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DOCKSTHEFUTURE
defining the concept of "Port of the Future"

D1.5 Port of the Future concepts, topics and projects - draft for experts validation.docx

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Table 1: Document status

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Table 2: Document history

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Executive summary

1 Executive summary

The DocksTheFuture Project aims at defining the vision for the ports of the future in 2030, covering all specific issues that could define this concept. From the work performed in WP1 the essential concepts of a port of the future emerge (Section 4 Ports of the future defined on page 29).

This report is the deliverable *D1.5 Port of the Future concepts, topics and projects - draft for experts validation* of work package 1 "Port of the Future": definition of the concept. It is the combination of the following reports:

1. D.1 Desktop analysis of the concept including EU policies (Section 6.2 on page 40);
   A long list of over 347 inputs, that is projects, studies, white papers and the like, was established based upon the feedback of all project partners, and the subcontractors Lloyds's register, TU Delft and Association des Villes Portuaires (AIVP). From this list, 78 inputs have been assessed. To perform the desktop study and information model (Section 9.1.1.1 on page 176) has been defined that is also very useful for the work of the next work packages and beyond the DocksTheFuture project;[1]
2. D1.2 Stakeholders consultation proceedings (Section 6.3 on page109);
   A consultation of private and public stakeholders reveals their focus on sustainability and digitalization and digital transformation;
3. D1.3 Maritime traffic analysis and forecast review – Key Results (Section 6.4 on page 122);
4. D1.4 Analysis of macro-trends and perspectives (Section 6.5 on page 149).
   Amongst the most important trends affecting the ports of the future are the climate change, the use of alternative fuel, the growing population and urbanisation, introduction of new technologies, shift of trade to non-OECD countries, and the increase of public debt.

This document will be reviewed by experts during a thematic workshop (Section 6.6 on page 157) to become the final deliverable of work package 1: "Port of the Future concepts, topics and projects - consolidated versions. It will then serve as the basis for the next work packages of DocksTheFuture.

A port of the future must be customer focused, in which customer covers both society, public entities and private companies. If we define sustainability as people, profit and planet (3P) then it covers most if not the full scope of the Port of the Future.

1. Much input deals with the people aspect both on safety, education, (re-)training and assistance in helping other port regions to become pools of economic activity, embedded in local communities;
2. While sometimes a negative connotation is given to profit, this aspect is of extreme importance to keep the sustainability drive going. Profit is not only to be considered from a business perspective, but also relates to port's contribution to society, as they often make use of tax payers' money. Profit is also quoted as invoking a mental shift among port authorities towards polluter pays principles and installing new revenue models that finance the huge investment costs of among others digitization;
3. Planet goes without saying. Ports are to grow with green, not against green. The analysis performed here shows a huge amount of good, economically viable solutions that often trigger new streams of cargo and created new clusters in the wider region of the port.

[1] Taking into account the warning of George Box " All models are wrong but some ar usefull

Document info

2 Document info

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2.3 List of tables

2.4 Abbreviations and acronyms

Abbreviation or acronym	Description
AAPA	The American Association of Port Authorities
AEO	Authorised Economic Operator https://ec.europa.eu/taxation_customs/general-information-customs/customs-security/authorised-economic-operator-aeo_en
AI	Artificial Intelligence
AAIM	Advanced Asset Integrity Management
AIVP	Association Internationale des Villes Portuaires www.aivp.org
ALICE	Alliance for Logistics Innovation through Collaboration in Europe https://www.etp-logistics.eu/
API	Application Programming Interface Advance Passenger Information
APP	An application, especially as downloaded by a user to a mobile device.
ATM	Air Traffic Management
AUTOSEC	Automated network security for software defined networks and connected clients https://www.sit.fraunhofer.de/en/autosec/
AWB	Air Waybill
BENEFIT	Business Models for Enhancing Funding & Enabling Financing for Infrastructure in Transport http://www.benefit4transport.eu/docs/BENEFIT_brief.pdf
BPO	Baltic Ports Organisation http://www.bpoports.com
BRI	Belt & Road Initiative
C-TPAT	Customs–Trade Partnership Against Terrorism https://www.cbp.gov/border-security/ports-entry/cargo-security/ctpat
CASSANDRA	Common Assessment and Analysis of Risk in Global Supply Chains http://www.cassandra-project.eu/
CAPEX	CAPital EXpenditure

Abbreviation or acronym	Description
CBA	Cost Benefit Analysis
CCS	Carbon Capture and Sequestration
CEF	Connecting Europe Facility https://ec.europa.eu/inea/en/connecting-europe-facility
CEN/CENELEC	European Committee for Standardization / European Committee for Electrotechnical Standardization
CH4	Methane
CIM	Contract de transport international ferroviaire des marchandises
CLECAT	European Association for Forwarding, Transport, Logistic and Customs Services
CMNI	Central Commission for the Navigation of the Rhine
CMR	Convention Relative au Contrat de Transport International de Marchandises par Route
CO2	Carbon dioxide
COP 21	Conference of the Parties, referring to the countries that have signed up to the 1992 United Nations Framework Convention on Climate Change. The COP in Paris is the 21st such conference
CORE	Consistently Optimised Resilient (ecosystem)
CRIS	Customs Real Time Information System http://www.coreproject.eu/
CSA	Coordinating and support action http://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2018-2020/annexes/h2020-wp1820-annex-d-csa_en.pdf
CSR	Corporate Social Responsibility
DG Clima	This Commission department is responsible for EU policy on climate action and it leads international climate negotiations for the EU https://ec.europa.eu/info/departments/climate-action_en
DG Devco	The Directorate-General for International Cooperation and Development is the Commission department responsible for EU policy on development and delivering international aid. https://ec.europa.eu/info/departments/international-cooperation-and-development_en
DG Home	This Commission department is responsible for EU policy on migration and home affairs.

Abbreviation or acronym	Description
	https://ec.europa.eu/info/departments/migration-and-home-affairs_en
DG Mare	This Commission department is responsible for EU policy on maritime affairs and fisheries. https://ec.europa.eu/info/departments/maritime-affairs-and-fisheries_en
DG Move	Commission department for EU policy on mobility and transport https://ec.europa.eu/info/departments/mobility-and-transport_en
DG RTD	This Commission department is responsible for EU policy on research, science and innovation, with a view to help create growth and jobs and tackle our biggest societal challenges. https://ec.europa.eu/info/departments/research-and-innovation_en
DG Taxud	This Commission department is responsible for EU policies on taxation and customs. https://ec.europa.eu/info/departments/taxation-and-customs-union_en
Drewry	https://www.drewry.co.uk/
DTA	Decision Tree Analysis
DtF	DockstheFuture http://www.docksthefuture.eu/
DTLF	Digital Transport and Logistics Forum
DCF	Discounted Cash Flow
EASME	The Executive Agency for Small and Medium-sized Enterprises (EASME) funds projects in the field of innovation, energy efficiency, environment and maritime affairs with a particular focus on SMEs. https://ec.europa.eu/info/departments/small-and-medium-sized-enterprises_en
EBDA	Ecosystem-Based Design Approach https://repository.tudelft.nl/islandora/object/uuid:5aa8c5bd-37ef-47f1-8fdd-20114ecc576e/
ECASBA	The European Community Association of Ship Brokers and Agents
ECSA	European Community Ship-owners' Association
ECDIS	Electronic Chart Display and Information System
EDI	Electronic Data Intercgange
EEDI	Energy Efficiency Design Index

Abbreviation or acronym	Description
EFIP	The European Federation of Inland Ports https://www.inlandports.eu/
EES	Entry exit system https://ec.europa.eu/home-affairs/sites/homeaffairs/files/what-we-do/policies/securing-eu-borders/fact-sheets/docs/factsheet_-_entryexit_system_en.pdf
EFSI	European Fund for Strategic Investments
eFTI platforms	Electronic Freight Transport Information: https://ec.europa.eu/info/law/better-regulation/initiatives/com-2018-279_de
EIB	European Investment Bank
EMPA	Europen Maritime Pilots' Association
EMS	Environmental Management System
EMSA	European Maritime Safety Agency www.emsa.europa.eu
EMSWe	European Maritime Single Window environment
ENC	Electronic Navigational Chart http://www.ris.eu/general/what_is_ris_/electronic_navig__charts__enc_
EPCIP	European Programme for Critical Infrastructure Protection
EPCSA	European Port Community Systems Association http://www.epcsa.eu/pcs
ESI	Environmental Shipping Index http://www.environmentalshipindex.org/Public/Home
ESPO	European Sea Ports Organisation https://www.espo.be/
ETIAS	European Travel Information and Authorisation System https://www.schengenvisainfo.com/etias/
ETO	Energy Transition Outlook
EU	European Union https://europa.eu/european-union/index_en
Eurostat	https://ec.europa.eu/eurostat
Euroshore	https://euroshore.com/

Abbreviation or acronym	Description
FAMOS	For future navigation in the Baltic Sea and beyond http://www.famosproject.eu/ /
FEPORT	Federation of European Private Port Operators
FERRMED	Promotion du Grand Axe Ferroviaire de Marchandises Scandinavie-Rhin-Rhone-Mediterranee Occidentale http://www.ferrmed.com
GDP	Gross Domestic Product is a monetary measure of the market value of all the final goods and services produced in a period of time often annually or quarterly
GDPR	Global Data Protection Regulation https://www.eugdpr.org/
GHG	Green House Gasses https://www.eea.europa.eu
GNP	Gross National Product
GNSS	Global Navigation Satellite System: https://www.gsa.europa.eu
GRI	Global Reporting Initiative
HAROPA	Les ports du Havre, de Rouen et de Paris http://www.haropaports.com/en
HFO	Heavy Fuel Oil
HPA	Hamburg Port Authority
HUL	Historic Urban Landscape http://www.historicurbanlandscape.com/index.php?classid=5357&id=35&t=show
IAPH	International Association of Ports and Harbors
IASB	International Accounting Standards Board
IATA	International Air Transport Association
IBM	Integrated Boarding Management
ICT	Information and Communication Technology
IHATEC	Förderprogramm für Innovative Hafentechnologien https://www.bmvi.de/SharedDocs/DE/Pressemitteilungen/2016/148-dobrindt-ihatec-foerderaufruf.html
ILO	International Labour Organisation www.ilo.org
IMO	International Maritime Organisation www.imo.org

Abbreviation or acronym	Description
IMP	Integrated Maritime Policy
ING	Internationale Nederlanden Groep (bank)
IAPH	International Association of Ports & Harbours
IOT	Internet of Things https://iot.ieee.org/
ISO	International Organization for Standardization www.iso.org
ISPS	International Ship and Port Facility Security Code http://www.imo.org/en/OurWork/Safety/Pages/Default.aspx
ITAIDE	Information technology for adoption and intelligent design for E-Government https://cordis.europa.eu/project/rcn/79327_en.html
ITU	Intermodal Transport Unit https://definedterm.com/intermodal_transport_unit_itu
IUCN	International Union for Conservation of Nature Resource
IWW	Inland Water Ways https://ec.europa.eu/transport/modes/inland_en
KET	Key Enabling Technologies
KPI	Key Performance Indicator
KRI	Key Result Indicator
LHV	Longer Heavier Vehicles
LIDAR	LIght Detection And Ranging of Laser Imaging Detection And Ranging
LKW	Lastkraftwagen (German)
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LRQA	Lloyds Register Quality Assurance Italy http://www.lrqa.it/
MDG	Millennium Development Goals
MEDCRUISE	The Association of Mediterranean Cruise Ports

Abbreviation or acronym	Description
MOS DIP	Motorways of the Sea Detailed Implementation Plan https://ec.europa.eu/transport/sites/transport/files/mos_detailed_implementation_plan_june2016_2.pdf
MSW	Maritime Single Window
Natura 2000	Natura 2000 is a network of nature protection areas in the territory of the European Union.
NOx	Nitrogen Oxides
NVOCC	Non Vessel Operating Common Carrier A shipment consolidator or freight forwarder who does not own any vessel, but functions as a carrier by issuing its own bills of lading or air waybills and assuming responsibility for the shipments.
OECD	Organisation for Economic Co-operation and Development
OPEX	OPerating EXpenditure
OPS	Onshore Power Supply http://www.onshorepowersupply.org/
p.a.	Per annum
PIPD	Priority Indicators for Port Development
PM10	Particulate Matter 10 micrometres or less in diameter
PNR	Passenger Name Record https://ec.europa.eu/home-affairs/what-we-do/policies/police-cooperation/information-exchange/pnr_en
PoFc	Preliminary "Port of the Future" concept
PoFpp	Preliminary Projects and Initiatives of Interest
PoFt	Port of the Future Topics
PPRISM	Port PeRformance Indicators: Selection and Measurement
PRMC	Port Road Management Centre https://www.hafen-hamburg.de/en/press/media/video/das-port-road-management-center---37738
PIANC	World Association for Waterborne Transport Infrastructure www.pianc.org
PortCDM	Port Collaborative Decision Making

Abbreviation or acronym	Description
	http://stmvalidation.eu/activity-item/activity-1-port-collaborative-decision-making/
PRISE	Port River Information System Elbe https://www.hafen-hamburg.de/en/news/prise-optimises-sequencing-and-arrival-of-mega-ships-on-the-river-elbe-and-at-the-port-of-hamburg---30987
Phyto	Phytosanitary certificate http://www.fao.org/docrep/004/y3241e/y3241e06.htm
R&D	Research & Development
RIA	Research and Innovation Action
RIS	River Information Services www.ris.eu
ROA	Return On Assets
RoRo	Roll on Roll Off
SAR	Search and Rescue
SDG	Sustainable Development Goals
SECA	Sulphur Emission Control Area http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Sulphur-oxides-(SOx)-%E2%80%93-Regulation-14.aspx
SESAR	Single European Sky ATM Research (SESAR) https://www.sesarju.eu/discover-sesar
SMART	Specific, measurable, attainable, relevant, timely Section 9.1.4 Smart tactical objectives on page 202
SOLAS	Safety of Life at Sea
Sox	Sulfur oxide
STM	Sea Traffic Management project
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TBL	Triple Bottom Line
TEU	Twenty foot Equivalent Unit
THETIS	Thetis is the information system that supports the new Port State Control inspection regime (NIR)

Abbreviation or acronym	Description
TO	Tactical Objective
TOS	Terminal Operating Systems
TENT-T	The Trans-European Transport Networks http://ec.europa.eu/transport/infrastructure/tentec/tentec-portal/site/en/maps.html
UIC	Union Internationale des Chemins de fer
UK	United Kingdom
UN	United Nations
UNEP	United Nation Environment Program
UN SDG	United Nations Strategic Development Goals https://www.un.org/sustainabledevelopment/sustainable-development-goals/
UN/CEFACT	United Nations Centre for Trade Facilitation and Electronic Business https://www.unece.org/cefact/
UNCTAD	United Nations Conference on Trade And Development https://unctad.org
USA	United States of America
VTMS	Vessel Traffic Management System http://emsa.europa.eu/implementation-tasks/visits-and-inspections/136-vtmis.html
WCED	World Commission on Environment and Development
WCO	World Customs Organisation
WPCI	World Ports Climate Initiative http://wpci.iaphworldports.org/
WSV	Wasser- und Schifffahrtsverwaltung des Bundes https://www.wsv.de/
WTO	World Trade Organisation https://www.wto.org/
WWF	World Wild Foundation for Nature
XML/XSD	Extensible Markup Language /XML Schema Definition

Table 3: Abbreviations and acronyms

Introduction

3 Introduction

The DocksTheFuture Project aims at defining the vision for the ports of the future in 2030, covering all specific issues that could define this concept including among others, dredging, emission reduction, energy transition, electrification, smart grids, port-city interface and the use of renewable energy management.

The project is a Horizon 2020 Coordination and Support Action, and consist by definition of actions consisting primarily of accompanying measures such as standardization, dissemination, awareness-raising and communication, networking, coordination or support services, policy dialogues and mutual learning exercises and studies, including design studies for new infrastructure and may also include complementary activities of strategic planning, networking and coordination between programs in different countries. The project consists of five work packages and a horizontal work package on project management.

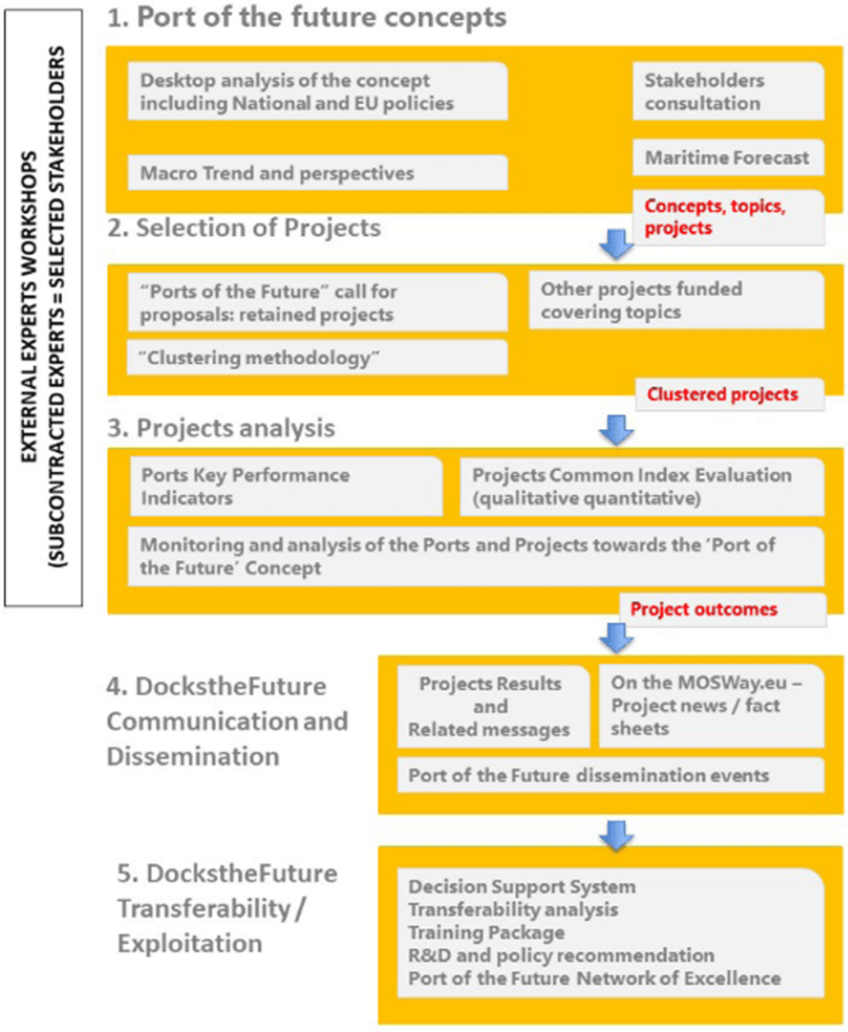


Figure 1: Overview of the Work Packages and their interrelation

4. **WP1: Port of the Future: definition of the concept.**
   The aim is to define consolidated "Port of the Future Concepts" based on preliminary activities (proposal preparation stage) and their review with the help of focused actions involving stakeholders and experts;
5. **WP2: Selection and clustering of projects and initiatives of interest.**
   The objectives are first to define the clustering methodology and second to cluster

retained proposals, plus other projects as defined in WP1 – Port of the Future potential projects to be clustered (actions stemming from this call, from other calls of this Programme and other ongoing activities in the sector);

6. **WP3: Evaluation: analysis of the clustered projects and activities of interest**.
   This work package will move from inputs produced by WP1 and WP2 in order to carry out the core activities related to the analysis and the monitoring of the clustered projects and activities of interest selected in WP2. In the previous WPs Port of the Future topics and related targets have been defined;
7. **WP4: Dissemination and Exploitation**:
   To create higher level of awareness and demand from stakeholders and target audience;
8. **Exploitation of results**:
   The aim is to define how to transfer results and in the most effective way, delivering a number of related tools;
9. **Project Management**:
   The overall goal of the WP is to ensure efficient project management, including interfacing the European Commission. To maximize the potential for exploitation the project management structure aims at a high transparency in work progress and transfer results.

The work packages are related to each other. WP1 sets the framework for all other packages, as it is to define the concept of the port of the future. By definition a concept is 'The reasoning behind an idea, strategy, or proposal with particular emphasis placed on the benefits brought on by that idea', or an abstract or generic idea generalized from particular instances[2]'. The other work packages will elaborate the concept into among others tools for evaluation and transferability of Port of the Future solutions.

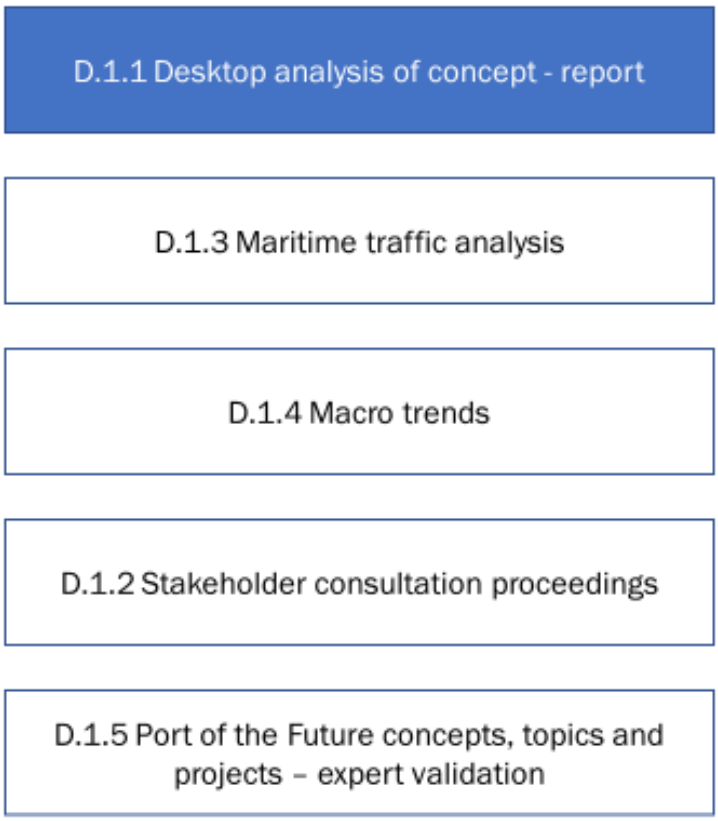


Figure 2: Overview of Work Package 1 deliverables

[2] Oxford and Merriam-Webster dictionary

This part of the document 'introduction' will detail on the used methodology, legislation, port of the future topics, port of the future projects and finally port of the future concept.

Note:

An important amount of additional time has been spent to elaborate in detail the methodology and setting up tools, and creating specific query tools. This work included creating assessment– and review templates, installing powerful workbench for the qualitative analysis of large bodies of textual data, designing database tools including data fields that facilitate the work of the next work packages 2 to 5, mapping data fields between assessment forms & database, adding relevant query functionalities and reporting, and status monitoring features in database.

Applicable to all work packages during and after the project, this activity contributes by:

1. Registration of the assessments of inputs, in a re-usable way for future reference;
2. The identification of additional projects and initiatives of interest;
3. Defining the strategic objectives, elaboration of tactical objectives and their interrelation;
4. Enabling of query activities in database for the underneath mentioned subjects.

The additional work performed is to facilitate:

1. Work Package 2: Selection and Clustering of Projects and Initiatives of interest:
    a. Task 1: Clustering methodology: the identification of existing clusters and the used methodology;
    b. Task 3: Thematic workshops with Experts: registration of relevant subject, questions, remarks to be addressed in thematic workshops, organised per topic, during assessment activities;
    c. Task 4: Mid Term Conference. Port of the Future validated concepts, topics and targets: pre-identification of subjects to be discussed during assessment activities.
2. Work Package 3 Evaluation: analysis of the clustered Projects and activities of interest:
    a. Task 1 - Identification of the Port of the Future related Key Performance Indicators for Ports and Projects (before-after implementation);
    b. Identification of KPI's related to topics and strategic objectives during assessment activities;
    c. Identification of measures;
    d. Identification of indexes, that are to inspire the modelling of the evaluation factors;
    e. Task 2 - Adaptation and transfer of the concept of "Adequacy" to the selected clustered projects;
    f. Identification of relevant indexes to facilitate the concept of 'adequacy';
    g. Task 3 - Deployment of the Projects Common Index: methodology for analysis and monitoring;
    h. Identification of similar analysis and monitoring methodologies that covered part of the DockstheFuture scope, in terms of environment, monetary values, productivity, economic and social indicators.
    i. Task 4 - Thematic Workshop with Experts:
        i. Organisation of thematic structure of topics and subjects during assessment, in such a way that it is to be used as a base to organize thematic workshops.
3. Work Package 4: Dissemination and Communication:
    a. Task 1 - Plan for the dissemination and communication of the action results (PDCR);
    b. Task 3 – Dissemination & Communication related events.

i. organisation of thematic structure of topics and subjects during assessment, in such a way that it is to be used as a base to organize thematic workshops;

4. Work Package 5: Exploitation of results:
   a. Task 3 - Transferability analysis;
   b. Identification in section 'measures' of the assessment activities of similar tools of transferability.

Ports of the future defined

4 Ports of the future defined

Initial definition of ports of the future

WP1 started with the desktop analysis (Section 6.2 page 40) without having, at that point, a clear definition of a port of the future. In fact one of the main objectives of work package 1 is to define the concept. So there was a little bit a "chicken and egg" problem. On the other we had to operate within the project's framework as defined in the grant agreement. The H2020-MG-2016 2017 call defines the scope in sufficient detail to get the project initiated: multi-modal, cost-effective, wider port area, reengineering of processes, interoperable ICT systems, integration in the supply chain, sustainability, better land use, KPI's, climate change adaption, port cities and efficient hinterland connections are some of the key words in the call. The initial list of topics defined in the grant agreement gave structure and the list of potential inputs to be assessed (Section 9.1.6.1 List of inputs and assessments on page 205) proposed by several experts, the DocksTheFuture partners and subcontractors such as AIVP, TU Delft and LLRQA helped us to scope our work.

A definition of the definition

It is not possible to give a universal definition of a port, let alone port of the future because it depends upon different views and viewpoints[3]. At the end of WP1, we list the key elements of a definition of a port of the future that fits the needs of the project and summarise these elements in a catch-all phrase.

Looking beyond the DocksTheFuture project, the definition should be actionable in the sense that different port actors can use it to develop their own strategy and vision based upon it. At the end of the desktop study we concluded that the information model (Section 9.1.1.1 on page 176) actually is a conceptual model or domain model of Ports of The Future and that the information gathered, if further completed during the projects, forms a "knowledge base "of the ports of the future domain. So the key entities in that model and the relations between these entities together define the Port of the Future concept and it is structured is such a way that key actors such as legislators, port authorities, operational managers, shippers, shipping companies, etc. could extract the relevant parts from it to tailor the ports of the future concept to a view that fits their needs.

Constituent elements of the ports of the future definition

The assertion that the information model defines the port of the future concept is valid more than ever, but with most work done in WP1 we can refine the definition. The label "Port of the future" actually contains 2 elements

1. What is the port?
2. The change dimension.

What is a port?

For a start, we are talking about maritime ports a not about any other type of ports such as airports. There are many definitions of a port in literature and the EU has many policies and legal instruments applicable to ports. From EU regulation 2017/352 on port services and financial transparency of ports, we borrow the following definition:

'Maritime port' means an area of land and water made up of such infrastructure and equipment so as to permit, principally, the reception of waterborne vessels, their loading and unloading, the storage of goods, the receipt and delivery of those goods and the embarkation and

[3] A concept derived from enterprise architecture

disembarkation of passengers, crew and other persons and any other infrastructure necessary for transport operators within the port area.

This definition contains 3 core elements:

1. The physical boundaries, such as “an area of land and water”;
2. Equipment and the means of transport such as “waterborne vessels”;
3. The port services such as “loading and unloading“

For the sake of scoping the DocksTheFuture project and to come to a definition of a port of the future we extend the previous definition with the following elements:

1. The physical boundaries and infrastructure
   a. The port hinterland is considered so fundamental that we consider it fully in scope;
   b. In view of the mixed situation of inland waterway and maritime transport, we include destinations on inland waterways – inner ports – as being in scope of our definition;
   c. The seaside is only considered as far as it has an impact on the port itself, so basically the maritime access and sea side protective infrastructure;
   d. For the infrastructure inside the port we do not only consider the maritime terminals, but also logistic, industrial and recreational areas and access infrastructure such as bridges, tunnels, locks, road, rail, anchorages, etc.;
   e. We include the port city and urban areas around the port.

   In the definition from EU regulation 2017/352 it looks as if a port is some kind of a “closed system” but in reality it is not. Consider e.g. the mechanism of centralised customs clearance. Is the customs office in another EU member state part of the destination port? What about cooperation or fusions between ports? Is a company performing big data analysis on port activities, but with offices outside the port, part of the port? In the end, defining the boundaries of a port, if this would be possible in the first place, depends again on the viewpoints taken and the cohesion or lack thereof in the core business processes that constitute the value chain of a port.
2. The means of transport
   a. For seagoing vessels and for ports where this is applicable special interest might be given to short sea shipping;
   b. For the hinterland transport, we include all transport modes such as road, rail, inland waterway, pipelines and connections by air to the maritime port;
   c. We do not only consider transport to and from the port but also inside the port. When it comes to passenger transport, modes such as waterbus, bike and other become more and more important;
   d. For a forward looking perspective we also consider the “autonomous” variants of these transport means and new emerging transport technology such as hyperloop, drones, etc.
3. The services
   a. Industrial and logistics activities are in scope as far as they are linked to the pure port activities;
   b. A port is a node in a logistics chain, so all aspects of supply chain integration are considered in scope and also all activities of 3 and 4 PL’s
   c. While in a port the key services are indeed to load, unload and store cargo and to embark or disembark people on board there are many, many ancillary services necessary to make that happen including but not limited to pilotage, towage,

dredging, giving shelter to ships in distress, financial and insurance services, legal consultancy, engineering, etc.;

d. Data will be the new oil and many services will emerge that have to do with data management, transfer this data into information and take action based upon that information;

e. Services are delivered by executing business processes and the tasks in the business processes are performed by actors. There are many ways to classify actors, but at least the port authorities, private companies delivering services, people and organisations consuming these services and inspection and law enforcing authorities are in scope;

f. To include the perspective of small ports, islands, deserted areas, etc. to delivered services tailored to their specific needs.

The change dimension

Generally speaking an organization is characterized by what it "*does*", its services and business processes and what it "*is*", its characteristics. When defining the future of ports we must define what future we are talking about, what trends and external conditions affect that future, what "gaps" need to be closed to come to a desired future situation, the "to-be", what "tools" the port of the future should dispose of and how the transition from the current situation, the "as-is" to the "to be" can be managed. Finally considering the change dimension, and reducing things to their bare essence, it is important to also define what has changed and what not changed by looking at the value chain.

1. The horizon in the 'Port of the Future' project is set at 2030. This is important in considering for example alternative energies. Where LNG is considered as a transition fuel in a 2050 horizon, in this context – 2030 – it is considered as a valid alternative to the classical carbon based energy sources. It is considered to be capable of both cutting coal-based greenhouse gas emissions and giving way to an emissions-free future. So fixing our planning horizon at 2030 is a good thing, because it is feasible, but there is a risk if we do so without looking further ahead;
2. The trends that shape the future of ports have been analysed and described in detail in all tasks of WP1. The 2 key elements that are omnipresent are digitalization/digital transformation and sustainability. However many of the trends mentioned, and certainly those 2, are not specific to ports. We should also look outside Europe. So, in defining what kind of future we are planning for, we should really avoid navel-gazing. We should also avoid chasing hypes when it comes to ICT technology trends and focus on ICT technologies that are on the verge of maturing[4]. And last, monitoring trends is a continuous effort that does not stop at the end of the DocksTheFuture project, so port authorities and port actors should continuously adapt their strategic plans to be prepared for that future. As DocksTheFuture we should develop a mechanism on how to do this;
3. The are many gaps certain ports face today but some of the most important are related to their capability to accommodate ever bigger ships (maritime access, cargo handling facilities) and hinterland congestion on the roads;
4. In the port of the future new services will be delivered and business processes will change drastically. These services should be delivered on equal terms. The main driving force for that change is the technological evolution. In order to deliver these services and run these processes new jobs will be created. European ports will have to compete over human resources with other sectors in a context of an ageing population;

[4] In Gartner speak, new technologies that are on the slope of enlightement.

5. Key characteristics of a port of the future are among others: connected, smart, sustainable, accessible, competitive, collaborative, lean, adaptable, customer oriented, fully, integrated, managed, customer oriented, etc.;
6. The tools, ports of the future should dispose of, are the "measures" as defined in section 6.2.5 on page 106. An important part of these measures, but definitely not the only one, are the new technologies that whil shape the future of the port. It is important to prioritize these measures from a business perspective and again tailored to the specific needs of a port;
7. The change management starts from defining clear objectives for ports of the future (Section 6.2.4 Tactical objectives on page 105) and defining ways to monitor and control progress towards these objectives. Change management also contains an element of overcoming resistance against change by involving all port actors, the port city, the wider environment and a good social dialogue between employees and employers;
8. The value chain, what stays the same and what has changed?
   Looking at the essence of things from ancient ports thousands years ago, to the ports of today, there is actually little that has fundamentally changed. These ancient ports did not use blockchain, but they too had to exchange information between actors.
   Ports just like any other organization only exist to satisfy the needs of their customers. The port of Piraeus was the base of the Athenian fleet and played a fundamental role in the battle against the Persians. The customers in this case are the military and their needs were shelter against the enemy and supplies for the army. While the focus of DocksTheFuture is not so much on military activities, the question is then what are criteria for decision makers such as shipping companies, shippers, freight forwarders, to choose one port over another, so what are their fundamental needs? Currently cost, location, deep sea access, hinterland connections, service levels and capacity are amongst the main criteria to select a port and these criteria probably applied to commercial activities in ancient ports too. The questions then are "Will a customer of a port of the future select a port on the same criteria?" and "Is the viewpoint of the customer the only relevant one to define the port of the future concept". This would be of no concern for the ancient Greek army in 480 BC, but in a forward looking view on ports we need to add 2 other fundamental viewpoints to get a complete picture of the port of the future: that of the wider society including the environment and that of the legislator.

So, the short definition of a port of the future is:

The port of the future delivers value to its customers by deploying managed services. These services have with minimum negative impact on the society and the environment and are compliant with all applicable legal instruments. The port of the future delivers these services by running lean business processes supported by maturing technology. These processes are tailored to the needs of the customers and are easy to adapt [5]to ever changing circumstances.

[5] It is not the strongest of the species that survives, nor the most intelligent that survives. It is the most adaptable to change. Charles Darwin

EU policies

5 EU policies and legislation

This section covers a non-exhaustive list of EU policies and legislations – regional, national, European and global level that were identified during the analysis of the inputs or added by the authors. Be aware that this is just a list of EU and international policies, legislation, standards, frameworks and good practices found during the desk top study. These list need to be further completed to what is relevant for Ports of the Future 2030.

