria is significantly lower in comparison to those of railway and road transportation.

The table[17] below represents data (thousand tons) regarding cargo transported in Bulgarian Danube ports on an annual basis – import, export, and domestic shipping.

	2016	2017	2018	2019	2020
Total	3993	3705	3547	4038	3815

[16] Source: NSI

[17] Ibid.

	2016	2017	2018	2019	2020
Imports - unloaded	1312	1721	1547	1497	1294
Exports - loaded	1459	892	1150	1471	1711
Domestic	1222	1092	850	1070	810

Table 21: Loaded and unloaded goods in Bulgarian river ports

As it is seen in the table, import has been following a tendency of a stable decline ever since 2017 and export, on the contrary, has been increasing. A trend for decline could also be observed in the domestic transportation, where the slight growth in 2019 is an exception. Due to those tendencies the total amount of cargo transported through Bulgarian river ports has been more or less at the same levels throughout the last five years, with some moderate fluctuations occurring.

The table[18] below represents statistics of cargo transportation via IWT in Bulgaria in million tonne-kilometres:

	2016	2017	2018	2019	2020
Total	5447	5279	4858	5901	6256

Table 22: Goods transported by inland waterways in million tonne-kilometres

Further, the following table[19] presents the structure of freight transportation via Bulgarian inland waterway routes from 2018 to 2020, based on the shares of different cargo types.

Year	Export				Import			
	granulated goods	general cargo	liquid goods	"ro-ro" cargo transport	granulated goods	general cargo	liquid goods	"ro-ro" cargo transport
2020	51.5%	6.3%	2.8%	39.4%	31.2%	23.2%	17.5%	28.1%

[18] Source: Eurostat

[19] Source: Danube Commission

Year	Export				Import			
	granulated goods	general cargo	liquid goods	"ro-ro" cargo transport	granulated goods	general cargo	liquid goods	"ro-ro" cargo transport
2019	52.57%	4.38%	2.25%	40.8%	35.9%	27.6%	18%	18.5%
2018	43.8%	6.4%	3.6%	46,2%	39.2%	22.3%	18.8%	19.7%

Table 23: Structure of export and import by inland waterway transportation

10.2 Summary statistics for railway transportation

Railway traffic in Bulgaria has a greater share of the overall cargo transportation when compared to IWT but is still significantly behind the usage of the road network, which marks an important area of potential for improvement of the freight transportation system.

The country's railroads are predominantly used for the movement of solid mineral fuels, oil and petroleum products, iron ore and scrap, non-ferrous metal ores, metal products, natural and chemical fertilizers.

The state-owned BDZ Freight Services is the main railroad company in Bulgaria. It accounts for approximately 45% of the market share in the area of railway cargo transportation (data from 2018). The other 55% are attributed to smaller entities who are licensed to perform freight transportation services.

The table[20] below shows the amount of goods carried (thousand tonnes) and transport performance (tonne-kilometres) in the Bulgarian railroad sector on an annual basis.

	2016	2017	2018	2019	2020
Goods carried - thousand tonnes	14225.8	16029.9	14796.0	14948.1	16373.6
of which: inland carriages	9677.1	11374.1	10405.8	9893.4	9906.2
international carriages	4548.7	4655.8	4390.2	5054.7	6467.4

[20] Source: NSI

	2016	2017	2018	2019	2020
Transport performance - million tkm	3433.7	3931.0	3824.2	3901.6	4502.8
of which: inland carriages	2364.3	2788.8	2685.9	2524.2	2803.8
international carriages	1069.4	1142.2	1138.2	1377.4	1699.0

Table 24: Goods carried and transport performance in the railroad sector

The data on a quarterly basis is provided in the table[21] below.

Year	**2016**				**2017**			
Quarter	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Goods carried - thousand tonnes	3245.6	3354.5	3701.4	3924.3	3731.9	4093.9	4137.8	4066.6
of which: inland carriages	2209.2	2123.8	2596.1	2748.0	2549.5	2942.3	2977.7	2904.7
international carriages	1036.4	1230.7	1105.3	1176.3	1182.4	1151.6	1160.1	1161.9
Transport performance - million tkm	800.0	806.9	883.2	943.5	923.7	994.4	998.1	1009.1
of which: inland carriages	534.8	519.9	635.5	674.1	638.5	708.5	713.4	723.3
international carriages	265.2	287.0	247.7	269.4	285.2	285.9	284.7	285.9
Year	2018				2019			
Quarter	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Goods carried - thousand tonnes	3456.8	3757.5	3769.8	3768.6	3595.7	3490.3	3913.1	3946.9
of which: inland carriages	2458.7	2686.8	2647.1	2575.5	2412.8	2290.7	2546.4	2641.4
international	998.1	1070.7	1122.7	1193.1	1182.9	1199.6	1366.7	1305.5

