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Policy linkages, interrelations and benchmarking suggestions

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ABSTRACT

The deliverable 4.4 provides a structured overview of the eight developed logistics and operational performance indicators. An analysis of the relation of the indicators with EU policy objectives and with other port performance indicators takes place. Finally, the relation to benchmarking methods including ICT requirements is added.

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LIST OF ABBREVIATIONS

AIS	Automatic Identification System
EU	European Union
ICT	Information and Communication Technology
LPI	Logistics Performance Index
LSCI	Liner Shipping Connectivity Index
PPI	Port Performance Indicator
TEN	Trans-European Networks
TEN-T	Trans-European Transport Networks
TEU	Twenty Foot Equivalent Unit
THC	Terminal Handling Charges
WB	World Bank
WP	Work Package

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1. INTRODUCTION

The deliverable "Policy linkages, interrelations and benchmarking suggestions" (D4.4) in the work package "Logistics chain and operational performance indicators" (WP4) provides a structured overview of the results of task 4.4 analysing the linkages of the logistics and operational performance indicators (developed in task 4.1 to 4.3), and current transport policy objectives of the European Union (EU). The focus lies on the followings tasks:

- An analysis of the relation of logistics chain and operational performance indicators with policy objectives,
- An analysis of the relation of logistics chain and operational performance indicators with other port performance indicators,
- An assessment of meaningful benchmarking methods for logistics chain and operational performance indicators, including Information and Communication Technology (ICT) requirements.

2. OVERVIEW OF DEVELOPED LOGISTICS CHAIN AND OPERATIONAL PERFORMANCE INDICATORS

Several logistics and operations performance indicators have been developed in the context of PORTOPIA:

1. Intermodal connectivity indicator (D4.1)
2. Roll-On/Roll-Off (RoRo) connectivity indicator (D4.2)
3. Road congestion indicator (D4.2)
4. Maritime fluidity indicator (D4.2)
5. Average terminal handling charges (THCs) (D4.2)
6. Average port dues (D4.2)
7. Maritime container connectivity indicator (D4.2)
8. EU terminal productivity indicator (D4.3)

A detailed description of the Intermodal connectivity indicator can be found in PORTOPIA Deliverable 4.1 “The intermodal connectivity indicator”. A summary of the majority of developed indicators and possible measurement ways is available in PORTOPIA Deliverable 4.2 “Connectivity, cost and congestion indicators”. PORTOPIA Deliverable 4.3 deals with a discussion of an “EU terminal productivity indicator”. In the following, a brief overview of all developed indicators, ways of measurement and data needs is provided.

2.1 Intermodal connectivity indicator

Despite the growing interest by ports and EU level policymakers, there are no established indicators to measure intermodal connectivity at the level of seaports. The PORTOPIA intermodal connectivity indicator was developed in order to measure a port’s hinterland by rail and barge as well as development of the intermodal linkages over time. It measures the connectivity of ports on the basis of their deep-sea connections with container ships and can be used by a single port when comparing its performance by the EU average, or by a group of similar ports, or on the basis of the throughput volumes of ports. However, the last two comparisons can only be done on the condition that a sufficient amount of ports provide data on their intermodal connectivity. Unfortunately ports were reluctant to give such data.

2.2 RoRo connectivity indicator

The RoRo connectivity indicator measures the intra-EU connectedness of ports on the basis of their short sea shipping links. The indicators enable making geographical comparisons between different TEN-T core ports inside the EU areas (vertical changes) as well as assessing changes in port connectivity over time (horizontal changes). In addition, the graph-based analysis of the existing RoRo links between seaports (route connectivity) enables identification of missing links between ports.

- The RoRo connectivity indicator is based on publicly available data (provided by RoRo/ferry operators). The indicator consist of the following components:
    - Number of connections to other ports,
    - Frequency of connections (measured as a number of a port’s weekly connections to other ports),
    - Number of service providers,
    - Time range,
    - Maritime distance between ports,
    - The number of ports a single port connects, and
    - Travel time.

However, as the indicator relies solely on schedule data available on the Internet, which is provided by the shipping companies, the reliability of the data is not fully guaranteed. Means for harmonized way of data collection can improve the accuracy of the data.

2.3 Road congestion indicator

The road congestion indicator measures the extent of road congestion based on publicly available data from WAZE, that uses data from in-car devices (such as phones) to determine congestion levels on roads. As no formal partnership with WAZE was established, data collection was done manually, for three test ports. These three tests demonstrated the validity of the indicator. The next step, beyond the PORTOPIA project would be to develop a “scraping tool” to automate data collection.

2.4 Maritime fluidity indicator

Port congestion is difficult to define and measure, there are different regional perceptions and reasons are diverse. Additionally, carriers, shippers, terminals, etc. all have different demands. A new approach has been developed which considers this complexity as well as controversy by utilizing readily available ship traffic data to enable subsequent port-specific congestion analysis. Therefore, the proposed approach can be better described as a process to visualize “maritime fluidity” with a port-independent data source as a starting point for individual maritime congestion analysis. The maritime fluidity indicator uses Automatic Identification System (AIS) data for basic analysis of general ship movements in geographical pre-defined port areas. Main goal is the visualization and pre-analysis of vessel movements in port areas overtime. The indicator gives an insight into waterborne traffic flows in port areas. The outcome indicates the distribution of arriving vessels in a spatially restricted area. Major assumption for the indicator is that a continuous fluid journey to a port will always take the same transition time (with less variation) from a certain distance. A discontinuous journey leads to more fluctuating transition times. The approach for the maritime fluidity indicator is applied to the Port of Bremerhaven, Germany and the Port of Valencia, Spain. Data provider Marine Traffic agreed to share AIS data for research purposes. To sum up, port performance indicators are usually confronted with a lack of publicly available data. AIS data is an often under-valued exception. The automated vessel tracking has transformed the problem of data gaps into a challenge of data analysis. Building on this insight, discussion with data providers was initiated and agreements rely on the legal and organizational structure of the project’s follow up initiatives.

2.5 Average terminal handling charges

Terminal Handling Charges (THCs) are important components of the cost of transporting containerized cargo. THCs are defined by shipping lines as ancillary charges and represent the additional increase in costs that are associated with the operation of moving containers (loading and discharging of containers). THCs vary between ports and carriers and can thus be used as an indicator for port related supply chain costs. The analysis of the feasibility of the indicator has been carried out by comparing the THCs of the 98 TEN-T Core Ports, where publically available. THCs were determined for the 20 largest container liner carries in 2013, 2015 and 2016. This selection of carriers is representative for the whole industry because they form around 90 percent of the world liner fleet in TEU. However, due to the fact that THCs were not publically available for each of the carries the number of analyzed carriers was reduced to 17. Table 1 illustrates the average THCs per port and the number of carriers. For this deliverable new data for 2016 is collected and compared.

THCs of the analyzed ports vary between 98 EUR in the Port of Galati and 272 EUR in the Port of Bremen. They are very similar for ports of the same country. This is especially true for Germany, France, Spain, Italy, Portugal and Great Britain. The highest average THCs can be found in Germany, which amount to 288 EUR in 2016. This is 54 percent higher than the average THCs for all countries. Additionally, THCs for different types of containers were analyzed (dry, reefer, import, export). 20-foot- or 40-foot-containers are the same. In almost all countries the THCs for import and export containers are the same.

Concluding, THCs are an important part but only one element of the total container supply chain costs. Special rates are discussed between carriers and terminal operators individually. But as an indicating starting point data can be collected free of charge and over time, which is of advantage for following project initiatives.