1. EU Directives, regulations and policies
   a. Regulation (EC) 648/2005 community customs code;
   b. COM (2018)279 - Electronic freight transport information;
   c. Commission regulation EC 414/2007 the "RIS guidelines" is based (almost a copy of) the RIS guidelines from PIANC. These guidelines are accepted amongst other by CCNR and ENECE (resolution 57);
   d. Directive 2005/44/EC on harmonized river information services;
   e. Regulation 414/2007 Technical guidelines for the planning, implementation and operational use of river information systems;
   f. Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) (Text with EEA relevance);
   g. Regulation (EU) No 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC;
   h. Directive 2010/65/EU on reporting formalities for ships calling in or departing from the EU ports;
   i. COUNCIL DIRECTIVE 2008/114/EC of 8 December 2008 on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection;
   j. Directive 2014/94/EU on the deployment of alternative fuels infrastructure;
   k. Directive 2005/65/EC security in port perimeter and physically separate port from surrounding area;
   l. Directive 2000/59/EC, on west collection from ships and Proposal for a directive - COM(2018)33/DOCUMENT-2017-85277;
   m. The following laws and regulations apply to occupational health and safety in port labour;
      i. Bulk Terminals Directive (Annex II, Art. 1-4)
         - OSH Framework Directive 89/391/EEC of 12th June 1989 x Directive 2003/88/EC ("Working Time Directive"), Art. 17(3)(c)(ii): Derogations for dock and airport workers;
         - Charter of Fundamental Rights of the European Union (Art. 31 (1) and (2)) x European Social Charter (Part I, items 2 and 3; Part II Art. 2, 3 and 11);
   n. The following laws and regulations apply to occupational health and safety in port labour: x Bulk Terminals Directive (Annex II, Art. 1-4) x OSH Framework Directive 89/391/EEC of 12th June 1989 x Directive 2003/88/EC ("Working Time Directive"), Art. 17(3)(c)(ii): Derogations for dock and airport workers x Charter of Fundamental

Rights of the European Union (Art. 31 (1) and (2)) x European Social Charter (Part I, items 2 and 3; Part II Art. 2, 3 and 11);

o. EU port cities and port area regeneration, European Parliamentary Research Service, Author Marketa Pape, PE 593.500 briefing, November 2016;

p. Communication on a European Ports Policy, Communication from the Commission, COM(2007)616 final;

q. EU regulation 2017/352 of the European parliament and of the council of 15 February 2017 establishing a framework for the provision of port services and common rules on the financial transparency of ports;

2. Provisions on electronic documents in international conventions of carriage

a. Inland Waterways

i. Budapest convention (CMNI) 2000;

b. Maritime

i. Hamburg Rules 1978;

c. Rail

i. Contract de transport international ferroviaire des marchandises (CIM) 1998

d. Road

i. Convention on the Contract for the International Carriage of Goods by Road (CMR) 1956;

i. Additional protocol to the CMR concerning the electronic consignment note (eCMR).

3. Applicable international conventions governing the contract of the carriage of goods

e. Rail

i. Uniform Rules concerning the Contract of International Carriage of Goods by Rail (CIM) 2006 – Appendix B to the Convention concerning International Carriage by Rail (COTIF) 1999.

f. Road

i. Convention on the Contract for the International carriage of Goods by Road (CMR) 1956;

ii. E-CMR Protocol 2008.

g. Sea

i. International Convention for the Unification of Certain Rules of Law relating to Bills of Lading ("Hague Rules") 1924, as amended by the two protocols from 1968 (“Visby Rules”) and 1979 (“SDR Protocol”), together known as the “Hague Rules”

ii. Hamburg rules 1978;

iii. Rotterdam rules 2008;

iv. Inland Waterway;

v. Budapest Convention on the Contract for the Carriage of Goods by Inland Waterway (CMNI) 2000.

4. Standards:

a. Security: SOLAS Chapter XI-2 and part A as well as certain parts of part B of the International Ship and Port Facility Security (ISPS) Code were added to the ‘acquis communautaire’ by means of Regulation (EC) No 725/2004 on enhancing ship and port facility security 27. The regime is complemented by Directive 2005/65/EC on

enhancing port security 28 that addresses elements of port security not covered by the Regulation;

b. UN/CEFACT is a standard setting organization under the United Nations Economic Commission for Europe, but with a global mandate and representation from every region of the world. Dating back to the 1960s, it has developed recommendations, eBusiness standards and Technical Specifications for every aspect of cross-border trade. Today's work is centred on the Buy-Ship-Pay model covering commercial, logistics, transport and regulatory procedures. There are over 400 experts participating in UN/CEFACT developments from both the public sector and the private sector. The transport and logistics domain work is one of the largest groups;

c. WCO Data Model Project Team develops and maintains the WCO-DM; their work is governed by the Information Management Sub-Committee of the WCO, and aims to cover all aspects of regulatory procedures not only from customs but also other government agencies. Besides the WCO-DM, the WCO also produces a number of recommendations, conventions and tools for customs administrations. Membership at the WCO-DM Project Team is restricted to member organizations (customs agencies), but the private sector and other government authorities are welcome to join the work as non-voting observers. Since the version 3.3 of the WCO-DM which implemented the principle of Information Packages, more and more customs administrations (are intending to) use the WCO-DM;

d. ISO consists of technical committees, each with their own leadership and each potentially capable of making their own decisions and standards development independent of all of the other technical committees. Therefore there is not just one ISO committee, but rather a collection of hundreds of technical committees. Several of the technical committees are pertinent to international transport and logistics, including ISO/IEC JTC 1 (Information technology), ISO TC 8 (Ships and maritime technology), ISO TC 104 (Freight containers), ISO TC 154 (Processes, data elements and documents in commerce, industry and administration), and ISO TC 204 (Intelligent transport systems). Membership is open to public and private sector experts through their national mirror committees; each country needs to establish a mirror committee for each technical committee it wants to work with and pay a fee in order to finance the TC secretariat. All voting is done through the member countries;

e. CEN-CENELEC coordinates standardization at EU level, with similar rules of participation and technical committee organization as ISO. Standards developed by CEN-CENELEC can be adopted by ISO. CEN-CENELEC standards are mandatory at national level.

5. Other relevant standardization bodies concern:

a. GS1 started from the standardization of electronic product codes. Additionally, they developed the so-called Electronic Product Code Information System (EPCIS), the Standard Serial Shipping Container number (SSSC), a Master Product data solution, and various messages supporting buy-sell of products. All GS1 IT solutions are for free; an enterprise has to pay for the electronic product codes;

b. IATA, the International Air Transport Association has developed a number of standards for the air industry, touching every aspect of air transport. IATA also develops conventions and resolutions for application in the air-industry supply chain. Only airlines may be full members (for pay), all other actors in the field may join as strategic partners (for pay). The resulting standards such as the Cargo XML or Cargo IMP are sold for a fee;

c. UIC, International Union of Railways is an international organization grouping together the actors in the rail industry. The ERA, European Agency for Railways, is an EU-level agency contributing to the implementation of EU legislation aiming to improve the competitive position of the railway sector. Membership is based on an equal single member from each member state and two additional members from the Commission. Both are working on the Electronic Consignment Note "EDN-xml-xsd" as a freight rail standard;

d. Other standards for data sharing, which are indirectly relevant to an electronic multimodal waybill, are those developed for managing a physical infrastructure. Examples are River Information Services (RIS) that also includes a dangerous goods declaration based on port community standards, DATEX II for road traffic information, and TAF/TSI for allocating paths on railway infrastructures to operate trains. Like stated before, these solutions either have their own dictionaries (e.g. TAF/TSI and DATEX II) and/or expand on the UNTDED. Additionally, systems supporting these standards have been developed like Rail Net Europe Train Information System (RNE TIS) for positioning of international trains and a hull database managed by EC DG Move with information of barges. National access points for road traffic data have been developed by Member States like NDW in the Netherlands. There is also a pan-European system for sharing licence data (EUCARIS).

6. With regards to standards for data representation:
Standards concerns data dictionaries, core components, messaging structures and models or frameworks.

   a. IMO, in July 2011, of a mandatory limit on the Energy Efficiency Design Index (EEDI) for ships built as of 2013;

   b. United Nations Trade Data Element Directory (UNTDED): UNTDED includes many elements like locations and countries, dates and times, and references that are relevant for an eWaybill solution. Their representation for data sharing by Core Components is also specified;

   c. UNECE Recommendation 34, "Data Simplification and Standardization for International Trade" ECE/TRADE/400, Geneva and New York, 2013;

   d. Pan-European mode specific dictionaries especially focusing on interfaces between carriers and infrastructure managers, for instance addressing path allocation in rail transport (TAF/TSI) and road traffic information (DATEX II). These pan-European dictionaries are based on EU Directives;

   e. Code Lists essential for electronic exchanges such as UN/EDIFACT, ISO;

   f. UN/CEFACT Core Component Library (UN-CCL);

   g. World Customs Organization Data Model (WCO-DM).

7. Good practices:

   a. ESPO Guide of good practices for cruise and ferry ports is the result of 2010 ESPO initiative (creation of a passenger committee, and in 2014 creation of Cruise and Ferry Port Network.

8. A list of IMO conventions:
http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/Default.aspx

Methodology summary

6 Results

This section is structured according to the main task of Work packages1 and the RIA's.

1. Section 6.1 Preliminary exploration of RIA's on page 39 gives as high level overview of Corealis, Pixel and Postforward, for their part relevant to work package 1;
2. Section 6.2 Task 1: Desktop analysis on page 40 describes the desktop study. 75+ Inputs have been assessed and the results have been structured according to an information model and persisted into a relational database;
3. Stakeholders have been consulted concerning their vision of the port of the future. The main focus is on digitalization and digital transformatio on the one hand and sustainability on the other hand. You find the results of this consultation in section 6.3 Task 2: Stakeholders consultation on page 109;
4. In order to set the scene for ports of the future we need to have data about recent traffic volumes and how they will evolve. Section 6.4 Task 3: Traffic analysis and forecast on page 122 contains the analysis of the results for 2017 for TEN-T core and comprehensive network ports, but also various non-TEN-T ports and growth trends for specific cargo types and countries and regions;
5. In section 6.5 Task4: Macro trends on page 149 contains a high level description of the economic, environmental, societal, technological, governmental and political trends.

6.1 Preliminary exploration of RIA's

3 Research and innovation actions are currently in a start-up phase: Corealis, Pixel and Portforward. From the initial scope definition of theses 3 projects it is clear that they align well with the entities defined in the information model such as topics, tactical objectives and measures (Section 9.1.1.1 The information model on page 176) and that consequently the DocksTheFuture information model would be a suitable instrument to coordinate and optimise the actions taken by these 4 projects.

1. Corealis
   a. Optimisation of processes inside the terminal and in the wider port area.
      In DocksTheFutuuture topic 90.10 Business processes;
   b. Better capacity management, identification of KPIs.
      In DocksTheFuture KPIs are linked to all tactical objectives. One tactical objective is TO10 Increase terminal productivity;
   c. Low environmental impact, climate change adaptation.
      In DocksTheFuture this matches topic T60.10 Environmental sustainability. The effect of climate change is covered under "External factors and market trends" affecting the ports of the future;
   d. Circular economy, smart urban development of port cities;
      Several inputs concerning circular economy have been assessed
      Port-city relations is topic T100;
   e. Efficient links to hinterland transport.
      This is covered among others under topics T10.40 Hinterland connections, T30.30 Multi and synchro modality and T90 Digitization, digitalization and digital transformation;
   f. Some of the Corealis innovations map well with measures defined in DocksTheFuture. E.g. IOT is measure MS400.

2. Pixel
    a. Pixels focus on the long tail – ports outside the top 20 – and the lack of process integration in these ports has been covered in the desk top study as far as it is mentioned in the assessment inputs. Focus on medium sized and small ports is an attention point for DocksTheFuture;
    b. It is not in scope of DocksTheFuture to analyse different architectures for process integration. A central system, the unified "Pixel" system concept, is maybe one of the possible solutions to connect port actors;
    c. Pixel claims to close the gaps between small and large ports by using IoT based communication. It is unclear what protocols will be used and if it is indeed feasible to implement these protocols by all actors in these target ports;
    d. The main goals of Pixel map with several tactical objectives defined in PortOfTheFuture.
3. PortForward
    a. DocksTheFuture also covers the smart, green and interconnected port but brings it to another level by aligning everything to the 3 dimension of sustainability: people, planet and profit;
    b. From the main concept of PortForward, IOT enabled devices that transmit information over a network to a cloud solution that exposes services to actors, we consider having a network with sufficient bandwidth as an "external factor", a precondition, for ports of the future.

6.2 Task 1: Desktop analysis

This section covers the outputs and outcomes of WP1 task1 « DeskTop analysis of the concept including national and EU policies», resulting in deliverable D1.1.

It is structured according information model defined in section 9.1.1.1 on page 176. To support the desktop study, a DocksTheFuture database has been developed. Most if not all data in this section is coming from that database. It is important to note that the DocksTheFuture database contains much more info, than what is included in this section. However including all the available data would overload this report. Please find in section 9.1.5 on page 203 the current list of reports and queries from the DocksTheFuture database.

6.2.1 Methodology summary

The intention of this section is to summarize the methodology used in the desktop study in sufficient detail to understand the results chapter, but without overloading the reader with too many details. Section 9.1.1 Assessment methodology on page 176 contains a complete description of the methodology.

The development of a formal methodology for the desktop study is a critical success factor considering the comprehensive nature of the DocksTheFuture project. The three constituent elements of the assessment methodology are: the information model, the work products and the work flow.

1. The information model
   The DocksTheFuture project proposal already contains a number of information entities such as "projects and initiatives of interests", "topics", "aims", "KPI's" etc. We renamed or restructured some entities, defined additional entities, gave entities metadata and structured the entities in an information model. A few examples:

a. Renaming
   i. "Projects and initiatives of interests" becomes "Inputs", in other words the projects studies, white papers etc. that might be part of the subject of the desk top study. (Section 9.1.1.1.2.1 on page 178) for a definition of inputs and Table 39: List of inputs on page 217 for the complete list of inputs;

c. Restructuring
   i. "Topic" remains "Topic", however we made it a taxonomy consisting of parent topics having child and grandchild topics, instead of a flat list as defined in the project proposal. (Table 40: List of topics on page 222). Table 36: Updated topic list on page 199 explains why and how the topic list from the project proposal has been changed.

d. Additional entities
   i. Some "Aims" became "Measures". (Section 9.1.1.1.2.6 on page 181) for a definition of measures and table;
   ii. Addition of strategic objectives to group together tactical objectives.

e. Metadata
   i. An input can be of one or more "natures" such as a study, a white paper, an action plan, a project, a national research program a piece of legislation.

f. Relations between entities
   i. The entity "Topic" is considered the key entity to group together other entities.

2. Work products are tools we use to perform the work
   a. Some assessors have been using Atlas to tag pieces of text in an input;
   b. An assessment template to fill out the result of an assessment;
   c. The assessment templates are imported in the DtF database. This database is the physical implementation of the information model. The database is then queried to deliver the results. The Dtf database will also be used for other tasks of Work Package 1 tasks and potentially also for other work packages.

3. The main steps of the work flow are:
   a. Creating a list of possible inputs to be assessed;
   b. Define criteria, select from that list the inputs to be assessed and how to assess, and define the priorities. This is done by grouping together inputs in assessment rounds;
   c. Assess the inputs by filling out an assessment template. Those wishing to use Atlas can tag relevant sections of text in this tool;
   d. Review the assessment templates;
   e. Import the assessment templates into the DtF database;
   f. Query the DtF database to deliver the raw data to be included in this database

Results

6.2.2 Inputs and assessments

Inputs are the work products that are proposed by the DocksTheFuture partners and their subcontractors to be assessed. There are 345 inputs proposed of which currently 78 have been assessed. Table 39: List of inputs on page 217 shows the inputs and assessments. There are different type inputs assessed such as project, strategic port plans, scientific papers, etc. Twenty six different types of inputs have been defined. The following table shows the top ten inputs by Type. Be aware that one input can be belong to more than one category or to none.

Type	Number of inputs
Project	14
Article	12
Scientific paper	10
Report	8
Study	7
Analysis	4
Best practice	4
Master thesis	4
Port Strategy	3
Research project	3

Table 4: Number of inputs by type

6.2.3 Topics

The project proposal already addressed a preliminary research on the Port of Future concept, the definition of several Ports of the Future topics to be addressed and their related targets in 2030 and a preliminary list of projects that could be potentially clustered together with the RIA retained proposals:

1. Port infrastructure & management;
2. Accessibility and fulfilment of EU standards;
3. Integration in supply chain & synchro modality;
4. Environmental concerns;
5. Sustainability;
6. Safety and security;
7. Digitalization;
8. Port-city relation;
9. Port governance;
10. Human element;
11. Relation with neighbouring countries.

As the assessment of the inputs progressed, additional topics were added, and the need for a classification of the various topics soon became apparent.
Table 36: Updated topic list on page 199 contains a mapping between the topic list of the project proposal and the current topic list with an explanation what these updates are about and why they have been implemented.

Specific topics:

1. The port-city relation topic is still largely unattended in international studies. Subcontractor AIVP therefore provided a port-city check list covering spatial organization, environmental challenges, socio-economic development strategies and governance and port city co-construction to facilitate the detection of port-city elements when assessing an input. See section 9.1.3 on page 200 for more information about that checklist;
2. We used the 17 UN SDG as a checklist for sustainability (See Table 32: UN sustainable development goals on page 183).

Not all topics have been assigned as frequently. The following table shows the number of assessed inputs by main topic. If in an assessment more than one subtopic under a main topic or a subtopic and a main topic are selected together it is still counted for 1.

Input	T10	T20	T30	T40	T50	T60	T70	T80	T90	T100	T110	T120	T130	T900	T901	T910
	6.2.3.1	6.2.3.2	6.2.3.3	6.2.3.4	6.2.3.5	6.2.3.6	6.2.3.7	6.2.3.8	6.2.3.9	6.2.3.10	6.2.3.11	6.2.3.12	6.2.3.13	6.2.3.14	6.2.3.15	6.2.3.16
Total	**44**	**16**	**18**	**16**	**12**	**47**	**21**	**19**	**30**	**17**	**21**	**38**	**7**	**27**	**5**	**8**
10: The future of port logistics, meeting the challenges of SC integration for ING - INPUTS: 0010-0 ExecSum; 0010-1 study by ING	*	*	*	*	*	*		*	*	*	*	*		*		*
20: RISCOMEX	*		*	*	*	*	*		*			*	*	*		
30: CoRISMa	*		*	*	*	*	*		*			*	*	*		
40: E-navigation for inland waterways 2017	*	*	*	*	*		*	*	*			*	*			
50: Économie Circulaire et Écosystèmes portuaires	*					*										
60: Port City Governance				*						*		*				
70: Trends in EU ports governance 2016	*		*							*		*		*		
80: Unmanned ships on the horizon/Remote and autonomous ships - the next steps	*	*		*			*	*	*							
110: The future of ports in 2060	*	*							*							
400: Digital innovation in the port sector: barriers and facilitators	*			*	*	*			*							
410: The Grand Challenge: Pathways towards Climate Neutral Freight corridors	*					*								*		
430: De toekomst van de arbeidsmarkt in haven van	*					*	*		*		*					

Input	T10	T20	T30	T40	T50	T60	T70	T80	T90	T100	T110	T120	T130	T900	T901	T910
Antwerpen																
450: BENEFIT: potential of investments in transport infrastructure									*			*				*
460: Decision-making for maritime innovation investments the significance of cost benefit and cost effectiveness analysis	*	*	*			*			*			*				*
550: C-Roads Platform is a joint initiative of European Member States and road operators for testing and implementing C-ITS services in light of cross-border harmonisation and interoperability.			*				*									
610: Intemodel EU	*					*	*		*			*				
620: RAGTIME	*		*	*	*	*		*	*			*		*	*	*
730: Shifting Freight2Rail	*															
880: ECOSSIAN	*							*	*					*		
890: CORE				*					*					*		*
920: MESA - Maritime Europe Strategy Action - FOSTER Waterborne)	*	*	*	*	*	*	*	*	*		*	*	*	*	*	
1030: Collaborative Innovation Clouds 2017 Logistics Report			*			*			*	*						
1070: European Sustainable Shipping Forum, 3 rd Plenary Meeting, Final Report Submission from ESSF Sub-Groups	*	*				*						*		*		
1080: STM Validation Project			*				*	*	*			*		*		
1090: Plan the city with the port: guide of good practices										*						
1100: The Blockchain Potential for Port Logistics					*			*	*							
1110: PORTOPIA-Observatory set-up guidelines						*	*	*			*	*		*		
1150: Commission staff working document on the implementation of the eu maritime transport strategy 2009-2018				*		*	*	*	*			*				
1160: Work Process Oriented Competence Development for the Port of the Future											*					
1180: Container terminal operations simulator (CTOS) – Simulating the impact of extreme weather events on port operation	*															

Input	T10	T20	T30	T40	T50	T60	T70	T80	T90	T100	T110	T120	T130	T900	T901	T910
1190: Changing training needs of port workers due to future trends							*				*	*				
1210: Sustainable port infrastructure, practical implementation of the green port concept						*										
1230: A study on role of green port implementation and ‘‘greencollar’’ workers in port facilities						*					*					
1240: The greening of ports: a comparison of port management tools used by leading ports in asia and europe						*						*				
1250: Environmental policies and practices in Cruise Ports: Waste reception facilities in the Med	*	*		*		*			*			*		*		
1261: Port Cooperation Policies in the Mediterranean Basin: an Experimental Approach using Cluster Analysis.												*		*		
1310: Challenges for the future of ports. What can be learnt from the Spanish Mediterranean ports?						*								*		
1350: ECOHUBS - Environmentally COherent measures and interventions to debottleneck HUBS of the multimodal network favoured by seamless flow of goods	*					*										
1400: Socio-ecological transitions toward low-carbon port cities: trends, changes and adaptation processes in Asia and Europe	*			*		*				*		*				
1500: Securing a port's future through Circular Economy: Experiences from the Port of Gävle in contributing to sustainability	*					*				*		*		*		
1510: A relationship between port profiles and policies regarding the circular economy		*				*	*		*		*	*		*		*
1520: Circular economy modelling to accelerate the transition of ports into self-sustainable ports: a case study in Copenhagen-Malmö Port (CMP)						*					*	*				
1530: Sustainable Development of Seaport Cities through Circular Economy: A Comparative Study with Implications to Suez Canal Corridor Project						*					*	*		*		
1580: MITIGATE - Multidimensional, IntegraTed, rIsk assessment framework and dynamic, collaborative Risk ManaGement tools for critical information	*			*				*						*		

Input	T10	T20	T30	T40	T50	T60	T70	T80	T90	T100	T110	T120	T130	T900	T901	T910
infrAstrucTurEs																
1630: The Impact of the Development of Seaport Objective Functions for a Cargo Logistics System in Urban Areas, Illustrated with an Example of the Szczecin Metropolis	*	*					*			*						
1680: Sustainable Development of Coastal Cities- Proposal of a Modelling Framework to Achieve Sustainable City-Port Connectivity	*					*				*				*		
1790: Portopia - Ports Observatory for Performance Indicator Analysis						*					*	*			*	
1930: Stratégie Nationale Portuaire	*		*			*		*	*	*	*	*		*		
1940: Nationales Hafenkonzept 2015	*				*	*	*	*	*		*	*			*	
1950: Port of Rotterdam - Port Vision 2030	*		*			*			*	*	*	*		*		*
1970: Motorways of the Sea - Detailed Implementation Plan	*	*	*		*	*	*	*	*		*	*		*		
2020: Port Development Plan to 2025	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
2070: Innovative Seaport Technologies (Innovative Seehafentechnologien) - ISETECT II	*	*	*				*		*							
2090: Maritime Energy Transition Outlook (ETO)						*										
2100: PORTOPIA - European Port Industry Sustainability Report 2017						*								*		
2130: Code of Good Practices for Cruise and Ferry Ports	*					*		*		*				*		
2630: Environmental sustainability in seaports: a framework for successful innovation						*										
3200: Sustainability report 2017 port of Antwerp	*	*				*	*	*	*	*	*	*	*			*
3210: Port of the future (Deltares)	*		*	*		*					*	*	*			
3220: Sustainable Ports - A Guide for Port Authorities. PIANC Report 150.	*					*			*			*				
3230: Doctoral dissertation Tanjera	*					*										
3240: Historic urban landscape	*					*				*		*		*		
3250: A sustainability assessment of ports and port-city plans	*	*	*		*	*				*	*	*			*	

Input	T10	T20	T30	T40	T50	T60	T70	T80	T90	T100	T110	T120	T130	T900	T901	T910
3270: Low-carbon infrastructure as an essential solution to climate change	*	*				*						*				
3280: Concept of building and working with nature.	*					*										
3320: Developing climate resilient ports.	*						*	*			*					
3330: Climate change impacts on the Port of Ijmuiden.								*								
3340: System dynamics model applied to the port of Tema in Ghana.									*	*						
3370: Nature friendly banks made of residual material in the port of Rotterdam	*					*	*									
3380: Ecosystem-based port design as an approach to sustainable development.						*										
3480: Non-Price Competition in the Port Sector: A Case Study of Ports in Turkey												*				
3490: Port performance evaluation. Case study: Ports in the Black Sea basin	*															
3500: The relations between the port business framework and the qualified manpower competencies – literature review and proposed guidelines.											*					
3510: EU investment plan booklet												*				

Table 5: Assessed inputs by main topic

The following sections contain the main result of the assessments described by main topic, so in other words the level 1 topic an all its child and grandchild topics. When and input is assigned to more than one topics the main conclusions are only described at the most relevant topic.

6.2.3.1 T10: Infrastructure

Topic	T10: Infrastructure
Description	This topic is about the physical infrastructure, the spatial organisation of the infrastructure, about the services to maintain the infrastructure but not about the services that use the infrastructure. It also includes smart infrastructure.
KPI's	• See also sustainability on dredging; • Adjusted terminals to large container vessels; • Wi-Fi network;

Topic	T10: Infrastructure
	• Removed bottlenecks; • Time slot allocation for trucks, night service at terminals; • Traffic monitoring & managing; • Industrial symbiosis; • Land plot allocation conditions to clients; • Recycling / circular economy focus; • Parking zones; • Installed ERTMS; • Integrated lock management systems; • Scanning technologies installed; • Cost Benefit Analysis • ROI • Terminal Profitability • Operating revenue / - benefit per unit • Jobs created • Road/Rail maintenance costs • Turnaround time • Waiting time • Delays on railway/road • Level of cyber security related to critical infrastructure
Co-related topics	• T60: Sustainability; • T100: Port city relations; • T120.10: Financing;
Keywords	• Alternative energy; • Adaptation to changing transport modes; • Critical infrastructure; • Cargo Logistics systems (concepts);
Gaps identified	• Funding; • Cyber security;
Trends	• Greening of energy sources, transport activities; • Better use of existing capacity through data sharing; • Completing TEN-T network;

Topic	T10: Infrastructure
	• Critical Infrastructure Protection.

Table 6: Assessment results for topic T10 infrastructure

The TEN-T programme's ultimate purpose is to ensure the cohesion, interconnection and interoperability of the trans-European transport network, as well as access to it. TEN-T projects, located in all EU's Member States, covering all transport modes, had a large impact on the development of infrastructure in maritime ports areas and the connection to these areas.

Maritime port authorities therefore embark on various initiatives mostly related to the environmental impact of such physical projects. This is not only done on individual basis but often situated in co-operation between ports authorities and their stakeholders.

Due to the continuous efforts of European investment plans, and the pressure of markets, ports gradually transform their infrastructure to the upcoming transport market needs.

These infrastructure works are increasingly required to align with sustainable port development models. As such they are subject to economic cost benefit analysis that is to evaluate both the positive (economy, society) and the negative effects (adverse social and health benefits, environment, and coastal ecosystems). Infrastructure expansion to facilitate future transport growth is to be motivated and green.

Europe's largest ports align the construction of new container terminals, upgrading and maintenance of maritime access infrastructure, to facilitate Ultra Large Container Ship already surpassing the capacity of more than 20 000 twenty-foot equivalent unit, with 22 000 TEU ship construction orders being scheduled to be delivered as from 2019. The impact on hinterland and shore feeding connections cause a major concern to this. At times this construction of new terminals has circular economy aspects, by using contaminated sediments as resource.

Innovations related to transport modes such driverless truck convoy platoons, Longer Heavier Vehicles (LHVs), autonomous shipping/barging, also force to the adaptation of a ports infrastructure.

Related to rail, the project INTERMODAL facilitates the decision making in multimodal terminal networks by evaluating design alternatives including its effect on environment. The study offers useful KRI, KPI and clear guidelines on how to define and assess the indicators:

The proposed method on KPI's may be useful to define the Port of the Future concept. The method of KPI and PI selection proposed is:

1. Identification of the strategy and mission of the organization (optimizing the economic performance, ensuring service quality, minimizing the effects of the terminal on its immediate surroundings, reducing the environmental impact and external costs, increasing the benefits);
2. Identification of stakeholders involved: public authorities (planning agency, port authorities), Operators (rail, haulage, shipping lines, terminal operators, freight forwarders), investors (private companies, investment organizations) ;
3. Identification of the different perspectives that should be considered in the performance system (operational, financial, quality, environmental, safety);
4. Identification of particular strategic goals;
5. Selection of effectiveness criteria and feasible KPIs and PIs set;
6. Criteria to assess indicators:
    g. Data access, effort;

h. Clarity;
i. Measurability;
j. Transferability;
k. SMART criteria

KPI's focus more on the big picture performance goals while PI's focus more on the daily processes. E.g. Terminal throughput is a KPI and berthing time is just a PI contributing to it.

Not only the superstructure needs modification. With the growing digital exchange of information and remote controlling of critical infrastructure, the EU initiated the European Programme for Critical Infrastructure Protection (EPCIP) facilitating initiatives to consider also the digital protection of the critical infrastructure (locks, bridges …).

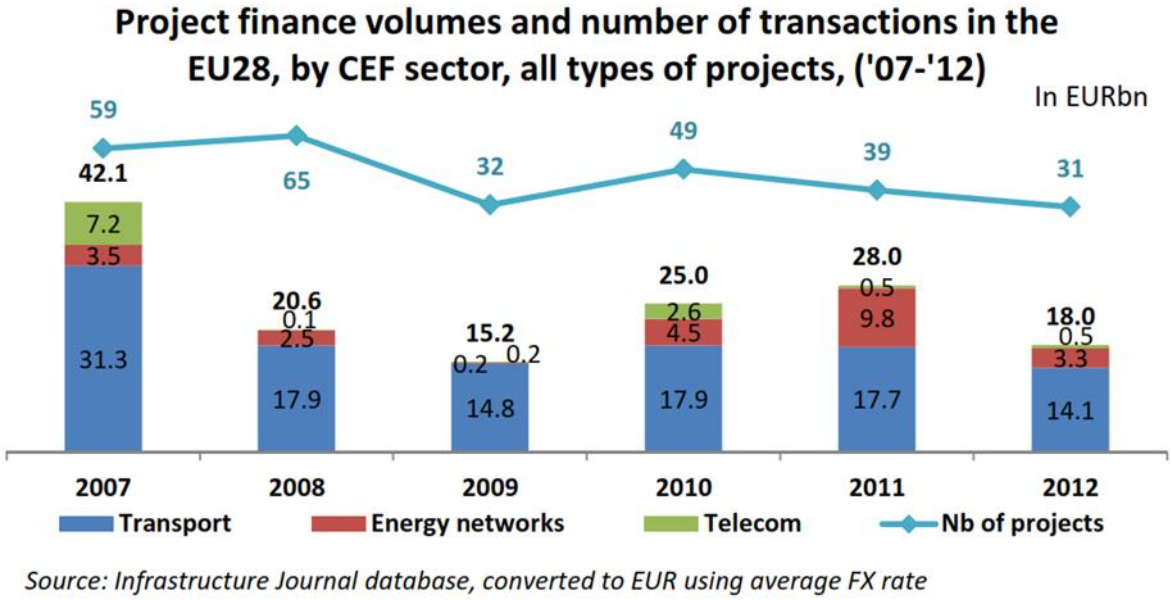
DTLF, an initiative of the European Commission to have experts to build a common vision and road map for digital transport and logistics, identified as benefit of using digital technologies a better use of the existing infrastructure by administrative simplification, optimization of cargo flows. As such the cross benefits of data sharing and more optimal use of existing infrastructure became more apparent.

Specific terminals, such as storage facilities, incorporate the flexibility to manage alternative fuels such as biogas, sourced from nearby methane plants. Linking up to energy networks connecting industrial entities within the port area, or even with the city is also identified as an element of a future ports sustainability performance.

1. Environment.
   Vessels are given the opportunity to offload black and grey water via tanker trucks or onto sewage water barges. Further on waste deposits infrastructures are expanded and integrated into a port's waste management plan;
2. Energy.
   Literature and project review identified the further deployment of alternative energy infrastructure, such as LNG for seagoing vessels, inland vessels and trucks with a view to lower the emission caused by these transport modes;
3. The port area's own energy source mix is being greenified with project examples from around the global, such as replacing coal by LNG. Increasing investments are scheduled to expand the current shore-based power supply, and efforts taken to decrease its own energy consumption and the emission of greenhouse gasses. Growing initiatives are taken here with regards to the transparency on the related KPI's by monitoring energy and water consumption, including indicators of urban environment quality (air quality, water, energy, and water use), by means of sustainability or similar reports;
4. Organisation transport.
   The study related to the 'Impact of the Development of Seaport Objective Functions for a Cargo Logistics System in Urban Areas', details on the presented thesis that the development of the logistics-distribution function as well as the industrial function of a seaport leads to an increase in the flow of cargo transported by road transport with a decreasing share of rail transport. Port expansion plans nowadays are more confronted with traffic analyses, and the requirement to achieve a minimum mix of transport modes related to the new generated maritime cargo flows;
5. Financing and Funding
   Considering all advices and good intentions in this desktop analysis, one may forget there is a price tag to it.

   The full deployment of the European Union's 2020 objectives relative to transport, ICT and energy requires financial means that range between €1.5 to €2 trillion up to 2025. The financial crisis indeed caused a dramatic drop in member states and private investment

initiatives to such extent that Europe launched a series of financial instruments to safeguard the progress. These include the Marguerite Fund (equity, the Project Bond Initiative (PBI).



Source: Infrastructure Journal database, converted to EUR using average FX rate

Figure 3: Project finance volumes and number of transactions EU 28 CEF '07-'12

The Investment Plan for Europe adopted in November 2014 as the first major initiative of the Juncker Commission has the potential to bring investments back in line with its historical trends. Via the EFSI, the European Investment Bank is able to respond quickly to financing needs in areas where alternative sources of financing are scarce or unavailable. The EIB's presence often provides reassurance to other financiers to provide co-financing. The EFSI projects need to be economically and technically viable, consistent with EU policies, provide additionality (i.e. they could not be realised without the backing of the EU guarantee), and maximise the mobilisation of private sector capital. The EFSI is a very flexible instrument and fully demand-driven: there is no sectorial or geographical preallocation.

Significant support to projects targeting similar sectors as those supported by the EFSI for instance comes from the Connecting Europe Facility (CEF), Horizon 2020 and the EU programme for Employment and Social Innovation, etc., as well as from those EU funds implemented by Member States' authorities under shared management, namely the European Structural and Investment (ESI) Funds.

An important shift is also noticed in Europe's financing strategies. Over the last decade the requirements on financing and revenue models in project proposals became more stringent. Co-financing, as subsidy is still possible, but needs motivation that the project will become financial sustainable, and/or has a high economic rate of return (which includes the societal effects).

Society nowadays is also more aligned with the concept of internalization of external costs, in short 'polluter pays'. This can be done through taxes, property rights, tolls, and government subsidies. A classic example is the case of pollution: instead of letting the whole society pay for the pollution of one sector (e.g. road transport), public authority's tax the pollution (polluter).

This shift made it possible to embark on the financial blending of projects: EFSI with other EU Funds and funding instruments, such as European Structural Investment Funds (ESI Funds), the Connecting Europe Facility (CEF) or the Private Finance for Energy Efficiency (PF4EE) could be effective in deploying higher-risk investments.

In 2017 the first of two Blending calls was organised in which the total indicative budget totalled of €1.35 billion, the second in February 2018.

While the procedure is quite similar to a regular CEF-call, CEF blending calls have following particularities:

1. Open only to proposals for works;
2. A minimum project budget of €10 million (later on € 5 million for "innovation and New technologies';
3. Applicants have to demonstrate that full financial close with a private sector investor, the EIB, or a National Promotional Bank can be reached within 12 months from the date of the signature of the grant agreement.