[21] Source: NSI

carriages								
Transport performance - million tkm	886.8	983.4	986.9	976.6	943.4	918.9	1003.6	1035.7
of which: inland carriages	632.6	710.7	703.7	650.3	627.3	589.7	634.6	672.7
international carriages	254.2	272.7	283.2	326.3	316.1	329.2	369.1	363.0
Year	2020				2021			
Quarter	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Goods carried - thousand tonnes	3734.6	4072.0	4352.4	4210.4	4183.3	4643.7	4460.2	4775.0
of which: inland carriages	2313.4	2345.2	2679.2	2571.0	2685.0	2985.3	2824.8	3058.9
international carriages	1421.1	1726.8	1673.2	1639.4	1498.3	1658.4	1635.4	1716.1
Transport performance - million tkm	1058.7	1170.5	1155.6	1140.9	1103.8	1188.2	1111.2	1251.9
of which: inland carriages	652.4	749.8	744.5	681.1	681.1	723.3	634.1	740.8
international carriages	406.3	420.7	411.1	459.7	422.7	464.9	477.1	511.1

Table 25: Goods carried and transport performance in the railroad sector (quarterly data)

10.3 Summary statistics for road transportation

Road transportation has a significant role for the whole sector in Bulgaria, especially in terms of domestic freight movement, where the share of operations conducted via the road network has a prominently dominant position.

The following table presents data (thousand tonnes) regarding the overall amounts of cargo transported by road in Bulgaria for the period 2016 – 2020, also taking into consideration the types of vehicles used.

National transport	2016	2017	2018	2019	2020
Lorries up to 7.5 t.	1497.4	900.2	309.2	365.1	718.7
Lorries from 7.5 to 15 t.	4013.6	3698.4	2573.4	2499.7	2941.1
Lorries from 15 to 17 t.	1537.3	1541.3	1074.0	433.2	891.2
Lorries from 17 to 25 t.	14811.9	13667.5	13486.5	7220.8	8419.4
Lorries 25 t. and more	55115.7	53310.6	56450.5	42826.5	50855.5

Road tractors	35274.3	43961.7	45853.4	42860.6	42057.1
Total	112250.2	117079.7	119747.0	96205.9	105883.0
International transport	2016	2017	2018	2019	2020
Lorries up to 7.5 t.	27.5	35.4	9.2	-	-
Lorries from 7.5 to 15 t.	66.9	109.3	13.8	44.1	117.7
Lorries from 15 to 17 t.	22.2	14.0	8.3	4.7	-
Lorries from 17 to 25 t.	420.9	175.1	142.7	132.7	148.7
Lorries 25 t. and more	1608.3	1551.3	1410.2	761.1	1214.0
Road tractors	32739.8	32837.5	22006.1	17808.6	29044.1
Total	34885.6	34722.6	23590.3	18751.2	30568.9
Total	2016	2017	2018	2019	2020
Lorries up to 7.5 t.	1524.9	935.6	318.4	365.1	757.7
Lorries from 7.5 to 15 t.	4080.5	3807.7	2587.2	2543.8	3058.8
Lorries from 15 to 17 t.	1559.5	1555.3	1082.3	437.9	896.6
Lorries from 17 to 25 t.	15232.8	13842.6	13629.2	7353.5	8568.1
Lorries 25 t. and more	56724.0	54861.9	57860.7	43587.6	52069.5
Road tractors	68014.1	76799.2	67859.5	60669.2	71101.2
Total	147135.8	151802.3	143337.3	114957.1	136451.9

Table 26: Goods transported by road

The table below shows data (thousand tons) regarding some of the more common goods, transported by road in Bulgaria.

	2016	2017	2018	2019	2020
Products of agriculture, hunting, forestry, and fish	13621.6	4092.6	16868.2	18361.9	15456.3
Coal and lignite, crude petroleum, and natural gas	753.6	198.9	2777.5	779.4	400.9
Metal ores and other mining and quarrying products	42113.9	6423.8	46023.3	35830.8	41345.7
Food products, beverages, and tobacco	8580.4	1356.7	8989.2	6029.9	5763.4
Textiles and leather products	135.0	36.2	210.1	127.2	288.9
Products of wood and cork (except furniture)	2345.9	382.6	2017.4	1590.0	1917.9
Coke and refined petroleum products	3359.3	1377.4	4005.5	2931.0	5116.2
Chemicals and chemical products	2568.5	176.5	4313.0	1668.0	2470.4

	2016	2017	2018	2019	2020
Basic metals and metal products	2312.3	1068.8	2519.8	2847.1	3353.5
Transport equipment	237.8	63.5	274.1	178.9	589.0
Furniture	434.5	57.3	604.3	422.1	481.2
Secondary raw materials; municipal wastes	12600.2	2001.2	11231.1	6547.6	8374.4
Mail, parcels	1138.8	566.5	500.9	385.5	272.5
Equipment and material utilized in the transport of goods	1385.8	155.9	546.1	679.0	428.0

Table 27: Types of goods transported by road

10.4 Summary statistics for maritime transportation

In Bulgaria, maritime transportation has a negligible share of the domestic freight movement but is the leading mode of transportation for international operations. Almost all shipping activities withing the sector are conducted in port facilities in the cities of Varna and Burgas.

