Integrated and Sustainable Transport in Efficient Network - ISTEN

DT1.1.11 Analysis of ISTEN site contexts

WP no. and title	T1 Transnational Cooperation Network
WP leader	CERTH/HIT
Responsible Author(s)	Aristos Halatsis, Orestis Tsolakis
Contributor(s)	
Planned delivery date	M7 – June 2018
Actual delivery date	M24 – November 2019
Reporting period	RP4.1

Dissemination Level		
PU	Public	X
PP	Restricted to other program participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

This document has been produced with the financial assistance of the European Union. The content of the document is the sole responsibility of the authors and contributors and can under no circumstances be regarded as reflecting the position of the European Union and/or ADRION programme authorities.

Document information

Abstract

This report is a collection of the results of the detailed local context analysis carried out in the ISTEN sites regarding infrastructure, connections and services related to intermodal transportation of ISTEN sites, together with the assessments by the relevant stakeholders of each site of the bottlenecks hindering port-hinterland integration. It identifies the common challenges and paves the way to the formulation of Local Action Plans.

Keywords

Collection, results, intermodal connections, services, bottlenecks, scenarios, assessment, Local Action Plans

Authors

Editor(s)	Aristos Halatsis, Orestis Tsolakis – CERTH/HIT
Contributors	-
Peer Reviewers	-

Document history

Version	Date	Reviewed paragraphs	Short description
1.0	14/01/2019	-	1st draft
2.0	24/05/2019	2.1, 2.2, 2.3, 2.4	2nd draft
3.0	29/11/2019	4.1, 4.2	Final version
4.0	30/3/2020	4.2	Revised version

Table of contents

List of figures

List of tables

List of abbreviations and definitions

EU	European Union
ICT	Information and Communications Technology
ISTEN	Integrated and Sustainable Transport in Efficient Network
IT	Information Technology
PCS	Port Community System
TEN-T	Trans-European Transport Network
TEU	Twenty-foot Equivalent Unit

1 Introduction

As defined in the ISTEN AF, the aim of this deliverable is to collect the results of the detailed local context analysis carried out in the ISTEN sites (DT1.1.2-10), with specific consideration to infrastructures, connections, available services and main critical aspects and bottlenecks. The analysis details the common challenges identified and paves the way to the development of Local Action Plans.

The report is structured in four chapters. In chapter 2 a comparative analysis of the infrastructure, connections and services related to intermodal transportation of ISTEN sites is made with specific consideration to ports as the main origin/destination of hinterland transportation. In chapter 3, the main bottlenecks of ISTEN sites are identified, as emerged from the structured interviews performed to stakeholders. Finally, in chapter 4, an outline of the plausible future scenarios for ISTEN sites is made followed by an assessment of the effect of intermediate scenarios on the previously identified bottlenecks with the scope to define the common challenges and facilitate the formulation of local action plans.

2 ISTEN Sites Local Context Comparative Analysis

This chapter draws from the local context analysis performed in each ISTEN site regarding intermodal infrastructure, available connections and services, supplemented by information collected through web research (e.g. from the websites of Port Authorities and Terminal Operators), aiming to assess the current status of intermodal transportation of ISTEN sites. Ports are the main generators for hinterland flows. However, the data collected is not limited to infrastructure within ports, namely the terminals related to intermodal operations, the ports' internal rail network and rail handling facilities, or to the availability of rail connections and intermodal services. It also includes data regarding the connectivity of ports to the intermodal infrastructure in their wider region and especially to the TEN-T networks, since the realization of a hinterland network for intermodal transportation is largely depended in the consistency of the corresponding infrastructure along the hinterland corridors. Detailed information regarding each site can be found in the individual local context analysis reports of ISTEN partners.

2.1 Cargo handling in ISTEN ports and main port infrastructure related to intermodal transportation

The majority of the ISTEN ports are multipurpose ports, having however diverse specialisations. The ports of Trieste, Ravenna, Koper, Thessaloniki and Bar handle all types of cargo, while the port of Durres handles all types of cargo except liquid bulk. The port of Gioia Tauro handles containers and the transportation of new cars and is mainly a container transhipment hub with currently very limited traffic to the hinterland. As for the other Calabrian ports, these specialize in bulk cargo handling, with Corigliano focusing on dry bulk, Vibo Valentia on liquid bulk and Crotone on both. Finally, the port of Sibenik handles mainly dry cargo for the local industry and Hungary. In the following table, the types of operations in each ISTEN port along with their cargo specialisation are presented.

Table 1: Types of cargo handled by the ISTEN ports

Port	Types of cargo handled					Main cargo specialisation
	Dry Bulk	Liquid Bulk	General Cargo	Ro-Ro	Containers	
Gioia Tauro		√		√	√	Containers, Ro-Ro (new cars)
Vibo Valentia	√	√				Liquid Bulk
Crotone	√	√	√	√		Liquid & dry bulk
Corigliano	√			√		Dry bulk
Ravenna	√	√	√	√	√	Dry bulk, Ro-Ro cargo, containers
Trieste	√	√	√	√	√	Liquid bulk, Ro-Ro cargo, containers
Koper	√	√	√	√	√	Containers, Ro-Ro (new cars)

Sibenik	√		√	√		Dry bulk
Bar	√	√	√	√	√	Dry bulk, containers
Durres	√		√	√	√	General cargo, containers
Thessaloniki	√	√	√	√	√	Containers, liquid & dry bulk

Sources: ISTEN sites local context analysis reports, Port Authorities.

The port operations which are most related to intermodal port-hinterland flows are the ones related to the handling of containers and Ro-Ro cargo. As shown in the table above, all ISTEN ports with the exception of the port of Vibo Valentia are handling containers and/or Ro-Ro cargo. With regard to container transportation, the container-handling sea terminals of ISTEN sites are presented in the following table.

Table 2: Dedicated container terminals and terminal operators of ISTEN ports

Port	Container terminal	Terminal operator
Gioia Tauro	Yes	Medcenter Container Terminal (MCT) S.p.A.
Vibo Valentia	No	-
Crotone	No	-
Corigliano	No	-
Trieste	Yes	Trieste Maritime Terminal (TMT) S.p.A.
Ravenna	Yes	Terminal Container Ravenna (TCR) S.P.A.
Sibenik	No	-
Durres	Yes	Durres Container Terminal (DCT) SH.A.
Koper	Yes	Luka Koper d.d.
Thessaloniki	Yes	Thessaloniki Port Authority S.A.
Bar	Yes	Port of Adria JSC

Sources: ISTEN sites local context analysis reports, Port Authorities.

As shown in the table, seven out of eleven ISTEN ports have dedicated terminals for handling containers. The container terminal of the port of Gioia Tauro is the largest among ISTEN ports in terms of infrastructure size (length of quays, terminal area, container stacking capacity), container handling capacity (4,200,000 TEUs[1]) and annual throughput (2,328,218 TEUs in 2018[2]).

[1] Terminal Investment Limited Sàrl official website (2019). Available at: https://www.tilgroup.com/ (Accessed: 25 September 2019).
[2] Assoporti (2019). *Autorità di Sistema Portuale - Movimenti portuali Anno 2018* [online]. Available at: http://www.assoporti.it/media/4305/adsp_movimenti_portuali_2018_agg_18aprile2019.pdf (accessed: 26 September 2019).

As for the available quay depth, only Gioia Tauro, Trieste and Koper currently have the required depth to serve fully loaded container ships with a capacity of more than 8,000 TEUs. More specifically, Trieste has the largest quay depth (18.00m), Gioia Tauro has 14.00 to 18.00m of depth while Koper with a quay depth ranging from 9.7 to 15.00m can serve ships with a draft up to 14.50m. It should be noted that there are plans for the deepening of quays in the ports of Ravenna and Thessaloniki, as part of their expansion plans. Regarding terminal size, the ports of Gioia Tauro, Trieste and Thessaloniki have the largest container terminals, followed by the ports of Ravenna and Koper. However, the stacking yard capacity of the port of Thessaloniki is significantly smaller compared to Koper and Ravenna, comparable to that of the smaller ports of Durres and Bar.

Table 3: Main technical characteristics of ISTEN ports container terminals

Port	Total length of quays (m)	Terminal quay depth (m)	Maximum vessel draft allowed* (m)	Total terminal area (m^2)	Container stacking capacity (TEUs)
Gioia Tauro	3,395	14.00-18.00	n.a.	1,700,000	67,000
Ravenna	670[3]	10.50[3]	9.60[4]	250,000[3]	13,500[3]
Trieste	770[5]	18.00	17.40[6]	400,000	n.a.
Koper	596[7]	10.10-15.10[8]	14.50[7]	270,000[7]	28,677[7]
Bar	330	n.a.	12.00[9]	80,000[9]	2,500[9]
Durres	265	8.60-10.00	8.00[10]	60,062	3,000
Thessaloniki	570	12.00	10.80	317,000	5,000[11]

*In all or part of the quay length

The container traffic data analysis shows that the total ISTEN ports container throughput was 4,876,935 TEUs in 2018 of which 45,94% (2,236,501 TEUs) moved to the hinterland. Despite the high overall rate of transshipment, the container traffic of most ISTEN ports is mainly directed

[3] Contship Italia S.P.A. official website (2019). Available at: https://www.contshipitalia.com/en (Accessed: 26 September 2019).
[4] Port System Authority of the Central-Northern Adriatic Sea official website (2019). Available at: http://www.port.ravenna.it/ (Accessed: 26 September 2019).
[5] Trieste Maritime Terminal S.p.a. official website (2019). Available at: http://www.trieste-marine-terminal.com/en (Accessed: 26 September 2019).
[6] MDS Transmodal Limited (2012). *NAPA: Market study on the potential cargo capacity of the North Adriatic ports system in the container sector - Final Report*.
[7] Luka Koper d.d. official website. (2019). Available at: https://www.luka-kp.si/eng/ (Accessed: 27 September 2019).
[8] Port of Koper (2019). *Port Info Book* [online]. Available at: https://www.luka-kp.si/eng/port-terminal-information-books (Accessed: 27 September 2019).
[9] Port of Adria JSC official website (2019). Available at: https://www.portofadria.me/ (accessed: 27 September 2019).
[10] Durres Container terminal SH.A. official website (2019). Available at: https://www.dct.al/ (Accessed: 27 September 2019).
[11] ThPA SA (2019) 'ONE HUB - New horizons: Development Concept for the Port of Thessaloniki after Privatization - Potential for Railfreight' [PowerPoint Presentation]. *International Rail Freight Bussiness Association Congress, Athens, April 4, 2019*.

towards the hinterland; the majority of transshipment recorded (over 88%) relates to the port of Gioia Tauro. Of the remaining ports, only Trieste has a significant transhipment rate with 59.8% of its container traffic in 2018 moving to the hinterland while all the other ports show minor transshipment rates (≤ 1%).