The funding objectives align with many topics identified in the DocksTheFuture project:

1. Removing bottlenecks and bridging missing links, enhancing rail interoperability, and, in particular, improving cross-border sections;
2. Ensuring sustainable and efficient transport systems in the long run, with a view to preparing for expected future transport flows, as well as enabling all modes of transport to be decarbonised;
3. Optimising the integration and interconnection of transport modes and enhancing the interoperability of transport services, while ensuring the accessibility of transport infrastructure.

In both calls a total funding was requested of € 3 199 875 065 for 133 projects, being 2.37 times more than available (1.8 billion euro).

6.2.3.2 T20: Means of transport

Topic	T20. Means of transport
Description	Currently this topic has only one child topic T120.10 "Sea going vessels". This topic is about the impact of changes to ship design on the ports and not about these ship design changes themselves.
KPI's	• Imposing transport modal split road/rail/barge; • Clustering of cargo before entering/before leaving port; • Number of active multimodal platforms • Number of e-barges; • % Single Wagon Loads; • Intermodal Transport Units; • Soot filters; • Sulphur Free/low areas.
Co-related topics	• T120.10: Sea-going vessels.
Keywords	• Decarbonisation; • Alternative fuels.
Gaps identified	• Transport mix remains in favour of road.

Topic	T20. Means of transport
Trends	• Favourable government policies.

Table 7: Assessment results for topic T20: Means of transport

As low carbon infrastructure, here 'means of transport', has become a global concern several studies focus on the paradox between 'low carbon projects' versus the 'conventional' projects (road). Examples of low-carbon infrastructure are: railway infrastructure, which can reduce the number of carbon-emitting trucks. Renewable energy projects (solar, wind, and hydropower), are quoted as good practices which have much lower carbon emissions compared to fossil fuels.

A World Bank report studies the trends related to investment in low carbon infrastructure in emerging markets and developing economies, and concluded that low-carbon land transport and energy projects presented a smaller potential for private investors before 2010. After 2010, favourable government policies in the form of both direct and indirect government support led to a surge of low-carbon projects. The percentage of low-carbon projects receiving government support grew from 3% before 2010 to 51% in the following years. The distribution of new project investments shifted in favour of low-carbon versus conventional energy.

It should indeed be noted, however, that this surge in low-carbon infrastructure is driven by renewable energy projects rather than climate-friendly transport projects.

The Maritime Energy Transition Outlook (ETO) describes the consequences of the energy transition for the maritime industry and predicts that heading to 2030 shipping will continue to enjoy robust growth, comparable to the last several decades. From 2030 to 2050, demand continues to increase, especially in non-energy commodities, such as the container trade and non-coal bulk. As energy production and export patterns change, the fuel mix will be much more diverse. In 2050 oil will remain the main option for trading vessels, but natural gas will step up to become the second-most widely used fuel, and new low carbon alternatives will proliferate. It estimates that short sea shipping will be electrified where possible, and biofuel will replace fossil fuel where electrification is not a viable option (deep-sea shipping, long distance trucking).

Furthermore it states that ports will experience more 'social pressure' to fully embark on shore power supply, creative energy storage systems (Power-to-Gas, hydrogen instead of battery), and optimising use of renewable energy included in smart grids (solar and energy storage).

In Europe in the first half of 2015 the modal split was divided as per underneath table in 41.6% barge, 46.2% [6]road and 12.2% rail (Port of Rotterdam, 2015). Share of renewable energy projects has risen from about 50% to 83%. But in land transport, conventional projects or road projects still dominate, accounting for almost three-fourths of the total sectoral PPI investments.

	Road	Rail	IWW
Amsterdam	31	2	44
Antwerp	48	7	41
Ghent	45	9	46
Hamburg	48	45.3	12.3

[6] 2015 figures, source Port Statistics

	Road	Rail	IWW
Rotterdam	46.2	12.2	41.6

Table 8: Modal split of certain ports in Hamburg Le Havre range

Despite additional investments and supporting European and national policies, the share of road transport continues, in the majority of ports, to have the largest share in the transport mode mix.

Not only are the modern seaports (operating as logistics centres) the transport hubs which allow changing the means of transport by way of cargo or ITU, but also they are areas in which forwarding and logistics services, typical of integrated logistics centres, are provided. Many ports worldwide also operate as places of production, and therefore their seaport areas become multi-functional economic systems with developed objective functions including transport, distribution and logistics as well as industrial and commercial functions.

Each function generates cargo streams which often become a component of a transport logistics system in urbanized areas. This happens especially in the case of historically mutual development of seaports and port cities.

In Europe, most ports with centuries-old traditions occupy a part of the city / metropolis area, and at the same time they are also components of urban logistics for passenger and cargo transport.

Efforts nevertheless are continued to greenify transport. HPA is pushing electrification in the port for road transport, pursuing further the commitment of the City of Hamburg in the field of electro mobility. The aim is to implement electro mobility in commercial traffic. The deployment of electric and hybrid vehicles used for inner-city deliveries is one focus area; another is the use of electrically powered vehicles to transfer containers within the area of the port.

The expansion of the energy efficient and thus environmentally friendly railway will continuously improve the environmental situation in the Hamburg port. This will be enhanced by the newly introduced user charge system that rewards rail freight operators for using soot filters and noise reduced brakes.

The parties in the port also actively implement emissions control measures in their own fields of activity. Truck fleets are gradually being modernised to comply with the EC Directives on emissions control. The HPA's floating fleet has permanently switched to sulphur free fuels.

Further on, ongoing projects were mentioned related to driverless truck convoy platoons, Longer Heavier Vehicles (LHVs), autonomous shipping/barging and electric small barges for cargo transport. Technological research continues making progress on reducing transport emissions, extending life-time of batteries, facilitating the uptake of alternative energy.

6.2.3.3 T30: Accessibility

Topic	T30: Accessibility
Description	Accessibility of all transport means to and from the ports
KPI's	• Monitoring; • Employment rate; • Volume growth; • Air quality (emissions GHG, NOx, Sox, PM10);

Topic	T30: Accessibility
	• Habitat destruction/Reduction; • Flooding damages; • Energy consumption; • Passengers (cruise); • Traffic density/congestion; • Accessibility to markets; • World Ports Climate Initiative (WPCI); • Environmental Shipping Index (ESI); • Onshore Power Supply (OPS).
Co-related topics	• T40: Standards and legal instruments • T10.10, T10.20, T10.30 concerning the infrastructure to make ports accessible; • T60.10 for environmental friendly accessibility; • T70 for safe accessibility; • T80 for secure accessibility; • T90 for ICT aspects of the accessibility including T90.20.10 for reporting formalities at arrival and departure; • T100: Port City relations.
Keywords	• Accessibility also for public; • Clustering; • Environmental impact; • Data sharing on ship details, voyage information.
Gaps identified	• Maintenance dredging program; • Impact on environment; • Funds.
Trends	• Navigability, maintenance of fairways; • Multiple uses of quays.

Table 9: Assessment results for topic T30 Accessibility

As seen in the section on governance, the majority of maritime ports in Europe still have 'public' ownerships. This fact together with the raising awareness of the public that tax money spent has to be accounted for, and the port authorities growing insights into the effect of a good public image, has led to growing investments of port authorities in public spending (e.g. public transport, mixed urban/port zones). Each investment related to pure port infrastructure, is also accompanied by a motivation what kind of benefits it is to bring to the society, and its limited

impact on the environment, or the compensation measures taken for any environmental 'collateral' damage need detailed explanation.

This sustainable port growth model is often related to the People, Planet, and Profit model reflecting society, environment and economy. This trend was also visible during the desk top analysis with quite a number of available inputs, showing examples throughout Europe.

Accessibility as indicated in the various inputs had different aspects among which the navigability, but also related to port/city relations when considering mixed used of port infrastructure.

The port of Rotterdam Port Vision 2030 specifically mentions their budgetary effort, along with share of the government, to invest '5 to 6 billion €', motivating that this money will be invested mainly in infrastructure to maintain accessibility, which is not only important for the port. All other businesses and the public have an interest in this too", referring to highways (among which connection to other members states ports), tunnels, solving rail bottlenecks, public transport facilities, cycle paths, increasing lock capacity to inland waterways, and (pro-)active road and water traffic management. Clear 'society' goals are sometimes included, such as "removing 20% of cars from rush hour traffic (for instance by encouraging commuters and employers to avoid the rush hour), on the one hand, and by implementing proactive traffic management at the network level, on the other. "

Hamburg Port Authority Port Development Plan contains a location strategy that is to enable production plants to jointly use quay facilities and thus make optimum use of handling capacities, including the required transport infrastructure with regards to roads, railway, with accompanying measures such as sustainable development of the modal split, and optimisation of existing systems to achieve fast improvements

In 2008 the Hamburg Port Authority in conjunction with the Federal Waterways and Shipping Administration (WSV) developed the Tidal Elbe River Engineering and Sediment Management Concept that is supported by the neighbouring federal states. Among others, the aims outlined in the concept are the reduction of dredged material volumes through river engineering measures and the optimisation of maintenance dredging with the environment in mind.

Reducing the burden of road traffic leads to another promising option to optimise traffic flows by controlling the inbound road traffic before vehicles enter the port. In future, truck drivers bound for the Port of Hamburg will be informed in advance of, for instance, traffic disruptions in the port and advised on the possible use of pre-gate car parks.

These are (buffer) car parks within or outside the area of the port where truck drivers, supported by IT, can communicate with their target destinations and obtain information about the traffic situation.

The Shippers Sustainability Assessment report aims to present a method for interpreting and comparing sustainability in long term port and city plans. The method is tested on 10 port city[7] long term plans (more on this in the section topic 'Sustainability'). The study selected 22 sustainable port measures that were categorised in:

1. Port Expansion and Navigation;
2. Environment and Governance;
3. Green Port City Infrastructure.

The actions undertaken by ports to obtain sustainable social, environmental and economic goals, including examples of sustainable measures and performance indicators.

[7] Antwerp, Dar es Salaam, Hamburg, Ho Chi Minh, Istanbul, Los Angeles, Melbourne, Rotterdam, Shanghai, Valparaiso.

We select the actions relevant for this topic T30: Accessibility. The full table is available under the section T60: Sustainability.

Subject	Example of sustainable measure	Performance Indicator	Examples of concerned ports' measures
Social dimension			
• Climate regulation • Flood and coastal protection	• Sand nourishment • Storm surge barrier	• Climate robustness • A higher potential of flood damages	• Energy & Climate Working group • Convention on Climate Change • LNG Concept • Climate Protection Master Plan • City Action plan as part of National plan • Sustainable Port Design • Climate Change Adaptation Strategy • Sustainability Report • Flood programmes • Earthquake resistance • River Revitalization Master plans
Environmental dimension			
• Air	• Pollution limits	• NOx, SOx, PM10	• ESI, LNG, AQM • Working Environment Convection • IMO Initiatives, • SECA regulation • ARGE Elbe classification • Strategic plans (Black Sea) • California Coastal Act • Clean Air Action Plan (California) • Sediment Assessment • Air pollution management • Flemish Environment Agency Air quality Monitoring
• Sensitive ecosystems/ • Marine biodiversity	• Sediment quality • Marine biodiversity	• Mapping • Ballast Water treatment	
• Climate regulation	• EIS • OPS	• Emission of greenhouse gases • World Ports	• WPCI • OPS • ESI • Greenhouse gases

Subject	Example of sustainable measure	Performance Indicator	Examples of concerned ports' measures
		Climate Initiative (WPCI) • Environmental Shipping Index (ESI) • Onshore Power Supply (OPS)	monitoring • Reduction of CO2 vehicular emission
• Micro climate regulation	• Habitat compensation	• Habitat destruction • Loss of benthos • Sand extraction	• United Nations Climate Change Conference, COP 21 • Regulations, plans (water, sediment…) • Areas of special conservation Interest related to Natura 2000 • Green infrastructure and low impact development • Integrated policies/decrees
• Water	• Water treatment	• Water quality	
• Soil formation	• Dredging	• Erosion • Sedimentation • Maintenance dredging	• Relocation of sediments • Treatment of sediments
Economic dimension			
• Accessibility	• Inland expansion	• Traffic; • Railways; • RoRo; • Hinterland connections; • Modal split.	• Monitoring traffic congestion density • Improving infrastructure and sustainable modes • Improve and mitigate accessibility

Table 10: Actions undertaken by ports to obtain sustainable social, environmental and economic goals

6.2.3.4 T40: Standards

Topic	T40: Standards
Description	All standards and legal instruments concerning certain topics are grouped together under this topic
KPI's	• Standard for assessment of long-term port plans are converted using Performance Indicator (PI) values to weigh the impacts of the measure, being the total sum of the sustainable social-

Topic	T40: Standards
	(SCSM), environmental- (EVSM), and economic- (ECSM) sustainable measures scores are expressed as a Sustainable Integrated Condition Index SICI (input 3250); • International standards applied per port authority; • ISPS certification • Updated international / EU standards by each member state.
Co-related topics	• T10 Infrastructural standards; • T20 Standards about the means of transport; • T60.10 Environmental standards; • T70 Safety standards; • T80 Security standards; • T90 ICT standards; • T90.20.10 Reporting formalities; • T110.10 Standards that regulate the labour market.
Keywords	• EU effort on standards; • Permanent standards issue in projects including different sectors, member states, and different authorities.
Gaps identified	• Missing standards. • Agreements between countries within and outside the EU must jointly address regulations concerning the systems.
Trends	• Missing standards; • Growing importance of existing standards due to requirements of digitization wave.

Table 11: Assessment results for topic T40 standards

The European Union pays much attention to standards, recognizing its leading role in creating the EU single market. They facilitate a level playing field, interoperability of services and products, are cost reducing and improve safety and security. The EU's active standardisation policy promotes standards as a way to better regulation and enhance the competitiveness of European industry. Standards are needed to invoke mutual understanding and required to facilitate communication, measurement, commerce and manufacturing.

Almost all analysed EU projects – both IT and non IT - identify the lack of standardisation as a major bottleneck to further dissemination of the projects results among sector and Member States. Experience from Cassandra - Common Assessment and Analysis of Risk in Global Supply Chains – concluded that the implementation of a Global Data Pipeline can be implemented in small realistic steps, which included using trade data and customs data standards such as WCO data model V3, UN/CEFACT, GS1, standards that are commonly used in the industry. The successor to this project, CORE, tested this exchange of data in practice successfully.

Synchronised and coordinated port call operations build upon the principle that information objects are shared among different stakeholders. Project STM (Sea Traffic Management) claims its 'Port Collaborative Decision Making -PortCDM' has been introduced for the purpose of ensuring synchronised and optimised port visits and it allows involved actors to share intentions, as well as actuals, about the occurrence of different events requiring standardised procedures, interfaces, and message formats. Through their PortCDM the coordination between all major stakeholders to the supply chain is envisaged (ships and port, between ports, between port call actors, and between ports and hinterland operators).

Among other deliverables, PortCDM introduced a proposed port call message format for sharing spatial-temporal planning and actual data among these four interaction areas. This route plan exchange format is based on standardising a single route plan

Other projects, such as River Information Services projects CORISMA and its successor RISCOMEX identified the many gaps between the interpretation and formatting of data by each Member State related to the envisaged data exchange in the inland waterway sector.

On top of this, new technologies urgently require new standards. On blockchain no clear regulations are yet in force since it concerns still an emerging technology: what regulation needs to be developed to implement this technology?

From a legal point of view the exchange of data between member states lacks permission and standardisation to both the content of the exchange and the format.

Missing technical standards related to the physical transport modes and their markets were also labelled as preventing the correct functioning of the free market. Especially the rail sector and to a lesser extent the road sector suffer from this issue. There is consensus that rail freight transport needs a direct and standardised access for third parties in order to prepare the level playing field for competition in the traction markets. In order to promote combined transport, the incentives for all in one logistics suppliers are essential. A successful example is available, being aviation and coastal shipping, which are good examples to demonstrate the relevance of transnational interoperability, made possible through – among others - standardisation.

The Motorways of the Sea Detailed Implementation plan promotes the standardisation of the environmental construction process of new vessels, to reach multiple effects in several sector areas such as yard, equipment, naval engineers and so forth.

The technological innovation though makes it possible – up to a certain level of complexity - to transform non-standardised incoming messages into a standardised outgoing message using API's that connected the data backbone and the receivers application. In this the incoming data in the data backbone (as in standardising the different incoming formats) is processed into a single format and connected to the receiver's application.

From environmental perspective, the 2007 USA Environmental Protection Agency's standard, forms the base for the port authority to authorise trucking firms to access the port through offering a limited number of concessions that will be granted to those that can meet certain criteria.

The Intergovernmental Panel on Climate Change considers that meeting existing standards is also an explanation for the global move toward a post carbon transition, next to the rising energy prices, the increasing environmental awareness leading.

Objective analysis between ports, on e.g. environmental port performance indicator, sustainability performance, is currently not possible due to the lack of standardized, publicly available environmental data. This pleads for the development of a worldwide standard set of KPI's for ports, which can then be used by ports to formulate long-term plans and for evaluating the progress realised by ports on the three main aspects of People, Planet and Prosperity. It is of

major importance that ports worldwide develop and adopt a uniform set of KPIs to assess and develop port operations, wealth, social welfare and sustainability. Only in that way can port plans be developed based on a proper set of optimised KPIs and can plans and results realised be compared directly to the performance of other ports.

Existing standards such as ISO14001 are increasingly being adopted by port authorities in order to facilitate the port's introduction of an environmental management standard.

6.2.3.5 T50: Integration in the supply chain

Topic	**T.50: Integration in the supply chain**
Description	The cooperation of all actors in the supply chain.
KPI's	• Sustainable performance; • Carbon footprint; • Number of active platforms.
Co-related topics	• T90 Digitization, digitalization and digital transformation. In practice the "Integration" part means the use of ICT to support the flow of information; • T10.20 Maritime terminals, T10.50 Logistic areas and T10.60 Industrial areas are a fundamental nodes in the supply chain; • T900 Cooperation.
Keywords	• Interconnectivity of platforms; • Managing logistics data.
Gaps identified	• Standards; • Interconnectivity between ports, between ports and hinterland(s), through transhipment zones (multimodal platforms, ..) both in maritime ports and in hinterland; • Logistics profiles with new skills (problem solving, data analyst,); • Change management from fossil to non-fossil industry, impact on logistics.

Topic	T.50: Integration in the supply chain
Trends	• Circular economy; • Corridor approach; • Platforms & bundling of cargo streams; • Nearshoring; • Consolidation in shipping industry, will be followed by consolidation in logistic service sector; • Competition between ports will to large part based on controlling hinterland connections; • Cooperation between ports to capture hinterland area; • Controlling information flow = controlling physical flow; • Gateway access points concept will be further developed.

Table 12: Assessment results for topic T50: Integration in the supply chain

Various inputs indicate the integration in the supply chain of ports, with a particular focus on the 'integration' aspect, the cooperation and coordination among its supply chain actors. This is done from a holistic supply chain view (overall), or per specific sector depending on the focus of the concerned input.

Each sector-centred input though recognises in full the importance of its transport modus' need to be 'included' into the overall supply chain, especially on the data sharing point of view. The current focus remains too much fragmented between transport modes, economic actors, or even within transport modes. The lack of information flowing between these groups is a major bottleneck.

Inland waterway, through its long tradition of River Information Services projects, states that in the end inland waterway transport is a service delivered to the cargo shipper, consigner and consignee by parties that organise or execute the transport.

Blockchain technology is indicated as enabler of a better integration of supply chain flows (physical, financial and information flows).

Other existing IT applications focus on a specific transport mode such as ecoTAURuS, a Truck Appointment & Unit Reporting status Solution designed to support both terminal operators and trucking companies to optimise their operation and at the same time their environmental performance. It comprises a set of versatile services (and where required interactive applications) that allow stakeholders (terminal operators, trucking companies, truckers, dispatchers, etc.) around a group of terminals to effectively optimize their operations through seamless integration of Terminal Operating Systems (TOS), Truck Appointment Systems and consolidation of Unit status data from multiple sources (multiple-TOSs, Trucker mobile interface).

Barge planning is another initiative, resulting from the continuous increasing waiting times of barges at maritime container terminals in port areas. It allows the planning department of each container terminal, to align with the barge's activities and time slots at other – competing - container terminals. As a consequence waiting hours reduced considerably.

Especially multi-modal platforms draw attention, as it already covers the 'physical' part of integration, the 'data'-part is believed to have promising benefits. As stated in the port of Rotterdam's vision "In the medium term, the proportion of truck traffic could be decreased

substantially in favour of the railway by integrating the port railway more closely in handling facilities, in particular by offering tri-modal transport combinations."

The study 'Future of ports logistics' identifies following main trends with regards to supply chain:

1. Continuous re-engineering of supply chains towards modal shifts and synchro modality (environmentally sustainable due to legal, political requirements);
2. Return to close-by manufacturing;
3. More horizontal collaboration between logistic transport companies and logistics service providers, partly due to further consolidation in sector;
4. Digitalization wave requires other skilled personnel, scarcely available. Re-training may be required and further automation to guarantee level of services provided;
5. Data analytics and visibility will further streamline supply chains, by means of segmentation and standardisation. This may result in modular supply chain, easier exchangeable with other supply chains;
6. Collaboration and data platforms will lead to new services being offered;
7. Continuous focus on sustainable, greener transport both from legal and public pressure;
8. Growing eastern European market may impact flow of cargo volumes;
9. Circular economy will gain market share, forcing transport services to work more aligned with industrial partners;
10. Supply chain resilience to remediate disruptions will call for data-driven models, and thus for affluent, correct, real time data;
11. Further integration of various existing and new platforms to grow towards an open global system founded on physical, digital and operational interconnectivity (as per ALCIE Alliance for Logistics Innovation).

The motivation to make 2018 the "Year of Multimodality" is related to the EU Commission's commitment to reducing CO_2 emissions, congestion and air pollution to improve the quality of life of European citizens and to reach the goals set by the Paris Agreement. At the same time ensure that European transport is safe and EU's industry remains competitive on the global market.

To this perspective some Member State's increased their effort to improve their maritime port area's hinterland connectivity by promoting modal-split.

Generic support measures are launched to allow a better usage of the current available transport infrastructure by involving transport, logistics services and their clients (shippers) to 'compress' the cargo streams in both directions. This is only achievable through a collaborative model, in which economic actors are willing to share cargo. 'Pooling' is more expensive than direct deliveries, but it is required to increase the supply chain's overall performance, frequency and number of destinations, through a more active involvement of rail and inland waterways.

The Flemish port commissioner drafted to this purpose three directions that contain potential solutions:

1. Corridor approach: increasing of the 'call sizes' of inland barges through the implementation of consolidation hubs alongside the inland waterways. This includes among other the transhipment of containers to one 'regional' central hub, that consolidates a minimum of 30 containers to be shipped by IWW to the port's maritime container terminal;
2. In a next phase a regular shuttle service between maritime port terminals and the hinterland consolidation zones (also called Gateway Access Points, inland distribution

zones, multimodal platforms, though each typology offers some additional services), will enable guaranteeing fixed timeslots at the maritime port terminal;

3. Intra-port consolidation areas, where shipments of less than 30 containers (call sizes) are first consolidated before being transported from the maritime port to the hinterland corridor;
4. Bundling of cargo volumes per rail in the various large maritime ports through lift on/lift off handling.
5. All proposed measures are the result of cooperation between government and the port authorities.

6.2.3.6 T60: Sustainability

A more detailed study on the subject can be found in section 9.1.7 Study on sustainability 238

Topic	T60: Sustainability
Description	This topic covers all aspects of the traditional 3P perspective on sustainability: planet is environmental sustainability, profit is the economic sustainability and people is the social sustainability. In other words initiatives to improve the environment should not have a too negative effect on the economy and on the social welfare The united nation sustainability guidelines have been added. When selecting Sustainability, you may wish to select items from this checklist and items from the port - city checklist from outline "Environmental challenges"
KPI's	• Sustainable Integrated Condition Index/SICI; • Accreditation e.g. Green Port, EcoPort or ISO 14001; • Green Energy, Green Ship; • Climate Protection Master Plan; • Sulphur air emission control; • Environment Policy Plan; • Clean Air Action Plan; • Greenhouse Gas Emission Tracking; • Mobility Plan; Transport Master Plan; • Air pollution management; Sustainability Report; • Employment rate; • Volume growth; • Air quality (emissions GHG, NOx, Sox, PM10); • Habitat destruction/Reduction; • Flooding damages; • Energy consumption; • Passengers (cruise); • Traffic density/congestion;

Topic	T60: Sustainability
	• Accessibility to markets; • World Ports Climate Initiative (WPCI); • Environmental Shipping Index (ESI); • Onshore Power Supply (OPS); • Monitoring of external factors; • Windmill parks will be doubled from 151 to 300 MW; • % Use the flat roofs of the many port warehouses as platforms for solar panel parks; • Indexes: EEDI (Energy Efficiency Design Index), SEEMP (Ship Energy Efficient Management Plan); • Fines collected and incentives paid.
Co-related topics	• T60.10: Environmental sustainability defined further in 4 subtopics; • T60.20: Economic sustainability and T60.30 Social sustainability.
Keywords	• Re-use of obsolete areas, social responsibility, greening tools for ports.
Gaps identified	• Standards; • Proper institutional arrangement and a legal framework set by the government are needed for sustainable outcomes; • Insufficient or missing autonomy of government departments, weak connections among the sectors and inefficient procedures in dealing with cross-sectoral issues (Stead, 2008).
Trends	• Sustainable dimension added to port expansion.

Table 13: Assessment results for topic T60 Sustainability

Environmental Sustainability

The paper "A sustainability assessment of ports and port-city plans: Comparing ambitions with achievements" identifies the rising tide of political interest in combining 'growth' with 'green' currently being an explicit item on the agenda of many countries, particularly in East Asia, Latin-America, Africa, and Europe. This particularly applies to ports, since they possess the ability to retain competitiveness while still taking into account the integrated (eco) system (Asgari et al., 2015; Laxe et al., 2016). Port developments following a growing (transport) market can significantly affect natural ecosystems (Gimenez et al., 2012), but also contribute positive to socio-economic aspects (Schipper et al., 2015; Carter and Rogers, 2008; Heaver, 2016). On the other hand, ports may use a sustainable approach as a selling point. Furthermore, particularly ports may "adopt a 'greener' approach to streamline and speed up port developments, since such large infrastructural projects, if done in a traditional way, nowadays may meet large social resistance."

The authors introduce the concept of a no-negative-impact port, reflecting their theoretical port concept perceived as the ultimate goal of an optimal sustainable port, but question if this is a paradigm related to a port's daily operations.

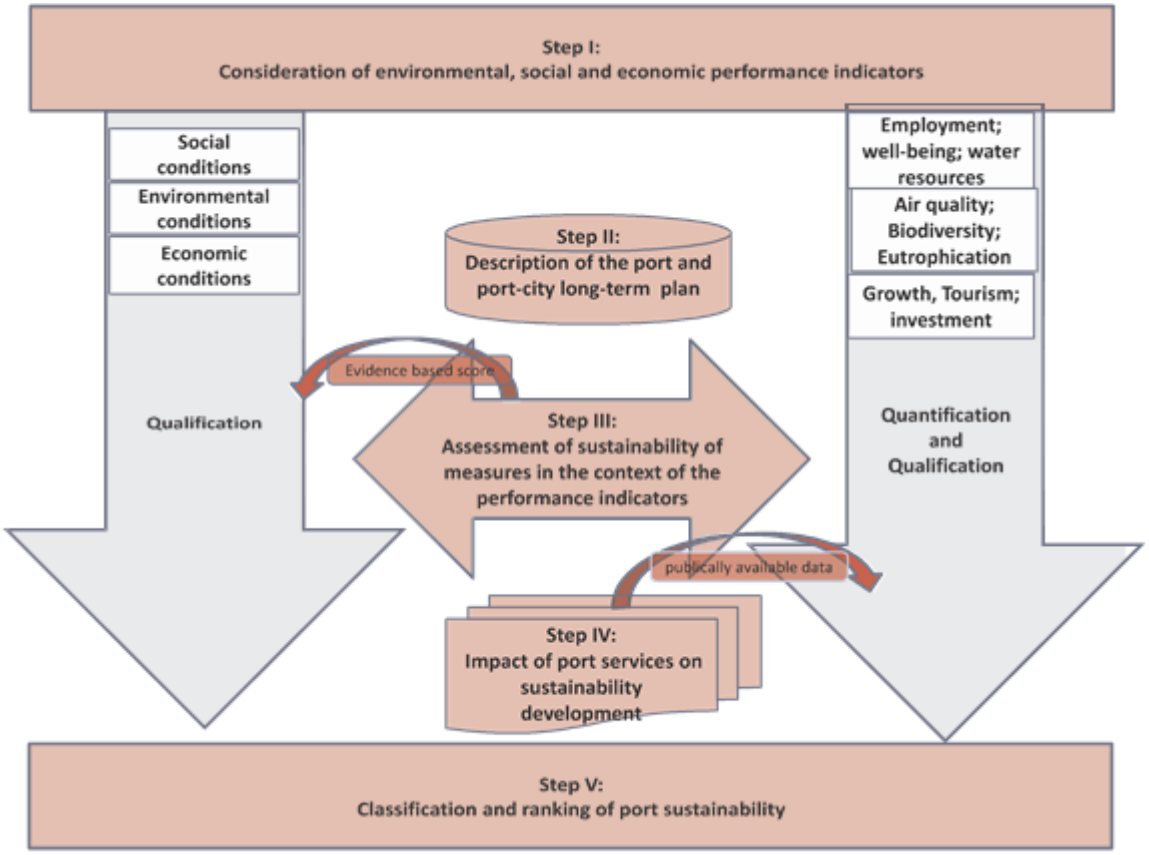


Figure 4: Port assessment methodology

The port assessment method has been developed for considering sustainability key performance indicators in port plans (Step I and II), by comparing the qualitative description of the sustainability in port and port-city long-term plans (Step III), with the sustainability assessment of publicly available data from comprehensive studies in the port-city integration. (Step IV). The impact of port services on sustainability development expresses the sustainability conditions in classes in order to form synergies with the overall objectives of sustainable port development (Step V).

Next to the attempt to evaluate a port's score on a 'sustainability' measuring methodology, various inputs also refer to the circular economy, for which a port is often considered crucial. A part on this topic has already been described in the section of topic 100: Port/City relations with relevant examples from around the globe.

Input 1500 'Securing a port's future through Circular Economy: Experiences from the Port of Gävle in contributing to sustainability', succeeds in integrating the concepts of a circular economy into a port's (infrastructure) life-cycle, which at least can minimize the lead time between the transfer of abandoned berths (and brownfields) to new (re-) developments of the area in question.

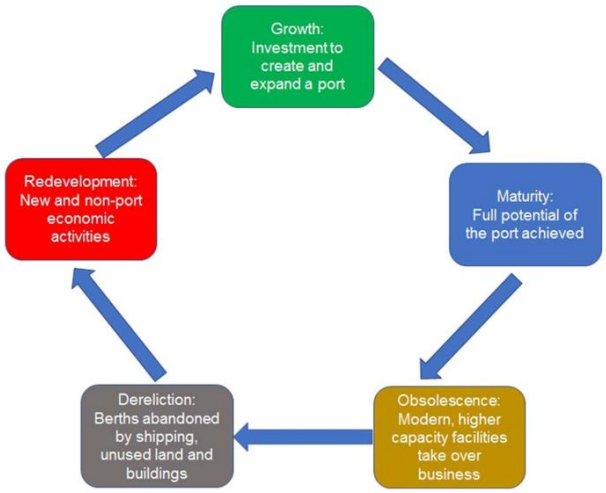


Figure 5 Port Facilities life-cycle concept

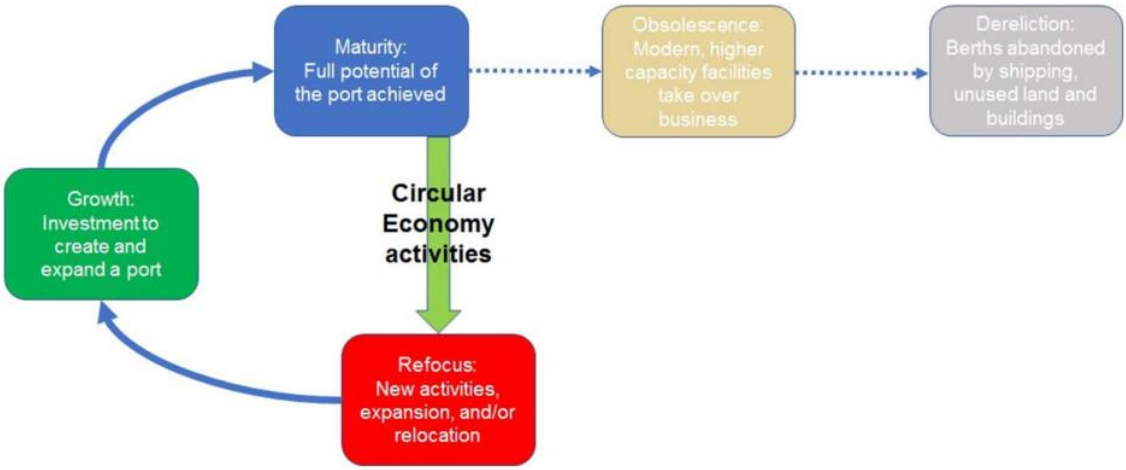


Figure 6: Revised port life cycle and circular economy approach

Various research papers embrace the idea of port growing with green, instead of destroying it or compensating the environmental damages caused. The EBDA methodology , based on existing philosophies (e.g. Building with Nature) and adopting theories from a PIANC-report on Sustainable Ports [Vellinga et al., 2014], was applied in a port development project in Tema. The focus is limited to the beneficial re-use of dredged material from the port basin and approach channel. The performed comparison of EBDA is then processed versus a traditional design, in which the ecosystem services (economy, ecology and society) are used as indicators. The approach as a result is considered to be effective to reach sustainable design in the initial phase and further phases of port development.

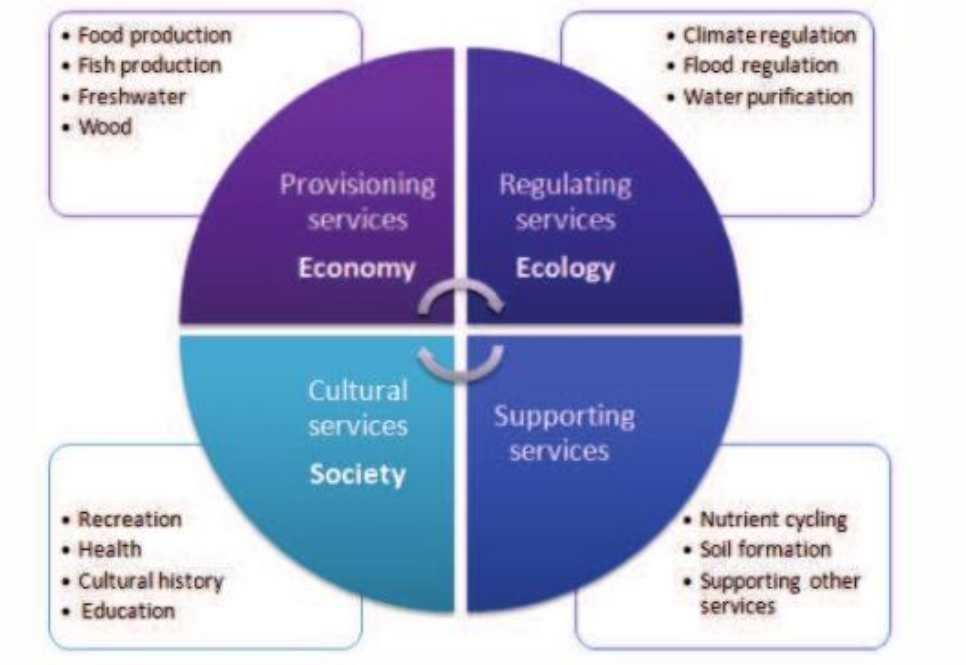


Figure 7: Based on Zakri and Watson [2005]) quoted from EBDA methodology

The sustainable measures included:

1. Placement of the dredged material, with a longer lifetime of the reclamation area;
2. Larger potential to boost tourism industry by means of promoting the ecosystem-based design;
3. Safeguarding the fishing industry, and improving recolonization of area by fish;
4. Safeguarding the potential of the lagoon;
5. Larger reclamation area creating possibility for the local community and fishing industry to expand.