Table 1: Ranking of ports according to their average THCs in EUR

Rank	Country	Core Port	Average THCs			Number of Carriers		
			2013	2015	2016	2013	2015	2016
1	Germany	Bremen	272	280	291	12	10	4
2	Germany	Lübeck	271	282	291	10	8	4
3	Germany	Rostock	271	282	291	10	9	4
4	Germany	Wilhelmshaven	271	282	288	10	6	5
5	Germany	Bremerhaven	269	275	283	16	10	11
6	Germany	Hamburg	268	277	282	17	6	12
7	France	Calais	231	242	244	8	7	5
8	France	Nantes - St Nazaire	231	242	244	8	9	5
9	France	Rouen	229	239	245	9	10	6
10	France	Dunkerque	229	238	242	9	10	8
11	France	Le Havre	228	236	241	15	9	12
12	France	Marseille	227	240	248	10	11	6
13	Spain	Barcelona	225	213	223	10	6	9
14	Spain	La coruna	225	206	228	6	13	4
15	Spain	Cartagena	225	206	216	6	1	6
16	Spain	Gijon	225	196	226	7	1	6
17	Spain	Huelva	225	206	227	6	1	5
18	Spain	Palma de Mallorca	225	206	227	6	1	5
19	Spain	Sevilla	225	206	227	6	8	5
20	Netherlands	Rotterdam	225	237	247	16	3	11
21	Spain	Valencia	224	212	222	10	4	9
22	France	Bordeaux	224	240	244	8	7	5
23	Spain	Algeciras	222	207	223	8	6	7
24	Spain	Tenerife	222	209	227	8	8	6
25	Spain	Tarragona	222	205	223	7	8	6
26	Spain	Las Palmas	220	208	224	9	2	7
27	Netherlands	Amsterdam	219	236	248	11	3	8
28	Spain	Bilbao	218	199	218	10	6	9
29	Netherlands	Moerdijk	215	235	248	10	3	6
30	Netherlands	Vlissingen + Terneuzen	215	235	248	10	7	6
31	Italy	Cagliari	205	208	216	11	8	9
32	Italy	Gioio Tauro	205	207	215	12	8	9
33	Italy	Taranto	204	208	218	9	8	7
34	Italy	Augusta	204	208	217	8	8	6
35	Italy	Ancona	204	207	214	10	8	9
36	Italy	Napoli	204	207	213	10	0	10
37	Italy	Palermo	204	207	216	10	0	8
38	Italy	Ravenna	204	207	214	10	10	9
39	Italy	Trieste	204	207	214	10	13	9
40	Belgium	Antwerp	204	214	227	17	14	12
41	Italy	Bari	204	207	215	9	8	7
42	Italy	Genoa	204	206	214	15	9	11
43	Italy	Livorno	203	206	215	12	8	9
44	Italy	Venezia	202	204	214	11	8	9
45	Italy	La Spezia	202	205	214	12	4	9
46	Belgium	Zeebrugge	199	215	226	13	11	8
47	Belgium	Ghent	195	213	224	11	10	6
48	Belgium	Oostende	195	213	224	11	10	6
49	Slovenia	Koper	185	189	187	6	4	6
50	Portugal	Leixoes	184	195	201	13	4	7
51	Portugal	Lisbon	183	195	201	12	5	7
52	Portugal	Sines	182	187	193	11	4	3

53	UK	Belfast	179	199	223	14	11	9
54	UK	Glasgow	178	200	223	11	10	8
55	UK	Southampton	178	199	221	14	13	11
56	UK	London Gateway Tilbury	178	199	221	11	10	9
57	UK	Edinburgh	177	199	222	12	11	9
58	UK	Teesport	177	198	222	13	12	10
59	UK	Cardiff-Newport	176	199	224	10	9	7
60	UK	Dover	176	199	224	10	9	7
61	UK	Harwich	176	199	224	10	10	7
62	UK	Milford Haven	176	199	224	10	9	7
63	UK	Bristol	176	198	223	11	10	8
64	UK	Liverpool	176	198	221	14	12	10
65	UK	Grimsby / Immingham	176	198	222	11	9	9
66	UK	Felixtowe	175	198	221	14	12	10
67	Poland	Gdansk	172	161	168	3	9	7
68	Poland	Sczecin, Swinoujscie	172	158	160	3	4	4
69	Sweden	Goteborg	161	157	168	14	6	10
70	Ireland	Dublin	159	168	172	13	8	8
71	Denmark	Copenhagen	158	155	159	14	3	10
72	Denmark	Aarhus	158	155	159	14	3	9
73	Poland	Gdynia	156	148	165	4	8	7
74	Ireland	Cork	154	168	172	12	7	8
75	Sweden	Malmo	154	152	163	11	8	8
76	Sweden	Lulea	151	153	167	7	11	6
77	Sweden	Trelleborg	151	153	167	7	6	6
78	Ireland	Limerick	150	164	171	7	12	4
79	Sweden	Stockholm	150	150	161	11	9	9
80	Latvia	Riga	143	136	141	10	4	9
81	Finland	Kotka-Hamina	141	159	168	13	5	10
82	Finland	Helsinki	138	155	166	12	6	9
83	Lithuania	Klaipeda	137	128	133	10	10	10
84	Latvia	Ventspils	134	141	154	5	2	4
85	Greece	Pireaus	133	64	204	3	8	1
86	Estonia	Tallin	132	144	149	10	7	9
87	Finland	Turku naantali	127	149	163	10	9	7
88	Romania	Constantza	118	91	110	7	6	2
89	Cyprus	Lemesos	118	112	126	3	3	5
90	Greece	Thessaloniki	116	42	178	2	13	1
91	Romania	Galati	98	91	-	2	4	0

2.6 Average port dues

The average port dues per ton are collected based on publicly available annual accounts of port authorities. Around 25% of all EU core ports provide such data, but these include some of the larger ports so that the share of total volume covered by this indicator is higher, around 40% of the total EU core port's throughput. The indicator shows the evolution of average port dues per ton over time. The interpretation of this indicator is not unambiguous, but it nevertheless remains a relevant indicator.

2.7 Maritime container connectivity indicator

Maritime container connectivity indicator was developed to measure connectivity at the level of a single port allowing comparisons between individual ports. The proposed indicator measures maritime connectivity based on a number of components. However, acquiring the required data for verifying the functionality of the indicator turned out difficult. First-hand data collection on the basis of liner services provided by shipping lines and processing it for the analysis turned out too difficult due to large amount of data and inconsistencies in the publicly available schedule information. An alternative approach was to utilize data on actual vessel movements (AIS data), but this data is also imperfect and cannot be processed. Ultimately, the value of the indicator was demonstrated for somewhat smaller ports where data could be collected first hand.

2.8 EU terminal productivity indicator

Given the availability – albeit on commercial terms - of a widely used terminal productivity indicator from a provider named HIS (formerly the Journal of Commerce JOC), that could not be incorporated in PORTOPIA, an additional indicator was developed that is complementary and can be calculated based on publically available data: the throughput per meter of quay length. This indicator is a second best option to approach the issue and shows the utilization of the quays, the most expensive asset in the port, and generally provided by port authorities.

3. RELATION TO EU POLICY OBJECTIVES

A powerful tool for strategic policy development and serving as topic-specific political framework the European Union publishes White Papers regularly. In addition, the EU has the chance to address policy objectives concerned with the logistics chain and operational performance of ports through regulations, directives, decisions, EU court cases, Commission (COM) legislative proposals/communications and green papers/joint proposals, or through staff and joint staff working documents (SWD; prior to 2012 SEC). Several publications explicitly consider the issue of "port performance".

3.1 The third White paper on Transport

Maritime transport and seaports are vital to the EU. Seaports handle around three quarters of the EU's trade with non-member countries, and more than a third of intra-EU freight transport.[1] In the third White paper on Transport "Roadmap to a Single European Transport Area — Towards a competitive and resource efficient transport system" the European Commission sets targets on the future of transport up to the year 2050. Key targets for the transport sector include:

- To use less and cleaner energy,
- To exploit modern infrastructure more effectively and
- To reduce its impact on the environment.

The White paper sets ten specific goals on how to achieve a competitive and resource efficient transport system and 60% reduction in greenhouse gas emissions. From the perspective of maritime logistics and seaports' performance the specific goal of "Optimising the performance of multimodal logistic chains, including by making greater use of more energy-efficient modes" has a specific relevance.