Table 4: Container traffic characteristics of ISTEN ports

Port	2018 total container throughput (TEU)	2018 Hinterland traffic			2018 Container Transshipment[12]		
		(TEU)	(%)	% of ISTEN total	(TEU)	(%)	% of ISTEN total
Gioia Tauro	2,328,218	-	0.00	0,00	2,328,218	100.00	88.48
Trieste	725,426	434,085	59.84	19.41	291,341	40.16	11.07
Ravenna	216,320	215,075	99.42	9.62	1,245	0.58	0.05
Durres	134,526	134,526	100.00	6.01	-	0.00	0.00
Koper	988,501	978,616	99.00	43.76	9,885	1.00	0.37
Thessaloniki	424,500	423,755	99.82	18.94	745	0.18	0.03
Bar	50,444	50,444	100.00	2.26	-	0.00	0.00
Total:	**4,867,935**	**2,236,501**	**45.94**	**100.00**	**2,631,434**	**54.06**	**100.00**

Sources: Assoporti, Port Authorities.

The total annual container handling capacity of ISTEN ports in 2018, excluding the port of Gioia Tauro which operates as a transshipment hub, was 3,650,000 TEUs, showing an overall utilisation rate of 69.58% (2,539,717 TEUs). The port of Bar had the lowest capacity utilisation (6.73%), while the ports of Koper and Thessaloniki reached their capacity limits showing 98,85% and 96.48% of capacity utilisation respectively. According to information published by the corresponding port authorities, the total container handling capacity of ISTEN is expected to rise by 56.66% after the implementation of various expansion plans all of which are expected to be completed by 2025. Among the ports that have plans for expanding their capacity are the congested ports of Koper and Thessaloniki, which intent to increase their capacity by 50.00% and 209.09% respectively. Most ISTEN ports had a positive growth rate in container traffic between the years 2013-2018 with Koper having the largest increase (+64.63%). Overall, ISTEN ports (excluding Gioia Tauro) had a 45.12% growth rate during the same period.

[12] According to information from the corresponding Port Authorities, the transshipment in the port of Koper is estimated at 1% of total throughput. The ports of Durres and Bar is estimated to have no transshipment.

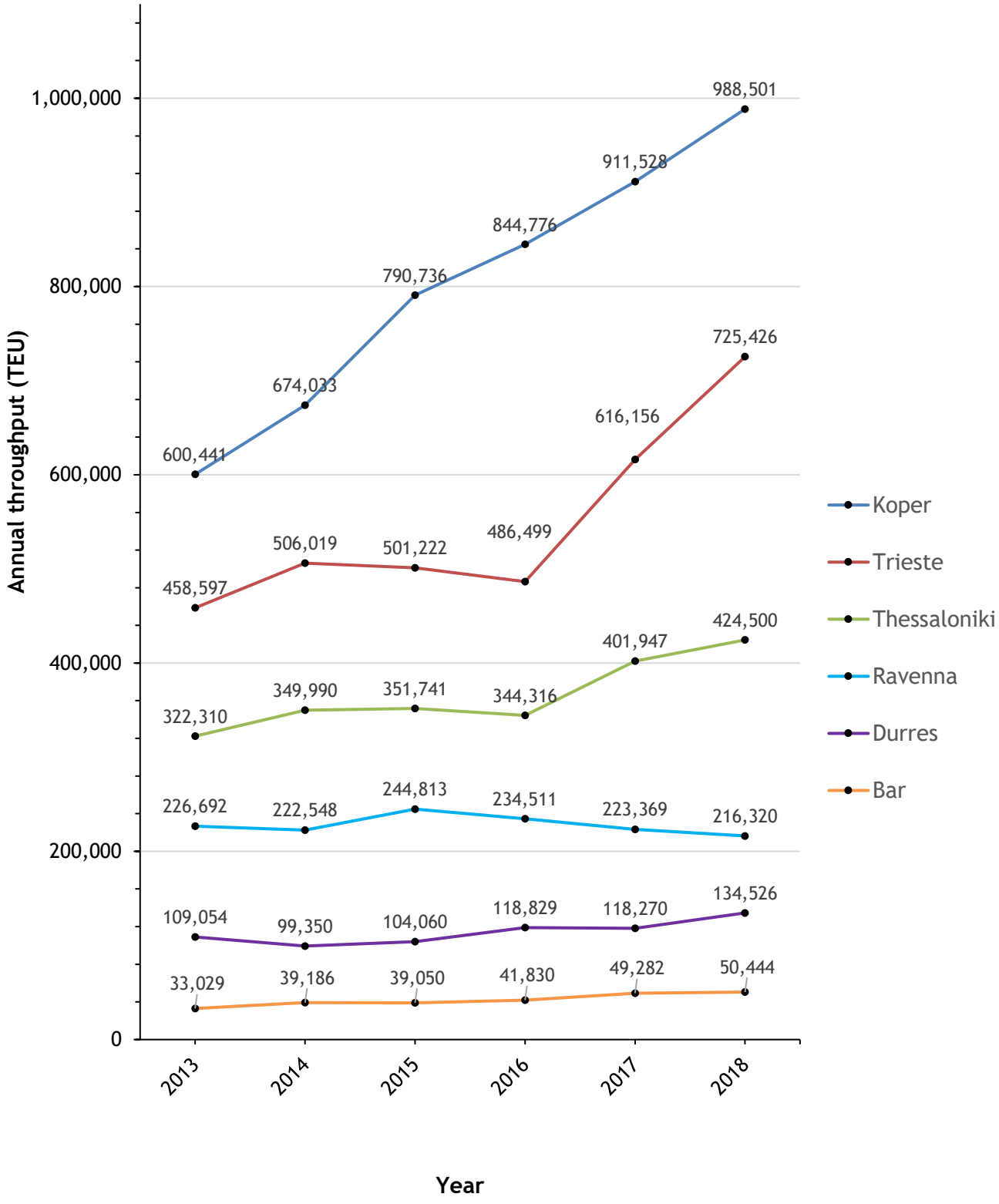

Figure 1: ISTEN ports container traffic growth between 2013 and 2018

Table 5: ISTEN ports' container terminal capacity data and container traffic growth[13]

Port	Annual total container throughput (TEUs) 2013	Annual total container throughput (TEUs) 2018	2018 estimated terminal capacity (TEUs)	2018 terminal capacity utilization (2018)	Planned capacity (TEUs) /year	Planned capacity growth	Growth of container traffic 2013-2018
	[A]	[B]	[C]	[D= B/C]	[E]	[F= (E-C)/C]	[G]
Ravenna	226,692	216,320	380,000[3]	56.93%	650,000[3]/n.a.	+71.05%	-4.58%
Trieste	458,597	725,426	900,000	80.60%	1,200,000[5]/n.a.	+33.33%	+58.18
Koper	600,441	988,501	1,000,000[14]	98.85%	1,500,000[7]/2021[7]	+50.00%	+64.63%
Bar	33,029	50,444	750,000[9]	6.73%	750,000/-	0.00%	+52.73%
Durres	109,054	134,526	180,000	74.74%	180,000/-	0.00%	+23.36%
Thessaloniki	322,310	424,500	440,000	96.48%	1,360,000/2023[15]	+209.09%	+31.71%
Total:	1,750,123	2,539,717	3,650,000	69.58%	5,640,000	+54.52%	+45.12%

Sources: Assoporti, Port Authorities.

2.2 Ports' rail infrastructure and connectivity to the rail network

Most ISTEN ports are directly connected to the rail network of their wider region which gives them the ability to develop a network of hinterland connections and intermodal logistics services. The only exceptions are the ports of Crotone and Corigliano which are not directly connected to the rail network and are served through railway stations located in their proximity. However, most other ports also face issues regarding their rail infrastructure which affect to a different extent their rail connectivity. The port of Vibo Valentia is connected to the rail network through a double track line but the tracks are currently in poor condition thus inoperative. Similarly, the port of Sibenik despite being connected through an operative link to the rail network, it faces issues due to the age and the inadequate maintenance of tracks. In the case of the port of Durres, the port is only partially connected to the network, having a rail link to the east terminal which is used for handling dry bulk and general cargo, while the container terminal is not connected. The connection of the port of Thessaloniki to the national network has issues mainly caused by inadequate geometric characteristics of the rail link and also due to its level crossings with a major road axis towards the city center which causes delays and congestion. The same problem is also identified at the port of Ravenna to which the line connecting the port to the rail network is

[13] The port of Gioia Tauro is excluded from the table because it is mainly a transshipment hub.
[14] (2019) 'Adriatic existing players strengthen their hand', *Port Strategy Magazine*, 26 September [online]. Available at: https://www.portstrategy.com/news101/port-operations/cargo-handling/adriatic-existing-players-strengthen-their-hand (accessed: 6 October 2019).
[15] Thessaloniki Port Authority S.A. official website (2019). Available at: https://www.thpa.gr/index.php/en/ (Accessed: 27 September 2019).

passing through urban areas. Finally, the port of Koper is connected through a single-track line to the network which results to capacity limitations.