The port of Rotterdam invested also in nature friendly banks made of residual material in their port area. 'De Groene Poort' initiative is the development of twenty hectares of nature outside the dikes at the Landtong Rozenburg. It is a sustainable and cost-efficient project: for the nature-friendly bank clean demolition material is reused from old quays and structures in the area. The project is a joined effort of Rijkswaterstaat, the Port of Rotterdam Authority, the Municipality of Rotterdam and the World Wildlife Fund.

The port of Antwerp publishes a sustainability report every two years. The port has along other measures a strong focus on waste collection, by means of an active waste management since 1996. There are three waste parks where inland vessels can drop their waste, which are operated by a waste collection company. Additionally the port authority gives advice about waste management to companies and operates a hotline for complains regarding liquid and dry bulk waste. They also collect floating waste which will contribute to a safer and more sustainable port. Furthermore the port authority tries to stimulate the exchange of residual products between companies by constructing new pipelines in the petrochemical area of the port (Scheldelaan). This idea is not only done with residual products, but also with residual heat. Currently the residual heat is transported to six companies located in the port area. This is such a success that the project will be expanded.

Important to mention is the existence of Environmental Management Systems (EMS), currently in three standards: ISO 14001, PERS (ECOPORTS) and EMAS (European Commission); all three

widely recognised and implemented among the sector. It is defined as a set of management processes and procedures that allow an organisation to analyse, control, and reduce the environmental impact of its activities, products and services and operate with greater efficiency and control.

The PORTOPIA report - based on PPRISM and sources of international organisations such as UNCTAD, OECD - on European Sustainability identified ten environmental management indicators to develop the Environmental Management Index. These indicators are:

1. Existence of an Environmental Management System (EMS);
2. Existence of an Environmental Policy;
3. Environmental Policy makes reference to ESPO's guideline documents;
4. Existence of an inventory of relevant environmental legislation;
5. Existence of an inventory of Significant Environmental Aspects (SEA);
6. Definition of objectives and targets for environmental improvement;
7. Existence of an environmental training program for port employees;
8. Existence of an environmental monitoring program;
9. Environmental responsibilities of key personnel are documented;
10. Publication of a publicly available environmental report.

The 2017 report confirms the strong growing trend within port authorities to reserve land areas for hosting renewable energy production, clean energy production (41% of respondents), and their own efforts to generate sustainable energy with wind, solar, biomass and waste-based energy production.

The in-the-field successes of real life innovations related to environmental sustainability as applied in port areas, is listed in the analysis 'Environmental sustainability in seaports a framework for successful innovation'. Some best practices

Subject	Best practice	Port
• The port environmental energy plan.	• Registering heat and electric energy consumptions of every port player to suggest/foresee possible interventions for reduction of consumption • Register pollutants	• Genoa, • Antwerp, Zeebrugge
• Pollution prevention, reduction elimation	• Reward/punish, co-finance initiatives • Vessel speed reduction < 20 nautical miles zone of ports	• Antwerp, Zeebrugge, Genoa, Singapore
• Production	• Power plants, wind farms, solar panels on warehouses, electrification	• All
• Use	• Design and retrofitting; • Automated Guided Vehicles (AGVs) that are entirely operated through a batter	• Hamburg

Table 14: Environmental best practices

Economic sustainability

Whereas circular economy also touches upon the economic viability of a sustainable approach and its elements, the Adaptive Port Planning goes a step further and suggests including flexibility, which results in an increase in the value of projects. The motivation for developing the methodology was the major factors being responsible for the failure of large infrastructural projects, being unforeseen external developments (uncertainties).

The uncertainty may be caused by external factors, here called port system and external forces, and includes 3 layers, being:

1. Port market (market size, other cargo, growth/no growth, new market, other activities);
2. Related industry (shipping, trade, investors/financial, new ports, transport, other stakeholders, port related industry clusters), and;
3. External environment (technology, political, regulatory, demographic, global forces, social and cultural shifts, natural disasters, world economic developments and ecological issues). How can an investment infrastructure have sufficient efficiency in its realisation taken into account the most relevant of these forces?
4. The APP methodology is then applied to various port infrastructure examples. The steps include:
    a. Defining Objectives (criteria and constraints) through client sessions, analyses SWOT/Trend/Expert; Generating alternatives (brainstorm, focus groups, Delphi, etc.);
    b. Selecting a set of alternatives (cost estimation tools, trade-off studies, multi criteria analysis);
    c. Identifying vulnerabilities and opportunities (brainstorm, scenarios, focus groups, Delphi's, experts, modelling, simulation);
    d. Identifying flexibilities and defining actions to make plan robust (brainstorm, scenario, focus groups, ...);
    e. Establishing cost-effectiveness of actions (Discounted Cash Flow, DTA, Simulations, ROI, CBA, ...);
    f. Evaluating Alternatives (lifecycle costing, multi-criteria analyses, Robust Decision Making, Scenarios with qualitative methods or EMA, Financial techniques such as DVF, DTA , ROA, CBA);
    g. Monitoring - Identifying key trends (media scanning, Delphi, expert panels, focus groups, S-curve analysis, imaging, Actor analysis, Competitor watch, Time series analysis);

The paper is not limited to the proposed methodology that calculates the cost/benefits of introducing flexibility in infrastructure decisions. It also contains examples as to what physical infrastructure is understood as a flexible solution:

Flexible structures:

Relocatable (buoys, dolphins, L-wall, block-wall, floating structures/multi-functional/multi-user and underground/Universal relocatable quay wall, container land (using containers as walls), maxisteck, and dismountable LNG jetty.

For purpose of re-use the 'strategies for re-use is based on the Delft Ladder, the ladder follows a questionnaire that enables to evaluate the re-cycling possibilities of an infrastructure project.

The paper also investigates the major factors as being responsible for the failure of large infrastructural projects:

1. Changes in scope or aim of project;
2. Weak project definition;
3. Interfering government;

4. Management problems;
5. Conflicting perspectives from different actors;
6. Optimistic cost and risk estimates;
7. Weak or risky contracts;
8. Variable components in those contracts;
9. An imbalance between process and product, and the project organization (Verbraeck, 2009).
10. Some critical driving forces which are relevant to the issue at hand (infrastructure investment decision) may be important in a future beyond 2030:
    a. Geopolitics and world trade;
    b. Economic growth;
    c. Environmental policies and regulations;
    d. Availability of fossil fuels and extent of their use which will depend upon process optimization and development in techniques of Carbon Capture and Sequestration (CCS);
    e. Costs of scarce natural resources and fossil fuels;
    f. Availability of renewable energy sources and extent of their use;
    g. Developments in biotechnology;
    h. Changes in the role of government;
    i. Investment climate.
11. Other mega trends are:
    a. Continuing globalization and containerization which is the driving force behind the need for infrastructural investment, also in emerging economies;
    b. Changing functions of a port which imply attention for the entire supply chain instead of a terminal or a port;
    c. Changing actors and networks resulting in changed distribution of power, and new demands related to port services; changing technology, which influences transportation costs on one hand and can necessitate drastic infrastructural adaptations on the other hand;
    d. An increasing awareness for the environment and society;
    e. Energy transition.

Societal sustainability:

The Historic Urban Landscape method safeguards the synergy principle (between different actors/systems, in particular the socio-cultural and economic system), the creativity principle and the circularization principle. The Historic Urban Landscape (HUL) approach becomes the guarantee that the transition toward the smart city development model is based on specific local cultural resources, and not only on technological innovations. In other words, the eco-town/eco-city strategy becomes culture-led.

Examples of good practices resulting from industrial symbioses had some fixed ingredients:

1. Industrial symbiosis was a driver for new sustainable eco-industrial developments and low carbon industrial systems;
2. Waste management systems played a crucial role in supporting circular economy;
3. Urban symbiosis and regional eco-industrial clustering network may provide more business opportunities.

The HUL approach stimulates circularization/synergies in managing change of port cities/areas for their regeneration, promoting places as spatial specific “loci”, where to meet, communicate, and exchange knowledge and practices among different actors.

ICT and innovative technologies are certainly to be introduced rigorously to implement circularization and synergistic processes. However, they also require a culture base. The city culture is reflected in the ways people live and work and in the linear or circular way of thinking of all city agents, opening a perspective to a multidimensional space, attentive to interdependences and connections.

According to the European Technology Platform ALICE, Alliance for Logistics Innovation through Collaboration in Europe, the supply chain will evolve towards an open global logistic system founded on physical, digital and operational interconnectivity.

The study on the role of green port implementation and ‘green collar’ workers in port facilities provides a description of "green jobs" the so called "green collar" with reference to the port environment.

The subject is in itself relevant and interesting for the Port of The Future;

The benefits are summarised as:

1. Reduction of energy consumption;
2. Restriction of greenhouse gas emissions;
3. Reduction of pollution;
4. Protection of the ecosystem;
5. Increase of efficiency.

The authors define the green port as an area where voluntary environmental awareness is consistently provided by all business people and services provided.

The authors underline that green port application is implemented by a number of ports in the world and this embodiment is regarded as a prestige element.

As for green jobs, the papers highlights that green professions are jobs that maintain environmental quality and sustainability. Examples of green jobs include the installation of solar panels on a port management building, where the operating crews are operated with electricity generated from renewable energy sources instead of fossil fuels. The six main sectors are divided into green jobs as energy, construction, transportation, industry and recycling, food and forestry.

In conclusion, this article brings out the need of training various engineering concepts related to green-fired professions. Trained green-collar workers will be needed by the increase of "Green Ports". For this reason, according to the authors, it would be useful to define maritime engineering as a green-collar worker.

A specific text concentrated on ‘The Greening of Ports – A comparison of Port Management Tools used by leading ports in Asia and Europe (2014). It lists and compares the management tools available to port authorities to impose or encourage a greener alternative on port activities.

The available tools are:

1. Monitoring and measuring;
2. Pricing;
3. Market access control;
4. Environmental standard regulation.

These measures were related to the targeted activity such as shipping traffic, cargo handling and storage operations, intermodal connection, industrial activities and port expansion.

Conclusion was that ports are well advanced in exercising environmental standards, meaning that enforcement attitude is leading. The most targeted sector is shipping traffic, resulting from the impact of IMO.

Underneath table is a complete review of the aforementioned study's (Shippers Sustainability Assessment) findings relative to the measures taken by the analysed ports (Antwerp, Dar es Salaam, Hamburg, Ho Chi Minh, Istanbul, Los Angeles, Melbourne, Rotterdam, Shanghai, and Valparaiso.)

Subject	Example of sustainable Measure	Performance Indicator	Examples of concerned ports' measures
Social dimension			
• Climate regulation • Flood and coastal protection	• Sand nourishment • Storm surge barrier	• Climate robustness • A higher potential of flood damages	• Energy & Climate Working group; • Convention on Climate Change; • LNG Concept; • Climate Protection Master Plan; • City Action plan as part of National plan; • Sustainable Port Design; • Climate Change Adaptation Strategy; • Sustainability Report; • Flood programmes; • Earthquake resistance; • River Revitalization Master plans.
• Job market	• Attract investors	• Employment rate	• Employment sustainability report; • Jobs Created; • Stimulation plans for specific sectors (green-blue economy; • ISO 26000 Diagnosis regarding social responsibility.
• Public Welfare	• Safety rules	• Human rights, we-being, education, injures,	• ISPS; • Water plans (supply, sanitation); • Planning for Sustainable Growth; • Safety and Health Management System offering social training.
• Urban and cultural values, urbanisation	• Sanitation	• Accessibility of the market, availability of territory and governance	• Promoting: • accessibility and leisure attractiveness, ecological city port, encourage hygienic attitudes,

Subject	Example of sustainable Measure	Performance Indicator	Examples of concerned ports' measures
• Sewage	• Water retention	• Regulation of water pollution	• Integrated Water Policy through decrees, plans, Acts • Plants to separate ports sediments • Dewater dredging material infrastructure
Environmental dimension			
• Air	• Pollution limits	• NOx, Sox, PM10	• ESI, LNG, AQM; • Working Environment Convection; • IMO Initiatives; • SECA regulation; • ARGE Elbe classification; • Strategic plans (Black Sea); • California Coastal Act; • Clean Air Action Plan (California); • Sediment Assessment; • Air pollution management; • Flemish Environment Agency Air quality Monitoring • Fines, incentives.
• Sensitive ecosystems / • Marine biodiversity	• Sediment quality • Marine biodiversity	• Mapping • Ballast Water treatment	
• Ecosystem	• Renewable energy	• Energy consumption	• Energy Efficiency Programs; • Environmental Management Systems; • Renewable Energy Program; • Port Clustering, wind turbines; • Urban Energy Restructuring Strategy; • Carbon Footprint Measurement certification.
• Climate regulation	• EIS • OPS	• Emission of greenhouse gases; • World Ports Climate Initiative (WPCI); • Environmental Shipping Index (ESI); • Onshore Power Supply (OPS).	• WPCI; • OPS; • ESI; • Greenhouse gases monitoring; • Reduction of CO2 vehicular emission; • Fines, incentives.
• Micro	• Habitat	• Habitat	• United Nations Climate Change

Subject	Example of sustainable Measure	Performance Indicator	Examples of concerned ports' measures
climate regulation	compensation	destruction; • Loss of benthos; • Sand extraction.	Conference, COP 21; • Regulations, plans (water, sediment…); • Areas of special conservation Interest related to Natura 2000; • Green infrastructure and low impact development; • Integrated policies/decrees; • Fines, incentives.
• Water	• Water treatment	• Water quality	
• Soil formation	• Dredging	• Erosion; • Sedimentation; • Maintenance dredging.	• Relocation of sediments; • Treatment of sediments.
• Stability in dynamic ecosystems	• Artificial mangroves	• Biodiversity	• Regulation: nature conservation plans, policies, acts (Natura 2000).
Economic dimension			
• Accessibility	• Inland expansion	• Traffic; • Railways; • RoRo; • Hinterland connections; • Modal split.	• Monitoring traffic congestion density; • Improving infrastructure and sustainable modes; • Improve and mitigate accessibility.
• Area productivity	• Land reclamation	• Investments; • Benefit; • Market share.	• Sustainability report; • Long term cargo forecast/demand through 2030 for all types of goods categories.
• Growth	• Cargo increase	• Port cargo growth	•
• Productivity	• Optimisation of inland connection	• Quality of handling; • Inland; • Connections; • Transport modes.	• Sustainability report; • Improving operational efficiency, safety; • Introduction of mobile device infrastructure; • Plans on multimodal transportation systems.
• Recreation	• Nature based	• Cruise passengers • tourism	• Plans (Cruise shipping).

Subject	Example of sustainable Measure	Performance Indicator	Examples of concerned ports' measures
	ecotourism		

Table 15: Study's (Shippers Sustainability Assessment) findings relative to the measures taken by the analysed ports

6.2.3.7 T70: Safety

Topic	T70: Safety
Description	Legislation, processes, technology, organizational structures and people to improve safety.
KPI's	• Number of accidents; lost working days; • Compliancy rate; • Number of near misses; • Number of certified labourers; • Parking areas; • Air quality monitoring (detection of odours dangerous goods); • Hydrographic surveys; • Use of (Updated) Electronic charts.
Co-related topics	• T90 ICT systems to improve safety; • T110.20 concerning safety training.
Keywords	• Air quality; • Data sharing. • Training.
Gaps identified	• Harmonizing education and training of port workers in EU; • Specific coordinated trainings on new special topics LNG, OPS; • Training related to cyber security (incidents).
Trends	• Digitization; • Certification programs; • Sensors to monitor safe working environments.

Table 16: Assessment results for topic T70 Safety

Hamburg port's development plan indicates its exchange of experiences with other European ports and takes part in activities initiated by international institutions, such as the International Association of Ports & Harbours (IAPH) based on which it develops environmental and safety

standards. Examples are secured parking areas for truck drivers in the port area with facilities for truckers.

Sharing data is an action that gains momentum, and is frequently being identified during the Work Package 1 activity, as contributing to safety of the overall supply chain, but also by sharing data in the local eco-system of a port area making information available to the relevant parties involved in vessel handling activities.

Examples of which is 'port monitor' that among others communicates tidal information to the concerned parties, otherwise, vessel with a draught above 15.1 meters can get stuck in the Elbe. This has already happened a few times (Paris & Wall, 2016).

Further investments that were called for related to intelligent vessel traffic management concerning route planning, alerts, avoidance of maritime incidents (collisions, grounding).

Both Antwerp and Rotterdam port areas implemented a network of intelligent sensors to identify and locate odours (so called "We-nose" or "E- nose", so that enforcement action can be taken more quickly. The networks are designed to protect the health and safety of people living or working in the area. Other stakeholders are involved in the organisation of the networks such as environmental authorities at regional level, city municipalities, etc.

Training needs were also identified during the desk top performance.

Indeed, the importance of health and safety issues is increasing in port workers' training as port work is one of the most dangerous jobs in the industry sector. In addition to focusing on accident prevention, recently more attention is paid to slowly developing sicknesses e.g. container fumigant exposures and poor ergonomics of port vehicles. Also increased threat of terrorism is considered. There are major differences between EU countries how education and training of port workers is organized. In order to ensure that ports and port workers are able to respond for the future trends of the port sector, the question of harmonizing education and training of port workers in EU emerges. The main benefit for harmonizing the port work education and training is to enable better movement of workforce between European countries.

An EU MoS co-funded Joint Industry Project has developed a safety data sheet after hazard identification where first aid measures, accidental release, handling and storage, exposure control and personal protection measures are specified when handling for instance the supply of scrubber additives and chemicals.

Training tools and measures used in port areas often reflect to some part national, or sector related regulations, that comply in full or in part to the ILO guidelines (mainly on safety issues related to labour):

1. Training policies;
2. Delivery of training through vocational training, organized by private, certified companies or official education centres, or own company related trainers;
3. Competence profiling: advise on career paths, list of trainings;
4. Testing, exams, skills demonstration;
5. Certification procedures.

Initiatives regarding the impact of digitisation on the job, is identified though did not result yet in coordinated action plans. Only some port areas have a well-developed private sector offering custom made trainings that anticipate on developing 'digital' capabilities.

Other safety initiatives include "FAMOS Freja: Finalising the Surveys for the Baltic Motorways of the Sea", a clear example of the contribution of Motorways of Sea to maritime safety.

The objective of that project is to improve the efficiency of hydrographic surveys – and subsequently navigational safety – in the Baltic Sea, with following activities:

1. Hydrographic surveys important for shipping activities;
2. Update nautical products such as charts and Electronic Navigation Charts (ENC), based on the survey data produced;
3. Produce bathymetry base data for future navigation applications, such as Sea Traffic Management or the next generation of Electronic Chart Display & Information System (ECDIS);
4. Improve possibilities for accurate GNSS positioning at sea, through gravimetric measurements aiming at the computation of a highly accurate and quality-ensured geoid model before 2020 (a model of global mean sea level that is used to measure precise surface elevations). Start re-calculating vertical datum dependent chart data, such as charted soundings, depth contours or bridge clearings.

The MONALISA 2.0 project encompassed a large part of Human Element and training. Training programmes for both safety at sea and safety in ports were elaborated. Within the MONALISA 2.0 project, a network of maritime simulator centres was also established (European Maritime Simulator Network).

Europe plays an important role, and its member states, alongside the international organisations with regards to safety of the transport sector. The 2009 commission staff working document on the implementation of the EU Maritime Strategy 2009-2018 strategy contained also clear measures on safety on identification of high risk vessels through the SafeSeaNet. It further enabled the sharing of information on marine casualties through the European Marine Casualty Information Database hosted in EMSA, and provides in technical support on the new inspection regime, manages the related THETIS[8] database. The commission also has powers to perform inspections to verify the effectiveness of national quality control systems and maritime security measures, procedures and structures, in order to ensure a harmonised implementation throughout the EU.

As results of the effects of global warming, Europe is expected to be more exposed to extreme weather events. The CTOS Container Terminal Operations Simulator was developed to exactly this purpose. It simulates the vulnerability of port operations (and thus their productivity) to extreme weather events.

6.2.3.8 T80: Security

Topic	T80: Security
Description	Legislation, processes, technology, organizational structures and people to improve security.
KPI's	• Avoiding, limiting impact of cyber-attacks on critical infrastructure; • Mutual recognitions of cargo regulatory regimes; • Electronic exchange of certificates; • Secured shipment of smart containers; • Compliancy to ISPS, AEO.
Co-related topics	• T90 ICT systems to improve security; • T110.20 concerning security training.

[8] THETIS is the information system that supports the new Port State Control inspection regime (NIR)

Topic	T80: Security
Keywords	• Secure flow of passengers, cargo; • No or limited negative impact on economic output; • Real time information exchange; • Secured smart containers; • Global Digitization Platform; • E-transport documents; • Pre-screening of IT vulnerabilities.
Gaps identified	• Security regulations not advanced as aviation sector; • Customs authority IT architecture not (yet) aligned with Digitization platforms; • Cooperation on Risk Assessment.
Trends	• Cyber security; • Mutual recognitions of cargo regulatory regimes; • Secured data exchange.

Table 17: Assessment results for topic T80 Security

The most relevant identified challenge on security was to secure the continuous flow of passenger and goods and to ensure the protection provided does not impede economic output, as per DG Move Head of Unit, Security, Mr. Zamarreño on the occasion of his speech at the final event of the CORE project.

Mutual recognitions of cargo regulatory regimes (such as C-TPAT, AEO) will gain importance, and require growing exchange of cargo and persons related data. Aviation security is where regulations are more advanced and more detailed, and can serve as an example to the (maritime) port sector.

An example of such an enhanced view on the supply chain by authorities was shown by CRIS (as extension to Import Control System) in which customs authorities succeeded in obtaining complete and clear data from known sources with regards to shipments.

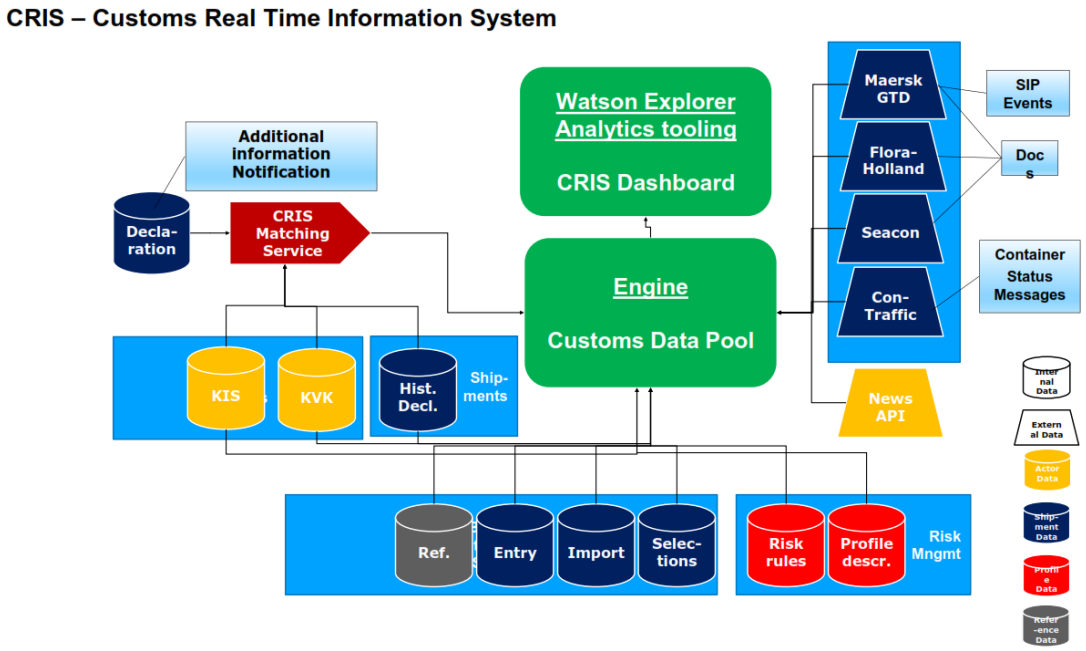


Figure 8: Customs Real Time Information System

The often quoted data sharing is to serve many benefits, among which the facilitation of more efficient customs operations and cargo clearance. Exchanging this information through a 'data pipeline', or platform enables finally the increase of the overall supply chain security, as proven through the CORE project.

This project had several successful pilots with regards to:

1. Secured shipment of smart containers, enabling the continuous tracking and tracing of each container, proving a compliant and resilient Trusted Trade Lane. The shipment concerned a container of Electronic components from Malaysia to Europe. Benefits included reduction of administration costs (30%) through ease of digital documents, improved notifications, lean and smart handover processes, improved visibility, and fast throughput of containers. An additional costs for seals/seal logistics and a reduction of false positive test remain actions for further improvement;
2. Electronic exchange of certificates (Phyto, AWB);
3. Bi-lateral data exchange to Global Digitization Platform, tested between Maersk, IBM and Custom Authorities, which included Distributed Blockchain Components.

Further new technologies are being tested, such as the use of new scanning technologies (e.g. muon tomography) and could entail considerable improvements (for instance, there is no harmful ionising radiation and the muon scanner can be used to detect nuclear matter encased on another material so it can be vital for port security) in comparison with the currently more commercial options (i.e. X-Ray or Gamma technologies).

Examples of platforms are numerous both on international and local eco-systems. The IT platform called PRISE, especially geared towards Hamburg's requirements, jointly developed by all users, serves to optimise allocation and planning processes. Information about arrivals, clearance and departures of ships is merged and made available to quay operators, pilots, tugboat operators, boatmen, shipping agents and HPA in real time.

With the incidence of the Maersk hack the danger of Critical Infrastructure being attacked all of sudden became reality. Some European member states acknowledge the danger of these developments and embark also on security measures related to data sharing. The seaport of

Lübeck (IT systems and general port security) tested the use of innovative IT solutions (e.g. dashboard functionality, use of unmanned vehicles). The requirements for companies with critical infrastructure, the German IT security law, requirements according to GoBD and also the EU GDPR play a central role in the project.

The AUTOSEC project aims to increase IT security in ports and logistics chains with project partners from research, development and end users as well as the preventive defence against cyber-attacks on IT systems. The planned project aims to develop a scalable set of methods and tools for the conception and implementation as well as the operation of automation projects in harbours, including pilots in maritime ports Hamburg, Wilhelmshaven and an inland port (Magdeburg).

In short as concluded in the report on Remote and Autonomous, the same conclusion can be drawn with regards to protection against cyber threats, that is to call for elimination of vulnerabilities in the ICT infrastructure and implementation of effective measures for intrusion prevention, as well as intrusion detection, damage control and safe recovery in case of the prevention measures failing.

Core's predecessor project Cassandra (along with ITAIDE) already identified the importance of implementing data – and process mining technology for authorities, seamless interoperability for traders, and separating access policies from data sharing technology. Data mining is defined as a business intelligence method that considers the goods, containers, transport means, etc., their associations like the goods packed in a box, and all relevant (historic) trader data (e.g. Duns & Bradstreet), and was tested in Living Labs. Process mining considers the stakeholders involved in logistic chains and their relations, as can be monitored by accessing their data sharing logs and audit trails.

An interesting form of cooperation on security related issues between ports and its relevant stakeholders was performed in the project MITIGATE - facilitating the assessment of risks for the maritime sector, by using a collaborative evidence-based Maritime Supply Chain Risk Assessment. To this end a dynamic, collaborative, standards-based Risk Management system (simulation tool) was developed for port's Critical Informative Infrastructures (CIIs), which considers all cyber-threats arising from the international Maritime Supply Chain (MSC), including threats associated with port CIIs interdependencies and associated cascading effects. On project level MITIGATE included 5 demos (ports of Ravenna and Livorno in Italy, Bremen in Germany, Piraeus in Greece, and Valencia in Spain), and 200 internal and over 90 external users.

The web based application offers logging new threats, and distinguishes between vulnerabilities, vendor management, and control management, sit management, networks and asset management, and business partner management, supply chain services and the actual risk assessment.

6.2.3.9 T90: Digitization, digitalization and digital transformation

Topic	T90: Digitization, digitalization and digital transformation
Description	Digitization is creating a digital (bits and bytes) version of analog or physical things such as paper documents, microfilm images, photographs, sounds and more. So, it's simply converting and/or representing something non-digital (other examples include signals, health records, location data, identity cards, etc.) into a digital format. Digitalization is the automation of existing manual and paper-based processes, enabled by the digitization of information. Digital transformation is about changing business operations, business

Topic	T90: Digitization, digitalization and digital transformation
	models and even revenue streams and new business opportunities.
KPI's	• Number of Real time voyage planning (IWW); • E-cmr implemented, acceptance of E-transport documents; • Compliance rate to directive 2010/65/EU (reporting formalities for ships arriving in and/or departing from ports of the Member States and repealing Directive 2002/6/EC) having MS accepted electronic reports via a single window (June 1 , 2015). • Connecting to a least one other TEN-T corridor port from another member state; • Number of active data/information sharing platforms and their interconnectivity; • Modal split share; Concerning sea traffic management: • 50% less accidents; • 10% reduction in voyage costs; • 30% reduction in waiting time for berthing; • 7% lower fuel consumption; • 7% lower greenhouse gas emissions.
Co-related topics	• T120.20 Communication
Keywords	• Platforms/clouds; • Security; • Paperless, corridor.
Gaps identified	• RIS information is not harmonized on EU level; standardisation • Different countries are at a very different maturity level, blocking synchronisation of the services between MS; • Cross Member States borders issues on RIS; • Member states do not update their national systems, preventing cooperation on EU level; • No connection between various platforms (within transport mode, between transport modes, between MS; • Factual acceptance of E-documents by authorities in different MS; • Governance of the systems applications; • Various regulation gaps; • Legal issues regarding exchange of data; • Blockchain regulation;

Topic	T90: Digitization, digitalization and digital transformation
	• Ownership of data; • Requirements for eFTI platforms; • Privacy policy with regards to GDPR; • Lacking interconnectivity between systems.
Trends	• Platforms; • e-reporting; • API; • GDPR.

Table 18: Assessment results for topic T90: Digitization, digitalization and digital transformation

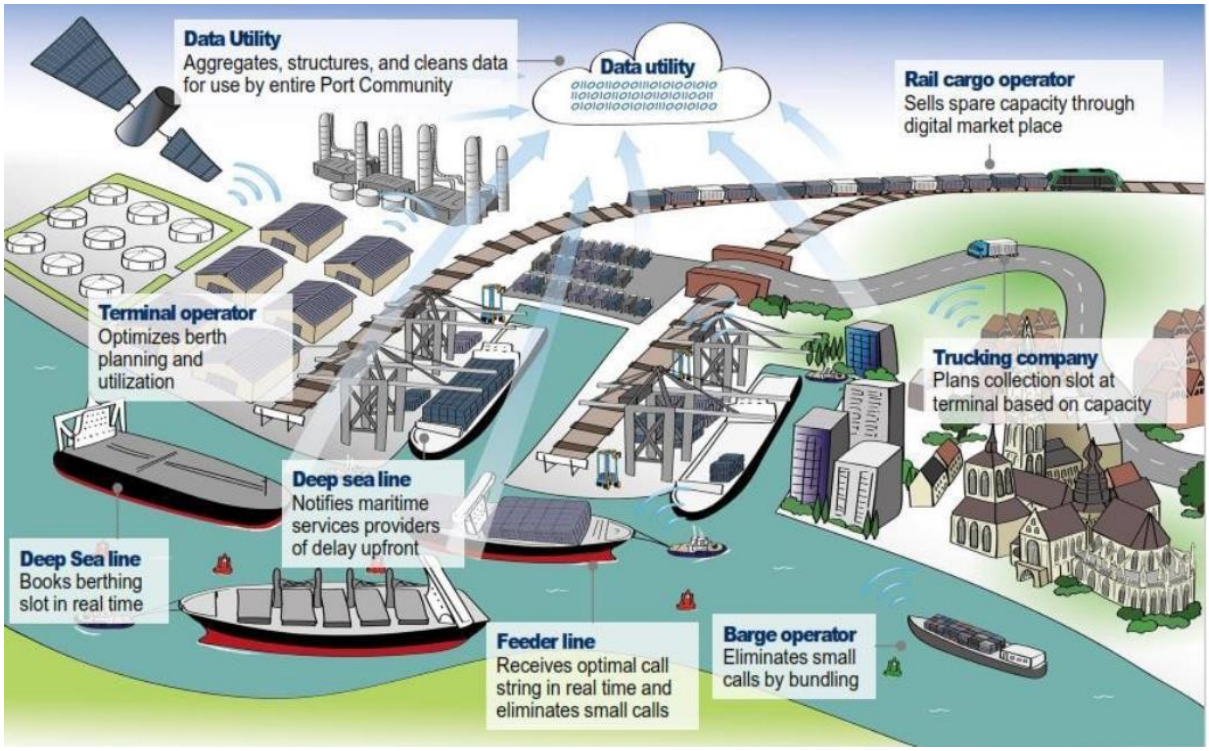


Figure 9: Some identified opportunities of digitization in maritime port areas (courtesy NxtPort)

This topic has affluent input related to all aspects of digitization and digital transformation, affecting all segments of maritime ports. Not only is it indicated to streamline the administrative processes between the relevant parties, it is also identified as offering new opportunities to optimize the related processes between the economic and public actors.

Various analysed material covers both the technological aspect of digitization, sharing (federal versus distributed platforms), and on the functional aspects of certain links of the supply chain. The first cross-modal projects are also launched, though in general a good working information sharing among the transport modes, through various members states, including both private and public stakeholders, remain a challenge.

The insight though is growing that:

1. Not always new platforms are needed;
2. Accessing of existing platforms is feasible through technology of API.

Next logical step is thus the creation of such 'exchange' platforms, in which the DTLF clearly focuses on setting the requirements for eFTI, defined as "any set of data elements processed on electronic support for purposes of exchanging regulatory information between the economic operators concerned and with the competent public authorities".

In some cases digitization is also conceived as the replacement of human interface, though with the awareness that human interaction is still needed though on other aspects of the concerned activities.

Identified areas in the desktop analysis include all transport modes, public and private authorities, and port economic actors including IT related sectors.

By transport mode:

1. Rail.
   The input 'grand challenge pathways (rail) towards climate neutral freight corridors' indicates that digitisation and automation technologies may have a profound impact on rail as well as road transport and on their interfaces. One might think of fully automated freight shuttles in combination with highly automated freight terminals. Although driver costs are not a major issue with longer trains, terminal access services for smaller quantities might profit and the automation of terminals with robotic loading and unloading facilities might improve flexibility and punctuality, and allow round the clock servicing.
2. Maritime
   Under the keyword "digital economy" we may see several radical shifts in the way we produce and distribute goods. Replacing the shipment of semi and final products by 3D printing, instant on demand manufacturing, delivery by drones or robots, and the use of robots in the service sector may change the structure and volume of transport demand. The actual effect whether these developments will favour emissions reduction or not, could not be estimated.
   On sea traffic management the potential of further digitization is countless. Real-time information is to optimize safety, speed and routing of vessels and barges, facilitate further pre-notification, reporting on FAL messages, interact with handling terminals before arrival, facilitate eco-performance of ships, SAR interventions and authority monitoring of movements.
   The STM project (based on previous MONALISA and MICE projects), currently ongoing, allow personnel on-board and on shore to make decisions based on real-time information. These services enable more just-in-time arrivals, right steaming, reduced administrative burden and decreased risk related to human factors. Potential services affected by the STM are Route optimisation services, Ship to ship route exchange, Enhanced Monitoring, Port Call Synchronisation and winter navigation. Over 300 ships, in 13 ports, 5 shore centres and 12 connected simulator centres are involved. Concrete goals, by 2030, are:
   a. Safety: 50% reduction of accidents;
   b. Efficiency: 10% reduction in voyage costs and 30% reduction in waiting time for berthing;
   c. Environment: 7% lower fuel consumption and 7% lower greenhouse gas emissions.
3. Road.
   Referring also to section T50: 'Integration in the supply chain', the corridor approach is certain to affect road transport. Bundling of road cargo volumes (containers) to create a

minimum quantity to make the shift to other transport modes economically viable when entering/leaving the port are options currently being discussed at authority levels. This modal transfer would be encouraged by means of incentives, at times financed through the revenues of road toll such as LKW Maut, ViaPass, and Péage. Such road toll systems have already been introduced at national, regional or local level in 20 Member States. The European Union's proposal on the interoperability of electronic road toll systems is strongly supported by the European Economic and Social Committee sector.
Digitization is also quoted to align better the 'connecting' role of road transport with regards to avoiding waiting hours. This results in time slots at container terminals, night openings to avoid traffic jams during 'normal' working hours;

4. IWW.
Inland Waterway digitization projects aim to enable the full use of River Information Services along corridors such as the Danube, Rhine, etc. Two projects were part of this desk top review (CoRISma and its sequel RISCOMEX). RIS services have three types of categories, being: Fairway Information Services, Traffic Information, and Traffic Management.