The table[22] below presents data (thousand tonnes) regarding the cargo transported to and from Bulgarian maritime ports.

	2016	2017	2018	2019	2020
Total	28685	30953	27868	30997	25258
Imports - unloaded	13115	14184	13046	14770	12535
Exports - loaded	15570	16769	14822	16227	12723

Table 28: Loaded and unloaded goods in maritime ports

10.5 Gaps and barriers for IWT development

10.5.1 Infrastructure gaps and barriers

Gap 1: Poor condition of port infrastructure on the Danube River

A significant obstacle for the development of inland waterway transportation in Bulgaria is the current condition of port infrastructure, which is in many cases unsatisfactory. Facilities within the Bulgarian section of the Danube are insufficiently

[22] Source: NSI

maintained and in deteriorated technical condition. The port of Ruse is a partial exception, being in a relatively good state when compared to others in the region, but investments are greatly needed for the development of the facilities in Vidin and Silistra, which are the country's other two big ports on the river. The lack of adequate infrastructure is a fundamental hindrance for IWT development which limits to a great extent the potential of growth within all activities and services provided within the sector.

This gap should be bridged through measures for rehabilitation and modernisation of the existing terminals and construction of new ones both for freight processing and passenger services. Despite the fact that this solution is an obvious one, its implementation would require significant financial resources and consistent administrative efforts on a national level. The optimal results in the long term could be achieved through efficient usage of EU's various funding schemes, where great potential in this regard lies in the National Recovery and Resilience Plan, the Transport Connectivity Programme, the Interreg Romania – Bulgaria Programme etc.

Gap 2: Lack of high-speed roads in the Danube Region

The lack of motorways is a major hindrance for the overall connectivity and mobility in Bulgaria's Danube Region. Road transport in the area is almost exclusively conducted on first, second and third class roads, where the capacity and speed of traffic are significantly lower. This is one of the main reasons for poor quality of services regarding the movement of goods and people, which in turn is an obstacle for the region's overall prosperity. Further, the low level of economic activities in the wider areas of ports reduces the interest towards IWT. A particular effect of this is that the lack of high-speed road infrastructure in the region makes movement of cargo from and to river ports generally more difficult and thus entire chains of transportation face hindrances. As a result, the capacity of river facilities suffers from indirect limitations.

A solution to this gap is the construction of motorways to connect the cities of Sofia and Varna on one hand, and the cities of Ruse and Veliko Tarnovo on the other. This would provide high-speed road connectivity on the West – East and North – South axes respectively. Those projects are already planned on a national level, with the construction of the Hemus highway (Sofia – Varna) being underway but progressing very slowly. We consider that explicit political and administrative effort is required to speed up the implementation of the projects, which would drastically improve the transport system in Northern Bulgaria.

Gap 3: Poor condition of lower-class roads in the Danube Region

In general, the network of lower-class roads in Bulgaria has a satisfactory level of density but is poorly maintained and depreciated with a great deal of the routes in the northern parts of the country being unsafe and in a bad condition. Just like the construction of highways, the modernisation of first, second and third class routes in the area of river ports would support local connectivity and mobility as a whole. Lower-class roads also have significant meaning for tourism activities (river cruises included) as they are used for traveling to popular tourist sites and between port cities.

This gap could be closed through measures in support of large-scale modernisation and development of the network of lower-class roads in all Bulgarian regions along the Danube River, with the need for optimisation being most acute in the Northwestern areas, namely the Vidin, Montana, and Vratsa districts. Renovation of infrastructure in other areas, including Pleven, Veliko Tarnovo, Ruse and Silistra districts, would also be beneficial. Another area for positive impact could be the construction of additional bridges across the Danube in the cities of Silistra, Ruse, Nikopol and Oryahovo, which would significantly boost international connectivity.

Gap 4: Poor condition and insufficient density of railroad infrastructure in the Danube Region

The technical condition of the railway infrastructure is unsatisfactory in many areas of the country, and one of the main reasons for this is the fact that the repair cycle has not been consistent throughout the last 20 years. Taking this into consideration, it could be stated with certainty that the network of railroads is in severe need of repair and modernisation. Another significant obstacle in the sector is the insufficient density of the existing infrastructure in some areas, especially in Northern Bulgaria.