In the White paper the role of seaports as logistics centres that require efficient hinterland connections is highlighted. Seaports have a pronounced role in ensuring the functionality of the common European market by handling freight both by short sea shipping within the EU and with the rest of the world. Inland waterways, where unused potential exists, have to play an increasing role in particular in moving goods to the hinterland and in linking the European seas. Existing barriers for intermodal transport and short sea shipping can be removed with infrastructure investments into EU-wide multimodal TEN-T network and corresponding information services. The White paper also sets a specific target on improving traffic management and information systems.

[1] European Court of Auditors 2016

3.2 A European port policy

In the "Communication on a European Ports Policy" the European Commission published its strategy to face recent challenges in the European port system. Main issues are port performance, hinterland connections, extending capacity by taking account of environment, modernization, communication as well as employment. In 2009, the European Economic and Social Committee published its opinion to this communication[2]. In general, the EESC agrees with the Commission's strategy. By realizing the mentioned initiatives the Committee's objective of a common EU ports policy can be achieved.

Policy objective related to ports embedded in logistics/supply chains is:

- To implement a rail-freight oriented network.

Policy objectives related to port operations are:

- To implement a solid investment climate,
- To ensure development in ports by taking account of sustainability,
- To support the dialogue between all parties in the port,
- To control the compliance of Treaty rules,
- To expand the offer and the diversity of EU ports, and
- To implement state aid guidelines and financial transparency to ensure fair competition.

3.3 Ports: an engine for growth

The European Commission's "Communication from the Commission – Ports: an engine for growth"[3] highlights current challenges regarding port performance and hinterland connections as well as European Port Policy and provides a strategy to face those issues. The European Commission sets six points to improve port performance:

1. Connecting ports to the TEN-T by a more integrated infrastructure planning, a coherent investment and efficient EU funding,
2. Improving port services and operations,
3. Attracting public and private funding in ports, transport infrastructure and facilities in particular,

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[2] 2009/C 27/11, Opinion of the European Economic and Social Committee on the 'Communication from the Commission — Communication on a European Ports Policy', Official Journal of the European Union, Brussels, 09.07.2008.
[3] COM (2013) 295 final, Communication from the Commission. Ports: an engine for growth, Brussels, 23.05.2013

4. Supporting the social dialogue between all parties in ports to attract the port as a workplace,
5. Promoting initiatives to improve the environmental profile of ports, especially the environmental management and performance,
6. Providing new innovations to ensure the competitiveness of European ports by encouraging research.

Main policy objective related to ports embedded in logistics/supply chains is to connect ports to the TEN-T by providing a "more integrated infrastructure planning, consistent investment strategies and efficient EU funding". Policy objectives related to port operations are:

- To modernise port services and operations by providing fair market access, a supervision of price and quality and a reduction of administrative burden.
- To attract investment by raising financial transparency of funding in ports.
- To support a social dialogue between all partners in the port to improve the social climate and working conditions.
- To reduce the significant negative impact of ports on the environment.
- To ensure the competitiveness of European ports by supporting research and innovations in ports.

3.4 Opinion on the promotion of Short Sea Shipping

In the document "Opinion of the European Economic and Social Committee on the Communication from the Commission Programme for the Promotion of Short Sea Shipping, and the Proposal for a Directive of the European Parliament and of the Council on Intermodal Loading Units"[4] the European Economic and Social Committee summarizes the programme for the promotion of short sea shipping and its 14 legislative, technical and operational actions as well as the proposal for a directive by naming the four objectives. In general, the Committee supports the Commission's strategy for the promotion of short sea shipping. However, the need for strict deadlines is highlighted. In the case of the proposal for a directive on intermodal loading units, the Committee adds some objectives that are missed. Policy objectives related to ports embedded in logistics/supply chains are:

[4] 2004/C 32/15, Opinion of the European Economic and Social Committee on: the 'Communication from the Commission Programme for the Promotion of Short Sea Shipping', and the 'Proposal for a Directive of the European Parliament and of the Council on Intermodal Loading Units', Brussels, 29.10.2003.

- To improve the parameters for short sea shipping in general to reach the objectives of the European transport policy, and
- To attract the intermodality to decrease road congestion.

3.5 Relation of EU policy objectives to maritime logistics and port operations indicators

Considering recent policy communications, the indicators measuring maritime logistics and port operations developed in the PORTOPIA project can help to monitor the progress of EU policy aims over time. According to the report of European Court of Auditors[5], the European Commission has little information on the actual situation at seaports, their core capacities and on their long-term investment strategies. The lack of information has resulted in overlapping, economically unsustainable and ineffective investments at seaports. In addition, many missing and inadequate links to the hinterland hinder efficient functionality of the seaports as key nodes. By providing information on terminal handling costs, maritime, intermodal and RoRo connectivity, and the rate of port congestion the indicators developed in PORTOPIA link European transport policy objectives with operations and activities taking place at seaports.

Figure 1 shows the main EU policy objectives in line with the previous overview, their implications for logistics operations in seaports as well as their links to the indicators developed in WP4.

[5] European Court of Auditors 2016, p. 59

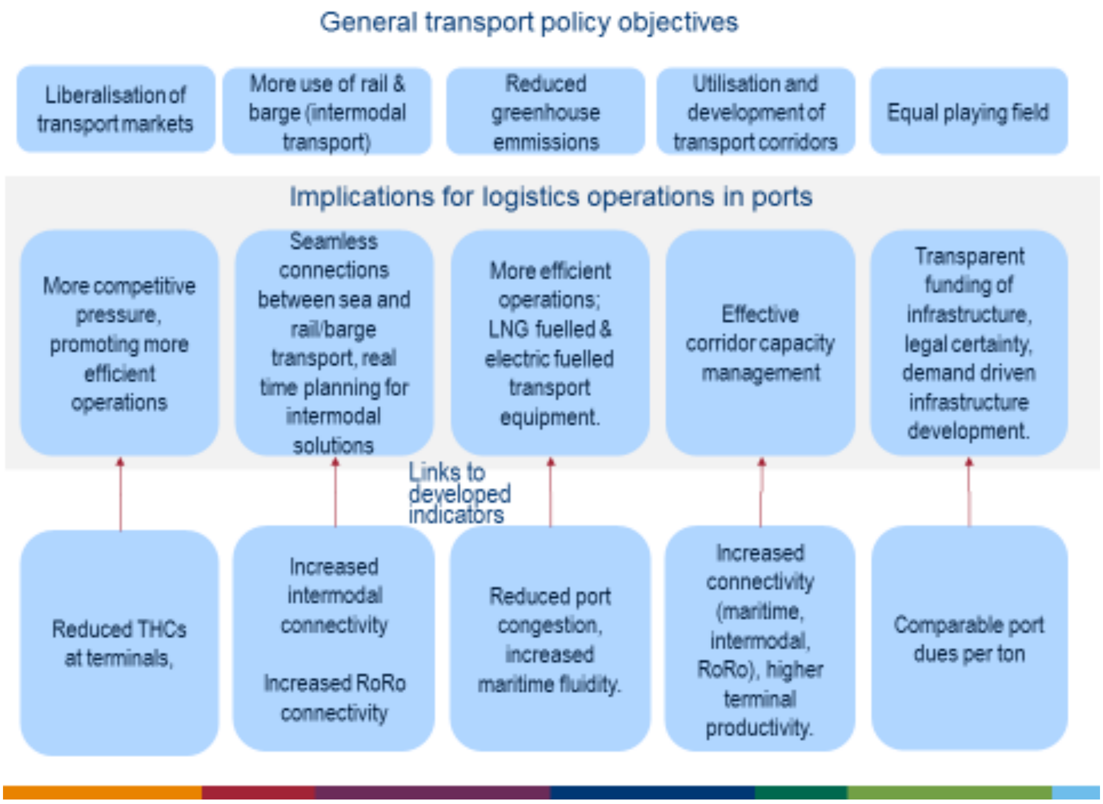

Figure 1: Relation of developed indicators and EU policy objectives (general)[6]

The liberalisation of transport markets would over time increase competitive pressure on port service providers (and transport service providers in general). This ultimately would be associated with reduced port costs, both for the terminals (THCs) and for the port managing bodies (port dues). Case studies have demonstrated relations between more competition and reduced port costs.[7] However, there is clearly no causal relationship, as technologies, market conditions as well as pricing decisions of port authorities also influence THCs.