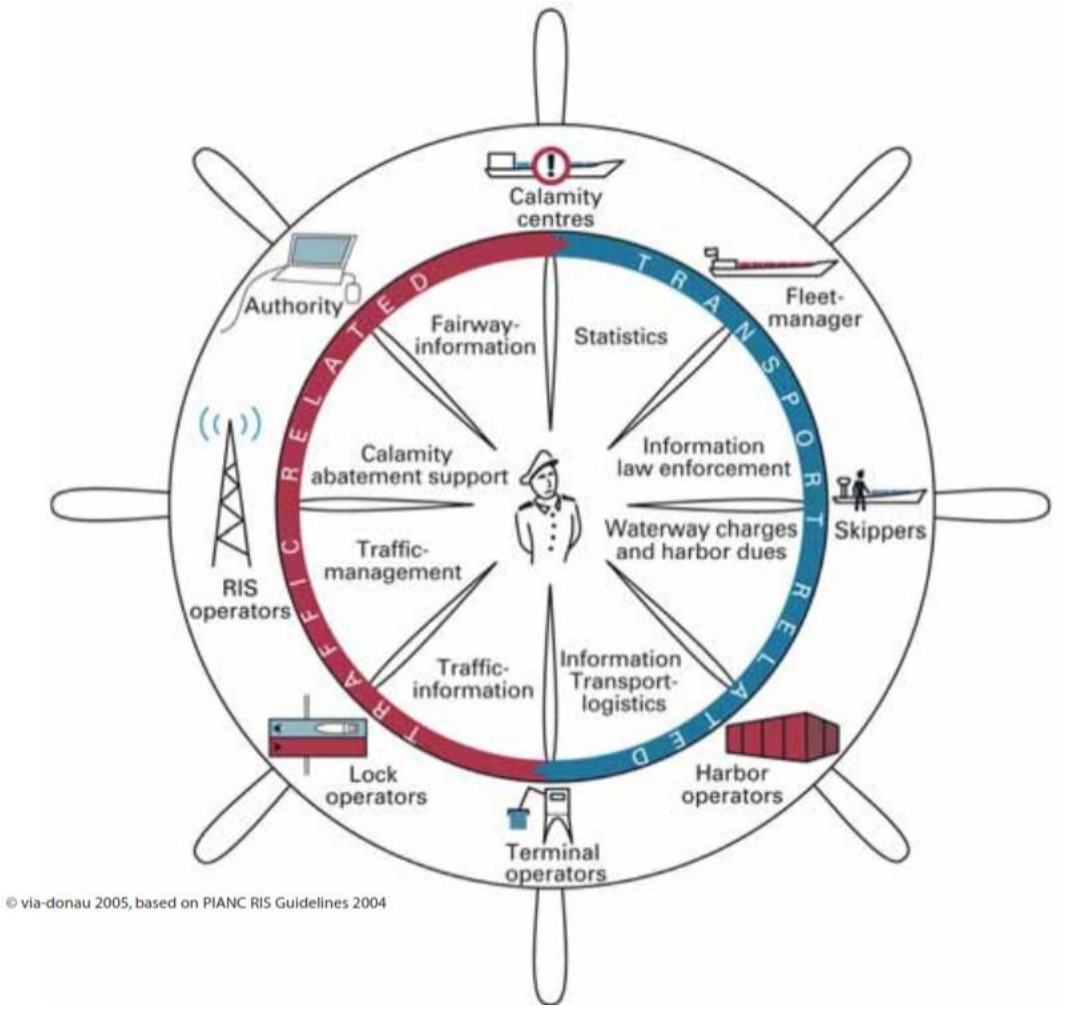


Figure 10: Overview of RIS services[9]

[9] via-Donau, 2005

One of the objectives of RIS is to stimulate safety of inland waterway transport. The EU therefore decided to implement River Information Services grouped together in 8 categories and for each category a number of RIS functions. The RIS directive (2005/44/EC) and regulation (414/2007) claims that by implementing these services inland navigation would be safer, more efficient and more environmental friendly and the beneficiaries are among others waterway authorities, ship masters and shippers. Corisma states that the best solution would be to set up a European system consisting of a register and or portal and defines the functional and technical requirements for such an EU system. Comex defines possible architectures for the corridor concept. An important remark is that Corisma does not really have a vision on centralisation/decentralisation while Comex does not aim for a big EU platform but aims for harmonization at the corridor level.

Human element

Specific on labour market the digitization is also identified as an opportunity for small companies, despite their often limited budget. Due to the nature of the applications it is often sufficient to have a basic software package and to supplement this with certain applications that work via cloud systems. Only a subscription fee or transaction fee is paid. This could for example be a planning tool or a visibility module that informs the customer where the goods are located. In this way digitization can also be an affordable story for these companies.

Various inputs relay to the governance of the system, wondering who is authorized to access data (accessibility) and who owns the data (ownership) shared in the blockchain. No clear regulations are yet in force in this area (need for regulation), since the blockchain is still an emerging technology: what regulation needs to be developed to implement the blockchain solution? Agreements between countries within and outside the EU must jointly address regulations concerning the systems.

Platforms:

As a logic next step to the huge efforts of optimizing the physical infrastructure of the TEN-T transport network in Europe, in recent years also the need for collaboration, connectivity and for example a symbiotic network of logistics clusters became clear, aimed at connecting TEN-T corridors' hubs with other hubs together.

Numerous platforms are created or being created, to name a few: Maritime Single Windows, IWW platforms, PRISE, at times the platforms are jointly developed by all users, and most often it serves to optimise the business processes and thus the activities between the relevant stakeholders (planning, reporting, informing, clearance and departures, booking of additional services such as quay operators, pilots, tugboat operators, boatmen, shipping agents and the port authorities in real time).

The urge to have these platforms linked to important systems such as, for example, maritime single windows, port community systems, is growing and gradually further implemented, such as in the STM project (see elsewhere), but also through IPCA's Network of Trusted Networks'. Within this network, port community systems are able to connect and share information via a specially created common shared global standard, based on API (Application Program Interface). It has developed a Track & Trace API for exchanging information relating to port calls and container shipment information. The ultimate plan is a 'federation of PCSs' which can develop new value-added services for logistics operators, thanks to new global standards. IPCSA's Network of Trusted Networks and Track & Trace initiatives deliver predictability, visibility and certainty within the supply chain – supporting existing PCS users, based on existing infrastructure, without the need to create any new operational systems.

Europe recognises this trend, and is to launch a proposal on the requirements for eFTI platforms, to be – among others – certified by one Member State respecting a minimum set of

European conditions. The acceptance by one member state is valid for activities in all member states (proposal phase).

Among the ever growing list of initiatives we quote the following:

1. CO-GISTICS is the first European project fully dedicated to the deployment of cooperative intelligent transport systems (C-ITS) focused on logistics;
2. Real-time Synchro-modal Logistics Optimisation: The ability of the SYNCHRO-NET model to take a more "holistic" view of supply chain optimisation is expected to drive major cost savings for operators, to enable reduced emission and congestion, and better management of risk in the supply chain;
3. AEOLIX will develop a platform for connecting logistics information systems of different characteristics, intra and cross-company, for immediate (real-time) exchange of information in support of logistics related decisions;
4. MODULUSHCA advanced particularly in the field of developing the concept of interconnected logistic and to develop a first set of modular loading unit concepts providing a basis for an interconnected logistics system for 2030.

The digital 'wave' is also to facilitate the conversion of transport hubs into low-carbon, resource-efficient and competitive freight corridors. With this in mind, the EU-funded ECOHUBS (Environmentally coherent measures and interventions to debottleneck hubs of the multimodal network favoured by seamless flow of goods) project set out to deliver several tools that can increase capacity at ports and terminals, thus leading to considerable reductions in carbon footprint.

Governments:

An often captured feedback is the backlog of Member States in facilitating the automatic exchange of data between Member States, but also the arear in facilitating e-reporting to public authorities within the territory of the Member State. Gradually, through their participation in projects (such as CORE, RIS, etc.) the awareness among MS authorities is growing to facilitate their connection to these platforms. The CORE project had the Dutch Customs Authorities enhance their existing CRIS platform. Large discrepancies between the maturity levels of the various public organisations exist in and between Member States.

The 2015 RAGTIME project identified various macro and micro evolutions that are likely to disrupt the current business models in transport infrastructure. These include - Environment protection policy and climate change effect; - Multimodal transportation; - Increase demand for transportation;- Enforced security policies; - The digital revolution.

The RAGTIME project had a specific focus on digital innovations, considered as underused in transport infrastructures compared with their potential positive impacts: digital platforms, new digital services, automation & optimisation and Building Information Modelling (BIM). The related innovative business models are associated to a number of benefits: cost reduction, eased collaboration and communication, more efficient activities, diversification of revenues streams, etc. In addition, the digitalisation of existing business models at early stage prevents from a future and inevitable dependency on outsiders specialised in digital solutions, such as Google, Ali Baba etc. All in all, six innovative business models were proposed for designers, constructors and operators of transport infrastructures:

1. Business model #1 - The "BIM" business model for designers and constructors
2. Business model #2 - The "automate & optimise" business model for constructors
3. Business model #3 - The "digital platform" business model for operators
4. Business model #4 - The "digital services" business model for operators

5. Business model #5 - The “automate & optimise” business model for operators
6. Business model #6 - The “BIM” business model for operators

Also to be known: Building Information Model (BIM) is a digital representation of the physical and functional characteristics of buildings and places. As such, it greatly facilitates the management of buildings and infrastructures from the design to the operation and maintenance stage. In this study, an innovative business model (BM) is defined as a BM that integrates an innovation that seizes new opportunities and mitigates risks.

Cyber incident management was the core topic of ECOSSIAN project, an incident management system for European interconnected critical infrastructures. The aim is to improve the detection and the management of highly sophisticated cyber security incidents of critical infrastructures across borders. These preventive functions are being followed within the cooperative effort:

1. Threat monitoring;
2. Early indicator and real threat detection;
3. Alerting;
4. Support of threat mitigation and disaster management.

Real life has already identified the weakness related to the existing security solutions that try to prevent, detect, and react to cyber threats by employing security measures that typically do not cross the organization’s boundaries. Novel targeted multi-stage attacks such as Advanced Persistent Threats (APTs) taking advantage of the interdependency between organizations. By exploiting vulnerabilities of various systems, APT campaigns intrude several organizations using them as stepping stones to reach the target infrastructure. A coordinated effort to timely reveal such attacks, and promptly deploy mitigation measures is therefore required.

The ECOSSIAN project contributes to other EU related programs such as European Programme for Critical Infrastructure Protection.

6.2.3.10 T100: Port city relations

Topic	T100: Port City Relations
Description	This is how the port infrastructure and port activities can be integrated with the city, the surroundings
KPI’s	• Producing alternative energy; • Connecting to city grid; • Industrial symbiosis analysis (waste,); • Membership of port/city organizations; • Transfer of taxes between port/city to compensate for burdens; • Action plans between port/city; • Compile an inventory of the different types of environmental impact; • Modify infrastructure or build new facilities to protect ecosystems from the negative effects of port / industrial activities; • Blue and green jobs stimulation: number of jobs created; • Public transport port/city (water, bus, cycle paths);

Topic	T100: Port City Relations
	• Port clusters connecting to local economy; • Financing of development projects through cross-financing between city and port.
Co-related topics	• T10: Infrastructure; • T10.40: Hinterland connections; • T10.30: Other port infrastructure; • T60.10: Environmental sustainability; • T80: Security; • T900: Cooperation.
Keywords	• Mixed urban and port functions; • Flexible land use/redevelop port within existing boundaries; • Transitional elements between city and ports; • Port Mobility plan interacts with city mobility plan; • Waterway as a logistics tool for the urban distribution of goods; • Compile an inventory of the different types of environmental impact; • Undertake a cooperative approach with all industrial stakeholders; • Imagine the port as a potential energy provider; • Modify infrastructure or build new facilities to protect ecosystems from the negative effects of port / industrial activities; • Explore new economic challenges for the port assets not necessary linked only to.
Gaps identified	• No real 'agreement' to advance on port/city relations between the stakeholders; • Financial flows port/city not transparent; • A port net contribution to regional economy not always reported.
Trends	• Weakening bondage between ports and cities, despite municipalities often still have majority of s shares; • Imbalance between city's burdens and port's profits related to port activities.

Table 19: Assessment results for topic T100 Port – city relations

The majority of the ports with a long history have a very strong connection with the city it 'belongs' to. From a 'model' point of view 2 main models are identified related to port-city evolution: the spatial model (Bird 1963 and Hoyle 1989 1963), and economic models (Murphy 189 and Fujita and Mori 1996).

This 'bond' is visible through various dimensions, such as historical, financial, governance and the partially shared culture. This close relation is though weakening. Many reasons can be identified for the widening gap between ports and cities. Need of space, decreasing benefits (to city) of port activities, growing hindrance of port activities, changing business environments. The topic 'Port City relations' is to identify elements that may contribute to re-intensify this weakening bondage.

From literature point of view, this topic has the lowest number of identified inputs. Partially because of its wide scope, causing sub-parts (such as alternative energy), being covered in other topics. The topic lacks evidence in terms of comparative studies, though various initiatives were launched by among others the OECD to remediate this.

There are a growing number of interesting, intensifying economic activities between ports and cities evoking an ecosystem in which both entities interact. Though seldom initiated from a port/city concern, it nevertheless reveals 'hidden' opportunities that are worthwhile considering when defining the concept of the port of the Future.

The dissemination of these best practices is addressed by organizations such as AIVP, responding to the need for an international network between port cities. Others, with a more precise scope are ENERCOAST (renewable energies in Adriatic-Ionian sea), ME-AIMER (mitigation of environmental risk in Mediterranean area, NEMO (Maritime tourism at EUSAIR level) and POSEIDON (monitoring of ship's emissions in Adriatic area), ESPO (working group on cruise/ferry ports).

Further initiatives between port and city communities exist on energy, transport, mobility, spatial planning and communication. Cities mix urban and port functions by collecting and process city- and port generated waste in port areas, and organizing this transport by inland waterway barges. Port companies become aware of fact that cities may have resources (raw material such as waste), and at the same time it may be a potential market (energy). Amsterdam's industrial Hotspot 'Greenmills' is an industrial complex where wastes (kitchen and production wastes, organic fats, residual pulp from juice installation) are transformed in electricity.

Another example is Rotterdam's Value Chain Bio based Industry, aimed at including the vital links of the production chain in the port. Such a value chain for an ecosystem would include four contexts: environment, fiscal, legal and land availability including stakeholders such as authorities, R&D, society, think-tanks and private companies. This sets an examples to exploring new economic challenges for the port assets not necessary linked to one another: as hotspots for new concepts, trials, project e.g. recycling, eco-systems. In France obsolete shipyards were transformed into central ship recycling facilities covering larger regional areas – and thus creating sufficient activities to become economically viable.

A specific alternative to land issues is POMU 'Port Offshore Multi Usage', being a large platform off-shore that operates as a port. It responses to land issues, draught, and facilitates the integration of circular economy (due to 'island' waste processed locally). A first example is being developed in Port de Guyana, aligned with Europe's Blue Growth initiative.

Initiating 'industrial symbiosis' - undertake a cooperative approach with all industrial stakeholders towards local economic activities– was not always successful, private stakeholders found it at times too theoretical. The visualisation of cargo streams within the wider city/port area, though led to new economic activities (such as waste collection,).

Greening of ports also offers possibilities with regard to modifying infrastructure or builds new facilities to protect ecosystems from the negative effects of port and its industrial activities: examples such as wind farms, solar panels on warehouses at times connect to the city's electrical grid.

From a financial point of view, cities that host cruise terminals are the most outspoken example of an imbalance between the burden and the 'revenue' of cruise/ferry terminal activities

towards the urban community. Amid the current trend of internalization of external costs, non-port stakeholders address that port and transport activities give rise to environmental impacts and accidents. Transfer of imposed taxes to finance city/urban projects (pollution of cars, road toll) become negotiable and a realistic policy option.

With regards to cruise and ferry ports, cities often have the bother, and gain less on the passengers stays. This overall sector (2014) had 402 million passengers, mostly ferry passengers estimated at 390 million. The need to address this the growing friction between port/city, become so urgent that ESPO decided to form a working group on the topic, to create a mutual understanding between city/port/ferry-cruise lines to ease these frictions. It addresses a wide variety of issues that arise between port and the city related to cruise and ferry terminals, both on the positive (more attractive appearance of the terminal to attract cruises) and the negative side (road congestions, waste, less spending by passengers,).

This sector's key challenges are: the port-city relationship, infrastructure, and cooperation, relation with the cruise and ferry lines and security, and lead to five likewise workgroups with representatives from port authorities and associations. Some of the best practices included:

1. Making port more attractive for cruises/ferry boats:
   a. Making security checks more fluid;
   b. Regular transport connections to port;
   c. Training of locals to welcome guests (language, habits), to promote own city and city business);
   d. Greening the port to address the problems related to their environmental performance: monitoring and classical measures are called for (ESI, waste collection, measuring air quality, etc.);
   e. During off-peak season organise city events on cruise/ferry terminals.
2. Cooperation between ports to align shipping schedules to avoid congestion in ports on terminals; cooperation at all levels city/port on good understanding, information, opening terminal to city public, planning of infrastructure strategy plans; cooperation between ports with regards to security planning; between authorities on security/planning of cruise/ferry; between shipping lines/ferry; all stakeholders to create one voice to policy makers.

6.2.3.11 T110: Human element

Topic	110: Human Element
Description	Labour market and education and training.
KPI's	• Accessibility and leisure attractiveness, ecological city port, encourage hygienic attitudes; • Adapted, integrated Search and Rescue actions immigrants; • Number of events in ports; • Training policies, education centres, competence profiling, number of training days • Labour market events (job days,); • Learning platforms; • Jobs created;

Topic	110: Human Element
	• New sector jobs (blue and green); • Number of accidents, fatality rate, • Lost working days • Occupational diseases • Near misses
Co-related topics	• T100 Port-City relations.
Keywords	• Transfer to new jobs (blue/green), digital; • Training aspects of resources; • Structural shortages in labour market; • Port authorities' efforts to take the 'public' concern into account.
Gaps identified	• Further development of VTMS; • Uniform procedure for immigrants.
Trends	• Citizen participation; • Increased efforts of port authorities and port major private players with regards to communication to 'society'; • Investments of port authorities in public services. • Increasing EHS reporting regulations

Table 20: Assessment results for topic T110 Human element

The human element related to this project Port of the Future comes with many different aspects. The desktop analysis identified initiatives related to safety, security, immigrants, involvement of the public in investments, and specific infrastructure aligned with human requirements.

The ongoing irregular and acute migration crisis is putting an additional strain on the shipping industry. Formal SAR (Search and Rescue) operations are struggling to cope with the flows of immigrants trying to reach Europe in overcrowded and unseaworthy vessels. Commercial vessels are therefore often involved in rescue operations involving immigrants: while saving life at sea is and remains a priority, it is important to consider that such operations could put vessel and crew safety as well as commercial operations at significant risk.

As such, increased efforts are taken to improve the interoperability among (SAR) within a country and between countries. DG Mare also launched specific financing programs related to the "ICT interoperability improvements in Member States to enhance information sharing for maritime surveillance ", and the project MONALISA 2.0's focus is to improve interoperability among SAR services, passenger ships, VTMIS and Mission Control Centres. Training programs were organized, and a network of maritime simulator centres was also established (European Maritime Simulator Network).

In responding to cyber security incidents, the human element will play a fundamental role. Adequate training on how to respond to such incidents and on how to execute plans to avoid safety accidents will be increasingly more crucial in the coming years.

As highlighted by the authors of input 3500, significant changes in port development recorded throughout the time, have directly determined the professional requirements in terms of specialized knowledge, skills and abilities, the training programs facing adaptive changes accordingly. As main conclusion drawn from the literature review as carried out by the authors, the dynamic adjustments of the qualifications assumed by the port labour will be decisive and will make the difference for building a future competitive advantage in the sharp challenging context induced on the port services market, by the evolving technologies and logistic chain modern flows. With the research still ongoing the authors intend to combine a broad range of qualitative and quantitative methods for the purpose of defining a model of professional competencies, in order with the international understanding and suitable for the port industry requirements, to finally reside in a coherent training programme suitable to be applied in the specialized companies, as suggested in the concept of “Port industRy cOMPeTencies” collocation (PROMPT).

Concerning the sustainable development model of ports, an increase in ‘citizen’ participation is noted throughout the port sector. On drafting the River Elbe Management Plan and the Integrated Elbe Estuary Management Plan (IBP, Natura 2000), not only the water and nature conservation authorities were involved, but also the Elbe residents formed part of a broad participation process. If not embedded in an environmental impact assessment, public consultation moments are often included in the full procedure of obtaining a building permit, though an active communication strategy to have these stakeholders involved is still too often only adapted reluctantly to the minimal required effort.

The port of Hamburg - in direct vicinity to emissions sensitive urban area - initiated a role model that is to mitigate noise of a nearby container terminal operator. The local residents are involved in this dialogue under the initiative of the port authority. The proposed solutions ranged from changed technical equipment and organizational measures to passive mitigation measures, such as noise reducing soft touchdown procedures.

The port authorities’ efforts to take the ‘public’ concern into account extended also to aligning numerous public-port events to the navigational control of vessel traffic on the port’s waters, enabling the organization of numerous events in the port. Further actions include financial participation in public transport (water taxi, tunnels, and bus services), preservation of cultural heritage of the port, port related theme parks. Rotterdam invests in renovation of the outdoor space, warehouses and piers in the coming years in public space, safety (including a car park with facilities for truckers) and ground decontamination in nearby residential areas.

Port Authorities in addition focuses on establishing maritime service cluster close to the urban areas, contributing to the creation of jobs.

A side effect to the growing wave of digitalization is the loss of the classic logistics jobs. At the moment the maximum mitigation measures detected exist of re-training programs, as the need for qualified logistics profiles is believed to increase towards the future.

The Portopia project aims at developing a platform to observe and monitor the efficiency and the overall performance of the European Port System. It builds on the results of the PPRISM Project that demonstrated that sufficient data and information is available to populate and deliver a representative observatory of the performance of the European port-sector.

Whereas PPRISM identified indicators in the domains market and structure indicators, socio-economic indicators, environmental indicators, logistics chain and operational performance indicators, governance indicators (including financial indicators), Portopia focuses on health,

security and safety indicators. The 4 main Portopia components are the Rapid ExchangeSystem + (RES+), Environmental dashboards, port governance and user perception measurement tool.

After consultation only 6 indicators for security, safety and occupational health are considered as adequate and implementable, partially due to compulsory reporting to insurance companies and Eurostat; 3 of the indicators are related to occupational health, 1 to safety and the last 2 to security.

The indicators are the following:

1. Days Lost;
2. Fatal work accidents;
3. Work related accidents;
4. Nautical accidents;
5. Port security incidents;
6. Investment in protection.

Criteria to select indicators are relevance (for port managers, port users or the society), feasibility (data availability, data comparability and data access and privacy) and acceptability (for port representatives and the society). PORTOPIA's main objectives include the development of:

1. A forecasting dimension in port performance management within the market trends and structure category;
2. Top-down methods for harmonised socio-economic impact calculation;
3. An innovative, port-individualized tool for environmental and safety performance;
4. European port-related logistics chain connectivity indicators;
5. New governance indicators based on the changing role of port authorities including indicators on financial capabilities and transparency;
6. A method to capture user perceptions of port performance;
7. A dedicated performance management system for the inland ports sector, including attention to the interaction between sea and inland ports;
8. A strategy map and an integrated benchmarking tool taking into account the specificities of ports;
9. Increase substantially the efficiency (user friendliness) of data collection;
10. Automate the calculations and the management system, and to build a solid data warehouse ensuring data confidentiality of individual contributors in all phases (collection, calculation, reporting);
11. Professionalizing of the communication and dissemination of results through a dedicated website;
12. Professional reporting, annual events on port performance.

6.2.3.12 T120: Governance

Topic	T120: Governance
Description	All governance issues of all private actors and authorities operating in the ports
KPI's	• Active Port cluster;

Topic	T120: Governance
	• CSR reporting; • Cost Benefit Analysis
Co-related topics	• T900.20 Cooperation between ports.
Keywords	• Social and economic growth of the region in terms of value added, wages, local, national taxes paid; • Energy targets on ports owned and controlled facilities. Some extend this to all port operations and facilities: a) reduce energy consumption, b) improve energy efficiency, c) promote or fund energy audits.
Gaps identified	• Cooperation at national and international level.
Trends	• Public ownership is still most used port governance model; • Mixed ownerships, PPP remain rare; • Increased uptake of international standards (ISO, etc.); • More transparency on performance, sustainability, and finance; • The 'public' as stakeholder.

Table 21: Assessment results for topic T120 Governance

The report by ESPO 'Trends in Port Governance' shows that ports are still mainly publicly held. Mainly UK has fully privatized ports. Mixed public/private ownerships remain rare, and in such a case the public partner holds the majority of shares. This is in sharp contrast with other sectors, such as airports where private ownerships have become more of a daily practice.

Port management in general remains structured around the ownership, the administrative management models, and the regulatory frameworks of ports (World Bank, 2013).

Changes though are ongoing in the way a port authority perceives its role, which causes changes in the organisation model. Port authorities indicate their shift from the classic landlord model to a more entrepreneurial or at least facilitating role. Energy (transition, lower consumption, energy efficiency) has gained a permanent place on the port authority's agenda. They are also increasing their efforts to take up their role as nodes in multimodal transport chain concepts, as specified by TEN-T policy framework (fore-hinterland become important to them). Two thirds of EU port authorities also partner in innovation projects with customers, port operators or other companies as a way to stimulate the uptake of innovative solutions in the port. The adoption of emerging technologies and digitalization is also taking of in the port sector with 60% of port authorities active in this field.

Their increased uptake of a more pro-active role, also initiated their growing insight of the need to be more transparent to the involved stakeholders. As a result port authorities increasingly adopt international recognized standards as ISO (ISO 9001 Quality Management, ISO 14001 Environmental Management, etc.). For instance, ESO's environmental review of 2016 shows that 70% of European ports are certified under either ISO 14001, or EMAS (European Management and Audit Scheme) or under the EcoPorts Port Environmental Review System (PERS). Furthermore, European ports have been reporting since 1996 on the sector's

performance and its evolution over time through dedicated surveys by ESPO and EcoPorts (www.ecoports.com). The review of 2016 shows that 2 out of 3 European ports produce a publicly available environmental report on a regular basis. This figure has more than doubled from the 30% in 2004 and the continuous positive trends demonstrate the ports' progress towards increased transparency.

At regular times national port strategies are updated. Looking at the National Hafenkonzept 2015, challenges and opportunities are followed by actions to undertake. These were not different from previously identified trends such as changing infrastructures, connectivity with hinterland, sustainability, and safety and security related topics. The same topics are found in the Rotterdam Port Vision with a focus on efficiency and sustainability. Here though the active participation of universities is embedded in the strategy.

Future oriented changes also appear in the port's concession policy. These policies get more used to direct port services in fulfilling environmental requirements (Notteboom, 2007). For example, the Port of Rotterdam sets sustainability as a key criterion in the assessment of concession competitive bidding. In the request for proposals for the Maasvlakte 2 expansion project, candidate terminal operators were asked to focus on minimizing the share of road transport with the aim to achieve an ecologically favourable modal split using higher proportion of barge and rail transport (De Langen, Van den Berg, & Willeumier, 2012).

Ports actively use generic policy instruments (infrastructure investments and land allocation), to foster the development of industrial ecosystems. Another governance tool, pricing, is used to encourage the decarbonisation efforts of the port's client terminals, industry, ships).

Ports realize however that their governance model needs frequent re-evaluation to stay aligned with newest, fast developing technologies such as a distributed ledger technologies.

Since 2010, cooperation expressed as merging of neighbouring port authorities happened either bottom-up, as a result of cooperation between port authorities, or driven by government's policy. To a lesser extent, cooperation with inland and dry ports is emerging and can even lead to integration under one umbrella organization (e.g. HAROPA) or to direct financial participation in inland and/or dry ports. Amongst others, cooperation can be found in cruise/port and other promotion efforts, but also in umbrella organizations such as HAROPA, which brings together the ports of Le Havre, Rouen and Paris, or NAPA, the North Adriatic Ports Association. Cooperation regarding to hinterland connections can be found in the FERRMED work on the Med Corridor.

Derived from the Sea Traffic Management Project, the international PortCDM Council has also been established and is comprised of members of maritime associations, maritime authorities, and port authorities for the purpose of global governance of the PortCDM concept as well as providing recommendations for regional and local implementations.

Three indicators on port governance were identified, next to the broad range of qualitative data contained in the factual reports. The first one is the integration of port cluster, which expresses the extent of port authorities' initiatives that aim towards the integration of various stakeholders composing a port cluster. The second one measures the extent to which port authorities undertake and report activities in a way that enhances corporate and social responsibility (CSR). Finally, autonomous management provides information on whether port authorities maintain features that enable them to develop vital initiatives.

In France, the new port reform redefined the role of French port authorities. Focusing on issues of local planning, economic development, and multi-modal connections, ports were invited to reconnect with their local context and especially re-build the port-city interface, an example also seen in the port of Ningbo, Ulsan Metropolitan area (Ulsan Eco-polis).

Port authorities develop strategic partnerships with other seaports either at national or international level to take action in specific areas. Partnerships may include joint promotion

efforts, developing joint ICT projects or participation in European projects within the TEN-T financial framework (e.g. Motorways of the Sea projects).

The study 'Assessment Decision-making for maritime innovation investments – cost benefit and effectiveness analysis' analysed the decision process of 47 private innovation projects, of which none used CBA, due to its complexness. 'Private' project decisions factors were more related to ROI, external factors and only to 1/3 of the cases public subsidy were a final decision factor. CBA was found to be motivated in case of public financing to valuate to actual benefit to society (and thus environment).

This is supported by the Deltares study Port of the Future that is to find possibilities to combine these "traditional" port investments with green initiatives. This is called ecosystem-based management. Recommended is to make a case-specific social cost benefit analysis.

Since a few years the Connecting Europe Facilty instrument strongly advises (read imposes) the use the 'Guide to Cost-Benefit Analysis of Investment Projects - Economic appraisal tool for Cohesion Policy 2014-2020' of the European Commission Directorate-General for Regional and Urban policy. Each project proposal is to be accompanied by a CBA based on this methodology and supported by relevant research data on emission effects. For transport the RICARDO-AEA Update of the Handbook on External Costs of Transport' is frequently used, as it combines all relevant research data on pricing the effects of transport.

6.2.3.13 T130: Incident management

Topic	T130: Incident management
Description	All incidents and accidents either in the port or at sea and in the latter case only if there is an impact on the ports. Legislation, processes, actors, technology, to prevent and manage incidents. This involves both authorities and private actors.
KPI's	• 50% less accidents (Maritime); • VTMS fully implemented; • Spillage and contamination remediation plans; • Connection to traffic sensors, allowing sharing of information and managing traffic streams (all modes); • Dynamic traffic volume information installed (larger ports).
Co-related topics	• T60.10 Environmental sustainability, the impact on the environment of an incident.
Keywords	• Sharing of traffic information and typical port warnings.
Gaps identified	• International statistics on port incidents not published.
Trends	• Fewer incidents are identified as benefit of digitization, data sharing, increased monitoring.

Table 22: Assessment results for topic T130 Incident management

Initiatives related to incident management remain limited to the implementation of dynamic traffic volume information system, and message boards informing drivers about the current

traffic situation in the port, or incidents. To enable this measuring stations are installed that record traffic volumes. As example the traffic data collected are transmitted to the HPA Port Road Management Centre.

The project STM has set forward clear goals related to fewer incidents in the maritime sector, by making essential information available in real time to crew of operational maritime ships.

Indirectly all projects related to VTMS, RIS have goals included on safer use of the waterways, seas by sharing information, and monitoring activities.

6.2.3.14 T900: Cooperation

Topic	T900: Cooperation
Description	Cooperation with other countries and ports
KPI's	• Active agreements with other associations, ports; • Defined action in port strategy plan; • National Port Strategy Plan; • Number of investments in fore-and hinterland infrastructure.
Co-related topics	• T100 Port City relations; • T120 Governance.
Keywords	• Trade lanes require co-operation; • Port/City co-operation on local issues; • Creation of specific workgroups under umbrella of port associations (ESPO); • Examples: HAROPA, Cruise & Ferry terminal working group, ESPO, PIANC, PortCDM, FERRMED.
Gaps identified	• Digital co-operation between ports remains unattended; • New forms of co-operation required.
Trends	• Increasing number of memberships at port sector organisations; • Impact of digitization on coordination requirements remains uncertain.

Table 23: Assessment results for topic T900 Cooperation

The analysis of the input reveals that the CASSANDRA project has also has shown strong commercial rationales for investing in business-driven control improvement, at times caused by international cooperation in the form of trade agreements. Better controls in the EU-China trade lane case were done for improving supply chain predictability on request of retailers, not to please custom.

De- facto all projects related to TEN-T corridor gently 'force' the relevant stakeholders to cooperate together by means of the funding programs.

Corporation is also set in the concept model of Triple Helix, where a port/city area's all squares, historic architectural assets, local characteristic warehouses, or buildings of specific quality become spatial platforms for a creative environment.

Under the organisation of ESPO ports, cruise and ferry terminals shipping lines, started to participate in a working grouping facilitating the cooperation at all levels city/port with all relevant public stakeholders.

A large 2017 enquiry (input 10: The future of port logistics, meeting the challenges of SC integration for ING) among port actors identified following main factors affecting co-ordination and co-operation among actors in port-related supply chains: (ranked according to the most relevant incentive):

1. Increased possibilities in the area of sharing and linking information flows;
2. Consolidation and increased market power at the customer side;
3. Unequal distribution of costs and benefits of coordination (free rider problem);
4. Lack of resources or willingness to invest by one or more actors;
5. Strategic/competitive considerations;
6. Presence of a dominant actor with supply chain power;
7. Mistrust between parties;
8. Risk-adverse behaviour and short term focus of companies/Actors.

At national (Member State) level, the major EU Member States have a national port strategy. France deployed this strategy later than most Member States, in their Stratégie National Portuaire. The strategy actually imposes the cooperation between the 'grands port maritimes', the 'ports décentralisés' and the 'ports intérieurs', and set forward a transformation of the ports organisation from 'landlord' to 'architect of logistics solutions' to facilitate the French industrial zones.