Table 6: Connection of ISTEN ports to the rail network and the respective connectivity issues

Port	Direct, operational connection to the rail network	Connectivity issues
Gioia Tauro	yes	Rail traction is diesel in local context and electric in national context
Vibo Valentia	no	Rail tracks in bad condition and thus inoperative
Crotone	no	No direct rail connection
Corigliano	no	No direct rail connection
Ravenna	yes	Connection lines passing through urban areas
Trieste	yes	-
Koper	yes	Connection through one, single track line
Sibenik	yes	Rail network old and poorly maintained
Bar	yes	-
Durres	partial	The container terminal is not connected
Thessaloniki	yes	Inadequate geometrical characteristics of the rail link, level crossing with a major road axis

Sources: ISTEN sites local context analysis.

With regard to the internal rail network of the ports and their handling facilities, the Italian ports of Trieste, Ravenna along with the ports of Koper, Thessaloniki and Bar appear to have the most developed rail infrastructure among the ISTEN ports. The port of Trieste has all its docks served by rail, through a 70km long rail network. Shunting and assembly of freight trains in Trieste can be done within the terminals and also a marshalling yard exists near the railway station which integrates the rail traffic from piers 5, 6 and, 7 (relevant for intermodal traffic). In the port of Ravenna, 10 out of the 27 terminals (including the container terminal) are served by a 35km long rail network and are connected to the network of the wider region through a freight railway station located in the ports' proximity. In the port of Gioia Tauro, the container and car terminals are served by rail and all train traffic to the port is conveyed through a railway station in the nearby area to the station located near the port's limits, where the composition and decomposition of the trains takes place. The total length of the rail network inside the port area is 18km with an additional 9.7km of rail tracks (outside the port area) which connect it to the national rail network. As for the port of Koper, all its quays and areas are served by a 35km rail network except from the area located at the North-Eastern part of the port where new cars are stored, for which however there are plans for the construction of a new set of railway tracks. The port of Thessaloniki also has all its quays served by rail through an internal rail network of 17,400m

developed mostly within the free zone area. Finally, the port of Bar has a total of 21.5km of rail tracks serving most of the ports' areas. The ports of Sibenik and Durres have a limited internal rail network of approximately 3,650m and 1,000m respectively.

Table 7: Total length of internal rail network of ISTEN ports

Port	Total length of operative internal rail network (m)
Gioia Tauro	18,000[16]
Vibo Valentia	-
Crotone	-
Corigliano	-
Ravenna	35,000
Trieste	70,000
Koper	35,000[7]
Sibenik	3,649[17]
Bar	21,500[18]
Durres	1,000
Thessaloniki	17,400

2.3 Connection to EU transportation networks

The TEN-T network in the ADRION region consists of four core road/rail corridors, implemented to facilitate the establishment of a single European transport area for freight and passengers within the EU. These corridors are:

1. the Mediterranean corridor
2. the Scandinavian-Mediterranean corridor
3. the Baltic-Adriatic corridor
4. the Orient/East Med corridor

[16] Source: Università Mediterranea di Reggio Calabria (UNIMED)
[17] Port of Sibenik (2016). *Rail network report* [online]. Available at: http://lukasibenik.hr/wp-content/uploads/2013/02/IZVJESCE-O-MREZI-OPERATORA-USLUZNOG-OBJEKTA-2016-IoM.pdf (Accessed: 6 October 2019).
[18] SEETO (2017) 'PORT OF BAR – CASE STUDY' [PowerPoint Presentation], *28th RWWG Meeting, Bar, October 9-11, 2017.*

All major ports of the ISTEN sites belonging to the EU are nodes of the core European transportation network. The Northern Adriatic ports of Trieste and Koper are nodes of the Baltic-Adriatic and Mediterranean corridors while Ravenna is a node of the Baltic-Adriatic and the Scandinavian-Mediterranean corridors. The port of Thessaloniki is also a node of the core TEN-T network, namely the Orient-East Med corridor. With regard to the Calabria region ports, only Gioia Tauro is a core node of the Scandinavian-Mediterranean corridor. The ports of Crotone and Corigliano, located on the Adriatic coast of Calabria region are in proximity of the Scandinavian-Mediterranean corridor thanks to the transversal rail connection (Lamezia Terme-Catanzaro Lido) that allows to link the Ionian and Tyrrhenian sides. However, it should be noted that the ports of Corigliano and Crotone do not have a dedicated rail connection that allows a direct connection to the railway network. The port of Sibenik is not a node of the core TEN-T network but rather a maritime port of the comprehensive network.

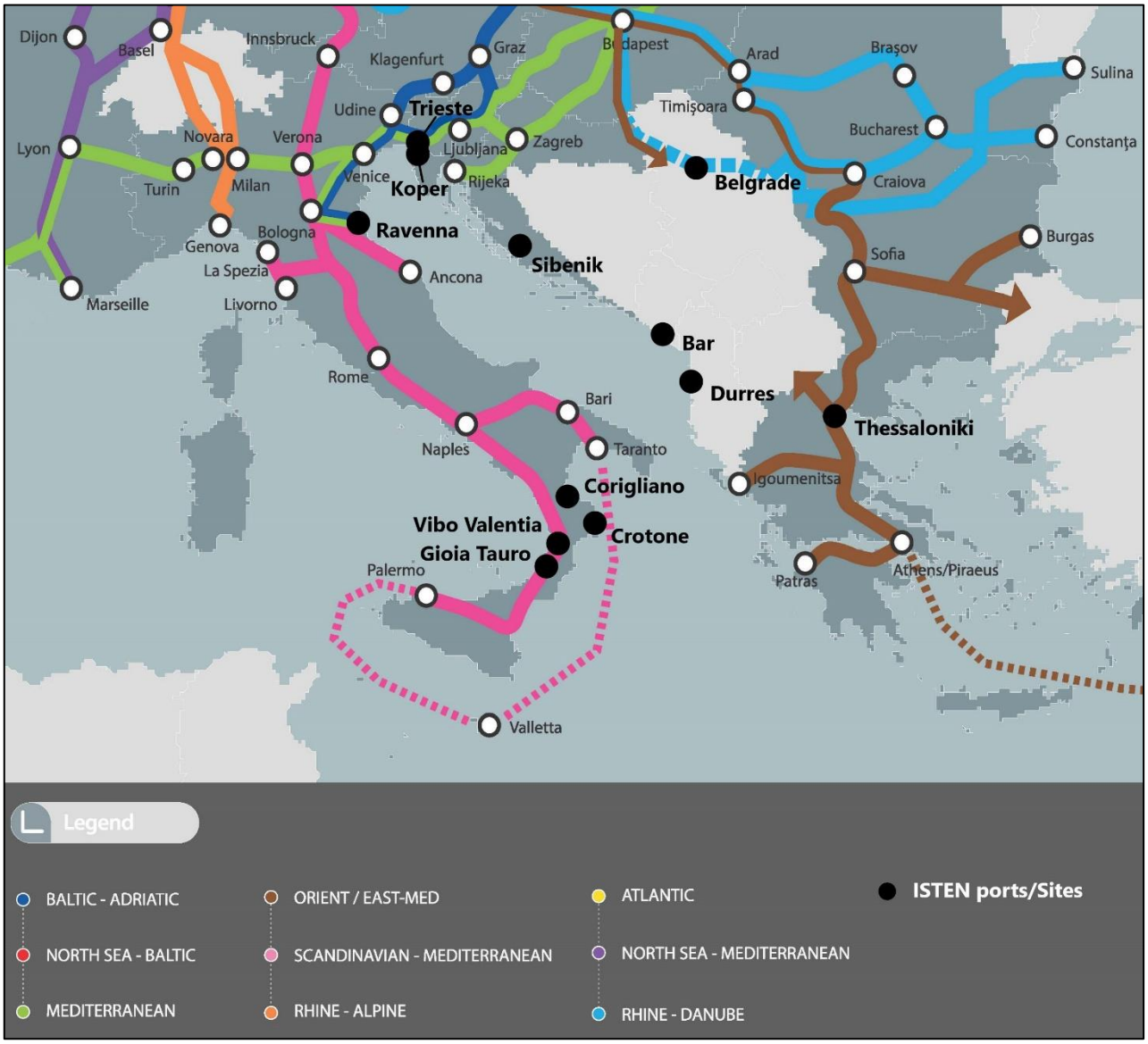

Figure 2: TEN-T core network corridors and nodes in the ADRION region according to Regulation (EU) 1316/2013 (Map source: TENtec)