The policy objective on promotion of intermodal transport would require more seamless connections between all transport modes, especially between rail-barge transport and maritime transport. In addition, it would require more data integration and availability to be able to allocate every shipment to the most suitable transport mode at low

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[6] We have summarised the policy objectives above in the five core themes included in the figure.
[7] Estache & Carbajo, 1996

transaction costs. Thus, this policy objective is related to both intermodal connectivity as well as to RoRo connectivity indicators. Intermodal connectivity is here defined as connectivity between seaports and their hinterland with rail and barge services. Intermodal connectivity contributes to several policy objectives identified above and is positively related to several other maritime logistic chain performance indicators, including port's maritime connectivity, quality of custom procedures, port road congestion, and investments in inland ports. The higher the intermodal connectivity of a port, the less carbon emissions are produced and the better possibilities are for increasing transported cargo volumes through ports.

In addition, the quality of port hinterland connections contributes to efficient and well-priced port services, which in turn are valued by ports' customers. Furthermore, information on evolution of connectivity of a port can contribute to the future development of transport corridors. The policy aim of well functioning transport corridors ultimately should result in better connectivity of the transport modes that are critical components of these corridors. Container, RoRo and intermodal connectivity indicators thus show whether policy aims have been achieved or not.

Substantial gains on greenhouse gas reduction can be made through reducing congestion, as congestion aggravates emissions. Thus, the indicators on maritime fluidity and especially road congestion are also relevant. However, limited availability of data without investing in regular data access made these indicators inoperable if no long-term relationship with data providers can be generated.

The market access to port services is in line with the policy objective for transport, and related to the THCs charged at European container terminals. The policy goal of a level playing field is loosely related to the revenue structures of port managing bodies. In the majority of EU's core ports, these managing bodies operate with a landlord business model and are government owned. A more equal level playing field would emerge if these managing bodies finance investments from their own revenues. This may imply a convergence of port dues. However this issue is not straightforward as in a situation where the ´user pays´ for the use of ports infrastructure, the costs of the infrastructure would have to be reflected in the port dues. Consequently, it would make sense for port dues to be relatively high in small ports (as these lack the scale economies, so that the infrastructure costs are relatively high), as well as in ports built in complicated physical/technical environments, as for these ports the costs of quay construction, breakwaters, locks or other types of infrastructure would be relatively high, and be passed on to users. To add to the complexity, all ports have different pricing structures, where the balance between land related income and ship related income may differ. In short, it is very hard to theorize about what would be the distribution of port dues per ton in a more equal playing field between ports.

In sum, Figure 2 shows the specific policy goals for ports as well as their implications for logistics operations in ports and links. Developed indicators showing uncertainty towards data access and future application are excluded.

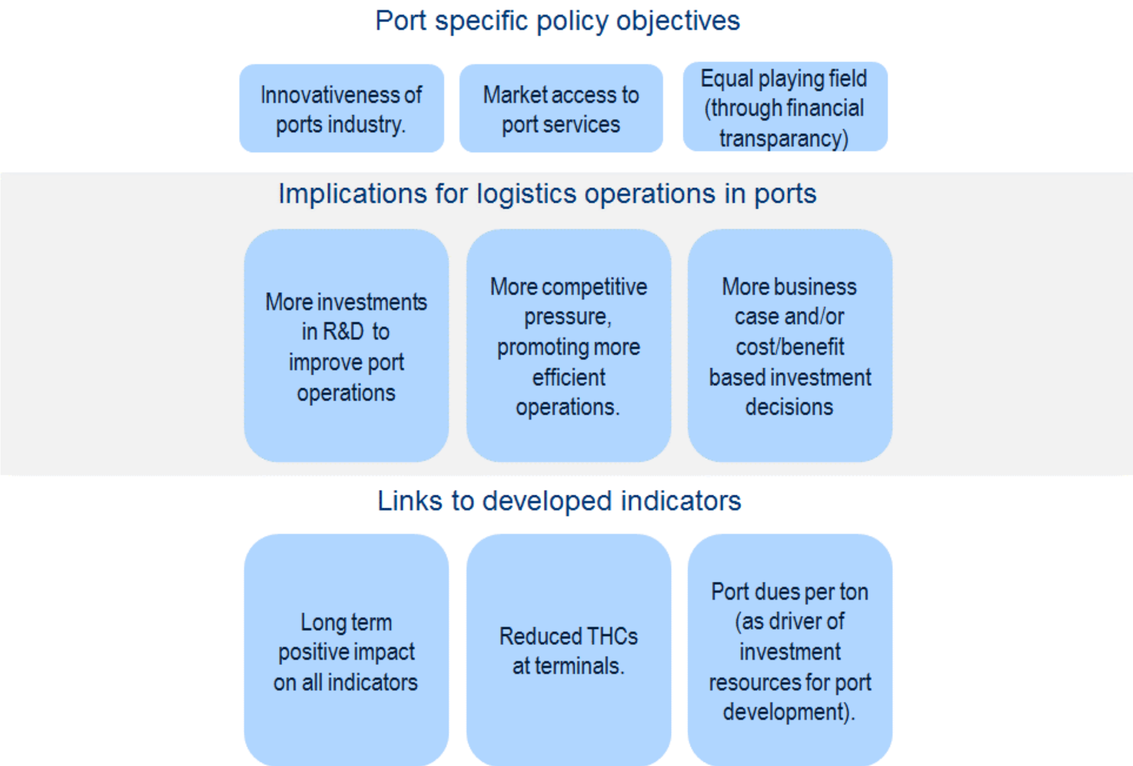

Figure 2: Relation of developed indicators and EU policy objectives (port specific)

4. RELATION TO OTHER PORT PERFORMANCE INDICATORS

In brief, benchmarking methods make a distinction into one or several single performance indicators or performance indicator index systems. A definition of single Port Performance Indicator (PPI) would be:

> *PPIs are the selected measures that provide visibility into the port performance and enable decision makers (in administration and operation) to take action in achieving the desired outcomes. The specification of key port performance indicators enables learning and improvement on critical operations, capabilities and processes of ports embedded in maritime supply chains.* [8]

Performance index systems refer according to OECD (2008) to a composite indicator, which is formed when individual indicators are compiled into a single index on the basis of an underlying model. The index systems are more complex than single indicators because they should ideally measure multi-dimensional concepts which cannot be captured by a single indicator, e.g. competitiveness, industrialisation, sustainability, single market integration, knowledge-based society.[9]

The interrelations of the indicators developed in different PORTOPIA work packages are analyzed in detail in Work Package 8 (WP8). Notwithstanding, the logistics chain and operational performance indicators are compared with externally developed contributions in order to show present market developments. The following two index systems and two single indicators are considered as relevant for comparison:

- The UNCTAD/World Bank Liner Shipping Connectivity Index
- The World Bank Logistics Performance Index
- The World Bank Indicator on Port Charges
- The Journal of Commerce Port Productivity Indicator

4.1 The UNCTAD Liner Shipping Connectivity Index

The Liner Shipping Connectivity Index (LSCI) is a well-established index, published by UNCTAD and the World Bank (WB) each year from 2004 onwards.[10] It is developed to measure countries' competitiveness in terms of access to regular and frequent liner services. It captures how well countries are connected to global shipping networks. The

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[8] See smartkpis.com for comprehensive definition without port focus
[9] OECD 2008, p.13
[10] http://unctadstat.unctad.org/TableViewer/dimView.aspx

underlying data come from Containerisation International Online. The LSCI is based on five components of the maritime transport sector:

1. Number of ships (that national and international liner shipping companies deploy on the liner services from and to the country's ports),
2. Ships container-carrying capacity (number of slots for Twenty Foot Equivalent Units (TEU) of the ships used in these services),
3. Maximum vessel size (that calls a country's port in TEU),
4. Number of services (provided by the shipping lines),
5. Number of companies that deploy container ships in a country's ports.