6.2.3.15 T901: Competition

Topic	T901: Competition
	The activity or condition of striving to gain or win something by defeating or establishing superiority over others.
	• Volume; • Price; • Number of ship calls.
	• T900 Cooperation
Keywords	• Non price competition; • Business Environment Attractiveness elements
Gaps identified	• None
Trends	• None

Table 24: Assessment results for topic T901 Competition

The existing competition among ports is often reflected by the pricing strategy that ports follow. Port authorities though realise that the 'client' is also to be convinced on other factors, sometimes called non-price competition factors. According to Alderson, the four major factors in non-price competition are:

1. Improvement in quality and service;
2. Differentiation of product;
3. Consumer advertising;
4. Trade promotion.

Over time, a lot of non-price tools have been added. For instance, according to Khatibi and Vergote (2011), R&D, developing long-term relationships with customers and building value are the other vital factors of non-price competition.

The efforts of the business development departments of Port Authorities (or port companies) increasingly capture the real location - or port decision process of their clients. A classic work related to site selection (in extenso then also port selection) is 'Location, location, location', and the IBM's 'Improving private sector land access'.

Underneath graph shows the major location selection factors derived from many years of assisting clients in their location process. Looking at those parameters, there a quite a lot that contain non-price competition elements.

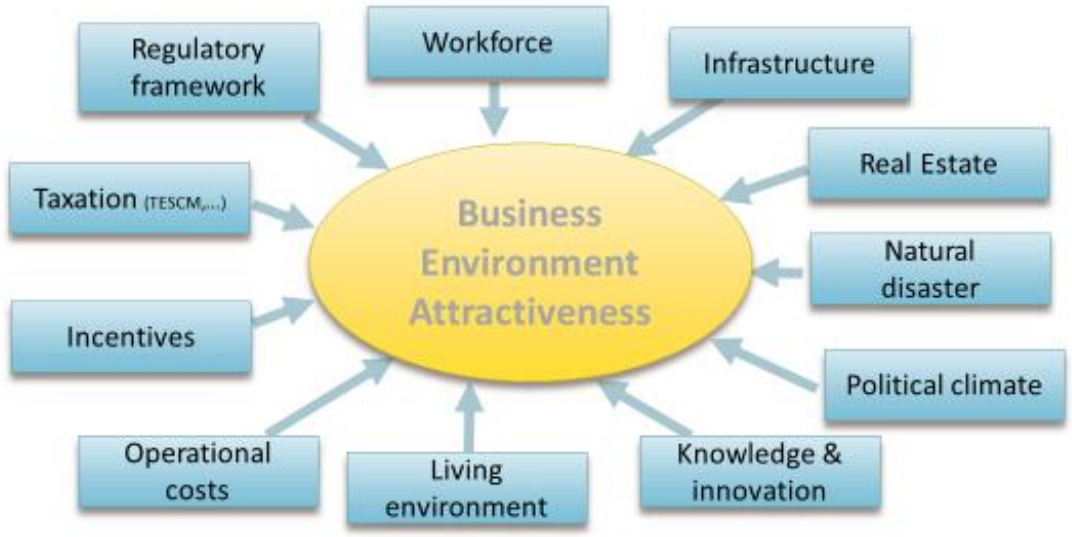


Figure 11 Locations selection factors (source IBM)

Cleary this involves working areas that do not belong to the organisations that manage ports. Co-operation between all levels (public and private) is by consequence the key message, which includes also co-operation between ports.

Drilling down to the aspect of roles of authorities in a typical 'client' location selection process, again the required interaction between all those levels becomes obvious.

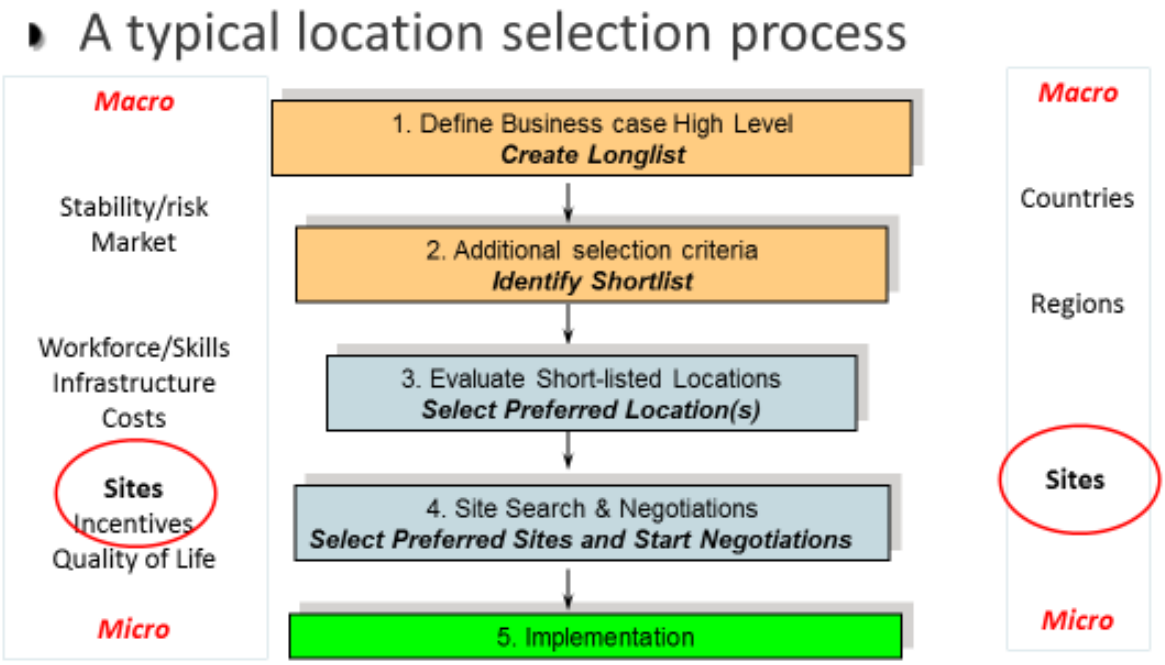


Figure 12 Location selection process (source IBM & Plant Location International)

Arguably indeed this complete scheme does not apply to all port customers. Shipping lines will focus more on the features not related to having their own physical location, but more on the available services, tax regimes, workforce, productivity, performance on various topics mentioned in this paper including digitization.

Related to this perspective the case study of Ports in the Black Sea basin, developed a set of Priority Indicators for Port Development (PIPD) to facilitate the assessing of ports in the Black Sea basin. Under these conditions, 15 European ports were identified: developed European ports as reference models (Rotterdam, Antwerp, Hamburg), average performance ports (Marseilles, Algeciras and Valencia, stating that in EU records also the port of Constanta is in this area) and the main ports in the Black Sea basin.

The results were centralized in the form of a set of 10 indicators, which can ensure the assessment of the level of development of a port. The proposed indicators are:

1. The advantages of geographic positioning;
2. The quality of hinterland connections;
3. The availability and efficiency of port services provided to goods and ships;
4. The price of port products;
5. Socio-economic sustainability;
6. Port infrastructure;
7. Information and communication systems in port activity;
8. Flexibility and adaptability to changes in international trade.

The obtained results highlight the structural disparities between these ports and the port reference model.

According to the authors, in conclusion, a correct assessment of a port activity is made when all the factors that influence its activity are considered.

6.2.3.16 T910: Bridging R&D and implementation

Topic	T910: Bridging R&D and implementation
Description	Develop transferability mechanisms to facilitate the application of H2020 results in CEF projects
KPI's	• Transport Infrastructure Resilience Indicator (TIRI); • Revenue generated by commercialised R&D; • Number of participation in research programs; • Cooperation agreements with universities, research centres.
Co-related topics	• All topics.
Keywords	• Key Enabling Technologies; • A Business Model for Enhancing Funding & Enabling Financing for Infrastructure in Transport;
Gaps identified	• Clear choice on focus areas with involvement of all participating stakeholders.
Trends	• Clustering innovative sector by co-operation with authorities, universities and private sector; • Government incentive programs; • Industry 4.0; • IoT.

Table 25 Assessment results for topic T910 Bridging R&D and implementation

The scope is to develop transferability mechanisms to facilitate the application of H2020 results in CEF projects, and applies to all topics.

The limited description of this topic is 'Develop transferability mechanisms to facilitate the application of H2020 results in CEF projects', reflected on a broader scale one may define it as transferring results of any project into real world conditions on a permanent basis.

A Business Model for Enhancing Funding & Enabling Financing for Infrastructure in Transport (BENEFIT) shows large similarities with the DtF project, though focused on an individual project approach. 11 cases (projects) were analysed and 75 project profile descriptions from 19 EU and 4 non-EU states were used. The study tried to capture the interaction between policy framework, financing / funding scheme (defined as revenue generating) and implementation. As such by using ex-post analysis they define an ex-ante analysis of transport infrastructure projects. The indicator developed is called the Transport Infrastructure Resilience Indicator (TIRI).

The TIRI considered – among others - infrastructure type, size of investment, location as well as the delivery model (fully public or including private financing). Based on studies conducted before the tendering stage, the key outcomes of a project have also been set. With respect to the BENEFIT Matching Framework these included: construction budget, duration, anticipated level of traffic, anticipated level of revenues.

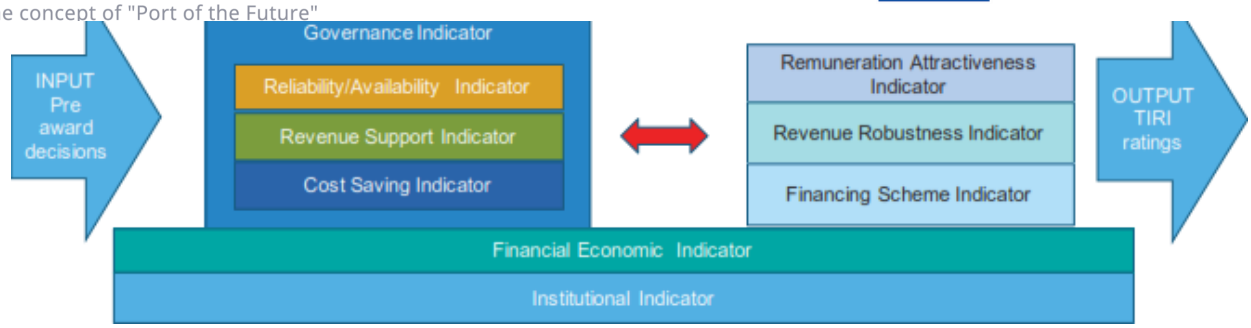


Figure 13: The components of the Transport Infrastructure Resilience Indicator

The project though excluded airports, ports and railway works due to the difficulty to include forecasts on traffic evolution and not sufficient projects (details) to be evaluated, to meet the developed methodology.

Universities play an important role in bridging the gaps between R&D and implementation. Examples identified during the desktop analysis include the port of Ghent and Rotterdam.

Through the efforts of the Ghent University, supported by the authorities and with the involvement of the regional bio-based industry, it succeeded at several occasions to speed research up to industrialisation scale. Today, the port of Ghent is one of the leaders in biofuels in Europe and the world. A unique position is the Ghent based Bio Base Europe Pilot Plant performing bio based research for companies to close the gap between the industrial sector and the laboratorial experiments. The pilot plant acts as an open centre of expertise for the development and upscaling of new bio based and industrial biotechnology processes, enabling KET's (Key Enabling Technologies) Industrial Biotech to shift from research to market applications. Nearby located private grain storage terminals, grain processing factories and bio-fuels producers are part of this cluster.

The Delft University of Technology and Erasmus University, for instance, are collaborating with the business sector, the government and the Port of Rotterdam Authority on implementing an innovation agenda. In a future-proof energy port, energy generated from fossil fuels will become increasingly cleaner, for instance through the Rotterdam Climate Initiative and the use of LNG. More electricity will be generated from biomass, the wind and the sun. Rotterdam indicates further it can strengthen its position in the chemical sector by switching slowly but surely to non-fossil resources.

Germany's ISETECT programs I and II (Innovative Seehafentechnologien) funded by the Bundesministerium für Wirstschaft und Technologie in which 'project I' had specific port and hinterland research topics related to optimization of the exchange of operational data and its processing and the industrialisation of transport activities. Projects were more or less evenly distributed across the subject areas "technologies and procedures" and "information and communication systems", however, the regional distribution of the projects and their volumes concentrated on Hamburg and Bremerhaven. ISETECT II concentrated on the intuitive human-robot interaction interface, as an alternative to the current inflexible and static sea port handling infrastructure. The aim of the project II is the development of a novel, mobile robot for improving the efficiency of seaport handling operations, to optimize manual handling conditions such as emptying of groupage containers. An additional study RoRo hafen-4.0, aligned with Germany's 'Industry 4.0' study, was to support Lübeckhafen decision process on the development of an integrated booking and scheduling platform within the overall supply chain.

Cooperation between ports was touched upon through the many international associations and organisations referred to in the various inputs, we identified ESPO, the International Port Community System Association (IPCSA).

Worth mentioning is also the EU continuous efforts to disseminate on innovations. Amid the numerous events organised we mention here 'Clouds and the Collaborative Innovation Days (www.collaborativeinnovationdays.eu). Their objectives are: Share and discuss achievements of collaborative innovation projects, and the challenges and opportunities addressed by new and ongoing projects. The European Commission and the ALICE organized three workshops on Logistics Innovation Clouds, which had the objective of consolidating progress and draft future visions and plan for the Logistics sector, as well as to facilitate collaboration and cross-fertilization among different Research & Innovation projects.

Project often are an interesting concept to bring together research and daily practice. One such example is the MESA-project. The main strategic objectives of the MESA project - Maritime Europe Strategy Action project was to reinforce the effectiveness of the research and development measures and plans of the European maritime industry through:

1. Optimization of the Research & Development & Innovation (R&D&I) strategies of the European maritime industry;
2. Improvement of the dissemination, visibility and application of the results achieved through R & D & I among the various agents that make up the maritime transport logistics chain;
3. Promoting the definition of R & D & I policies applied to maritime transport.

This project was based upon the work that is being done through the waterborne technology platform (as a forum of maritime industry). In this project four specific thematic areas were identified:

1. Energy efficiency;
2. Security;
3. Ship manufacturing;
4. Information and communication technologies (E-Maritime).

The key areas for future opportunities were identified as:

1. Smart vessels, fleets and ports that included new technologies and solutions related to ship resistance, propulsion, prime mover, conversion of auxiliary engines;
2. Automated and autonomous vessels;
3. Ultra-low energy and emissions vessels and systems;
4. Safe, secure and adaptable passenger vessels for inland, inshore and offshore duties;
5. Green, efficient and flexible inland-waterway vessels.

6.2.4 Tactical objectives

Tactical objectives are what we propose to be realized by the ports and its stakeholders by 2030. In the project proposal this is called "Aims", however not all aims are indeed tactical objectives, rather measures. (Section 9.1.1.1.2.5 on page 181) for more information about strategic and tactical objectives. (Table 41: List of tactical objectives on page 224) for the current list of tactical objectives with targets where already defined.

Not all tactical objectives have been assigned as frequently. The following table shows the top 10 tactical objective assignments. Be aware that in an assessment more than one tactical objective can be assigned

Number and name tactical objective	Number of assessments
TO180: Emission reductions	26
TO100: Improve modal shift	15
TO110: Increase efficiency and capacity of hinterland connections	15
TO290: Optimise and digitalise the logistic chain sharing data between all stakeholders in secure way, with usage of IT data security technology from other sectors.	15
TO340: ICT and communication: data sharing between all stakeholders including G2B (gov. to business), roadmap to fully deploy reporting directives further (waste reporting, SECA reporting, …)	14
TO10: Increase terminal productivity	14
TO380: Improved integrated port and city common development planning	13
TO20: Improve design and maintenance of the port infrastructure to increase overall resilience	13
TO330: Encourage harmonised data sharing.	12
TO360: Advanced and efficient links and integration in the socio-economic industrial and urban surrounding environment	12

Table 26: Top 10 tactical objectives

6.2.5 Measures

Measures are the things we propose should be done to attain tactical objectives (See section 6.2.4 on page 105). Measures are not necessarily the introduction of a new technology nor are they investments.

For ease of finding measures in Atlas (Section 9.1.1.2 The work products and tools on page 191) the measures have been grouped together as follows.

1. **Financial Measures;**
2. **Predefined regulatory and standardization measures;**
3. **Standards;**
4. **Predefined monitoring measures;**
5. **Predefined implementation measures Energy;**
6. **Digitalization (Platforms and systems);**
7. **Digitalization (technology);**
8. **Digitalization (data);**
9. **Port infrastructure;**
10. **Transport flow, transport mode related;**
11. **Transferability (Training …).**

Not all measures have been assigned as frequently. The following table shows the top 10 measures assignments. Be aware that in an assessment more than one measure can be assigned.

Number and name measure	Number of assessments
MS380: Information sharing platforms	20
MS220: Environmental compensation measures	17
MS20: Alternative fuels	14
MS440: LNG bunkering, supply and distribution chain	12
MS90: Collaborative network of ICT platforms	12
MS860: Training schemes	11
MS570: Port Collaborative Decision Making	10
MS270: Funding and financing	10
MS160: Developing governance structure	9
MS540: Optimise and digitalise the logistic chain	9

Table 27: Top 10 measures

Conclusions and recommendations

6.3 Task 2: Stakeholders consultation

This section covers the outputs and outcomes of WP1 task2 « Stakeholders consultations», resulting in deliverable D1.2 «Stakeholders consultations proceedings » 2 techniques have been used to consult the stakeholders:

1. A public survey (Section 6.3.1 on page 109);
2. Bilateral meetings with DG's (Section 6.3.2 on page 120).

6.3.1 Survey

6.3.1.1 Introduction

The consultation launched the 14th of September, aimed at collecting the vision of different stakeholders about the Port of the Future. The section "stakeholder consultation" contains the main outcomes, the characteristics of the involved stakeholders, the methodology followed, an analysis of the stakeholders' feedback and a focus on the main outcomes deriving from the bilateral meetings occurred with the Directorate Generals (DGs).

The survey was set up and the results were processed according to the criteria defined in the GDPR. The respondents could choose to participate anonymously and withdraw from the survey at any moment.

The online survey was closed on the 1st of October 2018 with 72 completed individual answers.

6.3.1.2 Stakeholders engagement

The rationale behind stakeholder engagement is described in section 9.2.1 on page 243 and the methodology used in section 9.2.2 on page 244

The survey was administered to 1585 stakeholders. Stakeholders are grouped according to the following criteria. The stakeholders were asked to select from the list so that the DocksTheFuture team could precisely outline the respondents' profiles.

1. Type of organisation:
   a. Port related such as port authority;
   b. Ship-related such as shipping agent; ship owner; broker;
   c. Multi-modal logistics operator;
   d. Terminal operator;
   e. Technology provider;
   f. Authorities such as customs;
   g. EU member state;
   h. City, municipality;
   i. Association;
   j. University, research associations.
2. Size of the company/organisation stakeholders are connected with:
   a. Micro-enterprise (<10 persons employed, up to €2 million turnover);
   b. SME (Small-Medium enterprise) (from 10 to 249 employees, up to €50 million turnover, or balance sheet total up to €43 million);
   c. Big company or organization (250 employees or more, more than €50 million turnover, and balance sheet total of more than €43 million).

3. **Country to which stakeholders belong;**
4. **Companies or organisations they work with;**
5. **Activities the stakeholder is involved in:**

Terminal operations (container or multipurpose) (e.g. container handling; storage of containers; container transhipment; weighing containers; loading/discharging of bulk cargo vessels; mooring and unmooring; warehousing; Receipt and delivery (gate control); Grab hire)
Territorial planning of the port area.
Address, planning, coordination, promotion and control of port operations and other activities carried out in the ports (e.g. identification of the port development strategies).
Ordinary and extraordinary maintenance of the common parts in the port area.
Assignment and control of activities aimed at providing services of general interest in the port area, not strictly connected to port operations.
Shipping agents activities such as requesting a berth for the incoming ship, fulfil reporting formalities before arrival and departure on behalf of the ship master, arranging for storage bunkers if these are needed, arranging for the necessary repairs; conveying instructions to and from the ship owner, organising the supply, transport and the handling of the goods, collecting freights, cargoes, contacting shippers and the receivers of the goods etc.
Shipbroking activities.
Freight forwarding.
Chartering
Equipping ships a ship-owner
Logistics and transport operations as freight forwarder
Logistics and transport operations as NVOCCs
Ship technology providing such as diesel and engines, engineering, icebreakers, emission reduction systems for ships etc.
Port technology providing such as container terminal automation, IT solutions and terminal operating systems etc.)
Regulatory, administrative, patrimonial, organisational, accounting and financial activities
Custom agencies activities such as administration of customs duties; management of customs services,

border control etc.)
Transport association related activities
Research activities
Other

Table 28: Activities the stakeholder is involved in

6.3.1.3 Results

The stakeholder consultation sought to mobilise relevant stakeholders in order to (a) generate knowledge about the project, and to (b) get opinions from the most relevant stakeholders about their vision of the Port of The Future. This Chapter is a summary of the main results of the stakeholder's consultation as well as the profile of the respondents.

6.3.1.3.1 Profile of respondents

1. Geographical coverage.
   The geographic coverage of the consultation was broad. Survey respondents from16 countries, mainly in the EU, as shown, with a large participation from Italy (20.3%), Belgium (12.5%) and Spain (15.6%).

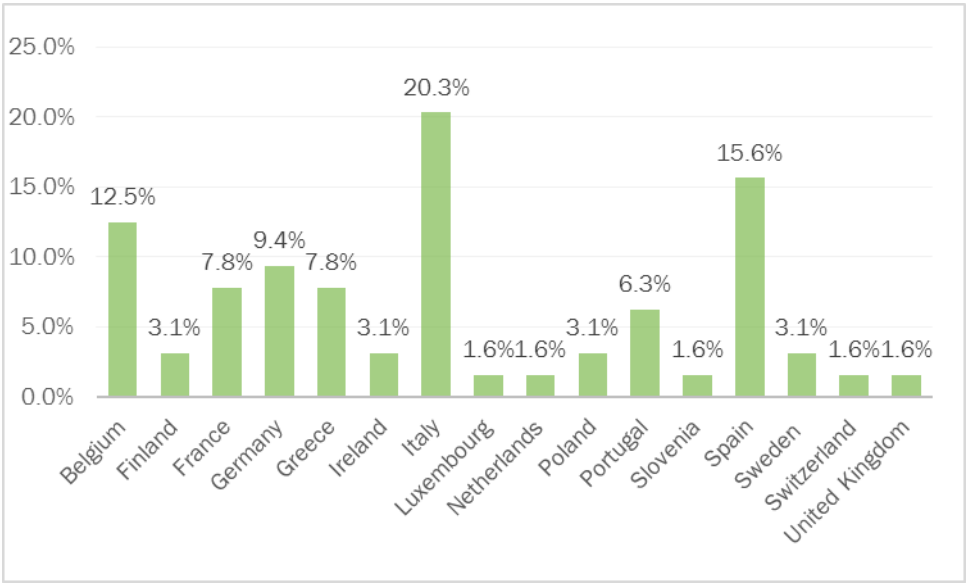


Figure 14: Percentage of respondents by country

2. Representation by stakeholder groups.
   The majority of respondents belong to the port –related sector (23%), followed by universities and research associations (22%), consultants (14%), and technology providers (11%).
   As for the activities carried out by the stakeholder's groups shows that the vast majority of respondents (26.98%) perform research activities, followed by the territorial planning of the port area (17.46%)

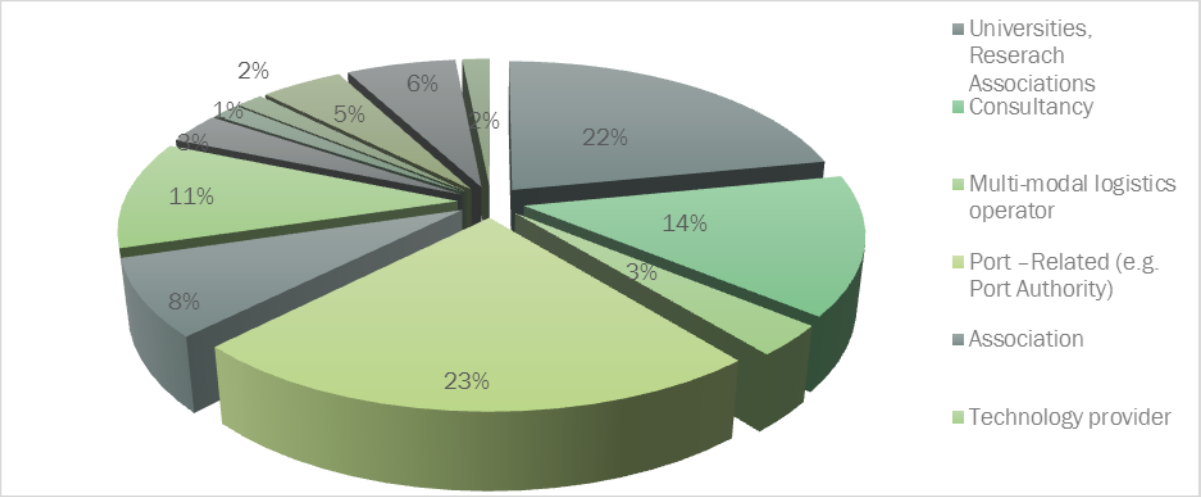


Figure 15: Participation by of stakeholder's groups

Activities carried out	% Respondents
Address, planning, coordination, promotion and control of port operations and other activities carried out in the ports (e.g. identification of the port development strategies)	**11.11%**
Terminal operations	**11.11%**
Territorial planning of the port area	**17.46%**
Logistics and transport operations as freight forwarder	**1.59%**
Shipping agents activities	**3.17%**
Research activities	**26.98%**
Assignment and control of activities aimed at providing services of general interest in the port area, not strictly connected to port operations	**3.17%**
Ship technology providing	**1.59%**
Regulatory, administrative, patrimonial, organizational, accounting and financial activities	**3.17%**
Port technology provider	**3.17%**
Transport association related activities	**7.94%**
Custom agencies procedures (e.g. administration of customs duties, management of customs services, border control etc.)	**1.59%**
Equipping ships (shipowner)	**1.59%**
Other	**6.35%**

Table 29: Percentage of respondents by activity carried out

6.3.1.3.2 Scores

The stakeholders were asked to score 9 subjects. The scores range from 0, no importance, to 4, the highest importance. On the exception of a few most subjects are actually topics as defined in the topic list (Sections 6.2.3 Topics on page 43 and 9.1.6.2 List of topics on page 217).

1. **Performance and quality of service.**
   59.38% of respondents attributed the highest importance to the topic 'Performance and quality of service', followed by a medium –high score (37.5%) while only 3.13% respondents attributed a medium-low importance.

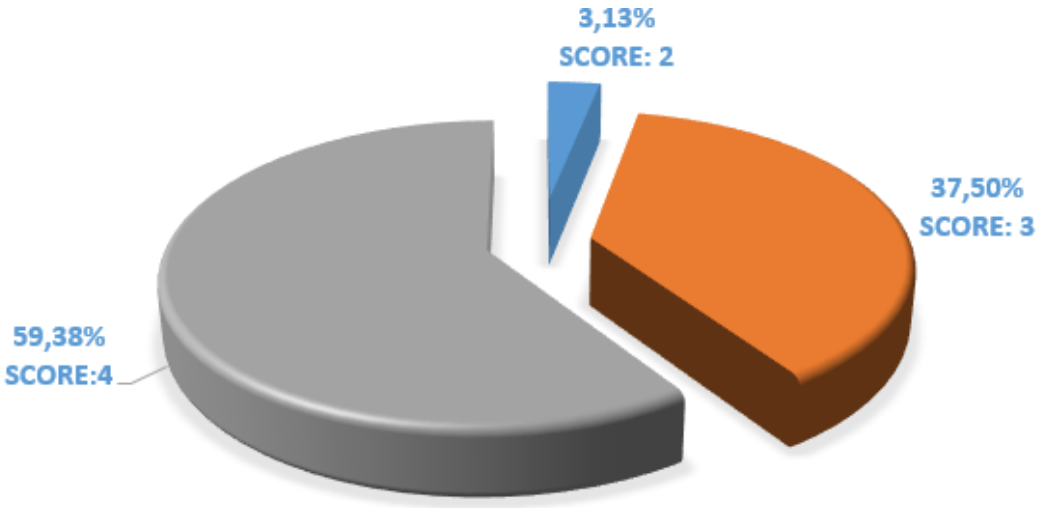
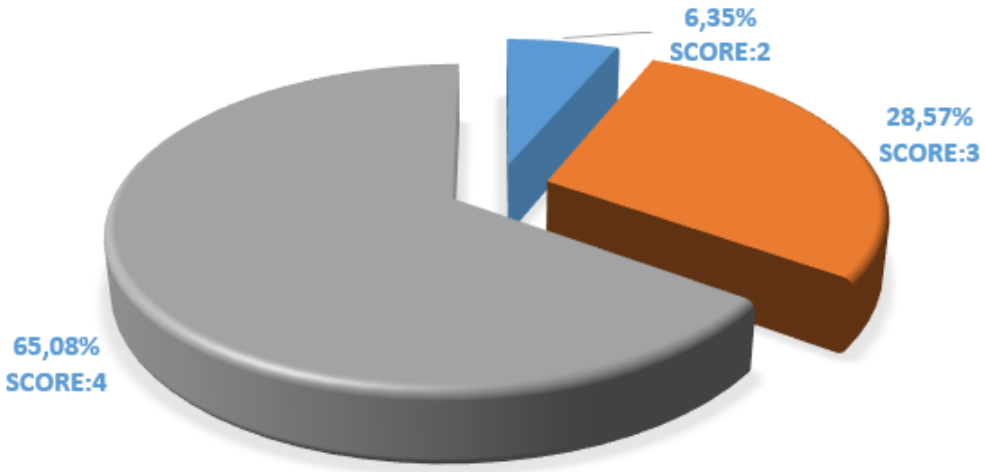


Figure 16: Performance and quality of service

2. **Hinterland, multi/synchro modality, supply chain integration, modal shift[10].**
   As many as 65.08% of respondents attributed the highest importance to these topics, followed by a 37.50% of them that attributed a medium-high importance.



[10] Multimodal transport refers to the use of different means of transport on the same journey
Synchro modal transport is the service which, through informed and flexible planning, booking and management, allows to make mode and routing decisions at the individual shipment level, as late as possible in the transport planning process including the trip itself.

Figure 17: Hinterland, multi/synchro modality, supply chain integration, modal shift

3. **Mobility and accessibility**.
These topics refer to the consistency between urban mobility plans and port connections. In this case, there are a higher percentage of respondents attributing a medium-high score to this tactical objective (45.91%) than those attributing the highest importance (35.94%).

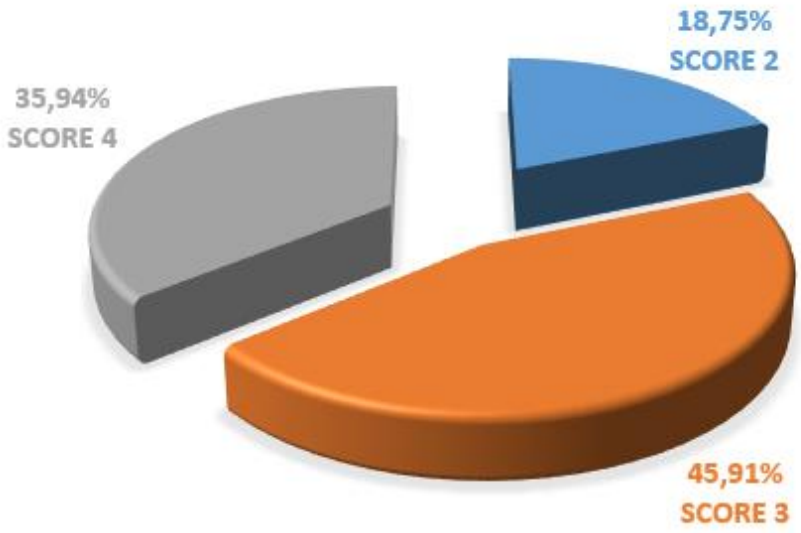


Figure 18: Mobility and accessibility

4. **TEN-T Networks**.
This subject is about the realisation of TEN-T core and comprehensive networks. Only 3.13% of respondents believe that the connection of a port to the TEN-T network has a very low importance.

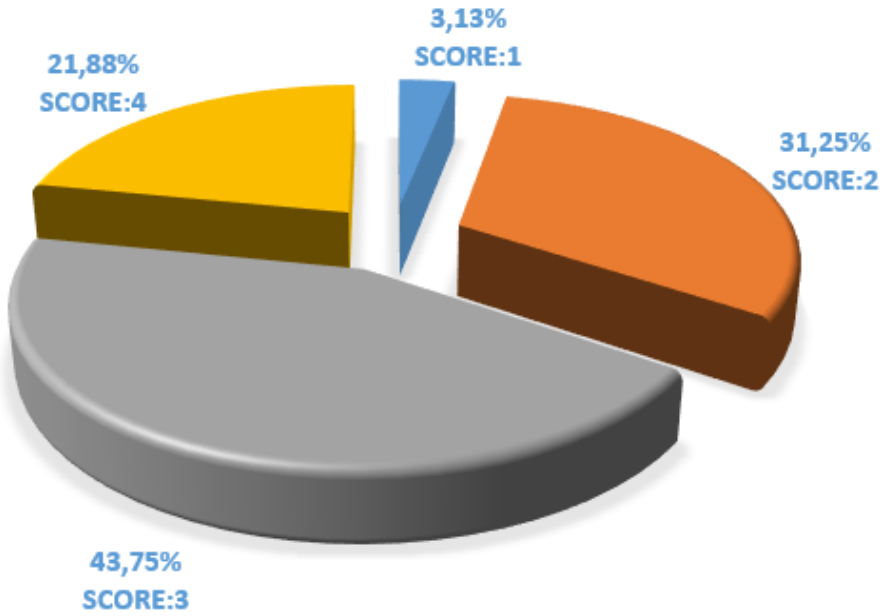


Figure 19: TEN-T networks

5. **Sustainability.**
This topic covers all aspects of the traditional 3P perspective on sustainability: "planet" is environmental sustainability, "profit" is the economic sustainability and "people" is the social sustainability. In other words, initiatives to improve the environment should not have a considerable negative effect on the economy and on the social welfare. A high percentage of respondents attributed the highest importance to this topic (68.75%), followed by a medium-high importance selected by the 23.44%).

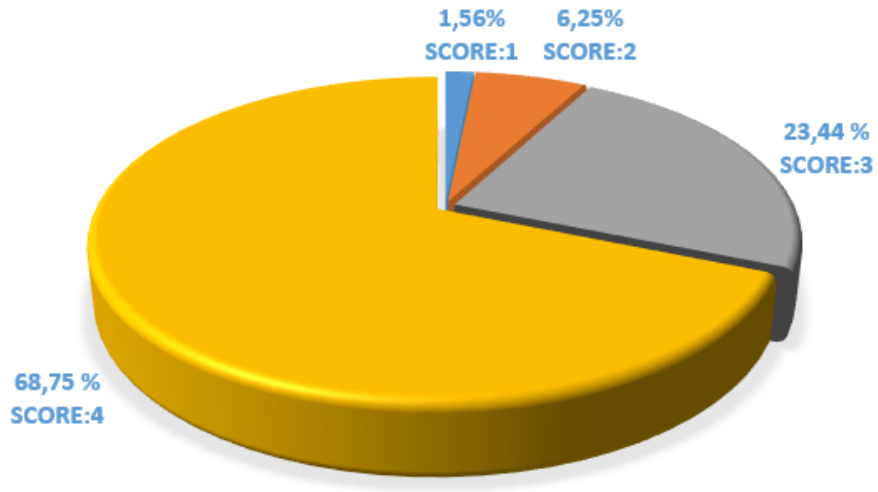


Figure 20: Sustainability

6. **Safety and security.**
Almost half of the respondents (46.88%) attributed the highest score to the safety and security topics.