We consider that the solution to overcome this gap lies in concrete investments for the rehabilitation of the most vital railway routes in Bulgaria's Danube Region. Especially suitable for incentives of such type are the tracks Vidin – Sofia and Ruse – Gorna Oryahovitsa, which are the two lines in Northern Bulgaria with potentially significant importance for international commerce. In addition, they go along European routes E79 and E85 and can have supplementary functions considering them. Another potential project for investment in rehabilitation is the railroad Ruse – Varna, which offers opportunities to connect inland and sea waterway transport. In regard to the network's expansion, especially suitable for such projects is the area of the port town of Tutrakan, which is between 60 and 80 km. away from the nearest train stations in Silistra, Razgrad and Ruse. The region of Tutrakan is actually one of the largest zones of the country without any railway lines.

The modernisation and expansion of the railroad routes is also an important prerequisite for improvements in the sector of intermodality and thus the development of some of the main railroad lines in Northern Bulgaria would create better conditions for the construction of intermodal facilities in key river ports on the Danube, including Vidin and Ruse. Further, enhancement of the railroad network could help reduce road traffic which would limit amortisation of roads and the negative effect on the environment from carbon dioxide emissions by cars. In terms of modernisation of train stations, most facilities in cities along the Danube River are in a state that requires improvement, including stations in Vidin, Lom, Svishtov, Ruse and Silistra. Large-scale incentives in regard to stations could increase their capacity for cargo transportation and make them more appealing for tourism.

It should be mentioned that some of the infrastructure gaps and barriers for the development of IWT are addressed to a certain extent in various strategies and programmes for the development of the transport sector on a national and regional level. In these documents there are projects for the construction and modernisation of different types of infrastructure. If they are to be implemented, a significant

improvement of the overall condition of Bulgaria's transport system could be expected.

10.5.2 Logistic and transport gaps and barriers

Gap 5: Poor navigation conditions in the Danube River

In the Bulgarian part of the Danube there are certain hindrances for efficient navigation that involve the occurrence throughout the dry season of risk zones along the river, where the water depth goes critically low, and it is more probable for ships to run aground. Such critical sections are the area of the Popina village and the areas of the islands of Belene, Vardim, Batin, Kosui, Albina and Garvan, where the river occasionally becomes very shallow. This poses risk for cargo ships, which generally have higher draught and bigger displacement, but for cruise ships as well, since they travel exceptionally throughout the dry summer season. Another existing problem for unimpeded navigation is the sand, gravel, and silt deposits, naturally occurring in the river basin.

One of the possible solutions for this gap is the installation of water level control facilities, which are currently completely absent within Bulgaria's section of the Danube. In regard to natural deposits, a resolution could be the intensification of dredging activities in the most critical sections of the river, which usually are performed by the Bulgarian Executive Agency for Exploration and Maintenance of the Danube River. We consider that initiatives for the enhancement of the institution's capacity for conducting such operations could help solve this problem in a more decisive manner.

10.5.3 Political and legal gaps and barriers

Gap 6: Inconsistency in the implementation of large-scale projects due to high political dynamics

During the last two years the domestic political scene in Bulgaria has been very dynamic, with often changes of governments occurring due to the deep fragmentation of the political landscape. Despite that there are no actual risks of significant political destabilization in the country, the repeated shifts in the administration have been causing certain difficulties in long-term planning. This process has influenced all aspects of public life, causing regular changes in policies. Transport development activities have been especially vulnerable to such circumstances due to the typically large scale of projects within the sector, including IWT. Rotation of cabinets has been causing delays in the actual implementation of strategic projects, such as the construction of motorways and other operations for infrastructure development.

There are no straight solutions for overcoming this barrier, since causing direct influence over the political processes in the country is not possible or ethically acceptable. Nevertheless, the risk of obstructions for the development of transport due to high political dynamics could be mitigated through more intensive engagement in the creation of long-term programmes in the particular area. Such

approach would make it possible for the various stakeholders to maintain consistency in their activities by applying coherent strategic policies on a professional level, regardless of current political circumstances. An example could be the elaboration of a strategy for the development of water transport, which is currently absent in the country's set of strategic documents in the sector, since the last programme with such focus had a horizon until 2015.

10.5.4 Socio-economic and environmental gaps and barriers

Gap 7: Poor socio-economic conditions in the Danube Region

Bulgaria is typically lagging behind Europe's average in terms of socio-economic conditions and quality of life in general. This trend is even more pronounced in the country's Danube Region, where prosperity is at a significantly lower levels in comparison to Southern Bulgaria. The situation is most acute in the north-western districts of Vidin, Montana, and Vratsa. In general, the regions along the river are one of the poorest in the EU, and with severe demographic problems – rapid depopulation and high average age due to a stable tendency for negative rate of natural increase and a high intensity in internal migration. The poor socio-economic conditions have been causing a reduction in economic activities as a whole. In the transport sector, the negative impact is especially strong on the domestic scene – both in terms of movement of people and goods, with the IWT not being an exception.