All of the components are calculated on a yearly basis, and each of the components is normalized by the value of the highest component in 2004. The obtained values are then averaged and once again normalized by the maximum average for 2004 and multiplied by 100. The LSCI is a country-level indicator even though the country is a less straightforward unit of analysis than a port (see D4.2). The LSCI is publicly available, on a country level.

4.2 The World Bank Logistics Performance Index

The World Bank has also developed a Logistics Performance Index (LPI), based partly on quantitative data and partly on user perceptions of the quality of logistics services in a country. It is a benchmarking tool assessing the performance of countries' trade logistics. Analysis relies on data collected by a structured online survey (1-5 scale) of logistics professionals at multinational freight forwarders and at the main express carriers. Eight overseas markets are rated on six core components of logistics performance which were chosen based on recent theoretical and empirical research and on the practical experience of logistics professionals involved in international freight forwarding:

1. The efficiency of customs and border management clearance ("Customs"),
2. The quality of trade and transport infrastructure ("Infrastructure"),
3. The ease of arranging competitively priced shipments ("Ease of arranging shipments"),
4. The competence and quality of logistics services (trucking, forwarding, and customs brokerage; "Quality of logistics services"),
5. The ability to track and trace consignments ("Tracking and tracing"),
6. The frequency shipments reach consignees within scheduled or expected delivery times ("Timeliness")

The LPI is split in two different scores: international LPI and a domestic LPI. This difference is not obvious, as some of the "domestic" issues deal with customs, port and airports. The domestic LPI has detailed information, for instance on costs, lead times and number of inspections per shipment. In addition, the domestic LPI has detailed information on the quality of the environment and institutions. The LPI uses standard statistical techniques to aggregate the data into a single indicator that can be used for cross-country comparisons. The scores of the components of the international LPI are publicly available on a country level.

4.3 The World Bank Indicator on Port Charges

The World Bank indicator on port charges is expert based, the assessment of the quality of port infrastructure and the level of port charges is given in Figure 3 which shows according to the respondents' assessment, port users in Sweden, Poland and Denmark are both satisfied with the quality and with the price level.

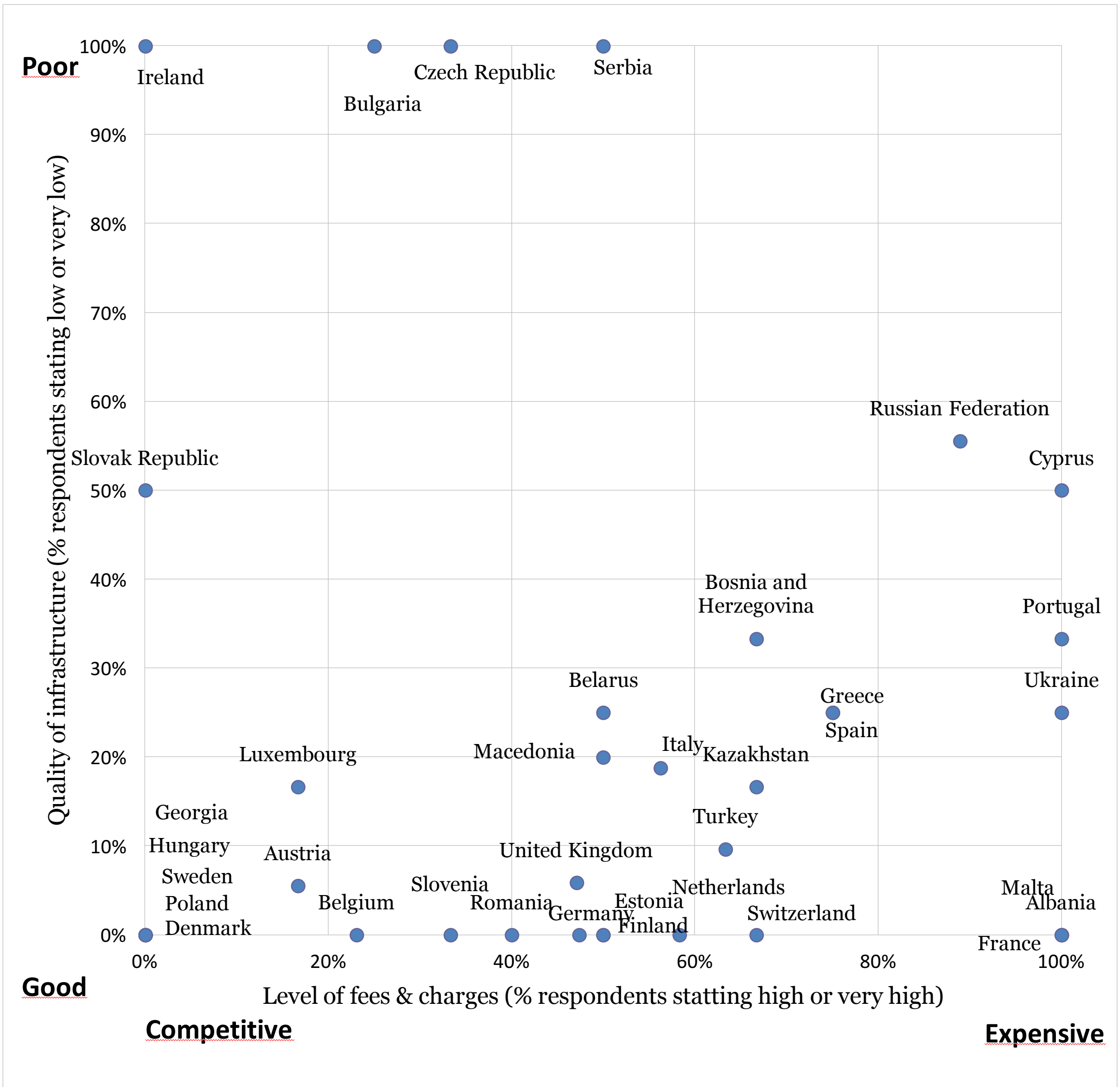

Figure 3: World Bank indicator on port charges

Source: own compilation based on publicly available data at http://lpi.worldbank.org/

On the other hand experts consider France's port infrastructure expensive. The opposite case is Ireland: respondents are positive about pricing, but negative about the quality of port facilities. These data can be compared with the data collected on the port dues per ton (see Table 2).

Table 2: Comparison of collected port dues per ton and LPI score

Country	Unweighted average port dues per ton	LPI score high port costs
Belgium	0,46	23%
Germany	0,35	47%

Estonia	2,33	50%
Ireland	1,27	0%
Spain	1,04	75%
France	0,83	100%
Italy	0,56	56%
Netherlands	0,61	58%
Portugal	0,32	100%
UK	1,16	47%

Source: PORTOPIA data collection of port dues per ton, LPI available from http://lpi.worldbank.org/

Table 2 and Figure 3 clearly show there is no relation between the average port dues per ton and the user scores on the level of port charges. The data points in the figure correspond to particular countries, the names of the countries are not given as the aim of the analysis is to assess validity. The figure suggests the LPI data have limited validity. For instance, respondents for Portugal indicated the Portuguese ports are expensive even though this is not apparent from an international comparison.