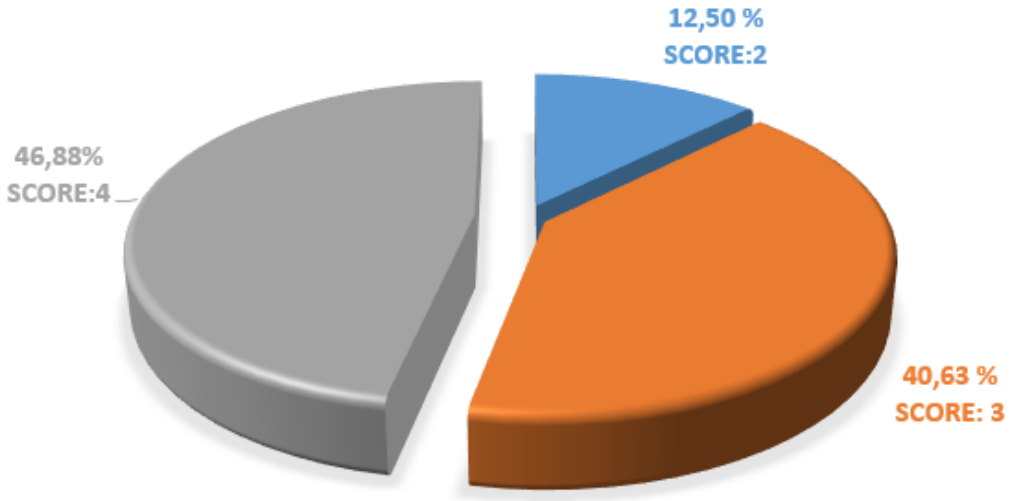


Figure 21: Safety and security

7. **Digitalisation and digital transformation.**
Digitalisation is the automation of existing manual and paper-based processes, enabled by the digitisation of information. Digital transformation is about changing business operations, business models and even revenue streams and new business opportunities. A high percentage of respondents attributed the highest importance to this topic (70.31%) followed by a medium-high importance selected by the 23.44% of respondents.

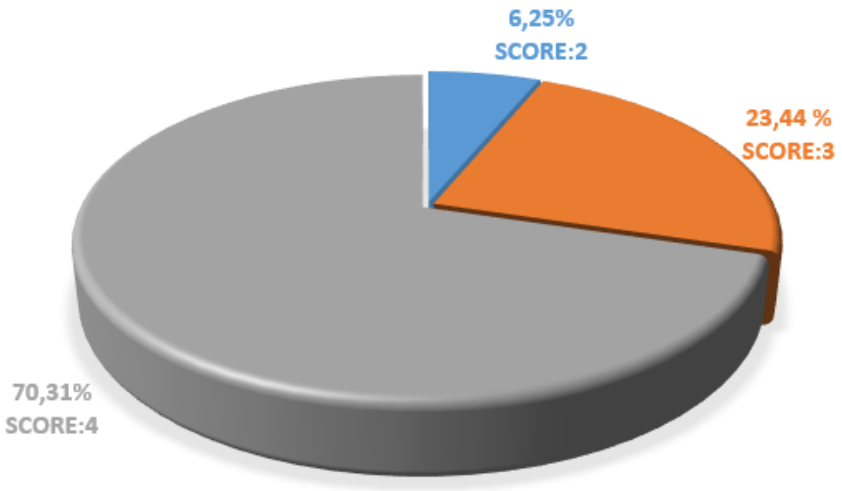


Figure 22: Digitalisation and digital transformation

8. **Port - city and human element.**
This is about how the port infrastructure and port activities can be integrated with the city and the surroundings. Almost half of the respondents (45.31%) attributed a medium-high score to these topics.

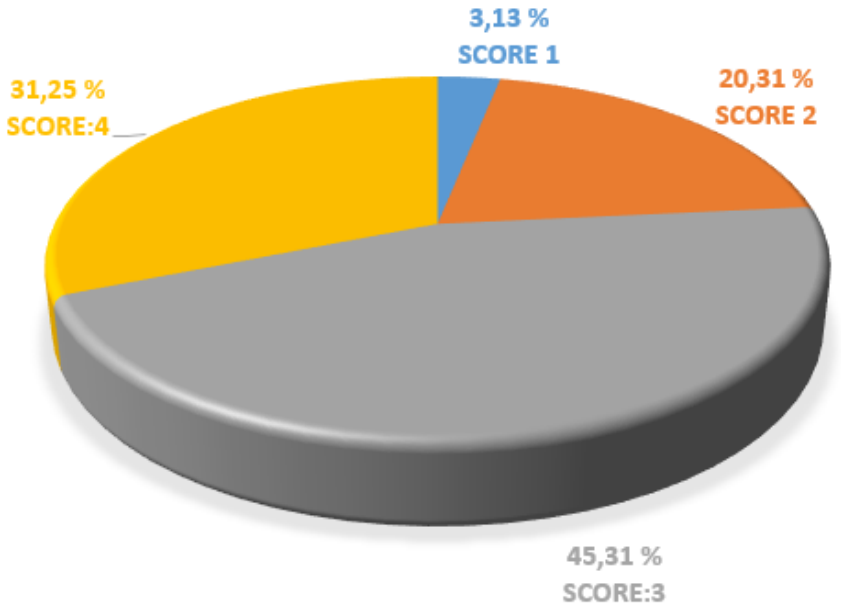


Figure 23: Port-city and human element

9. **Financing and funding.**
These topics refer to all financial and funding issues of all private actors and authorities

operating in the ports. This includes also funding by local, national, European and international authorities. It covers both the initial investment costs (CAPEX) and recurrent costs (OPEX): This is the only tactical objective which received a no importance score (by 1.56% of respondents).

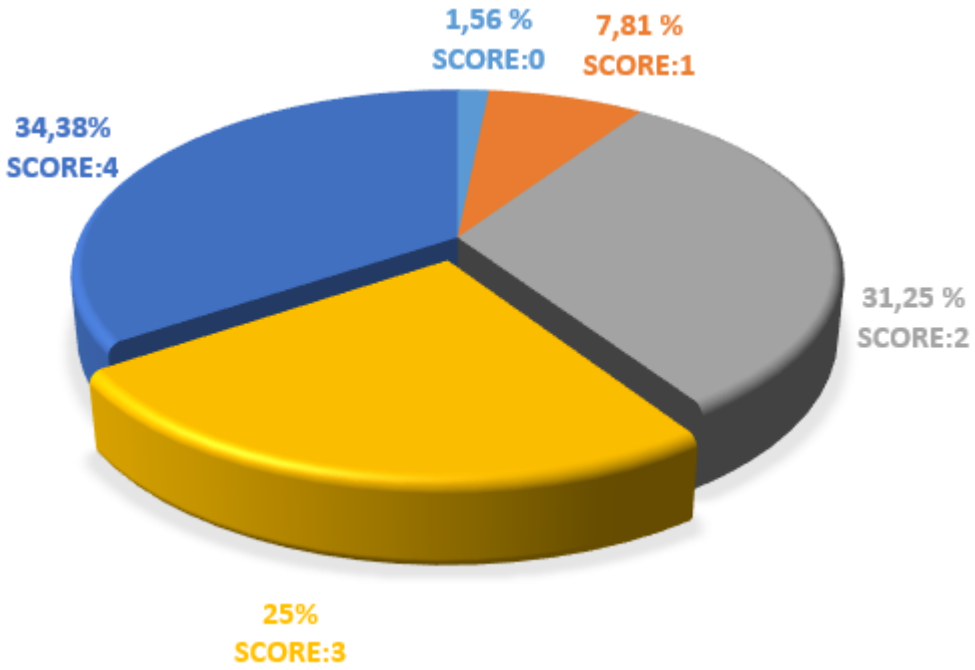


Figure 24: Financing and funding

Summary:

1. Digitalisation and digital transformation is the topic to which it was attributed the highest importance by the majority of the interviewed stakeholders (70.31%);
2. The second topic that is considered as the most important is sustainability (68.75%);
3. The third topic that is considered as the most important is hinterland, multi/synchro modality, supply chain integration, modal shift (65.08%);
4. Financing and funding is the only topic which received a 0 importance score by the 1.56% of respondents.

6.3.1.3.3 Vision of respondents about Port of the Future

The high importance attributed by the stakeholders to the above-mentioned topics, is fully confirmed and deeply explored in the open questions section, where they were asked to define their own vision on the Port of the Future.

In this section we summarise the answers to the question "*Please describe your idea about the Port of the Future - meant as near future (2030)*" (Table 43: Survey responses to the port of the future open question on page 255). The first column of this table collects all the answers received. The main key words related to these answers have been included in the second column. The third column presents the topics which can be associated and that are more linked to these key words. To give an example: if a stakeholder's vision of the Port of the Future refers to a less polluted port, such a statement has been connected to the key word "less pollution" which, in turn, is connected to the sustainability topic. Analysing the answers and the related keywords, it was noted that these answers can be associated to the following groups, meaning that some answers can be connected to only one tactical objective (e.g. sustainability), while

other can be connected to two tactical objectives (e.g. Sustainability on the one hand and digitalisation and digital transformation on the other hand), up to a maximum of 3 topics.

1. Sustainability and digitalisation and digital transformation;
2. Sustainability;
3. Port-city and human element;
4. Digitalisation and digital transformation;
5. Sustainability and safety and security;
6. Performance and quality of service;
7. Hinterland, multi/synchro modality, supply chain integration, modal shift;
8. Sustainability and hinterland, multi/synchro modality, supply chain integration, modal shift;
9. Sustainability and port-city and human element;
10. Sustainability and digitalisation and digital transformation and port-city and human element.

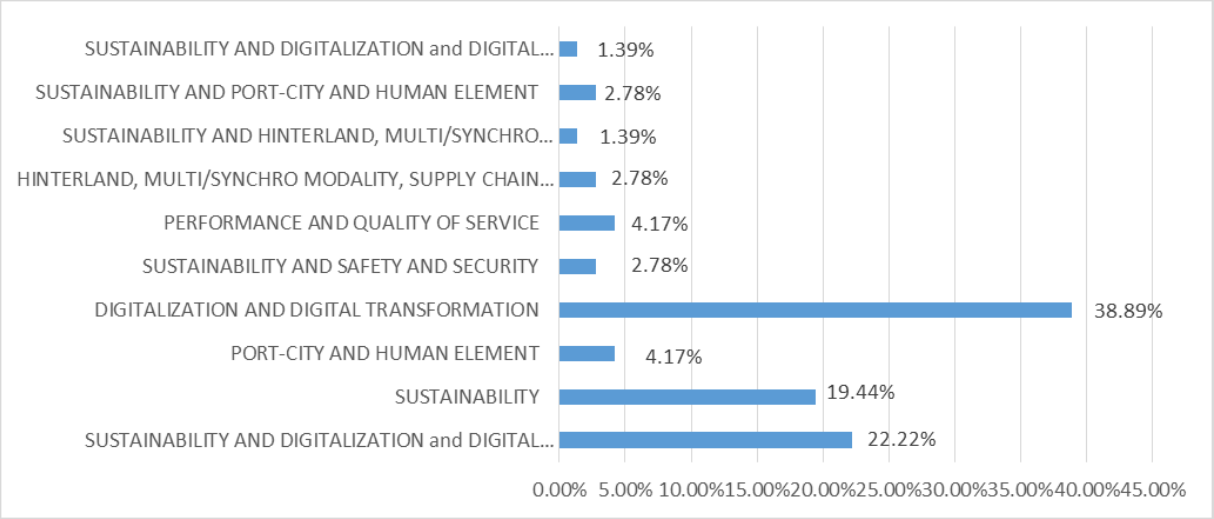


Figure 25: Port of the Future and topics

As shown in the above graphic, the vast majority of respondents (38.89%) gave answers related to the digitalisation and digital transformation topic; 22.22% of them have a vision of the port of the future which can be linked to both sustainability and digitalisation and digital transformation topics; followed by a group of stakeholders (19.44%) for which sustainability is the main topic.

The recurrent key words refer to environment and digitalisation. The port of the future is, for the majority of stakeholders, a less polluted, environmentally-friendly, green, carbon neutral, zero emission and connected, digital, digitised, smart and interoperable port.

Environmental concerns and the importance of seizing the opportunities provided by digitalization and digital transformation are further confirmed and elaborated in the question where stakeholders were asked to describe the most important external factors and market trends, which have an impact on their vision of the Port of The Future. Recurrent mentioned market trends are technologies such as block chain, internet of things, 5G, machine learning, big data and cybersecurity.

See Table 43: Survey responses to the port of the future open question on page 255 for a list of the answers given.

6.3.1.3.4 Vision of respondents about external factors and market trends

The survey asked the participants about the most important external factors and market trends having an impact on the port of the future. The answers were structured according to the following categories:

1. Regulatory issues and policies;
2. Environmental issues;
3. Political issues;
4. Digitalization;
5. Economic issues;
6. Historical issues

More than half of respondents gave answers which can be associated to the "Digitalisation" category, followed by regulatory issues and policies (17%) and Environmental issues (15%).

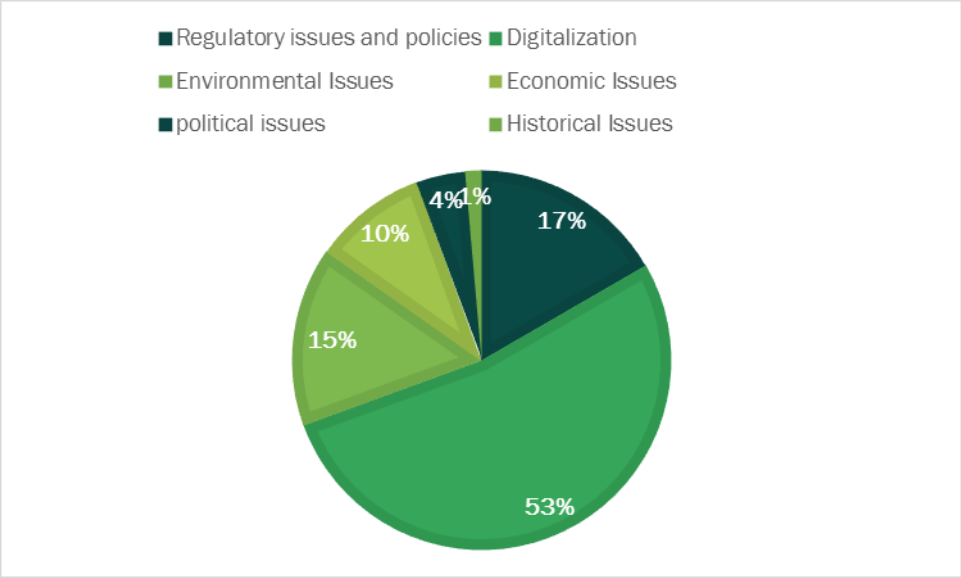


Figure 26: External factors and market trends, main categories

See Table 44: Survey responses to external factors and market trends question on page 261 for a list of the answers given.

6.3.1.3.5 Conclusions about the survey

The objectives of the survey were to gain a greater understanding of how the port of the future concept relates to the respondents work operation, their organisation and the wider community. The abovementioned results showed that there is almost unanimity among stakeholders in believing that sustainability and digitalisation and digital transformation are the most important topics for the port of the future.

Sustainability, in the stakeholders' vision, has different meanings. A sustainable port is less polluting, greener, environmentally friendly and emissions are zero or as low as possible. Digitalisation and digital transformation has also different meanings and embraces the adoption of several technologies such as blockchain and internet of things to mention only those. Cybersecurity is considered an important precondition for digitalisation and digital transformation.

These results are of great importance because they made the voice of the stakeholders heard and represent the basis for further investigations and in-depth analyses.

6.3.2 Bilateral meetings with DGs

In order to complement and get further ideas for future consultations and main areas of interest related to the Port of the Future, the abovementioned survey has been discussed with several DGs through bilateral meetings. Additional consultations may be carried out in the next months to further explore the outputs from the DGs.

The main conclusions from the meetings are summarised below:

1. DG RTD, 25th April 2018
    a. Participants: Agnieska Zaplatka, Peter Crowley, Policy officers UNIT H2- surface transport. Waterborne platform.
    b. The Directorate General for Research and Innovation stressed the importance of including the Expert Group of Port Forum in the survey. More in details: ESPO, EFIP, FEPORT, MEDCRUISE, EMPA, ECSA, CLECAT, BPO and Euroshore.
2. DG Home-25th April 2018
    a. Participants: Paolo Salieri-Michele Martino-Dir. B Migration, Mobility and Innovation-Unit 4-Innovation and Industry for Security
    b. Main interests of DG Home:
        i. Implementation of the integrated maritime policy;
        ii. Border controls for both passengers and goods;
        iii. Permanent evaluation of the Schengen area;
        iv. Efficiency of external borders;
        v. Suitability of port facilities dedicated to security Schengen evaluation to make ports as safe as airports.
    c. Some solutions of interest:
        i. Technological solutions for ports that are recognised as boarding crossing points;
        ii. Mobile biometry flow management;
        iii. Automated border crossing point with simplified and user-friendly access, dedicated interoperability systems;
        iv. Solutions to improve the efficiency of organisational capabilities for border controls and information controls-connectivity systems within ports;
        v. Strong interest in risk analysis systems, development of IBM systems or the homogenisation of procedures in the EU

    They highlighted how often in some ports (e.g. Italian ports) there are problems and no risk analysis is performed on the border crossing in particular related to passengers/refugees coming from Far East and North Africa. For this reason, a joint analysis could increase the level of forecast.
3. DG CLIMA, 25th April 2018
    a. Participants: Hans-Erink Siernik Dir B — European and International Carbon Markets-Unit 3. International Carbon Market, Aviation and Maritime
    b. All the subjects related to the low carbon economy are of interest
        i. Air quality;

ii. Slow steaming;
iii. Carbon footprint;
iv. Port transition in terms of climate change;
v. Sustainable shipping vs sustainable incentives.

c. DG Clima expressed its availability to follow the project

4. DG MARE, 25th April 2018
   a. Participants: Felix Leinemann-Dir A — Maritime Policy and Blue Economy Unit 2. Blue Economy Sectors, Aquaculture and Maritime Spatial Planning
   b. Stakeholders to involve according to DG MARE:
      i. Fisheries associations;
      ii. Offshore companies;
      iii. Wind ports.
5. EASME, 25th April 2018
   a. Participants: Solon Mias Unit 1 Life Environment
   b. Subjects of interest to be explored:
      i. Dredging;
      ii. Waste management;
      iii. Vessel maintenance;
      iv. Noise;
      v. Change behaviours;
      vi. Reduction of human pressure;
      vii. Maintenance biology system;
      viii. Development of industrial technology in ports.
   c. They are strongly interested in risk analysis in environmental terms (sustainability-financing-development of technology).
   d. Stakeholders to involve according to EASME:
      i. Hand users: military-fishery-security;
      ii. Agencies: EMSA-JRC-EMU;
      iii. Industrial partners: autonomous shipping.
6. DG DEVCO, 20th June 2018
   a. Participants: Meropi Paneli-Dir.C Planet and Prosperity-Unit 6 Sustainable energy, climate change
   b. Priority subjects.
      i. All the issues related to pollution in the ports;
      ii. Rapid and efficient management of loads to reduce the stay in the port, including personnel training aspects;
      iii. All the clean and renewable infrastructures for the production of electricity in port;
      iv. Common standards for energy transition;
      v. The survey of data on the transport corridors with China and the Far EAST ports.
7. DG TAXUD+DG MOVE, 31st July 2018

a. Participants: -Irena Mulica, DG TAXUD-DIR.B- Digital delivery of customs and taxation policies Process data custom-unit 2 Electronic customs project management.-Roberto Alongi-DG MOVE-Deputy General-Directorate D Waterborne-Unit 1. Maritime, Transport &logistic.
b. Priority subjects:
    i. Possible interconnection with the SESAR 2020 project on the security maritime area;
    ii. they see more strategic effects on cargo owners and the monitoring of goods

8. DG TAXUD, 1st August 2018
    a. Participants: A3 Risk Management and Security-Wilhelmus VAN-HEESWIJK
    b. Priority subjects:
        i. Risk analysis;
        ii. New goods increasing;
        iii. Data processing/ securing;
        iv. Transition number adoption;
        v. Detection data (process training to adapt the procedures at technological level);
        vi. Risk management action plan;
        vii. Difficulty in dialogue between stakeholders for operations in port;
        viii. Blockchain;
        ix. Port authority control;
        x. Legal activity shift equipment.

6.4 Task 3: Traffic analysis and forecast

This section covers the outputs and outcomes of WP1 task3 « Maritime traffic analysis and forecast review», resulting in deliverable D1.3

6.4.1 Introduction

In order to identify future trends and set priorities with regard to port development, it is necessary to appraise the structure of the European port landscape and the diversity among ports. This concerns the traffic volume in terms of tonnes or ship calls, but also the cargo structure. Based on data regularly collected by Eurostat, a database has been set up that helps filtering out ports that fulfil certain criteria, i.e. container ports, cruise ports, traffic density of, e.g., at least 50 ship calls per day, etc. These filtering possibilities will help identifying the number of ports to which a certain measure could be applied. This will form the basis for the Transferability Index to be developed in Work Package 3. Section 6.4.2 Maritime traffic analysis124 gives an overview of the major results of this analysis.

The detailed data-based analysis of EU ports will help to classify ports not only by size in terms of tonnes, but also by:

1. Traffic type;
2. Major commodities;
3. Ship types;
4. Ship sizes;
5. Density of ship traffic (number of ship calls);

6. Surrounding population density (greenfield vs. city ports);
7. Hinterland connections (distance to highway, distance to TEN-T network);
8. Outreach area (population within 150 km).

The database will cover all TEN-T core and comprehensive network ports, but also various non-TEN-T ports. The base year of the analysis will be 2017. For cargo traffic and ship traffic, a time series analysis will be performed to identify relevant structural trends.

Section 6.4.3 Forecast review on page 129 indicates current trends in major maritime market segments such as dry bulks, liquid bulks, containers and the like. These trends must be considered when approaching the "Ports of the Future" concept. Most notably, some segments will face growing trade volumes and hence capacity issues while others may actually see a decline of volumes, leading to issues such as reconversion of existing terminals and areas.

Building upon the status-quo analysis and the trends discerned therein, the forecast review identifies foreseeable structural changes in the port landscape. The aim is an adjustment of the database with regard to the different criteria. This will include:

1. Growth trends for specific cargo segments (e.g. oil, coal, containers)
2. Regional growth trends, incl. other structural changes

The different growth trends generally do not change the number of ports that could benefit from a certain measure (if the cargo segments and operator strategies stay the same). The aim of the analysis are hence not forecasts for single ports, but rather an adjustment of the number of ports in the different categories based on a focus on disruptions.

Explanatory note on sources used:

The studies mentioned in the proposal have been considered and analyzed. A general issue with these sources however was that they either did not provide forecast volumes or trends or have been published in 2015 when the radical paradigm changes in one of the largest maritime traded commodities has simply not been foreseeable. In addition, especially with regard to fossil fuels, these studies (e.g. Study on the Analysis and Evolution of International and EU Shipping) are often vague or contain no guidance on trends for volumes. This gap has been filled with the help of the industry expertise from BP (biased as they might be, BP's statistical publications are considered as some of the most relevant industry assessments by shipping community experts within Europe). The scenarios outlined have been reduced to a combination of items which seems most plausible. Hence, chapter 1.3 is mainly based on

1. Various issues of Drewrys „Dry Bulk Forecaster"from 2014 until 2018 (this is relevant because only the very last issues – according to ISLs assessment – fully reflect the fundamental paradigm change that the energy markets and here in particular the commodity "steam coal" (or to be more specific: the seaborne trade growth assessments for steam coal) have undergone. Drewry's Bulk studies also offer an up to date insight into the development potentials of other bulk commodities, which are reflected against the development stage of the European economies as well as the seaborne trade development model by Stopford/Rostow (Maritime Economics, 2009), which effectively also has been a source of the findings
2. The most recent edition of Drewry's Annual Container Forecast and Market Review has been used to comment on the growth potentials of container handling in Europe's port ranges (instead of Drewry's Container Terminal Operators Review)
3. BP's latest long-term forecast of fossil fuel production & consumption within Europe (has been used to run a supply/demand-balance analysis for the major fossil fuels consumed in Europe and to deduct infrastructure specific needs)

4. The long-lasting experience of the ISL in analyzing port handling developments, traffic structures and future handling potentials of containerized, roro and bulk/neo bulk commodities.
5. An ISL discussion paper which is about to be released shortly, forecasting the structure of the fully cellular container fleet

6.4.2 Maritime traffic analysis

6.4.2.1 Total traffic by ports and maritime regions 2017

In 2016, Eurostat listed 1,382 seaports,[11] of which

1. 956 ports reported cargo traffic (3.9 billion tonnes total);
2. 427 ports were considered “main ports” (3.7 billion tonnes total);
3. 957 ports reported passenger traffic (396 million passengers total)

The size distribution and classification of cargo handling ports and passenger ports is analysed below. About two thirds of the total cargo handled had origin or destination in short sea origins or destinations while only one third was direct deep-sea traffic. The majority of trade is within basins or between neighbouring basins such as the North Sea and Baltic Sea area.

6.4.2.1.1 Cargo-handling ports

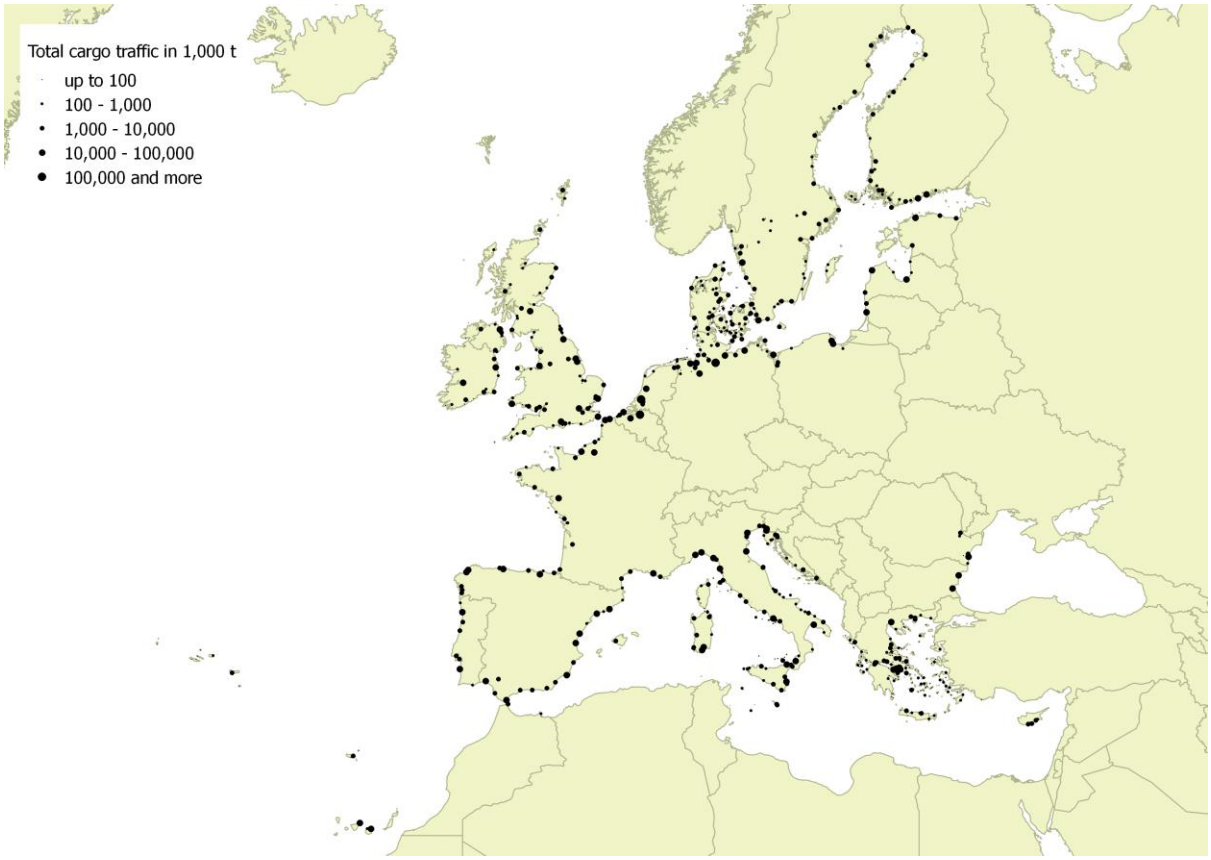


Figure 27: European ports by size class (cargo traffic)

[11] As of 29 July 2018, data for 2017 is not yet complete.

There are only three ports having handled more than 100 million tonnes in 2016 (Rotterdam, Antwerp, and Hamburg), but already 80 ports with a traffic volume between 10 and 100 million tonnes. The categories below count more than 200 ports each, indicating a rather balanced distribution of port sizes.

Detailed cargo data is given for 427 so-called 'main ports' only, which includes all TEN-T core and comprehensive network ports except Ullapool (UK, 280,000 tonnes handled in 2016). With 3.7 billion tonnes, the main ports accounted for 97% of the total EU maritime traffic in 2016.

The largest traffic volume passes through the main ports in the North Sea area (1.8 billion tonnes in 2017), followed by the Mediterranean (1.1 billion tonnes) and the Baltic Sea area (0.6 million tonnes.

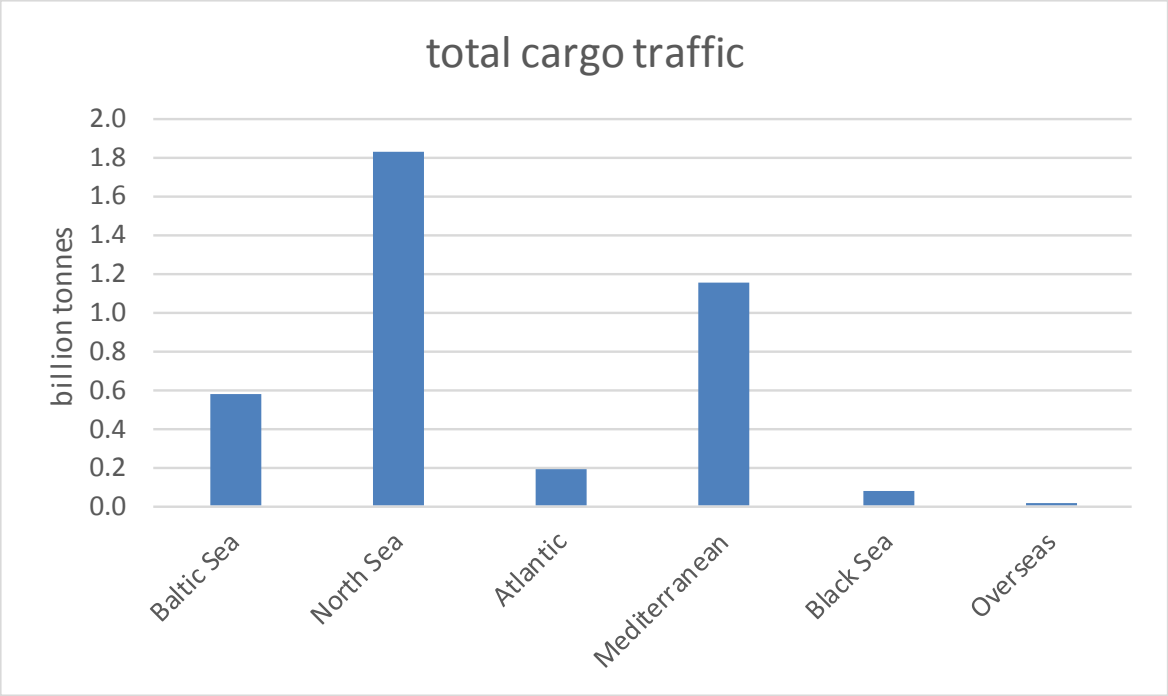


Figure 28: Cargo traffic in major European port ranges

Over the past 10 years (i.e. between 2017 and the pre-crisis year 2007), traffic was least dynamic in the North Range (-0.2% per year), while the Atlantic Coast, the Baltic Sea and the Black grew above average.

In terms of tonnes, the most important cargo type is liquid bulk (1.4 billion tonnes), followed by dry bulk and container traffic (0.9 billion each). The gap between dry bulk traffic and container traffic has narrowed considerably during the past 10 years. In 2007, the total dry bulk volume was 40% higher than the container volume. In 2017, the difference was less than one per cent and it is likely that container traffic will soon surpass dry bulk traffic in EU ports due to the higher growth expectations (see Forecast Review).

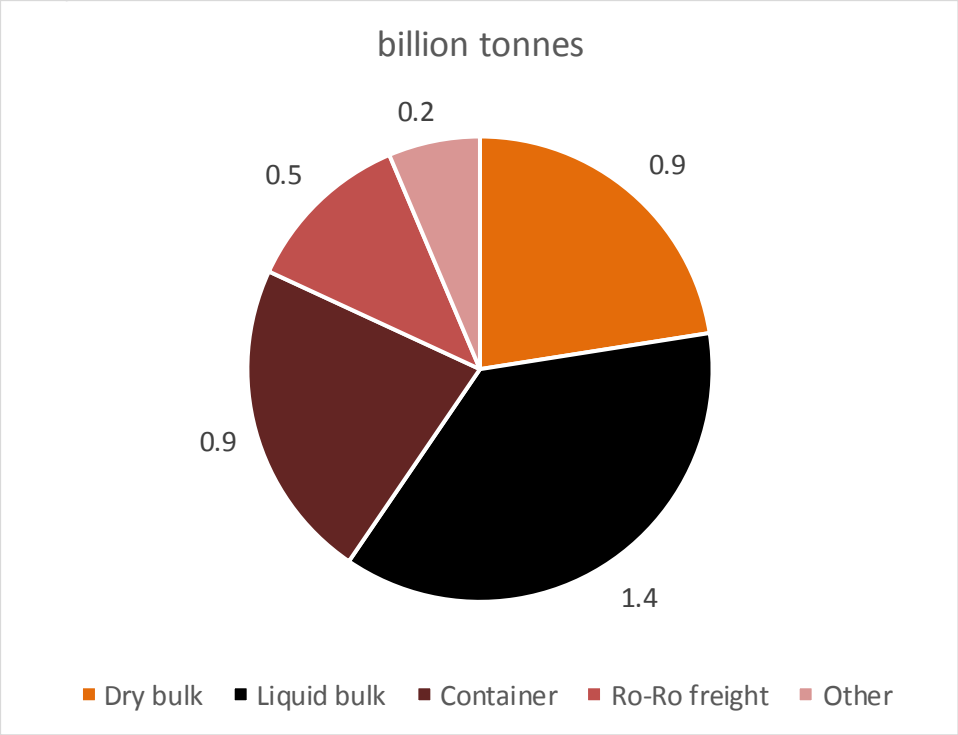


Figure 29: Cargo traffic in major European port ranges

6.4.2.1.2 Passenger ports

While cargo handling ports can be found all along the European coasts, maritime passenger traffic concentrates on short distances (except cruise shipping) and is hence particularly dense in major straits such as the Channel, the Fehmarn belt or the Strait of Gibraltar. In addition, passenger ferries connect islands with the mainland and are hence particularly dense in Greece, Croatia or Denmark, for example.