This barrier is of complex manner, and intersectoral efforts and long-term planning would be required to overcome it. One of the possible initiatives in this regard is the implementation of social policies in support of citizens who live in the northern regions of the country, including tax reliefs, free education in state institutions, temporary provision of land for agricultural purposes in areas with high rates of depopulation, preferential requirements for application for different funding schemes etc. A very impactful incentive could also be the elaboration of funding tools exclusively aimed at small and medium-sized enterprises, considering that these companies have significant contribution to local prosperity.

Gap 8: Insufficient efforts for environmental protection of river areas

Despite the fact that waterborne activities generally cause less pollution in comparison to other means of transport, the negative effect on the environment caused by shipping operations is not to be underestimated, especially when the infrastructure and vessels are highly depreciated. Such is the case in the Bulgarian inland waterway transport sector, where a great share of facilities and ships are extensively aged and do not meet contemporary ecological standards. According to scientific research fuel burned by ships is the reason for the generation of significant deal of pollutants, such as carbon dioxide, nitrogen oxides and sulphur oxides that have direct impact on climate change. Therefore, we consider that if no action is taken to mitigate the negative effect on nature from water transport services, this could cause further harm to the environment and in turn lead to additional financial and regulatory pressure on the sector in the context of EU's green policies.

There are different possibilities to overcome the ecological challenges in the field of IWT. One of the options lays in the administrative approach, which could be used to introduce appropriate regulations, including emission standards for nitrogen oxides which take into consideration the power output of different marine diesel engines. Further, institutions for monitoring and control of air emissions caused by ships could be established. In the mid to long term some of the more financially intensive solutions are the development of exhaust gas cleaning systems, implementation of digital systems for monitoring air quality parameters and data collection, construction of charging infrastructure for alternative fuels in ports, fleet renewal etc.

10.5.5 Summary of gaps and proposed solutions

Overview of identified gaps and proposed solutions is given in the table below.

Type of gap or barrier	Gaps and barriers	Proposed solutions
Infrastructure gap	Poor condition of port infrastructure on the Danube River	Rehabilitation and modernisation of the existing terminals and construction of new ones both for freight transportation and passenger services
Infrastructure gap	Lack of high-speed roads in the Danube Region	Construction of motorways to connect the cities of Sofia and Varna, and Ruse and Veliko Tarnovo
Infrastructure gap	Poor condition of lower-class roads in the Danube Region	Large-scale modernisation and development of the network of secondary roads in the districts of Vidin, Montana, Vratsa, Pleven, Veliko Tarnovo, Ruse and Silistra; construction of additional bridges over the Danube
Infrastructure gap	Poor condition and insufficient density of railroad infrastructure in the Danube Region	Rehabilitation of the Vidin – Sofia, Ruse – Gorna Oryahovitsa and Ruse – Varna lines; expansion of the national railway network in the area of Tutrakan; modernisation of train stations
Transport gap	Poor navigation conditions in the Danube River	Installation of water level control facilities; intensification of dredging activities in the most critical sections of the river
Political gap	Inconsistency in the implementation of large-scale projects due to high political dynamics	Elaboration of long-term strategic documents for the development of the transport sector
Socio-economic gap	Poor socio-economic conditions in the Danube Region	Implementation of social policies for citizens living in areas with poor socio-economic conditions, including tax relief, free education, access to funding etc.; elaboration of financial tools in support of small and medium-sized enterprises.

Type of gap or barrier	Gaps and barriers	Proposed solutions
Environmental gap	Insufficient efforts for environmental protection of river areas	Introduction of emission regulations; establishment of institutions for monitoring and control of pollution; construction of charging infrastructure for alternative fuels in ports; development of exhaust gas cleaning systems; fleet renewal

Table 29: Summary of gaps and barriers for IWT development in Bulgaria

11 Overall gap analysis

Apart from mere recording of the traffic flows in the Danube region, participating Project Partners provided their own analysis of gaps and barriers preventing and/or restricting the further growth of traffic flows on inland waterways.

The identified gaps and barriers in the countries of the Danube region are listed in the Table 30.

Type of gap or barrier	Gaps and barriers	Proposed solutions
Infrastructure gaps and barriers	Generally inadequate technical state of the infrastructure	• develop an investment plan for the renewal of the infrastructure and the reserve fund for its ongoing maintenance • implement and evaluate measurable performance indicators - investments in infrastructure modernization [mil. EUR]; length of upgraded road and rail infrastructure [km].
	Inadequate technical state of the transhipment technologies	• implement operational standards in the Operating rules of public ports aimed at the minimal technical level of transshipment technologies • implement and evaluate measurable performance indicators - the speed of transshipment of one ton of bulk goods [s]; loading speed of one container [s]; number of transshipment technologies meeting standards [n]
	Insufficient parking space for trucks	• define parking spaces for trucks in the port and in the Operating rules • establish and evaluate measurable performance indicators - area for truck parking [m2]
	Problematic railway system in the port of Bratislava	• assess the possibility of a technical solution for alternative railway system in the port
	Railway connection with the port	• Upgrading and electrification of the railway line from Vinkovci to Vukovar
	Road connection with the port	• Implementation of regional spatial plans that include investments in regional transport infrastructure
	Port area lack of space	• Construction of port roads, storage, and manipulative areas within unused port area
	Navigation restrictions in critical sectors of fairways in Serbia	• Carry out hydrographical riverbed monitoring and surveying
	Dependence of transport from current climatic factors and climate changes	• Conduct water level measurements and monitoring
	Dynamic changes of hydro-morphological regime	• Carry out fairway dredging and marking the fairway
	Old handling equipment in ports	• Improvement of pertaining port infrastructure and superstructure like expanding the port area, acquisition of new handling equipment