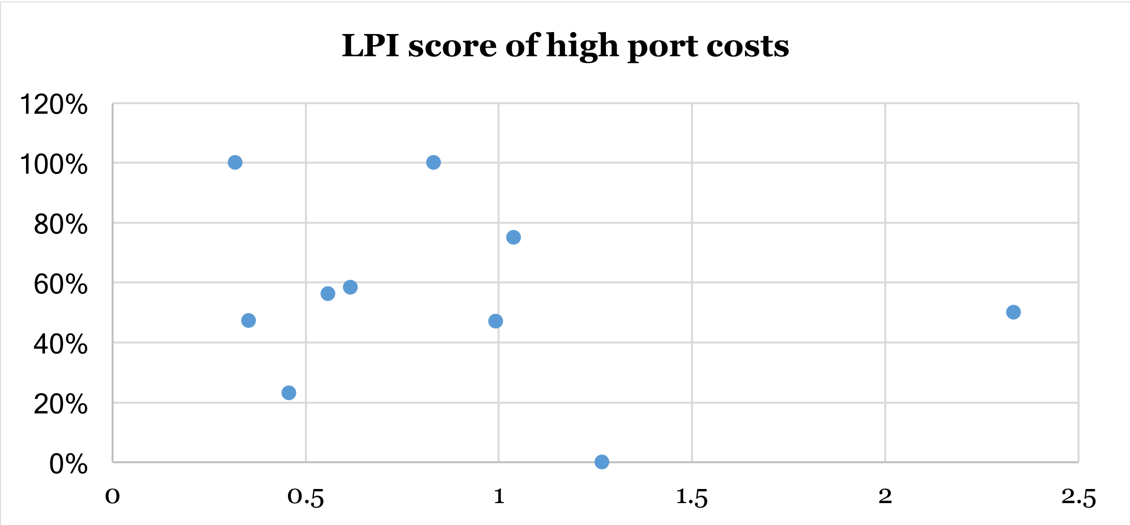

Figure 4: LPI score of high port costs and port dues collected in PORTOPIA

As THCs per country were also collected during the PORTOPIA project, a similar analysis is made for the relation between the LPI indicator and the average THCs per country.

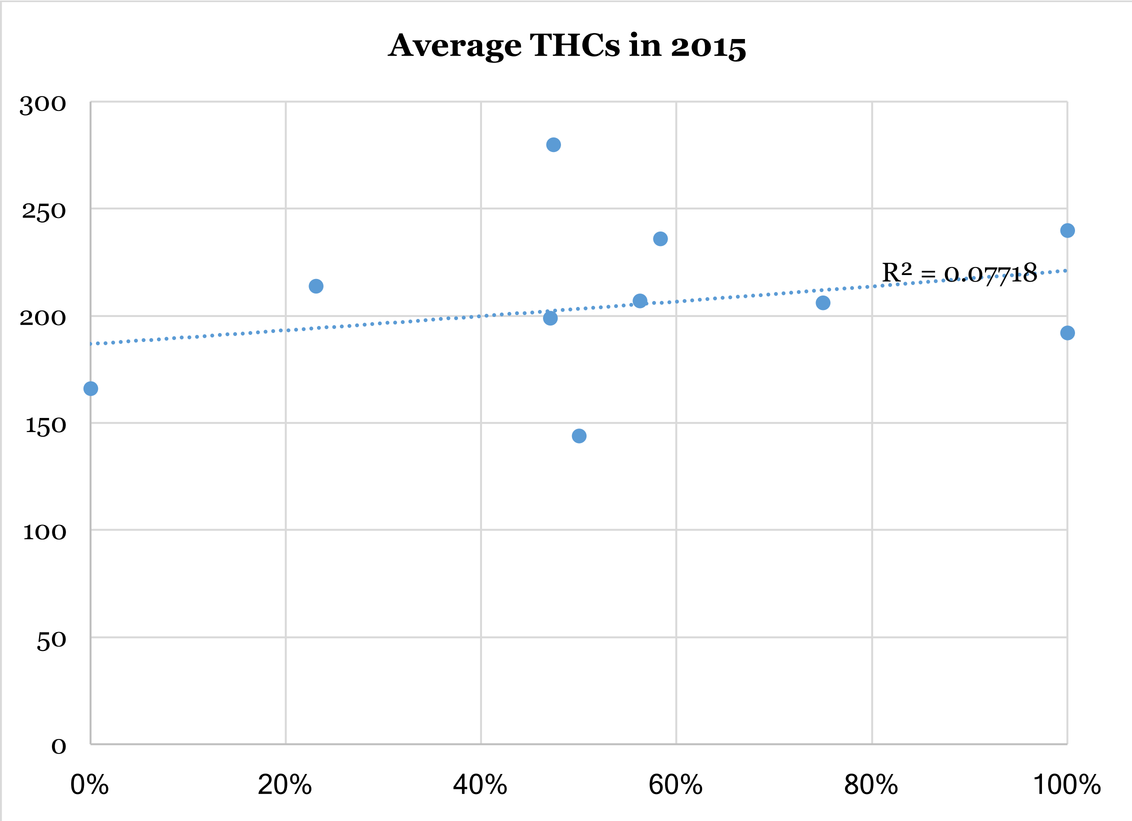

Figure 5: Average THCs in 2015 compared with the LPI indicator on port costs.

The conclusion of Figure 5 is that there also is hardly a relation (R2 below 10%, i.e. the average THCs explain less than 10% of the respondent scores) between the port cost perceptions and the THC cost data in collected in PORTOPIA. As a test of the validity of the World Bank indicator, it can be compared with the World Economic Forum (WEF) indicator. For this comparison, the judgement on the quality of ports from both surveys is taken.

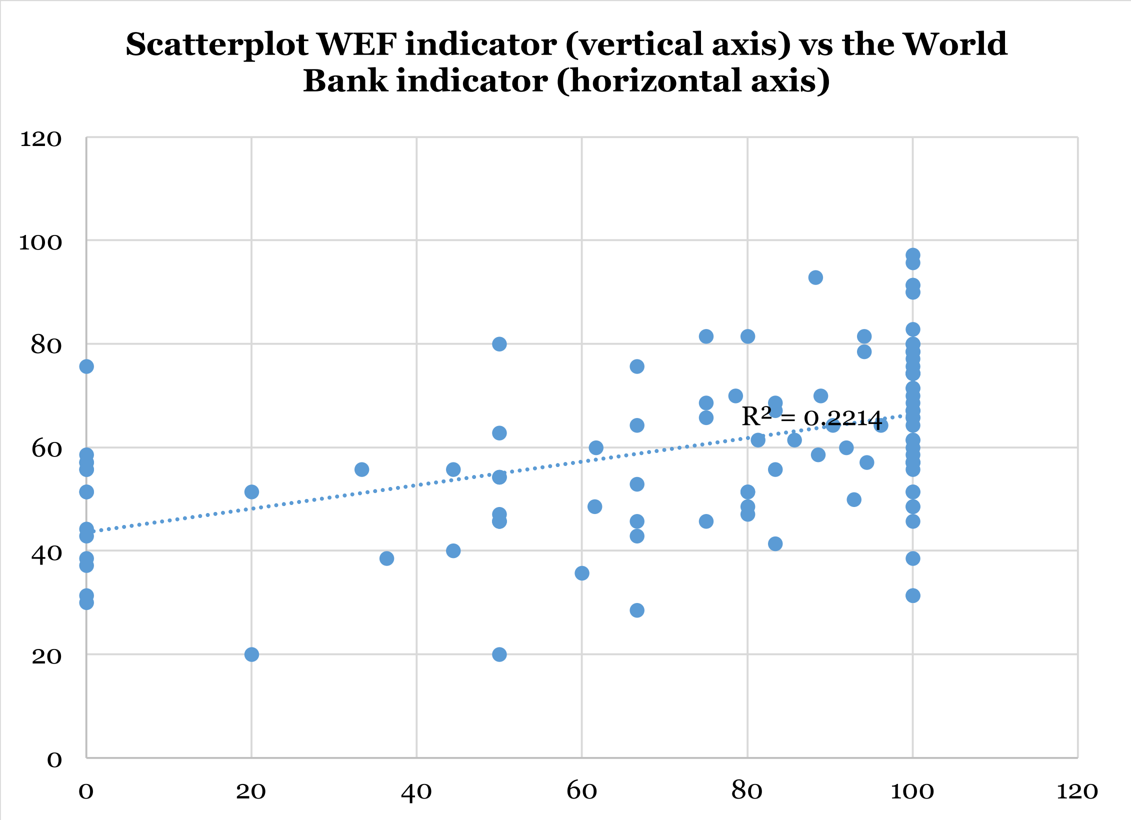

Figure 6: Comparison of World Bank indicator and WEF

Source: own compilation based on WEF and World Bank data.