Table 8: ISTEN ports/sites and TEN-T corridors

ISTEN ports/sites	Core node of the TEN-T network	TEN-T Corridor the port/site belongs to
Port of Gioia Tauro	yes	Scandinavian – Mediterranean
Port of Vibo Valentia	no	-
Port of Crotone	no	-
Port of Corigliano	no	-
Port of Ravenna	yes	Baltic – Adriatic/ Scandinavian – Mediterranean
Port of Trieste	yes	Baltic – Adriatic/ Mediterranean
Port of Koper	yes	Baltic – Adriatic/ Mediterranean
Port of Sibenik	no*	-
Port of Bar	no	-
Port of Durres	no	-
Port of Thessaloniki	yes	Orient – East Med
Belgrade area	no	-

* Maritime port of the comprehensive network

2.4 Intermodal connections and services of ISTEN sites

Among ISTEN ports, only Koper, Trieste and Ravenna have established rail connections and offer regular intermodal services to the hinterland. The port of Koper had a total rail traffic of 23,084[19] trains in 2018 from all its terminals, of which approximately 80-90 trains/week[20] were container block trains moving 50%[20] of its hinterland containers to destinations in Central, Eastern Europe and the Balkans. The port of Trieste had a total traffic of 9,732[21] trains in 2018, of which 7,595[21]

[19] Port of Koper (2019). *2018 Annual Report* [online]. Available at: https://www.luka-kp.si/eng/annual-reports (Accessed: 27 September 2019).
[20] Port of Koper (2019) [PowerPoint presentation], *Cairo, March 13, 2019*.
[21] Port of Trieste (2019). *Railway Statistics 2018* [online]. Available at: https://www.porto.trieste.it/wp-content/uploads/2019/02/Statistiche-treni-Porto-di-Trieste-Gen-Dic-2018-x-terminal-NV.ppt.pdf (Accessed: 6 October 2019).

were from its Ro-Ro and container terminals in the Free Zone, moving 29,50%[22] of its hinterland containers (3,213 trains[21]) to destinations in Central and Eastern Europe. Finally, the port of Ravenna also shows significant rail traffic (7,291 trains in 2016) and connections to Germany, Poland and France but it mainly consists of metallurgic and raw materials for ceramics, followed by containers and chemical products. Nevertheless, the rail share of Ravenna's container traffic to the hinterland is significant, reaching 8.80% in 2017[22].

As far as the other ISTEN ports are concerned, the port of Sibenik has a rail connection to Hungary but the service provided does not concern unitized cargo transportation but only dry bulk, mainly phosphates, for the industry. The port of Thessaloniki despite its significant container throughput and flows toward the Balkans, it does not have regular rail services to the hinterland and the transportation of containers is made almost exclusively by road. Similarly, the port of Bar does not have regular intermodal services; an occasional container train is connecting Bar and Belgrade. The port of Durres which faces serious rail connectivity issues also has all of its containers transported by road. Finally, the port of Gioia Tauro, being a transshipment hub, has not developed regular rail connections to the hinterland; only limited intermodal services are offered by one railway operator.

Table 9: Intermodal connections and services of ISTEN ports

Port	Rail connections and services
Gioia Tauro	No regular rail connections, limited intermodal services
Vibo Valentia	No regular rail connections and intermodal services
Crotone	No regular rail connections and intermodal services
Corigliano	No regular rail connections and intermodal services
Ravenna	Direct connections and services to Germany, Poland, France
Trieste	Intermodal connections and services to Germany, Austria, Luxemburg, Belgium, Czech Republic, Slovakia, Hungary
Koper	Intermodal connections and services to Germany, Italy, Austria, Hungary, Slovakia, Czech Republic, Poland, Romania, Bosnia & Herzegovina, Serbia
Sibenik	No regular rail connections and intermodal services
Bar	No regular intermodal services, only occasionally a container train between Bar and Belgrade
Durres	No regular rail connections and intermodal services
Thessaloniki	No regular rail connections and intermodal services

[22] International Union of Railways (UIC) (2018). *Report on Combined Transport in Europe*.

3 Main Bottlenecks & Critical Aspects of Port-Hinterland Integration

Through structured interviews, ISTEN partners provided an insight into the stakeholders' views on the main bottlenecks that hinder ports/areas from becoming integrated port-hinterland hubs. In this chapter these bottlenecks together with those emerged from partners local analysis are presented, categorized to Market, Infrastructure, Operational, Institutional and Innovation.

3.1 Market bottlenecks

The limited demand for intermodal port-hinterland services and the limited hinterland markets of several ISTEN ports/sites were identified by stakeholders as the main market bottlenecks to becoming integrated port-hinterland hubs. The causes of limited demand for intermodal port-hinterland services however, vary between ports/areas. These causes include the type of the port's operations, the main type of cargo handled, the port's orientation regarding target markets, infrastructural deficiencies of the rail network and the lack of marketing activities aiming to attract freight to rail. More specifically, ports which show some kind of monofunctionality or specialization of operations can have limited demand for hinterland intermodal transportation, depending on the type of these operations. This is the case of Gioia Tauro, a container transshipment port whose type of operations isolate it from its hinterland. Furthermore, the specialization of the ports of Ravenna, Sibenik and Crotone in the handling of cargo that serves their local industry by providing raw materials and their main orientation towards serving these markets, limits the demand for intermodal transportation. In the case of the port of Durres, the main reason for the lack of demand for intermodal port-hinterland services is the rail infrastructure problems which deter the use of rail. Finally, the lack of sufficient marketing activities in order to attract freight to rail was highlighted by stakeholders of the port of Koper as an important factor that hinders the increase of demand for intermodal transportation.

Regarding the bottleneck of limited hinterland markets of ISTEN ports/sites, according to stakeholders it is closely related to another type of bottleneck, namely the infrastructural. The inadequacy of the rail network, which is further analysed in the following section, hinders rail connection to the hinterland thus limiting the ability to reach far markets, extend the catchment area and develop a network of intermodal connections. The need for expanding the hinterland markets is even denser in the case of ports which have small domestic markets such as the port of Sibenik.

Table 10: Main market bottlenecks as highlighted by stakeholders.

Bottleneck	Gioia Tauro	Vibo Valentia	Crotone	Corigliano	Ravenna	Trieste	Koper	Sibenik	Bar	Durres	Thessaloniki	Belgrade area
Limited hinterland market of the port/area.		√		√		√		√	√		√	√
Limited demand for intermodal port-hinterland services.	√		√		√		√			√		

3.2 Infrastructural bottlenecks

Of the proposed types of infrastructural bottlenecks, the most common as identified by stakeholders of ISTEN are related to the infrastructure within ports, the adequacy of the network (road/rail) connecting the ports/areas and the implementation of soft infrastructure.

With regard to the infrastructure within ports, all ports appear to have deficiencies to a certain degree according to stakeholders. However, the type of these deficiencies in the majority of cases differs between smaller ports and the ports with larger volume throughput. In the smaller ports of Vibo Valentia, Crotone, Corigliano, Sibenik and also Durres, more fundamental deficiencies in infrastructure exist, such as the quays' technical characteristics and the lack or bad condition of the internal rail network. These deficiencies hinder them from attracting higher cargo volumes and thus create the conditions for development. On the other hand, the larger ports which are already partially integrated hubs have problems focused mainly on their need to expand their capacity and efficiency so as to improve their competitive position in the European logistics market. This is the case of the port of Trieste, Koper, Ravenna and Thessaloniki where the current infrastructure is adequate for current traffic volumes but needs expansion in order to increase their efficiency and serve the expected additional future flows. It should be mentioned however, that an additional infrastructural bottleneck complicates the process of ports' expansion as highlighted by stakeholders; most ISTEN ports, including the aforementioned ports of Trieste and Koper, are integrated into the urban fabric thus having little or no space available in their vicinity to implement their expansion plans.

Furthermore, it is a common finding among all ISTEN partners' reports, that ISTEN ports face issues regarding their rail connection to their wider region's network. Apart from ports which currently don't have rail connection, namely the ports of Crotone and Corigliano, other ports also have problems which vary significantly and include the partial connection (Durres), inadequate technical characteristics (Gioia Tauro, Vibo Valentia, Ravenna, Sibenik, Thessaloniki) and also capacity problems (Koper, Trieste). As for the railway network of their wider region all ISTEN sites also face problems to a certain extent, even the sites which show a relative dense network. In particular, problems with the poor condition of the network were highlighted in some cases (Sibenik, Serbia) as well as inadequate technical characteristics at specific points and sections of the network (Calabria and Emilia Romagna regions, Thessaloniki), network capacity inadequacy (Koper) and congestion problems (Friuli Venezia region).

Finally, the importance of soft infrastructure to a ports' process of becoming an integrated hub is recognized by all participants to the ISTEN partners' survey. It is also highlighted in all reports that currently the level of IT systems implementation is not sufficient regarding all kinds of systems (Port Terminal Operations Systems, Port Community Systems, Rail Operational Systems, Customs clearance systems, interfaces between systems). Furthermore, it appears that there are significant differences between ports regarding this matter. In some ports such as Sibenik and Durres there is complete absence of IT systems implementation while in others, namely Trieste and Ravenna a process to implement such systems (PCS specifically) is ongoing, still lagging behind however, in terms of functionality and stakeholder involvement.

Table 11: Main infrastructure bottlenecks as highlighted by stakeholders.