	Low connectivity of port area with national railway and access roads	• Building a new quay and port roads, building more operational railway tracks which can connect ports to the national railway network
	Lack of port storage facilities and short length of operational quay	• Building open-space storage facilities
	Poor condition of port infrastructure on the Danube River	• Rehabilitation and modernisation of the existing terminals and construction of new ones both for freight transportation and passenger services
	Lack of high-speed roads in the Danube Region	• Construction of motorways to connect the cities of Sofia and Varna, and Ruse and Veliko Tarnovo
	Poor condition of lower-class roads in the Danube Region	• Large-scale modernisation and development of the network of secondary roads in the districts of Vidin, Montana, Vratsa, Pleven, Veliko Tarnovo, Ruse and Silistra; construction of additional bridges over the Danube
	Poor condition and insufficient density of railroad infrastructure in the Danube Region	• Rehabilitation of the Vidin – Sofia, Ruse – Gorna Oryahovitsa and Ruse – Varna lines; expansion of the national railway network in the area of Tutrakan; modernisation of train stations
	Navigational bottleneck at Straubing Vilshofen section on the Danube in Germany	• Ongoing international discussion
Logistic and transport gaps and barriers	Several strategically important enterprises that produce commodities exported abroad	• to remove critical bottlenecks according to the action plan • It is recommended to establish and regularly assess measurable performance indicators to monitor the navigability of the Váh river - number of navigable kilometres [km]
	Absence of necessary data (VPAS)	• maintain a relationship and implement data interfaces with tenants in the port for the collection and statistical evaluation of relevant data.
	Port Community system	• Harmonization of port administration procedure through unique electronic platform
	Lack of RIS and Port Information Systems	• Installing to promote sharing of information about navigation
	Lack of Single Window applications	• Create political will and inter part collaboration with activities of government and high-level strategic decision makers
	Lack of transport/traffic management platforms	• Installation of transport/traffic management platforms in order to encourage operational

		exchange of transport/traffic data related to cross-border information services
	Lack of adequate vessels, fleet age	• Innovations in propulsion plants and fuels (including innovative energy sources and innovative propulsion systems) and modern design concept of ships
	Lack of automation in port operations	• Organizing labor which covers introduction of labor men with their interests and possible gains
	Missing of ship operations	• Installing new equipment that will overcome the existing shortcomings
	Capacity reserves of fleet	• Introducing operational rationalization potentials like reduction of port waiting times, reduction of non-productive empty trips, extension of lock-operating periods and use of modern communication technology
Political and legal gaps and barriers	Insufficient support for the development of inland waterway transport	• promote water transport as a sustainable mode of transport, which has the potential to bring economic benefits, e.g. due to the high capacity of the goods transport. • develop a long-term concept of inland waterway development, establishing action plans and allocating sufficient resources • establish and ongoingly evaluate measurable performance indicators - investments in inland waterway transport [mil. EUR]; number of promotional materials produced [n]
	No internal competition in the port	• create a formal contractual ownership relationship to port infrastructure • search proactively for new operators for unused port capacities.
	Cross sector strategic documents validity period harmonization	• Strategic documents from water and inland sector should be harmonized in the period of their validity
	Methodology for sector specific projects coordination	• Projects that are of interest for both, water and inland navigation sector should be up to date and coordinated.
	Lack of harmonization of national legislation with the EU legislation	• Courageous political decisions that will be in line with Strategy for sustainable and smart mobility in the western Balkans
	Administrative restrictions	• Improvement of administrative capacities and administrative simplification
	Complicated border procedures for crossing	• Improvement and standardization of the inspection services in charge of navigation safety control procedures for all types of