These results show a very limited correlation between the two different user satisfaction measurements that are available on a country level. Given the huge number of "boundary scores" (scores of either 0 or 100) of the World Bank indicator, the number of respondents seems to be limited. Furthermore, the WEF forum results (Singapore, the Netherlands on top) are more in line with industry perceptions. Thus, the validity of the World Bank results is limited.

4.4 The Journal of Commerce Port Productivity Indicator

The Journal of Commerce (JOC) introduced a new indicator of port performance in 2013 dealing with the user perspective of berth productivity. It examines the total moves at terminal berth per hour achieved. Initially, data from 17 liner carriers (70% of global vessel capacity) on 400 ports with 650 container terminals worldwide could be gathered. Available details are:

1. Time ships arrived,

2. Time ships departed, and
3. Number of moves achieved.

The performance indicator is broken down by terminal level, port, region, ship size, call size. Data are collected at the level of terminals, and can be aggregated to ports. Only deep-sea terminals are included. The JOC makes a distinction between calls of ships with a capacity below 8,000 TEU and ships with a capacity of more than 8,000 TEU. Even though some disclaimers can be made (see D4.3), this indicator is relevant and broadly accepted in the industry. However, the terminal productivity data are not publicly available. The indicator provides decision support for:

- Liner carriers: If productivity differs from peer group, the carrier can decide on operational actions, e.g. on holding ships for valued customers, skipping certain terminals, refraining from loading too much break-bulk cargo, or improving the reliability of ship arrivals.
- Terminal operators: If productivity differs from peer group, the terminal operator can decide, e.g. to invest into faster berth handling technology, or to increase the yard support.

Ideas on the next steps of indicator development are to undertake measurements on operating time, crane density, and total port stay time.

4.1 Comparison matrix

After summarizing PORTOPIA's WP4 results, the relation to EU policy objectives and the relation to other port performance indicators insights are incorporated into the following "confrontation matrix" (see Table 3). This matrix shows the developed PPIs in WP4 of PORTOPIA and assesses how they relate to other externally developed indicators.

Overlaps of the indicators exist especially between the Liner Shipping Connectivity Index and the PORTOPIA's connectivity indicators dealing with intermodal transport, RoRo and vessel traffic on the maritime link. In addition, maritime connectivity is one part (although measured differently) of the Logistics Performance Index. The Journal of Commerce profits from direct data access to measure port productivity and thus, is a terminal productivity indicator based on a richer data set.

Table 3: Relation of PORTOPIA WP4 indicators to other port performance indicators

PORTOPIA **WP4 indicators**	UNCTAD **Liner Shipping Connectivity Index**	The World Bank **Logistics Performance Index**	The World Bank **Indicator on Port Charges**	Journal of Commerce **Port Productivity Indicator**
Intermodal connectivity	Same concept, complementary coverage	Not related	Not related	Not related
RoRo connectivity	Same concept, complementary coverage	Not related	Not related	Not related
Road congestion	Not related	Not related	Not related	Not related
Maritime fluidity	Not related	Not related	Not related	Not related
Average THCs	Not related	Not related	Not related (see previous analysis)	Not related
Average port dues	Not related	Not related	Not related (see previous analysis)	Not related
Maritime container connectivity	Same concept, same segment, different unit of analysis.	One component of LPI	Not related	Not related
EU terminal productivity	Not related	Not related	Not related	Complementary, JOC based on richer data

5. RELATION TO MEANINGFUL BENCHMARKING METHODS

In this chapter meaningful benchmarking methods for logistics chain and operational performance indicators are highlighted and ICT requirements included. For a detailed discussion of existing benchmarking techniques please refer to D9.1. Table 4 shows the indicators developed in WP4, the extent to which they are implementation ready and the implementation costs.

Table 4: WP4 indicators and implementation costs

Indicator	Implementation ready?	Implementation costs (*= limited to ***** = huge)
Maritime RoRo connectivity	Yes	**
Average THCs per port	Yes	*
Average port dues per ton	Yes	*
Terminal productivity	Yes but the method is not fully satisfactory given lack of data.	***
Intermodal connectivity	Partly, tested indicator, implementation depends on third party data provision.	***
Maritime fluidity	Partly, tested indicator, implementation depends on agreement with data provider.	****
Road congestion	Partly, theoretical clarity and data is available, but full-scale implementation is problematic and costly given issues with data collection and processing.	****
Maritime container connectivity	Partly, tested indicator, implementation depends on third party data provision.	****

Given the differences in implementation readiness of the indicators, the first four indicators from Table 4 are discussed in more detail the others four. An analysis of the potential value for benchmarking is provided considering the following stakeholder groups; the potential value of benchmarks is assessed for each stakeholder individually:

1. Port users
2. Port service providers
3. Port managing bodies
4. Policy makers

In addition to the stakeholders, the individual port authority can find the indicators useful for self-improvement over time including the verification of development to other stakeholders.

5.1 Benchmarking RoRo connectivity

The benchmark of RoRo connectivity is potentially highly relevant for policy makers and port managing bodies and somewhat relevant for port users. Clearly, as in all benchmarks, there are all kinds of differences between ports that are relevant. Thus, these benchmarks are not to be considered as conclusive evidence, but as a starting point of an in-depth conversation (see Table 5).

Table 5: Potential value of benchmarking RoRo connectivity

Stakeholder group	Value of benchmarking	Summary of benchmarking approach
Port users	Moderate	Port users generally have rather stable transport needs in terms of destinations. A benchmark of RoRo connectivity is in most cases "nice to know" (as opposed to "need to know").
Port service providers	Low	Port service providers would generally be more focused on operations than on such indicators.
Port managing bodies	High	Ports create value through providing connectivity. A benchmark of connectivity (both in a comparison with other ports, and in a comparison of the evolution of connectivity over time) is relevant for such managing bodies.
Policy makers	High	Policy makers at regional, national and supra-national (EU) levels promote a shift towards more use of short sea traffic. This requires improved connectivity. Thus, this indicator is directly relevant for policy makers. The differences between ports in any given moment in time are less valuable, a comparison of the evolution over time is more relevant. Finally, for EU policy makers a comparative analysis of RoRo connectivity between various regions in Europe, such as the Baltic and the Mediterranean, is likely to be relevant.

5.2 Benchmarking average port dues per ton and average THCs

Currently, many ports and/or port authorities receive state funding, either through funding for public services, or through state funding for port infrastructure, port labour or exemptions of taxes. The differences between the port with the highest port dues per ton has been compared with the port with the lowest port dues per ton showing a huge difference (a factor 5). This is likely to be at least partially explained by distortions on the playing field, as the "port product" is rather price elastic, and as a consequence such huge price differences are unlikely to be completely caused by market forces. However, other reasons also explain differences in port dues:

- Ports differ in the mix between land/concession rents and port dues. Ports with a high share of land rents can have low port dues and still be self-financing.
- Scale economies are likely to exist in port infrastructure. These could in a competitive market explain differences in port dues between small and large ports.
- Landlord port authorities have different 'service bundles'. Some provide mooring, and a port community system, others do not. These differences would in a fully commercial market be reflected in the port dues.
- Ports are not perfect substitutes and port costs are of minor importance compared to hinterland costs. So there may be business logic to port development in a complicated environment when this saves hinterland transport costs. The high construction costs would be reflected in the port dues per ton.

In short, even though the port dues per ton are important contextual indicators, they are not linked in a straightforward way to a more equal playing field.