Bottleneck	Gioia Tauro	Vibo Valentia	Crotone	Corigliano	Ravenna	Trieste	Koper	Sibenik	Bar	Durres	Thessaloniki	Belgrade area
Port infrastructure inadequate, incomplete or in poor condition (e.g. quays length, yard area, quay depth, rail track length, alternative fuels).	√	√	√	√	√	√	√	√	√	√	√	
Lack of port expansion area		√			√	√	√	√				
Deficiency or inadequate capacity of port handling equipment (e.g. ship-to-shore cranes, handling equipment in the port, equipment for transferring loads from/to rail or road).						√		√	√		√	√
Inadequate (capacity of) equipment of the rail operator (e.g. wagons) to support hinterland flows.											√	
Inadequate capacity of hinterland transport networks (e.g. congested rail & road networks around the port).	√	√	√	√	√	√	√	√	√	√	√	√
Infrastructure/equipment incompatibilities between port and hinterland transport operators.												
Inadequate soft infrastructure (e.g. Port Terminal Operation System, Port Community System, Rail Operational System, Customs clearance system, interfaces between systems).	√				√	√	√	√		√	√	√

3.3 Operational bottlenecks

The main operational bottlenecks highlighted by stakeholders in ISTEN partner's reports appear to be largely common among most ports regardless of their size or location. The most common problem noted is the limited breadth or quality of services provided by the ports or the hinterland actors. However, the intensity of this type of bottleneck varies among ports. In some smaller ports such as Crotone, Corigliano and Vibo Valentia there is absence of port operators as well as logistics operators mainly due to infrastructural deficiencies, while in larger ports such as Koper and Trieste which offer a wide range of port and intermodal services, the main problems stem from infrastructure capacity issues and coordination problems. More specifically, in the case of Koper the single rail track connecting the port to the rail network causes significant delays and organizational issues to intermodal transportation. In the port of Trieste, the shunting procedures

are delayed due to inadequate number of available locomotives and the scheduling of service interruptions for maintenance purposes.

Another important bottleneck concerns the alignment of processes between private actors and the customs services. As highlighted by stakeholders in several ports/areas, significant delays and difficulties in customs procedures occur. In the case of the port of Thessaloniki these problems are caused by the complex regulatory requirements and also the lack of staff as reported by the customs authorities. Even in the case of the Italian ports of Gioia Tauro and Trieste where the "Customs single windows" was implemented, a system aiming to simplify customs procedures, stakeholders reported that significant delays still exist mainly because of the incomplete implementation of the system. Furthermore, in the case of Gioia Tauro the non-24hour operation of the customs office causes additional delays.

Regarding cross-border coordination issues, stakeholders from all ISTEN sites with significant international hinterland traffic, namely the ports of Trieste, Ravenna, Thessaloniki, Koper but also the Belgrade area, highlighted various problems which reduce the attractiveness of rail transportation. More specifically, the port of Ravenna has communication and operational rules issues related to its international rail traffic while the port of Thessaloniki faces lack of coordination regarding rail traffic management, capacity offer and the planning of rail works as well as delays in border inspections. Finally, the port of Koper faces another type of cross-border coordination issue which is related to the lack of transparency in the charging for the use of rail infrastructure in some neighbouring countries.

Table 12: Main operational bottlenecks as highlighted by stakeholders.

Bottleneck	**Gioia Tauro**	**Vibo Valentia**	**Crotone**	**Corigliano**	**Ravenna**	**Trieste**	**Koper**	**Sibenik**	**Bar**	**Durres**	**Thessaloniki**	**Belgrade area**
Not aligned operational processes of port-hinterland actors.					√	√				√	√	√
Not aligned operational processes between operational & public (e.g. customs) actors.	√				√	√	√	√		√	√	√
Limited breadth (or inadequate quality) of services provided by the port and/or the hinterland actors. (e.g. logistics service providers, inland terminals)	√	√	√	√		√	√	√	√		√	√
Inadequate cross-border coordination of port-hinterland corridor.					√	√	√				√	√
Available workforce (e.g. number of qualified port workers, qualification structure of port workers)									√			
Inadequate operative planning									√			

3.4 Institutional bottlenecks

With regard to institutional bottlenecks, the most common problem among ISTEN ports appears to be the ineffectiveness of the institutional framework of their governance. Stakeholders from most of the Italian ports highlighted problems related to conflicts of interests and competencies within their governance systems. These problems are expected to be solved through the ongoing reform of the Port Authorities system which has not yet been fully implemented, thus creating problems to the ports operations and planning. Stakeholders from other ISTEN sites also highlighted the inadequacy of their governance system, such as the port of Sibenik and Serbia. Additionally, the existence of fragmented planning at local, regional and national level was another important bottleneck noted in several reports.

Table 13: Main Institutional bottlenecks as highlighted by stakeholders.

Bottleneck	Gioia Tauro	Vibo Valentia	Crotone	Corigliano	Ravenna	Trieste	Koper	Sibenik	Bar	Durres	Thessaloniki	Belgrade area
Fragmented planning at local/regional/national level.								√		√	√	√
Problematic national legal/institutional framework.	√	√	√	√		√	√	√	√		√	√
Low coordination/cooperation between the port and the city in terms of port-hinterland development.										√		
Low coordination/cooperation with other ports or port-hinterland corridors.										√		√

3.5 Innovation bottlenecks

The low innovation content in the services provided is noted by stakeholders in most reports of ISTEN partners, especially those of the ports of Sibenik, Durres and also Serbia. In these sites the innovation is considered by stakeholders to be very low or even absent. Nevertheless, even in the ports of Ravenna and Trieste which have implemented and continue to develop PCS and ICT systems, the effectiveness of those systems is not in the desired level yet. Furthermore, additionally to the proposed innovation bottlenecks, most ISTEN partners (Calabria, Trieste, Durres, Serbia and Thessaloniki) highlighted in their reports the phenomenon of inadequate level of digital skills of employees working within the logistics chain, especially in port organisations and public entities. These skills are regarded by stakeholders as crucial for implementing and operating innovative IT systems.

Table 14: Main Innovation bottlenecks as highlighted by stakeholders.

Bottleneck	Gioia Tauro	Vibo Valentia	Crotone	Corigliano	Ravenna	Trieste	Koper	Sibenik	Bar	Durres	Thessaloniki	Belgrade area
Low innovation content in the services provided.	√	√	√	√		√		√	√	√	√	√
Not harmonised (or missing) digital information exchange between port-hinterland actors and between operational & public (e.g. customs) actors.	√	√	√	√				√		√	√	√
Inability to provide seamless port-hinterland cargo visibility to operational actors and shippers.					√			√				√
Differentiated levels of digital skills of staff within the same organisation or between different organisations or absence of adequate digital skills.	√	√	√	√		√				√	√	

4 Plausible Scenarios and Main Challenges for Local Plan Formulation

4.1 Plausible Scenarios

The plausible future scenarios of ISTEN sites as these were identified by the project partners are based on an assessment of a number of influence factors. These influence factors together with the identified scenarios for each ISTEN site, which consist of one pessimistic, one optimistic and one or two intermediate scenarios, are summarized in the following table (the intermediate scenarios are highlighted in grey).

Table 15: Plausible future scenarios for ISTEN ports/sites

Calabria region	**Influence factor**	**Variation**
	A. Number of trade routes	A1: decreases A2: remains unchanged A3: increases
	B. Automation in port & hinterland processes	B1: slight increase B2: firm increase
	C. Role of institutions in promoting port-hinterland corridor	C1: weak C2: strong
	D. Implementation time and cost of emerging tech solutions	D1: high cost & long time of implementation D2: high cost & short time of implementation D3: low cost & long time of implementation D4: low cost & short time of implementation
	Plausible scenarios summary: A. Increase in the number of trade routes (A3). Firm increase of automation in port & hinterland processes (B2). Institutions have a strong role in promoting port-hinterland corridor (C2). The implementation of emerging tech solutions has high cost but short time of implementation (D2). B. Increase in the number of trade routes (A3). Slight increase of automation in port & hinterland processes (B1). Institutions have a weak role in promoting port-hinterland corridor (C1). The implementation of emerging tech solutions has high cost and long time of implementation (D1). C. Decrease in the number of trade routes (A1). Firm increase of automation in port & hinterland processes (B2). Institutions have a strong role in promoting port-hinterland corridor (C2). The implementation of emerging tech solutions has low cost and short time of implementation (D4).	

	D. The number of trade routes remains unchanged (A2). Slight increase of automation in port & hinterland processes (B1). Institutions have a weak role in promoting port-hinterland corridor (C1). The implementation of emerging tech solutions has low cost but long time of implementation (D3).	
Ravenna	**Influence factor**	**Variation**
	A. Number of trade routes	A1: possible decline A2: remains unchanged A3: slight increase A4: increase
	B. Development of Major port infrastructure	B1: limited to phase 1 of Ravenna hub project B2: limited to phase 1 of Ravenna hub project and expansion of the Ro-Ro terminal B3: both phases of the Ravenna hub project and expansion of the Ro-Ro terminal
	C. Innovation deployment along the intermodal logistics chain	C1: limited to soft measures and equipment C2: limited to soft measures and equipment and partial relocation of logistics facilities in the proximity of the port C3: firm increase in soft measures and equipment and partial relocation of logistics facilities C4: firm increase in soft measures and equipment and relocation of logistics facilities
	D. Importance placed by clients on improved efficiency of the port as a potential import/export gateway	D1: unchanged importance of efficiency D2: higher importance of efficiency D3: very high importance of efficiency
	Plausible scenarios summary: A. Increase in the trade routes to Ravenna (A4). The development of port infrastructure includes both phases of the Ravenna hub project and also the expansion of the Ro-Ro terminal (B3). The traffic growth supports the firm increase in the deployment of innovative solutions including soft measures and equipment, together with the relocation of the logistics facilities in the proximity of the port (C4). The clients place a very high importance on efficiency as a criterion for the selection of the port also for export purposes (D3) and the port and hinterland logistics community promote effectively the port as a hinterland hub.	