	into/out of EU	foreign and local vessels
	Outdated regulations	• Changing rules and amending resolutions enough times in order to be in accordance with the development of new technology; making resolutions effective and translating them into the official national language; adopting resolutions by the government branch
	Inconsistency in the implementation of large-scale projects due to high political dynamics	• Elaboration of long-term strategic documents for the development of the transport sector
Trade gaps and barriers	Decrease in iron ore transhipment segment	• mines to be fully operational again.
	Lack of trade agreements	• Lowering tariffs, making legislative and regulatory measures with detail analysis and consultation with private sector
	Lack of diversity of transported goods	• Increasing the use of container on the Danube River; construction of new container terminals, securing own container flows
	Large share of agricultural products	• Including as many types of cargos as possible in transport by IWT fleet
Economic gaps and barriers	Unstable navigability on the Danube River	• develop an action plan to address navigability at national level. • allocate financial resources to remove critical bottlenecks according to the action plan. • implement and evaluate measurable performance indicators to monitor Danube navigability - number of full navigation days in year [n / year].
	Lack of competitiveness of IWT	• Invest in marketing which could provide profitable freight contracts in IWT, bring skilled personnel and select cost-effective service providers
	Insufficient investments in ports and waterway maintenance	• Investments in mobile equipment and superstructures, such as new quay cranes and safety and security of handling processes; modernizing old equipment and installation of aid units
	Lack of competitiveness of IWT enterprises	• Establishing unions of small enterprises in order to be more competitive on transport market; avoiding further dependence on shipping firms, forwarders and chartering companies

Socio-economic and environmental gaps and barriers	Human resources and technical skills	• promote the training of water transport workers, in particular crew members.
	Safety aspect of ship operations	• Return on investment, wining well-paying freight contracts, minimizing damage on cargo, keeping on schedule, operating and maintaining vessel, attracting competent personnel, selecting efficient service providers and minimizing unplanned off-hire
	Uncertain business environment	• Solution through the new Strategy on waterborne transport development of the Republic of Serbia in cooperation with the relevant EU organizations
	IWT labour market attractiveness	• Joint cooperation between employers and trade unions; employers and workers to find mutual interest like organizing longer periods of rest after longer periods of work; workers to join trade unions which can enable them understanding of the sector's developments and range of job opportunities
	Poor socio-economic conditions in the Danube Region	• Implementation of social policies for citizens living in areas with poor socio-economic conditions, including tax relief, free education, access to funding etc.; elaboration of financial tools in support of small and medium-sized enterprises.
	Insufficient efforts for environmental protection of river areas	• Introduction of emission regulations; establishment of institutions for monitoring and control of pollution; construction of charging infrastructure for alternative fuels in ports; development of exhaust gas cleaning systems; fleet renewal

Table 30: Summary of gaps and barriers for IWT development in all considered countries

Gaps and barriers and their proposed solutions were identified for the most of the countries in the above table. The process of "generalization" of the gaps and barriers (to provide a generalized view of gaps and barriers for further development of IWT in the Danube area) included their combination, reduction, adjustment and replacement on the basis of their type and proposed solutions.

Eighteen listed national-based infrastructure gaps and barriers are reduced to five gaps and barriers that can be seen as common for the entire Danube region. Following the same approach, eleven listed logistic and transport gaps and barriers are reduced to two gaps and barriers, nine listed political and legal gaps and barriers are reduced to two gaps and barriers, four listed trade gaps and barriers are reduced to one gap and barrier, four listed economic gaps and barriers are reduced to one gap and barrier, seven listed socio-economic and environmental gaps and barriers are

reduced to three gaps and barriers. All new combined (or "generalized") gaps and barriers are listed in Table 31.

Type of gap or barrier	Gaps and barriers	Proposed solutions
Infrastructure gaps and barriers	Poor condition of port infrastructure and inadequate technical state of handling equipment in ports	• Renewal, rehabilitation and maintenance, modernization of handling equipment • Construction of port infrastructure
	Insufficient port area space (port storage facilities, length of operational quay and parking for trucks)	• Define and build port storage facilities, parking spaces, establish and evaluate measurable performance indicators for parking areas, conversion of unused port area
	Railway system in the port and railway and road accesses	• Building new quays, port roads and more operational railway tracks • upgrading and electrification of the existing railways
	Road connection with the port and poor condition of lower-class roads in the Danube Region	• Implementation of regional spatial plans that include investments in regional transport infrastructure. • Large-scale modernisation and development of the network of secondary roads and construction of additional bridges over the Danube.
	Navigation bottlenecks	• Carry out hydrographical riverbed monitoring and surveying • allocate financial resources to remove critical bottlenecks. • implement and evaluate measurable performance indicators to monitor Danube navigability.
Logistic and transport gaps and barriers	Port Community system	• Harmonization of port administration procedure through unique electronic platform • maintain a relationship and implement data interfaces with tenants in the port for the collection and statistical evaluation of relevant data. • Installing to promote sharing of information about navigation
	Lack of strategically important enterprises that produce commodities exported abroad, Lack of adequate vessels and automation in	• Installing new equipment that will overcome the existing shortcomings • Innovations in propulsion plants and fuels • Organizing labour which covers introduction