With this background, this benchmark is relevant, for port users, policy makers and to a lesser extent port managing bodies (see Table 6). Clearly, as in all benchmarks, there are all kinds of differences between ports and terminals that are relevant. Thus, these benchmarks are not to be considered as conclusive evidence, but as a starting point of an in-depth conversation.

Table 6: Potential value of benchmarking port dues per ton and THCs

Stakeholder group	**Value of benchmarking**	**Summary of benchmarking approach**
Port users	High	Port users will be both interested in the comparison between port dues/ton and THCs between ports (in absolute values) and in comparing the evolution of port dues over time.
Port service providers	Low	Only for container terminal operators (one specific type of port service provider) does a benchmark yield information on its relative price level compared to other ports.
Port managing bodies	Moderate	For port managing bodies benchmarking the port dues per ton is relevant as it shows how their charges compare to those in other ports. However, the dues cannot be related to the efficiency of the managing body due to significant distortions in the playing field. For managing bodies, the benchmark of THCs may be valuable as input for strategy development aimed at improving port competitiveness (that benefits from low THCs.
Policy makers	High	Given the importance of location as a differentiator between ports, port competition is seldom perfect. Thus, market power may emerge. A benchmark of port dues/ton and THCs provides a first indicator of potential abuse of market power by the port managing body respectively the terminal operating company in the port.

5.3 Benchmarking terminal productivity

The benchmark of terminal productivity is relevant, for policy makers and port managing bodies (see Table 7). Clearly, as in all benchmarks, there are all kinds of differences between ports and terminals that are relevant. Thus, these benchmarks are not to be considered as conclusive evidence, but as a starting point of an in-depth conversation.

Table 7: Potential value of benchmarking terminal productivity

Stakeholder group	Value of benchmarking	Summary of benchmarking approach
Port users	Moderate	Port users have more directly relevant benchmarks, especially in terms of productivity and on-time performance.
Port service providers	Low	Relevant for terminal operating companies but not for other port service providers.
Port managing bodies	High	For port managing bodies, utilisation of their assets is directly relevant. This terminal productivity indicator focuses on the asset that, under a landlord model, is generally provided by the port managing body.
Policy makers	High	Port expansion decisions generally affect the general interest, and this indicator is an important indicator for assessing the potential for more intensive use of existing facilities.

5.4 The value of intermodal connectivity, maritime fluidity, road congestion and maritime container connectivity

The other indicators are also potentially relevant from a benchmarking perspective, but implementation issues remain. Given these implementation issues, these indicators are of a lesser priority when developing next steps towards a permanent dashboard of European port performance.

Table 8: Potential value of benchmarking intermodal connectivity, maritime fluidity, road congestion and maritime container connectivity

Indicator	Assessment of potential value
Intermodal connectivity	High for policy makers given their commitment to shifting cargo away from the road. Moderate for port managing bodies assessing their competitive position.
Maritime fluidity	Limited, port managing bodies expressed limited interest in this indicator, port users may consider this as a relevant benchmark, but in the European port context, maritime congestion is rather exceptional.
Road congestion	Limited, as congestion is mostly caused by commuters.
Maritime container connectivity	High for port users, port managing bodies and policy makers (this assessment is similar to the assessment of RoRo connectivity).

5.5 ICT requirements

This paragraph assesses the ICT requirements of the developed indicators. The paragraph does not address ICT requirements for a dashboard in view of enabling users to easily access data, but focuses on ICT requirements in the data collection and analysis.

Indicator	Implementation ready?	ICT requirements
Maritime RoRo connectivity	Yes	No heavy ICT requirements. He data collection is done first hand through accessing the websites of RoRo service providers and manually collecting the required data.
Average THCs per port	Yes	No heavy ICT requirements. He data collection is done first hand through accessing the websites of shipping lines and manually collecting the required data.
Average port dues per ton	Yes	No heavy ICT requirements. He data collection is done first hand through accessing the websites of port authorities and manually collecting the required data.

Terminal productivity	Yes	No heavy ICT requirements. The data collection is done first hand through using Google Earth for quay length data collection.
Intermodal connectivity	Partly, tested indicator, implementation depends on third party data provision.	Potential for automated data processing based on a data feed.
Maritime fluidity	Partly, tested indicator, implementation depends on agreement with data provider.	Potential for automated data processing based on a data feed.
Road congestion	Partly, theoretical clarity and data is available, but full-scale implementation is problematic and costly given issues with data collection and processing.	Unclear whether scraping would be legal, in case it is not, no ICT tool can be developed.
Maritime container connectivity	Partly, tested indicator, implementation depends on third party data provision.	Unclear given lack of third party interest.

For the RoRo connectivity data, two alternative and more 'ICT heavy' alternatives have been explored:

1. A partnership with one of the companies that provide RoRo schedules of various operators, so that their data could be used. However, we were not successful in developing such a partnership. In addition, none of these RoRo information providers (such as www.aferry.com/ or www.directferries.co.uk) has a full coverage of RoRo services.
2. A 'data scraping' solution whereby instead of manually colleting the data, an ICT tool would automatically scrape this data. However, this is feasible especially when websites have standard search functions for their databases, which is not the case here.

In the case of THCs, the use of a scraping tool is also not effective, as all shipping lines have their own method to publish THCs, ranging from THV finders to PDF documents.

In the case of terminal productivity, Google Earth is used to quay length data collection. Given the limited number of data collection efforts, attempts to automate this were deemed overly complicated.

The intermodal data collection could potentially be done automatically based on a periodical data feed. However, implementation depends on an agreement with Intermodal Links, the entity that collects the data on intermodal links in Europe. Based on a data feed, an automated data cleaning and calculation tool could be developed.

Likewise for maritime fluidity, an automated calculation based on a data feed from Marine Traffic (or another provider of AIS data) is feasible, as the data cleaning an processing are standardised. In ICT terms this would still be fairly simple, as there is no need for real time data exchange, so a standard data feed, for instance once overy three months would allow the development of an automated data cleaning and calculation tool.

In the case of road congestion, the data scraping seems a potentially viable process, since the data are available from one website (www.waze.com) that has a standard form for searching. However, there are legal issues surrounding scraping, while scraping has been allowed in some cases, it has not been allowed in other cases. Based on previous rulings (mostly in the US) scraping may not be legal in case:

- Content being scraped is copyright protected
- The act of scraping burdens the services of the site being scraped
- Scraping violates the Terms of Use of the site being scraped
- Scraping yields sensitive user information

In the case of the data from WAZE, both copyright protection and the terms of use are likely to be hurdles for scraping.

6. CONCLUSION

Eight indicators have been developed in WP4. During this process, data collection referred to primary data with a first-hand collection approach and secondary data sources which could be accessed free of charge access (at least for the research purposes in the projects boundary, e.g. in the case of the maritime fluidity indicator). Nevertheless, access to external data remains a problematic issue dealing with sensitive performance indicators such as congestion and productivity of ports. In spite of negotiations with several external providing institutions data issues remained unsolved for the maritime connectivity indicator, the intermodal connectivity indicator and the productivity indicator. For instance, the request for data access to the Journal of Commerce concerning their freight forwarder and shipper survey was declined. Conversations with the World Bank to find a solution for future application did not materialize during the project life time. One future solution is to either collect data through a new empirical study (the most likely option for maritime connectivity) or to find other secondary sources (the most likely option for productivity data). Especially success regarding the latter is still highly uncertain.

In sum, WP4 is confronted to a large part on the willingness of external parties to provide data (e.g. TomTom, EMSA, DG TAXUD, shipping lines). Some of obstacles were financial, some involved with confidentiality or policy decisions. The final challenge is to decide for all WPs within PORTOPIA on:

- The indicators with the highest value for different stakeholder groups,
- How to generate longer-lasting data access agreements with external data providers, and
- The value of performing primary data collection surveys and specification of survey participants (Port authorities, terminal operators, shippers, liner carriers etc.).

In spite of the limitations to acquire data to benchmark performance of the ports, or the port system as a whole, the indicators developed in WP4 can provide valuable support for individual port authorities in self-improvement over time since the data for a single port is often more obtainable.

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