	B. Slight increase in the trade routes to Ravenna (A3). The development of port infrastructure includes the first phase of the Ravenna hub project and also the expansion of the Ro-Ro terminal (B2). Innovative solutions are deployed including soft measures and equipment, together with the partial allocation of the logistics facilities in the proximity of the port (C2). The clients place a high importance on efficiency as a criterion for the selection of the port also for export purposes (D2) and the port and hinterland logistics community promote effectively the port as a gateway for imports/exports. C. The trade routes to Ravenna remain unchanged (A2). The development of port infrastructure is limited to the first phase of the Ravenna hub project (B1) thus the increase in competitiveness relies on a firm increase in the deployment of innovative solutions including soft measures and equipment, together with the partial relocation of the logistics facilities in the proximity of the port (C3). The client's perception of efficiency as a criterion for the selection of the port also for export purposes remains unchanged (D1). These measures are not sufficient to turn the port into an import/export node; imports still dominate the port activities.	
Trieste	**Influence factor**	**Variation**
	A. Number of trade routes	A1: decreases A2: remains unchanged A3: increases
	B. Automation in port & hinterland processes	B1: slight decrease B2: slight increase B3: firm decrease B4: firm increase
	C. Importance of efficiency as a port/corridor selection criterion for clients	C1: decreases C2: remains unchanged C3: increases
	D. Role of the port authority in promoting port-hinterland corridor and role as hinterland corridor's landlord	D1: weak as promoter D2: strong as promoter D3: weak as landlord D4: strong as landlord
	E. Implementation time and cost of emerging tech solutions	E1: high cost & long time of implementation E2: high cost & short time of implementation E3: low cost & long time of implementation E4: low cost & short time of implementation
	Plausible scenarios summary:	

	A. Increase in the number of trade routes (A3). Slight increase of automation in port & hinterland processes (B2). The importance of efficiency as a port/corridor selection criterion for clients increases (C3). The port authority has a strong role in promoting port-hinterland corridor (D2). The implementation of emerging tech solutions has high cost and long time of implementation (E1). B. The number of trade routes remains unchanged (A2). The importance of efficiency as a port/corridor selection criterion for clients decreases (C1). The port authority has a strong role as the hinterland corridors' landlord (D4). The implementation of emerging tech solutions has low cost but long time of implementation (E3). C. Decrease in the number of trade routes (A1). Firm increase of automation in port & hinterland processes (B4). The importance of efficiency as a port/corridor selection criterion for clients remains unchanged (C2). The port authority has a weak role as the hinterland corridors' landlord (D3). The implementation of emerging tech solutions has low cost and short time of implementation (E4).	
Koper	**Influence factor**	**Variation**
	A. Level of trades and freight flows	A1: increases A2: remains unchanged A3: decreases
	B. Operational level linked with automation and the development of IT systems	B1: Increased development and use of IT systems, better communication among stakeholders, automation is essential for maintaining the ports' competitive position B2: Moderate development and use of IT systems, automation is helpful but not essential B3: No further development of IT systems or equipment upgrade, automation and communication levels remain the same level
	C. Role of Luka Koper in the logistic chain	C1: Enhanced position of Luka Koper in the logistics chain recognised by customers (especially from/to far East) and important role in the decision making regarding the development of national transport infrastructure C2: Luka Koper maintains its crucial role in the national and regional level. The increased volumes from far East are distributed

		among NAPA ports as expected and the port has a neutral role in the logistics chain decision making C3: Luka Koper loses its leading role in the Northern Adriatic and the volume of cargo decreases
	D. Level of employment	D1: Employment in Luka Koper and the related companies increases significantly. Luka Koper becomes very important for the national logistics and the national economy D2: Luka Koper and the related companies maintain the number of their employees D3: Luka Koper and the related companies may reduce the number of their employees in some cases because of the decrease in the freight volumes
	E. Development of transport infrastructure connecting the port to the hinterland	E1: Luka Koper is involved in the development of transport infrastructure which connects it to the hinterland. The rail and road network length increases E2: Luka Koper doesn't have a crucial role in the development of transport infrastructure and has a fluctuating financial participation. The rate of transport infrastructure development remains unchanged E3: Luka Koper is not involved in the development of transport infrastructure and has the same financial participation as in previous years. The port's connection to the hinterland deteriorates.
	Plausible scenarios summary: A. Trade and freight flows increase (A1). Increased development and use of IT and ICT systems while automation becomes essential for maintaining a competitive position (B1). The port has a leading role in the Northern Adriatic and an important role in the decision making regarding national transport infrastructure (C1). The employment in the port and the related companies increase (D1) and the port is involved in the development of transport infrastructure which connects it to the hinterland (E1). B. Trade and freight flows remain unchanged (A2). Moderate development and use of IT systems while automation is helpful for the modest growing markets but not essential for the port (B2). The port maintains its crucial role in the	

	national and regional level while the flows from Far East are distributed among NAPA ports as expected. The port has a neutral role in the logistics chain decision making (C2). The employment in the port and the related companies remains the same (D2) and the port has a fluctuating financial participation and does not have a crucial role in the development of hinterland transport infrastructure. The rate of transport infrastructure development remains unchanged (E2). C. Trade and freight flows decrease (A3). There is no further development of IT systems or equipment upgrade while automation and communication remain at the same levels (B3). The port loses its leading role in the Northern Adriatic and the volume of cargo decreases (C3) which may lead the port and the related companies to reduce the number of their employees in some cases (D3). The port has the same financial participation as in the previous years and is not involved in the development of transport infrastructure which connects it to the hinterland. The port's connection to the hinterland deteriorates (E3).	
Sibenik	**Influence factor**	**Variation**
	A. Infrastructure development (rail connectivity, port infrastructure and equipment, soft infrastructure)	A1: Significantly improved connectivity through the Una railway, development of the ports' infrastructure (hard and soft), intermodal services and human resources. A2: Connection with Lika railway, development of port capacity and infrastructure. A3: No investments in rail connectivity, mainly focus on the road transportation and the island infrastructure/connectivity
	B. Ports role/ focus	B1: Besides passenger transport, the port retains its crucial position in the local market and also complements other ports of national interest regarding cargo transportation B2: The port continues to provide passenger transportation services together with the improvement of island and port-hinterland connectivity B3: The port focuses on local passenger transportation and island connectivity
	Plausible scenarios summary: A. Significantly improved hinterland connectivity through the Una railway which together with other improvements (e.g. storage capacity, equipment modernisation) (A1), responds to the growing local market needs and allows	

	the port to retain its crucial position in the local market and also to complement the other ports of national interest regarding cargo transportation (B1). B. Improved hinterland connectivity through the Lika railway and the improvement of road network (A2) which will facilitate the growth of local market. The port still focuses in passenger transportation along with the improvement of island and hinterland connectivity (B2). C. No improvement in rail connectivity, focus only on road transportation and the improvement of island infrastructure (A3). The port will continue to improve only local passenger transportation and island connectivity (B3).	
Bar	**Influence factor**	**Variation**
	A. Level of economic activities	A1: remains unchanged A2: slight increase A3: strong increase A4: strong decrease
	B. Infrastructure (road, rail, ports)	B1: unchanged B2: slight improvement B3: strong improvement
	C. Port operations	C1: slight improvement C2: significant improvement C3: unchanged C4: slight regression
	D. Involvement of state institutions	D1: regular involvement, solving recognised problems D2: involvement remains unchanged D3: not involved and thus not solving recognised problems
	E. Development of innovative solutions	E1: not a priority of institutions, port leading in digitalisation E2: priority of institutions with the support by the port E3: priority of institutions but implementation costs are high E4: priority of institutions and implementation costs are acceptable
	Plausible scenarios summary: A. The level of economic activities in the region has a strong decrease (A4) and consequently infrastructure remains unchanged (B1). The state institutions	

	are not involved and do not solve recognized problems (D3) which causes port operations to remain unchanged (C3). The development of innovative solutions is not a priority of the institutions, rather lead by the port (E1). B. The level of economic activities in the region remains unchanged (A1) and infrastructure has a slight upgrade (B2). The state institutions involvement in solving the port's problems remains unchanged (D2) and port operations show a slight improvement (C1). The development of innovative solutions is a priority of the institutions but the implementation costs are considered high (E3). C. The level of economic activities in the region has a strong increase (A3) which leads to investments and a significant improvement of infrastructure (B3) and of port operations (C2). The state institutions have a high involvement in solving the port's problems (D1) and give high priority in the development of innovative solutions thus regarding the implementation costs acceptable (E4).	
Durres	**Influence factor**	**Variation**
	A. Public investments in hard and soft infrastructure	A1: Low A2: Unchanged A3: Increased
	B. Private investments in the port/rail industry	B1: Slight decrease B2: Slight increase B3: Coordinated investments at local/national level B4: Fragmented investments at local/national level
	C. Automation in port and hinterland processes	C1: Low C2: Slight C3: Deep automation experiences difficulties due to high cost of implementation C4: A slight automation in port & hinterland processes experiences increase
	D. Governance system of Port Authority	D1: A – politic system of Port Authority leaders D2: A weak political influence in the system of Port Authority governance D3: A strong political influence in the system of Port Authority governance
	Plausible scenarios summary: A. Increased public investments in hard and soft infrastructure (A3) together with coordinated private investments in the port/rail industry at local/national level (B3). Deep automation in port & hinterland processes experiences difficulties in implementation due to increased cost (C3).	