Type of gap or barrier	Gaps and barriers	Proposed solutions
	port operations	of labour men with their interests and possible gains
Political and legal gaps and barriers	Insufficient support, harmonization, validity documents that are significant for the development of inland waterway transport	• develop a long-term concept of inland waterway development, establishing action plans and allocating sufficient resources • Strategic documents from water and inland sector should be harmonized in the period of their validity • Improvement of administrative capacities and administrative simplification • Changing rules and amending resolutions enough times in order to be in accordance with the development of new technology
	Inconsistency in the implementation of large-scale projects due to high political dynamics	• Elaboration of long-term strategic documents for the development of the inland waterway transport sector
Trade gaps and barriers	Lack of trade agreements and lack of diversity of transported goods – Decrease in iron ore transhipment segment	• Lowering tariffs, making legislative and regulatory measures with detail analysis and consultation with private sector • Including as many types of cargos as possible in transport by IWT fleet • Increasing the use of container on the Danube River
Economic gaps and barriers	Lack of competitiveness of IWT enterprises, insufficient investments in ports and waterway maintenance	• Invest in marketing which could provide profitable freight contracts in IWT, bring skilled personnel and select cost-effective service providers • Establishing unions of small enterprises in order to be more competitive on transport market; avoiding further dependence on shipping firms, forwarders and chartering companies
Socio-economic and environmental gaps and barriers	Low attractiveness of IWT labour market and lack of labour with certain technical skills	• Joint cooperation between employers and trade unions; employers and workers to find mutual interest • Implementation of social policies for citizens living in areas with poor socio-economic conditions, including tax relief, free education, access to funding etc.; elaboration of financial tools in support of small and medium-sized enterprises.

Type of gap or barrier	Gaps and barriers	Proposed solutions
	Insufficient efforts for environmental protection of river areas	• Solution through the new Strategy on waterborne transport development in cooperation with the relevant EU organizations • Introduction of emission regulations; establishment of institutions for monitoring and control of pollution; construction of charging infrastructure for alternative fuels in ports; development of exhaust gas cleaning systems; fleet renewal
	Improving the energy efficiency of the transport system	• Development of future studies with aim to analyse specific requirements for energy efficiency in IWT

Table 31: Classification of combined gaps and barriers for IWT development in all considered countries

12 Conclusions

This report brings a general overview of the traffic flows of cargo transports on the transport infrastructure of the Danube region, thus revealing the market situation and transport demands of all transport modes. The current and future development of transport Infrastructure on the transport corridors in the Danube Region will be considered in terms of gaps. Gaps and barriers impeding further development of inland waterway transportation are identified, such as the lack of cross-border connections, missing links or bottlenecks on other parts of the corridor which have an impact to the overall functioning, absence or insufficient quality of intermodal connections and/or their accessibility (e. g. of ports by railway lines), infrastructure gaps in urban nodes, lack of standards preventing seamless services.

Apart from the traffic flows of all transport modes, which are given for the purposes of general overview of the quantities of cargoes moved in the Danube region and of assessing the potentials for capturing larger share of traffic flows for inland waterway transportation, the identified gaps and barriers on both national and supranational (regional) level are also presented. Based on various gaps and barriers, a set of concrete and targeted recommendations to bridge those gaps and overcome the barriers are developed.

The most important directions of future actions are grouped in the following domains having direct or indirect influence on the share of traffic flows on inland waterways:

- Infrastructure (waterside infrastructure and hinterland connections of ports);
- Logistics and transport operations;
- Political and legal;
- Trade patterns;
- Economic conditions in various areas along the Danube;
- Socio-economic and environmental;

Some of the highlights of the necessary interventions in the transport system of the Danube region are as follows:

- develop an investment plan for the renewal of the infrastructure and the reserve fund for its ongoing maintenance;
- the need to establish various key performance indicators (KPIs) for investments, technologies, operations, quality of service, etc.
- the need for an overall upgrade and modernization of port operations, cargo handling and storage;
- Digitalization and Single Window applications adapted to the conditions of IWT;
- Increase of automation in port operations and inland navigation;
- Fostering the development of intra-port competition;
- Elaboration of long-term strategies for development of IWT and inland ports in the region;

- The need for more focused education of young professionals towards modern port economics, port management, planning and operations.

13 References

1) Group of authors (2021), DIONYSUS project, Deliverable D.T1.2.2: Report on cargo transport flows (Status quo and forecasts).
2) Group of authors (2021), DIONYSUS project, Deliverable: D.T1.2.3 Report on IWT cargo potential

Internet sources:

https://ec.europa.eu/eurostat/web/transport

http://www.statistik.at/web_de/statistiken/energie_umwelt_innovation_mobilitaet/verkehr/binnenschifffahrt/index.html)

https://www.wko.at/branchen/transport-verkehr/die-oesterreichische-verkehrswirtschaft-2020.pdf

https://www.nsi.bg/en

https://www.danubecommission.org/dc/en/

https://www.sciencedirect.com/science/article/pii/S2667096821000240

https://tfig.unece.org/contents/port-community-systems.htm

https://inland-navigation-market.org/archives/?lang=en