	B. The public investments in hard and soft infrastructure remain unchanged (A2) while private investments in the rail/port industry have a slight increase (B2). The Port Authority is managed through an apolitical system (D1). C. Low public investments in hard infrastructure (A1) while private investments in the port/rail industry at local/national level are fragmented (B4). The political influence in the Port Authority governance system is weak (D2).	
Thessaloniki	**Influence factor**	**Variation**
	A. Local political stability (regarding the relationship with FYROM)	A1: Achievement of an agreement – EU membership A2: Fail to reach an agreement
	B. Private investments of port & rail operators	B1: no investments B2: not sufficient investments B3: sufficient investments only by ports B4: sufficient investments
	C. Public/European investments	C1: no investments C2: not sufficient investments C3: only public investments sufficient C4: only EU investments sufficient C5: sufficient investments
	D. Importance of efficiency as a port/corridor selection criterion for clients	D1: decreases D2: remains unchanged D3: increases
	E. Level of integration of development planning between port & hinterland actors	E1: low E2: medium E3: high
	F. Emerging tech solutions	F1: not required F2: required but high cost of implementation F3: implemented
	Plausible scenarios summary: A. Greece and FYROM reach an agreement and FYROM becomes a member of the EU (A1). Sufficient private investments are realised by port & rail operators (B4) as well as by the public sector and EU (C5). The importance of efficiency as a port/corridor selection criterion for clients increases (D3) and the level of integration of development planning between port & hinterland actors is high (E3). Emerging tech solutions are implemented (F3).	

	B. Greece and FYROM reach an agreement and FYROM becomes a member of the EU (A1). Sufficient private investments are realised by port operators (B3) as well as by the public sector (C3). Emerging tech solutions are required but have a high cost of implementation (F2). C. Greece and FYROM fail to reach an agreement and FYROM do not become a member of the EU (A2). Sufficient investments are realised only by the port (B3/C2). The level of integration of development planning between port & hinterland actors is low (E1). Emerging tech solutions are required but have a high cost of implementation (F2).	
Serbia (Belgrade area)	**Influence factor**	**Variation**
	A. Change of global/regional trade routes - freight flows to or over Belgrade area	A1: increase A2: unchanged A3: decrease
	B. Road and railway Belgrade by-pass and intermodal terminal construction and completion	B1: both by-passes completed B2: terminal constructed B3: all completed & constructed B4: no changes
	C. Alignment of operational processes between operational and public actors	C1: better alignment – public processes improved C2: no changes in the alignment of processes C3: increase of misalignment – operational actors' processes improved, public remain unchanged
	D. Coordinated planning and legal framework creating	D1: coordinated planning and regulations adopted and implemented D2: planning remains fragmented but legal framework established D3: even greater fragmentation in planning, adoption of contradictory regulations
	E. Gap of employees' skills in technological innovation	E1: skills increased to the desired level E2: skills will reach the desired level through new educated employees E3: skills will remain at the same level E4: skills gap increased because of "brain drain"
	Plausible scenarios summary: A. Freight flows over/to the Belgrade area increase (A1). The road and railway bypass and intermodal terminals are both constructed (B3). The misalignment of operational processes increases because while operational actors'	

	processes improve, the processes of public actors remain the same (C3). A coordinated planning is established and regulations are adopted and implemented (D1). The skills of employees in technological innovation remain unchanged (E3). B. Freight flows over/to the Belgrade area remain unchanged (A1). The road and railway bypass are completed (B1). The alignment of operational processes increases and the processes of public actors improve (C1). The planning remains fragmented but a legal framework is established (D2). The skills of employees in technological innovation reach the desired level mainly through the recruitment new employees (E2). C. Freight flows over/to the Belgrade area decrease (A3). The road and railway bypass and intermodal terminals are both not completed (B4). There is no change in the alignment of operational processes (C2). The planning remains fragmented but a legal framework is established (D2). The gap in the skills of employees in technological innovation increases because of the brain drain (E4).

The intermediate scenario for each site was selected in order to assess its impact on the main bottlenecks identified in the Local Context Analysis report using a scale of one to five. The bottlenecks which are rated with a value equal or greater than 3.00 are expected to remain unchanged or to intensify if the most possible (intermediate) scenario is realised. More specifically, bottlenecks with a value between 3.00 and 4.00 are expected to show a moderate worsening while those with a value between 4.01 and 5.00 are expected to worsen significantly. On the other hand, the bottlenecks with a value of less than 3.00 are expected to improve if the most possible scenario is realised. The result of the assessments for each site is presented in the following table.

Table 16: Summary of the assessment of intermediate scenarios influence on bottlenecks (1-very positive, 5-very negative)

	Gioia Tauro	Vibo Valentia	Crotone	Corigliano	Ravenna	Trieste	Sibenik	Bar	Durres	Thessaloniki	Belgrade area	Num. of observations	Average value
Market bottlenecks													
Limited hinterland market of the port/area.	-	2	-	2	-	2	2	2	-	3	2	7	2.14

Limited demand for intermodal port-hinterland services.	2	-	2	-	4	-	-	-	3	-	-	4	2.75
Infrastructure bottlenecks													
Port infrastructure inadequate, incomplete or in poor condition (e.g. quays length, yard area, quay depth, rail track length, alternative fuels).	2	2	2	2	3	3	2	2	4	3	-	10	2.50
Lack of port expansion area	-	-	-	-	2	3	3	-	-	-	-	3	2.67
Deficiency or inadequate capacity of port handling equipment (e.g. ship-to-shore cranes, handling equipment in the port, equipment for transferring loads from/to rail or road).	-	-	-	-	-	3	3	2	-	3	2	5	2.60
Inadequate (capacity of) equipment of the rail operator (e.g. wagons) to support hinterland flows.	-	-	-	-	-	-	-	-	-	3	-	1	3.00
Inadequate capacity of hinterland transport networks (e.g. congested rail & road networks around the port).	2	2	2	2	-	2	2	2	3	3	2	10	2.20
Infrastructure/equipment incompatibilities between port and hinterland transport operators.	-	-	-	-	-	-	-	-	-	-	-	0	n.a.
Inadequate soft infrastructure (e.g. Port Terminal Operation System, Port Community System, Rail Operational System, Customs clearance system, interfaces between systems).	2	-	-	-	3	1	3	-	3	4	3	7	2.71
Operational bottlenecks													
Not aligned operational processes of port-hinterland actors.	-	-	-	-	2	1	-	-	2	4	2	5	2.20
Not aligned operational processes between operational & public (e.g. customs) actors.	4	-	-	-	2	2	2	-	3	4	3	7	2.86
Limited breadth (or inadequate quality) of services provided by the port and/or the hinterland actors. (e.g. logistics service providers, inland terminals)	4	4	4	4	-	2	3	1	-	3	3	9	3.11

Inadequate cross-border coordination of port-hinterland corridor.	-	-	-	-	3	2	-	-	-	4	2	4	2.75
Available workforce (e.g. number of qualified port workers, qualification structure of port workers)	-	-	-	-	-	-	-	2	-	-	-	1	2.00
Inadequate operative planning	-	-	-	-	-	-	-	2	-	-	-	1	2.00
Institutional bottlenecks													
Fragmented planning at local/regional/national level.	-	-	-	-	-	-	3	-	3	3	4	4	3.25
Problematic national legal/institutional framework.	4	4	4	4	-	3	3	2	-	3	4	9	3.44
Low coordination/cooperation between the port and the city in terms of port-hinterland development.	-	-	-	-	-	-	-	-	2	-	-	1	2.00
Low coordination/cooperation with other ports or port-hinterland corridors.	-	-	-	-	-	-	-	-	3	-	2	2	2.50
Innovation bottlenecks													
Low innovation content in the services provided.	3	3	3	3	-	1	3	2	2	3	2	10	2.50
Not harmonised (or missing) digital information exchange between port-hinterland actors and between operational & public (e.g. customs) actors.	3	3	3	3	-	-	2	-	3	3	3	8	2.88
Inability to provide seamless port-hinterland cargo visibility to operational actors and shippers.	-	-	-	-	2	-	2	-	-	-	3	3	2.33
Differentiated levels of digital skills of staff within the same organisation or between different organisations or absence of adequate digital skills.	3	3	3	3	-	-	-	-	-	3	-	5	3.00

4.2 Main challenges for Local Plan formulation

Based on the assessment results on the table above, local action plans shall focus on the mitigation of bottlenecks with a value of ≥3.00. These bottlenecks are categorized into two sub-categories; the first one includes the bottlenecks of first priority which are the ones that show a value larger than 3 thus are expected to worsen in the most probable scenario. The second one includes the bottlenecks of second priority, which are the ones with a value equal to 3 and are expected to remain unchanged (and to continue to cause problems to port-hinterland integration to the same degree as they do today). Since Action Plans are formulated locally, the corresponding bottlenecks of 1st and 2nd priority are presented separately for each port/site in the following table:

Table 17: Bottlenecks of 1st and 2nd priority regarding the formulation of local action plans

Port	Bottlenecks	Category
Gioia Tauro	**1st priority:**	
	• Not aligned operational processes between operational & public actors.	Operational
	• Limited breadth (or inadequate quality) of services provided by the port and/or the hinterland actors.	Operational
	• Problematic national legal/institutional framework.	Institutional
	2nd priority:	
	• Low innovation content in the services provided.	Innovation
	• Not harmonised (or missing) digital information exchange between port-hinterland actors and between operational & public actors.	Innovation
	• Differentiated levels of digital skills of staff within the same organisation or between different organisations or absence of adequate digital skills.	Innovation
Vibo Valentia	**1st priority:**	
	• Limited breadth (or inadequate quality) of services provided by the port and/or the hinterland actors.	Operational
	• Problematic national legal/institutional framework.	Institutional
	2nd priority:	
	• Low innovation content in the services provided.	Innovation

	• Not harmonised (or missing) digital information exchange between port-hinterland actors and between operational & public actors. • Differentiated levels of digital skills of staff within the same organisation or between different organisations or absence of adequate digital skills.	Innovation Innovation
Crotone	**1st priority:** • Limited breadth (or inadequate quality) of services provided by the port and/or the hinterland actors. • Problematic national legal/institutional framework. **2nd priority:** • Low innovation content in the services provided. • Not harmonised (or missing) digital information exchange between port-hinterland actors and between operational & public actors. • Differentiated levels of digital skills of staff within the same organisation or between different organisations or absence of adequate digital skills.	Operational Institutional Innovation Innovation Innovation
Corigliano	**1st priority:** • Limited breadth (or inadequate quality) of services provided by the port and/or the hinterland actors. • Problematic national legal/institutional framework. **2nd priority:** • Low innovation content in the services provided. • Not harmonised (or missing) digital information exchange between port-hinterland actors and between operational & public actors. • Differentiated levels of digital skills of staff within the same organisation or between different organisations or absence of adequate digital skills.	Operational Institutional Innovation Innovation Innovation
Ravenna	**1st priority:**	

	• Limited demand for intermodal port-hinterland services.	Market
	2nd priority:	
	• Port infrastructure inadequate, incomplete or in poor condition.	Infrastructural
	• Inadequate soft infrastructure.	Infrastructural
	• Inadequate cross-border coordination of port-hinterland corridor.	Operational
Trieste	**2nd priority:**	
	• Port infrastructure inadequate, incomplete or in poor condition.	Infrastructural
	• Lack of port expansion area.	Infrastructural
	• Deficiency or inadequate capacity of port handling equipment.	Infrastructural
	• Problematic national legal/institutional framework.	Institutional
Sibenik	**2nd priority:**	
	• Port infrastructure inadequate, incomplete or in poor condition.	Infrastructural
	• Lack of port expansion area.	Infrastructural
	• Inadequate soft infrastructure.	Infrastructural
	• Limited breadth (or inadequate quality) of services provided by the port and/or the hinterland actors.	Operational
	• Fragmented planning at local/regional/national level.	Institutional
	• Problematic national legal/institutional framework.	Institutional
	• Low innovation content in the services provided.	Innovation
Bar	-	
Durres	**1st priority:**	
	Port infrastructure inadequate, incomplete or in poor condition.	Infrastructural

	2nd priority:	
	Limited demand for intermodal port-hinterland services.	Market
	Inadequate capacity of hinterland transport networks.	Infrastructural
	Inadequate soft infrastructure.	Infrastructural
	Not aligned operational processes between operational & public actors.	Operational
	Fragmented planning at local/regional/national level	Institutional
	Low coordination/cooperation with other ports or port-hinterland corridors.	Institutional
	Not harmonised (or missing) digital information exchange between port-hinterland actors and between operational & public actors.	Innovation
Thessaloniki	**1st priority:**	
	Inadequate soft infrastructure.	Infrastructural
	Not aligned operational processes of port-hinterland actors.	Operational
	Not aligned operational processes between operational & public actors.	Operational
	Inadequate cross-border coordination of port-hinterland corridor	Operational
	2nd priority:	
	Limited hinterland market of the port/area	Market
	Port infrastructure inadequate, incomplete or in poor condition.	Infrastructural
	Deficiency or inadequate capacity of port handling equipment.	Infrastructural
	Inadequate (capacity of) equipment of the rail operator to support hinterland flows.	Infrastructural
	Inadequate capacity of hinterland transport networks.	Infrastructural
	Limited breadth (or inadequate quality) of services provided by the port and/or the hinterland actors.	Operational

	Fragmented planning at local/regional/national level.	Institutional
	Problematic national legal/institutional framework.	Institutional
	Low innovation content in the services provided.	Innovation
	Not harmonised (or missing) digital information exchange between port-hinterland actors and between operational & public actors.	Innovation
	Differentiated levels of digital skills of staff within the same organisation or between different organisations or absence of adequate digital skills.	Innovation
Belgrade area	**1st priority:**	
	Fragmented planning at local/regional/national level.	Institutional
	Problematic national legal/institutional framework.	Institutional
	2nd priority:	
	Inadequate soft infrastructure.	Infrastructural
	Not aligned operational processes between operational & public actors.	Operational
	Limited breadth (or inadequate quality) of services provided by the port and/or the hinterland actors.	Operational
	Not harmonised (or missing) digital information exchange between port-hinterland actors and between operational & public actors.	Operational
	Inability to provide seamless port-hinterland cargo visibility to operational actors and shippers.	Innovation

Overall, for the ISTEN area, the conclusions from the analysis above can be summarised to the following:

- 17 cases out of 120 identified bottlenecks (<15%) are expected to intensify if the most possible scenario in each case is realized (assessed with a value >3.00) and 49 bottlenecks (≈40%) are expected to remain unchanged.
- 45% of the identified bottlenecks are expected to improve in the most probable future scenarios.
- Innovation bottlenecks are expected to remain unchanged in the majority of cases and in no case to intensify.

- Operational and Institutional are the categories with the most cases of bottlenecks expected to intensify (8 & 6 respectively).

Finally, by combining all the results of the analysis, a prioritisation of the main bottlenecks can be proposed, which is presented in the following chart:

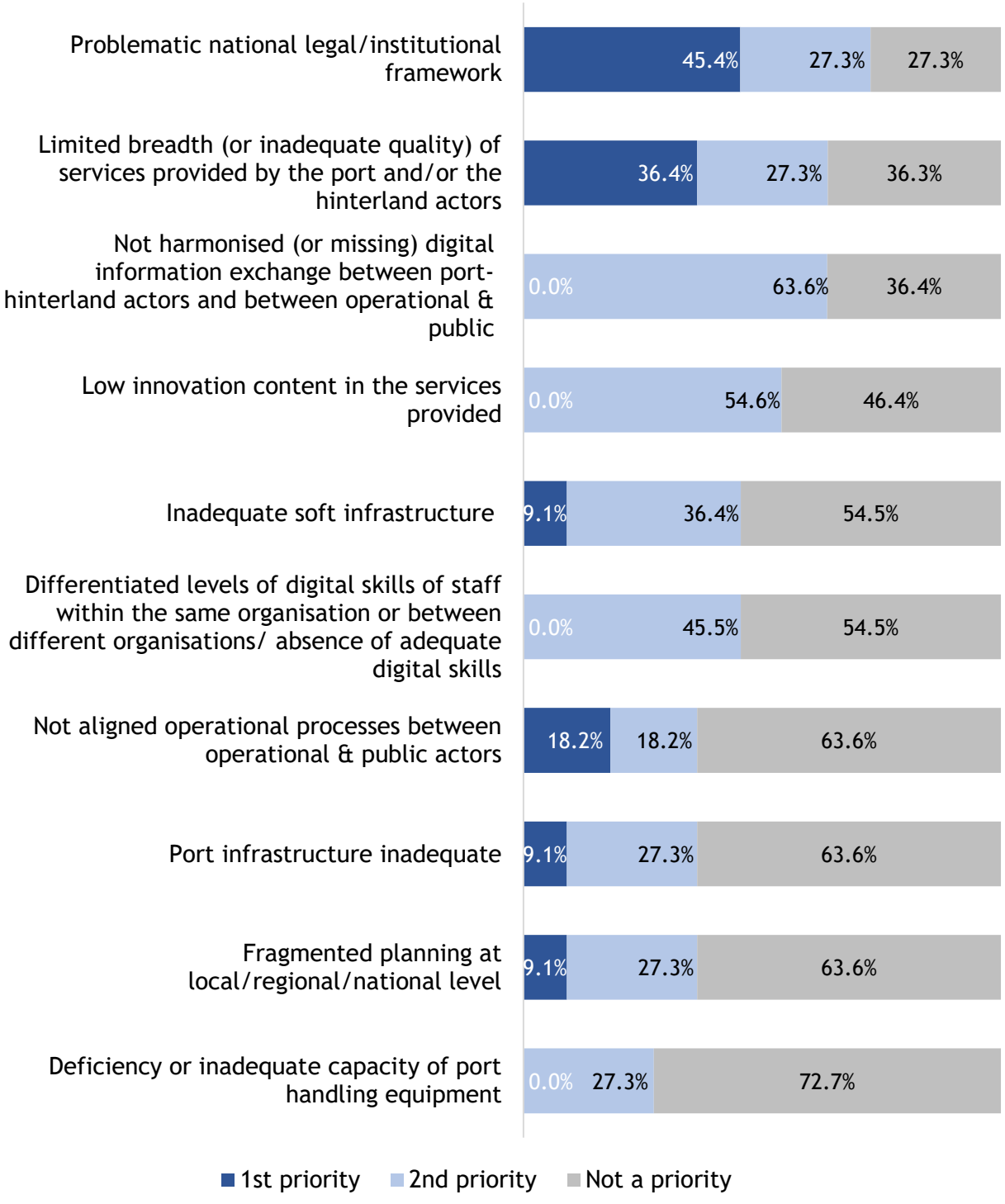

Figure 3: Prioritisation of main identified bottlenecks of ISTEN sites