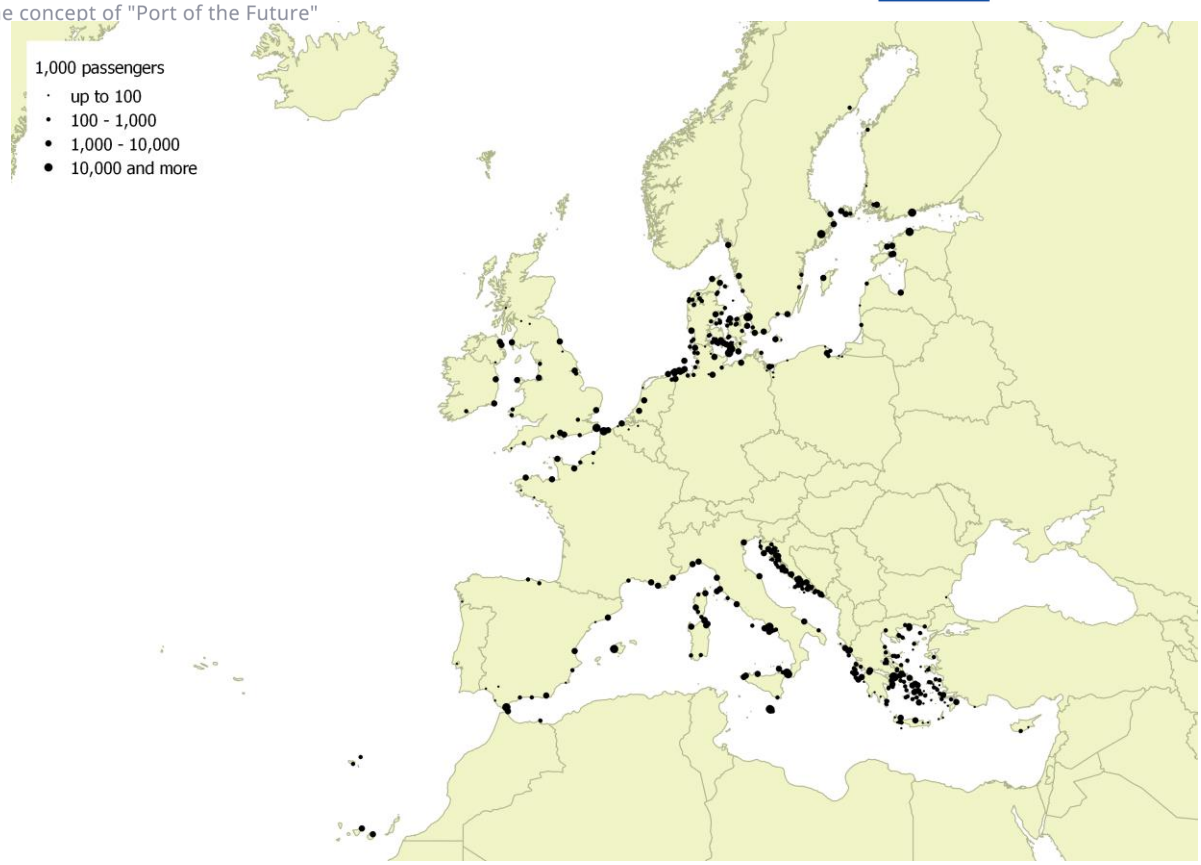


Figure 30: European ports by size class (passenger traffic)

Around half of the ports (480) having reported passenger traffic registered 1,000 passengers or less in 2016. The second-largest group is composed of 225 ports with a passenger volume between 100,000 and one million passengers. Another 105 ports had more than 1,000,000 passengers, two out of which (Dover and Helsinki) counted more than 10,000,000. In total, almost 400 million passengers passed through EU ports, including 12.9 million cruise passengers.[12]

6.4.2.2 *Structural port characteristics*

Besides cargo and passenger volume, ports are characterised by their geographical position and the surrounding area. Measures concerning the port-city relationships are most relevant for ports in populated areas. On the other hand, some measures may be specific for ports in sparsely-populated areas with low outreach. Another important factor is the distance to the European Core Network Corridors. These characteristics have been identified for the sample ports in order to provide additional filtering options for the Transferability Index.

6.4.2.2.1 Population density and outreach area

Among the 1,256 ports for which a unique geographical location could be identified,[13] 548 ports (44% of the ports) counted less than 10,000 inhabitants in a radius of 5 kilometres. In total, 1074 ports (roughly 85%) count less than 100,000 inhabitants. For these ports, measures

[12] Passengers travelling between two EU ports are counted twice.
[13] i.e. excluding ports grouped by Eurostat for statistical reasons such as “Zeekanaal Brussel-Schelde ports”

targeted to densely populated areas may be less relevant. The remaining 15%, however, account for two thirds of the population in port vicinities.[14]

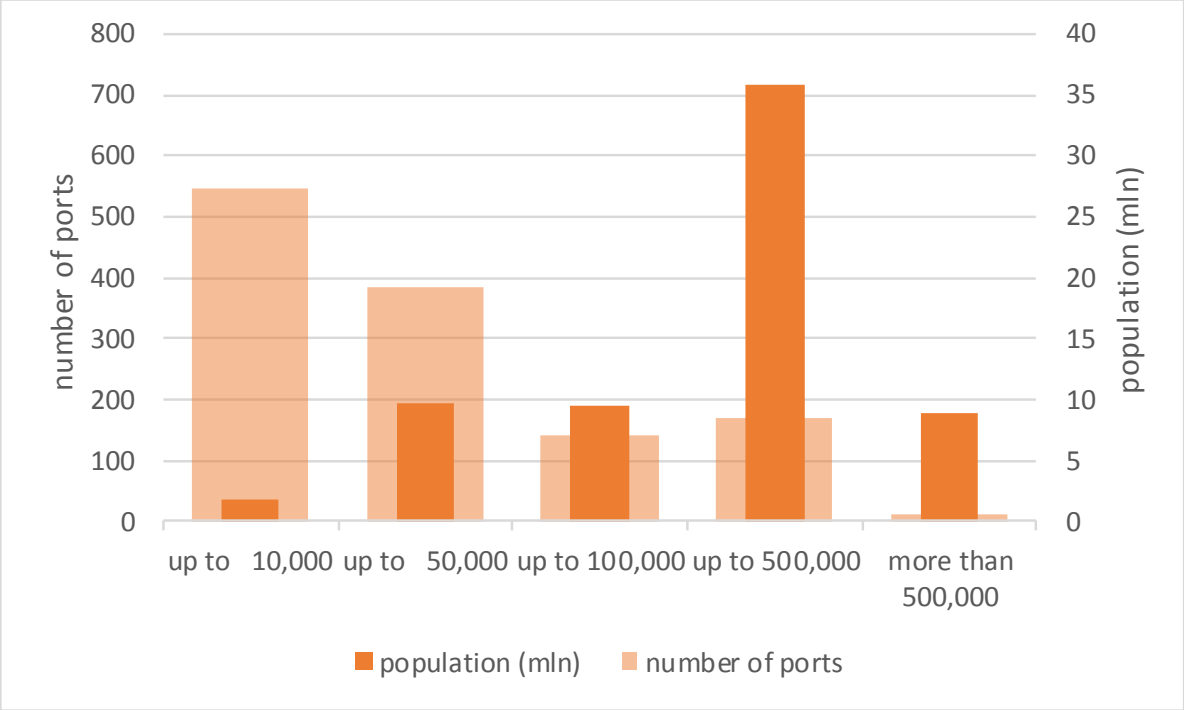


Figure 31: European ports: population within a radius of 5 km[15]

Some measures are specific to ports in large cities with large local traffic volumes (e.g. dynamic traffic lights and real-time traffic information). These measures would be transferable to around 200 ports. Other port-city relations measures like protection against noise are relevant also for ports in smaller cities, particularly if the measures are not very costly to implement. Additional filtering will be possible with different distances.

In addition to the direct vicinity, ports can also be characterised by their outreach areas. Ports with a large population in the short-distance range (typically a radius of 150km) have a high potential for 'local consumption' traffic. High shares of this local and regional traffic will be transported by truck. Other ports may have a stronger focus on long-distance traffic with intermodal hinterland chains.

6.4.2.2.2 Integration into Core Network Corridors

As of spring 2018, there are 106 TEN-T Core Network ports, of which 84 are situated on one of the nine Core Network Corridors. The TEN-T Comprehensive Network comprises another 225 seaports. The remaining 1,000+ seaports are not part of the TEN-T network. Some of them have a high share of domestic traffic (i.e. inter-island traffic), others fill a regional gap or market niche. The 'Port of the future' per se is not limited to TEN-T ports, so all ports will be included in the Transferability Index unless measures are explicitly targeted towards the Corridors.

[14] double counting of inhabitants in closeby ports
[15] Source: ISL based on Eurostat population grid

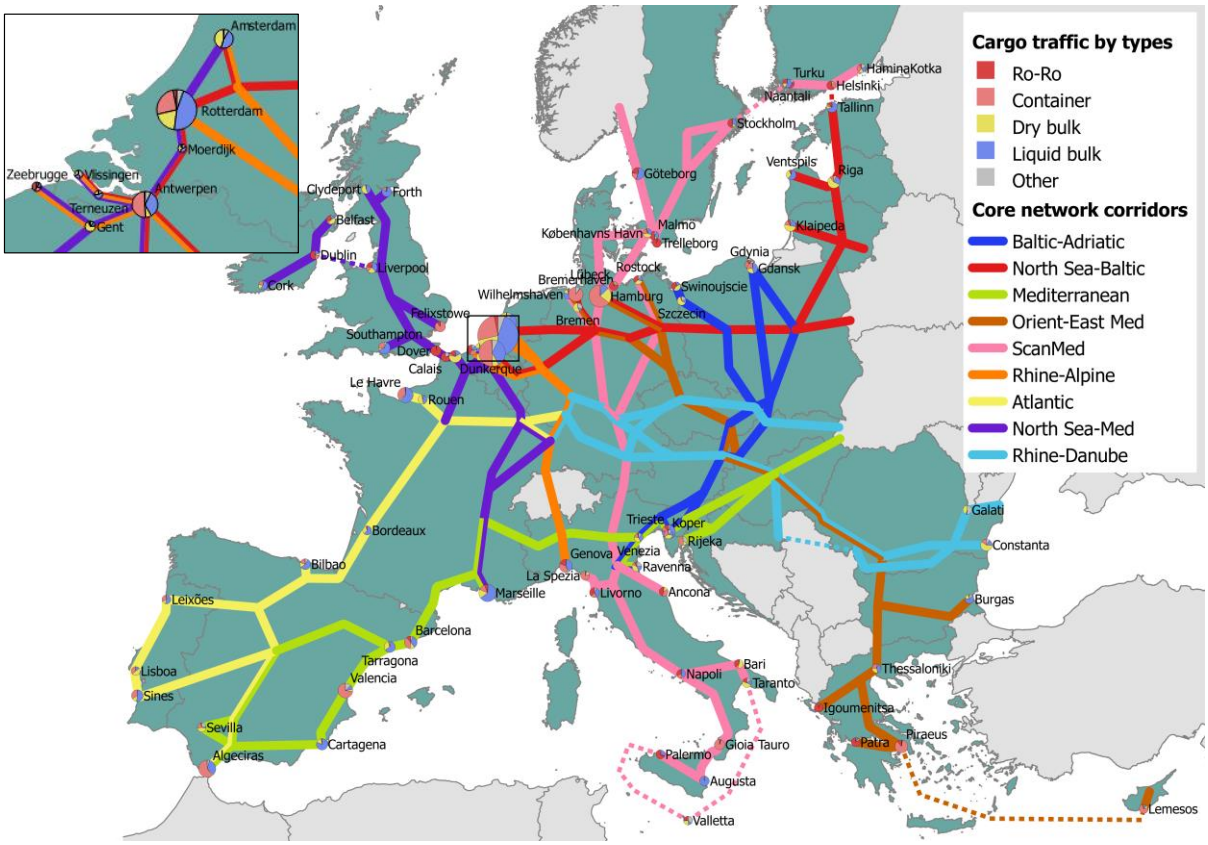


Figure 32: Core Network Corridors and Core Network Corridor seaports[16]

Many of the ports that are not included in the Core or Comprehensive Network are situated close to one of the Corridors. The distance to the next Core Network Corridor will be determined for each port so the possibility of linking the non-CNC ports to the core network can be assessed.

6.4.3 Forecast review

6.4.3.1 Container trade

Until the global financial crisis struck hard in 2008, shipping of commodities in containers presented itself to be the most pressuring issue for port development with volumes doubling roughly every 7 to 10 years and growth rates even accelerating sharply after Chinas WTO ascension in 2001. This has induced a significant amount of expansion projects, particularly within the Major North Range ports. Today as the growth has slowed markedly and terminal overcapacities are a reality, capacity concerns are muted especially in light of changing transport strategies i.e. the implementation of more direct calls as emerging markets have matured and volumes justified the switch from hub and spoke strategies to direct calls or the expected revival of the rail connection to China.

[16] Source: ISL based on Eurostat maritime traffic statistics

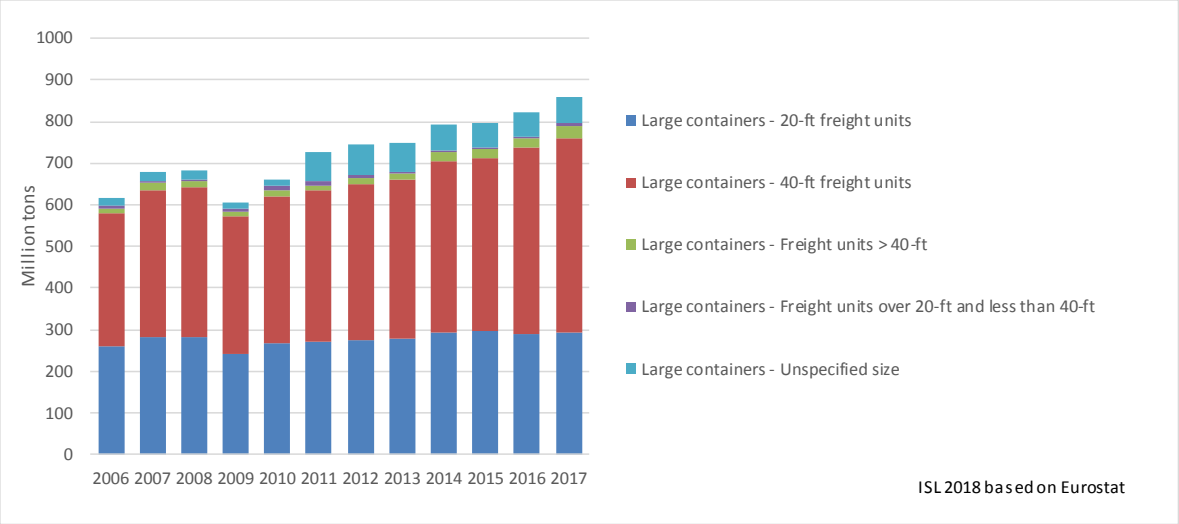


Figure 33: Container Handling in European Ports 2006-2017

After the crisis, it took two years for the European container handling segment as a whole to recover but growth has recently been anemic (compared to the years before 2008) as the relocation of manufacturing jobs to other countries (predominantly China) has reached saturation levels, transshipment demand from Russia has been hit by falling oil prices and imposed sanctions on a global level, and de-globalization became more pronounced with more trade barriers installed than have been removed during the last 10 years on a global level.

Looking forward, it is easy to attest that, in a world in which most trade barriers have been removed already and initiatives to remove additional trade barriers are met with greater skepticism, additional trade volumes would need to be generated from additional economic activity. This however comes with the issues that the already mature economies of Western Europe are set to grow at low rates and also that consumers nowadays are being offered a multitude of options to spend additional income – none of which are all that prone to fuel containerised trade. When the following points are taken into consideration, it becomes clear that long-run growth prospects for container handling in North Sea container ports are subdued:

1. Cargo owners will benefit from additional hub and transshipment activities in the Baltic Sea;
2. The new interpretation of the silk road will also provide – particularly Chinese exporters – with a fast and competitive access to the Eurozone economic heavy weights

A forecast from Drewry Shipping Consultants looks at total port handling volumes and differentiates into individual sub markets. Drewry believes that the container handling demand will grow between 2.7 and 3.1% in the years 2018-2021 with the Eastern Med/Black Sea market and the Scandinavia/Baltic market slightly outperforming this growth in terms of dynamic.

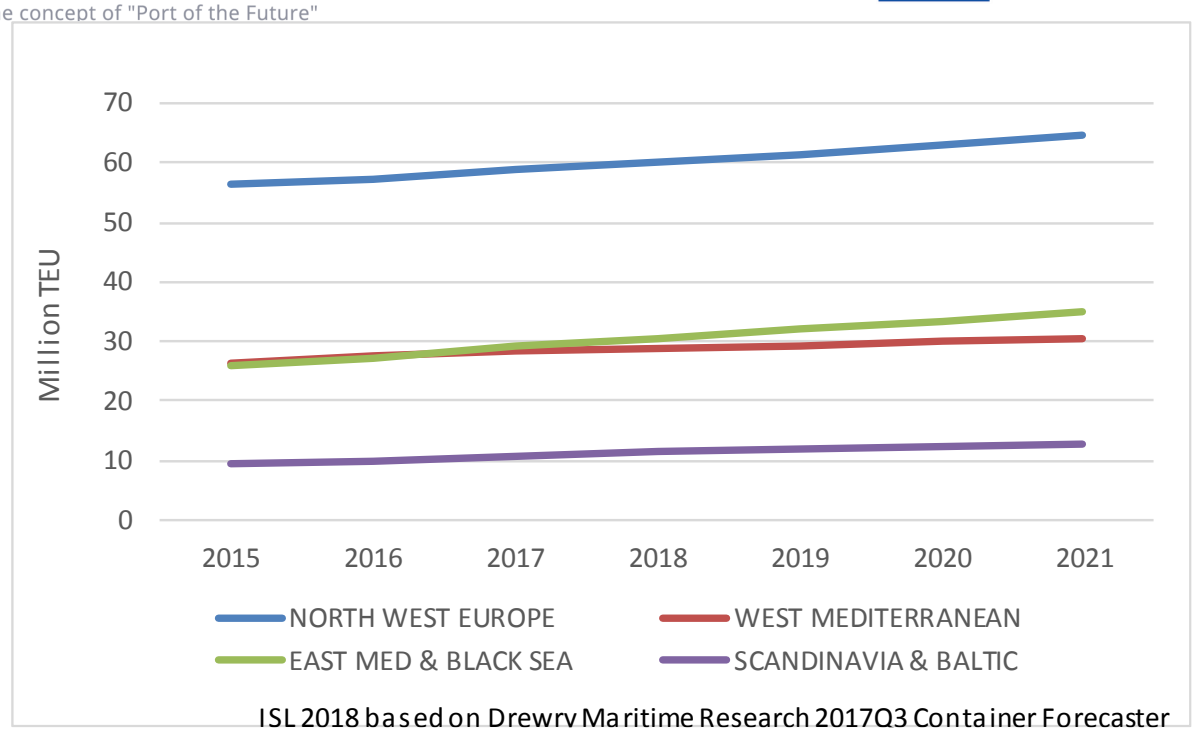


Figure 34: Forecast of Container Growth by European Regions 2017-2021

When it comes to ship sizes, the fully cellular container fleet during the last decades has behaved fundamentally different from the already matured dry- and liquid bulk fleets. For the latter two, a clear segmentation into size classes has been observable for years now. Thereby the individual segments recorded a minimal and very gradual expansion of dwt capacity over time as engineers have been finding clever ways to optimize how many tons of cargo any vessel could hold at given beam, draught and width.

The fully cellular containership fleet has behaved different in this regard insofar as it has brought entirely new size classes every 7-11 years, each time outperforming previously seen dimension by far. The current upper limit if this are vessels with a length of 400m, a beam of close to 60m an draughts between 16m and 16.5m, listed with a nominal capacity of up to 22,000 TEU. A subset of ordered vessels is believed by industry experts from Alphaliner to potentially achieve a beam of as much as 62.5m. ISL believes that in the last 30 years – give or take – it has been a combination of the regular double-digit demand growth of trade lanes and the constant introduction of ever larger ships that has led to the fully cellular fleet being – until today – a somewhat homogenous pulpy mass with vessels of all sizes and little recognizable segmentation. However, studying recent order behaviour, ISL has concluded that as the liner shipping markets are maturing and the growth is slowing down, this fleet is to become more segmented into precise segments. The effects of which will not be seen for a couple of years to come though. This results from the fact that the ordering activity of recent years shows a clear focus on selected segments while the existing fleet is still relatively young and distributed from the smallest to the very largest ships.

The following table includes ISL's most recent fully cellular fleet forecast and the colouring indicates the expected segmentation by nominal TEU capacities, which will become clearer around the year 2030 as the older and wildly distributed vessels are being "combed" out gradually. This phenomenon is something that is – according to ISLs assessment – unique for the fully cellular containership fleet. The dry bulk and liquid bulk fleets are already very clearly segmented and have already tested and accepted their individual commercial upper limits to dwt capacity.

	Fully Cellular Container Ship Fleet Forecast *in million TEU*			Average annual growth of capacity (rounded)		
	Start 2020	Start 2025	Start 2030	2018-2020	2020-2025	2025-2030
01: 0 - 999 TEU	**0.6**	**0.5**	**0.5**	-1%	-2%	-2%
02: 1000 - 1999 TEU	**1.8**	**2.1**	**2.3**	2%	3%	2%
03: 2000 - 2999 TEU	**1.8**	**2.2**	**2.5**	6%	5%	3%
04: 3000 - 3999 TEU	**0.9**	**1.0**	**1.1**	4%	3%	2%
05: 4000 - 4999 TEU	**2.5**	**2.4**	**2.2**	0%	-1%	-2%
06: 5000 - 5999 TEU	**1.6**	**1.5**	**1.4**	0%	-1%	-1%
07: 6000 - 6999 TEU	**1.5**	**1.4**	**1.3**	0%	-1%	-3%
08: 7000 - 7999 TEU	**0.3**	**0.3**	**0.3**	0%	-1%	-2%
09: 8000 - 8999 TEU	**2.6**	**2.0**	**1.9**	0%	-6%	0%
10: 9000 - 9999 TEU	**1.6**	**2.0**	**2.4**	0%	5%	4%
11: 10000 - 10999 TEU	**0.9**	**1.1**	**1.3**	4%	5%	3%
12: 11000 - 11999 TEU	**0.7**	**1.0**	**1.3**	20%	8%	5%
13: 12000 - 12999 TEU	**0.1**	**0.2**	**0.3**	0%	8%	5%
14: 13000 - 13999 TEU	**2.1**	**2.8**	**3.4**	5%	6%	4%
15: 14000 - 14999 TEU	**1.2**	**1.7**	**1.8**	17%	6%	2%
16: 15000 - 15999 TEU	**0.3**	**0.4**	**0.6**	17%	9%	8%
17: 16000 - 16999 TEU	**0.0**	**0.0**	**0.0**	0%	0%	0%
18: 17000 - 17999 TEU	**0.2**	**0.2**	**0.2**	0%	0%	0%
19: 18000 - 18999 TEU	**0.5**	**0.7**	**0.7**	4%	6%	0%
20: 19000 - 19999 TEU	**0.6**	**0.9**	**0.9**	11%	8%	0%
21: 20000 - 20999 TEU	**0.7**	**1.4**	**1.4**	95%	15%	0%
22: 21000 - 21999 TEU	**0.1**	**0.4**	**0.4**	10%	23%	0%
23: 22000 TEU +	**0.2**	**1.1**	**4.2**	n.v.	45%	30%
Total (million TEU)	**22.83**	**27.34**	**32.49**	**5%**	**4%**	**4%**

Source: ISL Forecast May 2018

Figure 35: Forecast of Fully Cellular Container Fleet until 2030

The container market is somewhat special in that it regularly enjoys the detailed medium-term attention of analysts, trying to understand the medium outlook in relatively detailed regional aggregates (as above). When it comes to other commodities, forecasts of industry observers will often aggregate stronger. This is the reason, why the following discussions will need to consider more broadly based global outlooks and demand drivers.

6.4.3.2 Dry Bulk Cargoes

According to Eurostat information, European ports handle more than one billion tons of dry bulk commodities (including general cargoes, which are not containerized or ro-ro cargoes) annually. During the time of the industrialization, these commodity flows grew almost hand in hand with economic activity but ever since the economies matured and additional growth took place in the less resource demanding service sector, traffic growth stalled. Thereby the commodities do possess a fundamentally different outlook which warrants for individual discussion.

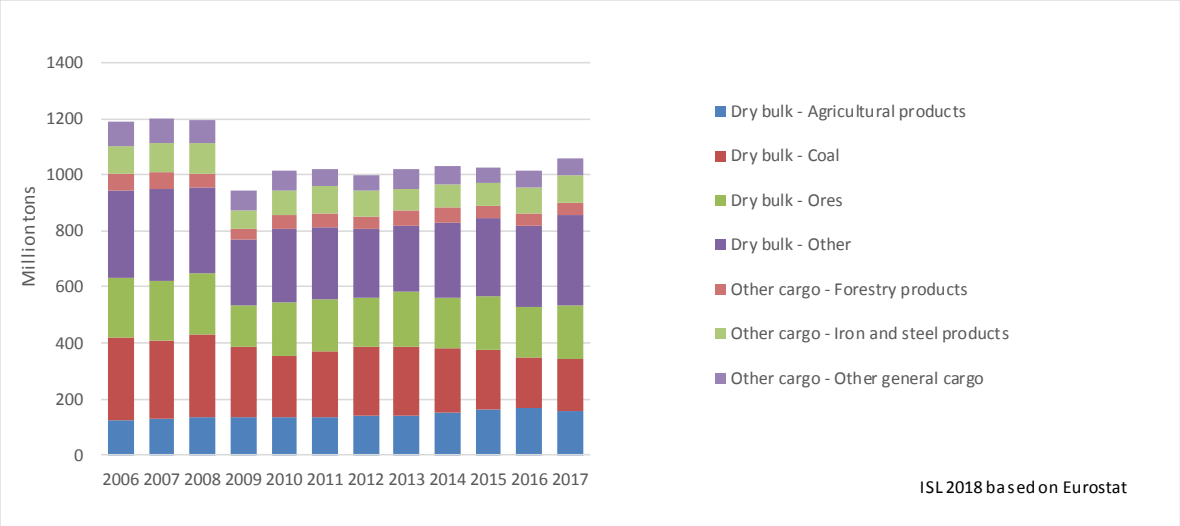


Figure 36: Dry Bulks and Non Ro-Ro/Container- other Dry Cargoes in European ports 2006-2017

6.4.3.2.1 Ores

The trade in ores – which except for Sweden is regularly a net import – stagnated long ago. However, the European steel industry has so far been able to tackle competition from low wage countries and is expected to continue to do so for the foreseeable future. Yet it seems unlikely, that additional sites will be set up in the high wage/environmental standard European countries. So, the most realistic outlook for the trade of iron ore is a constant development at given levels. As far as the (much smaller) bauxite import is concerned, the same reasoning applies.

6.4.3.2.2 Coal

Coal imported via European ports consists of steam coal and coking coal – both have different demand drivers. Until 2008, the imports of steam coal actually showed a regular growth as domestic production of coal was abandoned to rely on cheaper (and often better quality - i.e. higher caloric value) maritime imports. On a global level, it seems that this commodity has peaked due to global warming concerns (or at least on a global average) with even China and India mothballing some of their initially planned coal fired power plants projects. On a European average, it is to be expected that some coal fired power plants will shut down ahead of their effective life expectancy as methane-based electricity generation is starting to take over as the fossil fuel du jour in electricity generation, while energy produced from renewables is enjoying a steady year-on-year growth. The 2018 BP Energy Outlook assumes that EU coal consumption will decline by 4.2% on average during 2016 to 2040, cutting consumption effectively by two thirds. The impact on ports will be partially offset since coal is currently still being mined within the EU but the net impact will be a noticeable drop in the import of hard coal during the next decades.

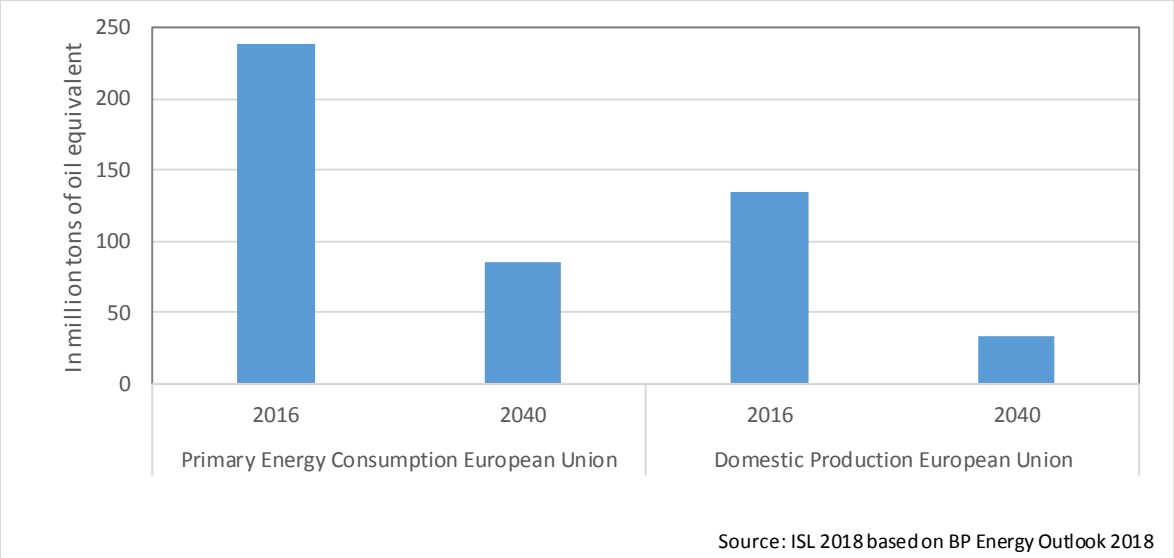


Figure 37: Coal consumption and domestic production, European Union 2016 / 2040

The second (much smaller) segment of coal that is handled in European ports is coking coal, which is used in blast furnace operations of the steel industry. Since it is expected that the steel industry will persist, this smaller segment of cargo handling is expected to remain constant as well. However, the end of coal as a fuel for power plants seems to be agreed upon for the time being and some ports have already discussed (behind closed doors to the expert knowledge of the ISL) how to put the vast spaces of soon to be freed up land to a good and productive use, once the need to handle coal in previously seen amounts will be gone. It would be entirely speculative to specify a time frame for this development. Erratic climate developments could spark political initiatives and disruptive developments in terms of reduced costs for renewables or LNG (methane) becoming more and more of a global commodity could advance the decline of coal in European ports.

6.4.3.2.3 Grain

Grain handled in European ports is one of the commodities where a long run growth trend is visible and plausible. Whilst during the years around 2000, many industry observers chose to ignore grain as a topic since the Chinese import of Iron ore and the entire Asian import demand growth for steam coal have been the dominant topics, the trade of grain has two growth drivers which remain intact even as economies mature. First of all, a growing world population is expected to consume more staple foods than a smaller population would have – at any given point, which works as a growth driver for grain used in the bread industry. Second of all, the income increases in developing economies bring about changing diets and consumers tend to increase their consumption of meat, which has a superproportionate impact on the demand for animal fodder. Whilst the world population and the GDP per capita continue to grow, there is a superproportional impact on the demand for grains. European ports are suited to benefit from this impact as they are located close to fertile and often unused land. At the same time, countries where the population is expanding rapidly are suffering from poor agricultural conditions and the trade of grains – at the end of the day – is effectively a trade in fresh water. Since the trade in agricultural products is notoriously volatile there have always been reasons to not escalate investments in suitable infrastructure in ports too far. As a result, the grain trade volume of European ports is spread over numerous smaller ports in significantly smaller amounts compared to e.g. the trade in ores and coal. In the long run, the silo capacities in

European ports could turn out to be bottlenecks of a trade with – as of now – very much intact growth drivers.

6.4.3.2.4 Other dry bulk commodities and dry cargoes

Next to the major bulks, iron ore, coal and grain, there exists a noticeable amount of industry raw materials, industry products and agricultural raw materials or products. These prove to be particularly hard to analyse as they are in fact a very broad mixture of commodities with fundamentally different origin-destination patterns, sometimes linked and sometimes independent demand drivers and will sometimes chose to travel in containers without that meaning that they will remain containerized forever. In the following, sub categories will be introduced and discussed.

In those instances, where “metals and minerals” are imported to Europe, the reasoning is that growth is likely to remain at or around zero % - similar to the reasoning for the “ores” as discussed above. It is unlikely that Europe will see some sort of core industry expansion so there also seems to be no plausible case for the development of maritime imports of these raw materials. Similarly, an unchanging or potentially declining population in mature European economies does typically not give rise to additional imports of steel coils, which may be reported as general cargoes or “other bulk” depending on the individual understanding of the ports. This also explains why sometimes project cargoes may be listed as “other bulk” if they are for example steel products like pipes and shipped in huge amounts.

Somewhere hidden within the “other dry cargoes” are typically the non-containerized and non-RoRo cargoes which fall under the heading of project cargoes. Their fortune will to a large extent depend on the development of the world economy and political interactions with energy markets. This sector went by almost unnoticed while the liner shipping markets have been booming. It is assumed that there should be always a bit of spare capacity available allowing Europe to remain competitive and able to import and export key project machinery/components. However unfortunately, until this very day there exists no comprehensive assessment of the global or even regional project cargo shipment industry.

The trade in fertilizers could benefit slightly from the overall intact demand for grain which could imply a 1-2% annual growth of the demand for storing and handling fertilizers in European ports. Similarly, the remaining agricultural products (including forest products) are likely to grow at rates of or around 1%.

6.4.3.3 Liquid bulks

Combined, all European ports regularly handle around 1.4 billion tons in liquefied bulk cargoes which warrant a specific discussion each.

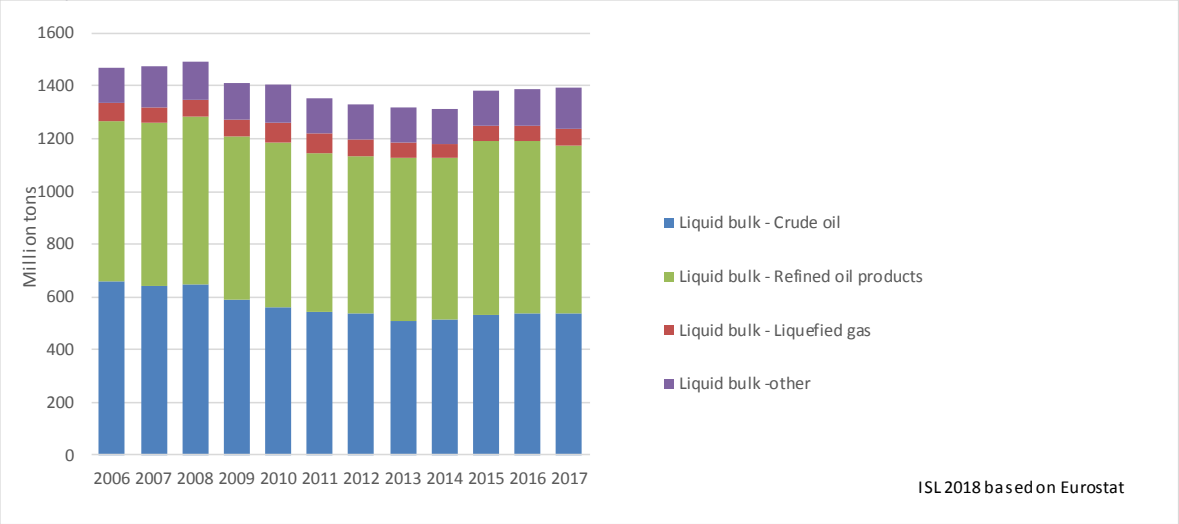


Figure 38: Liquid Bulk Handling in European Ports 2006-2017

6.4.3.3.1 Oil and oil products

European ports regularly handle 570 million tons of crude oil on average. This breaks down into mostly (around 500 million tons) of imports to continental Europe and around 70 million tons of exports which mainly originate from British ports or – in rare occasion relate to transshipment or storage moves. As it once was coined that "the stone age did not end for a lack of stones, much the same as the oil age will not end for a lack of oil", oil is expected to lose relevance with a growing share of electric propulsion of cars and new mobility concepts. The BP Energy outlook 2018 expects that the primary energy consumption in oil (including e.g. shale oil and naturals gas liquids but excluding biofuels) within the European Union will decline by 1.9% on average annually during the years from 2016 to 2040. This implies a drop in consumption from 13 million barrels per day in 2016 to 8 million barrels per day in 2040. Domestic production is expected to decline from 2 million barrels per day to 1 million barrels per day still leaving import terminals with a considerably reduced amount of work.

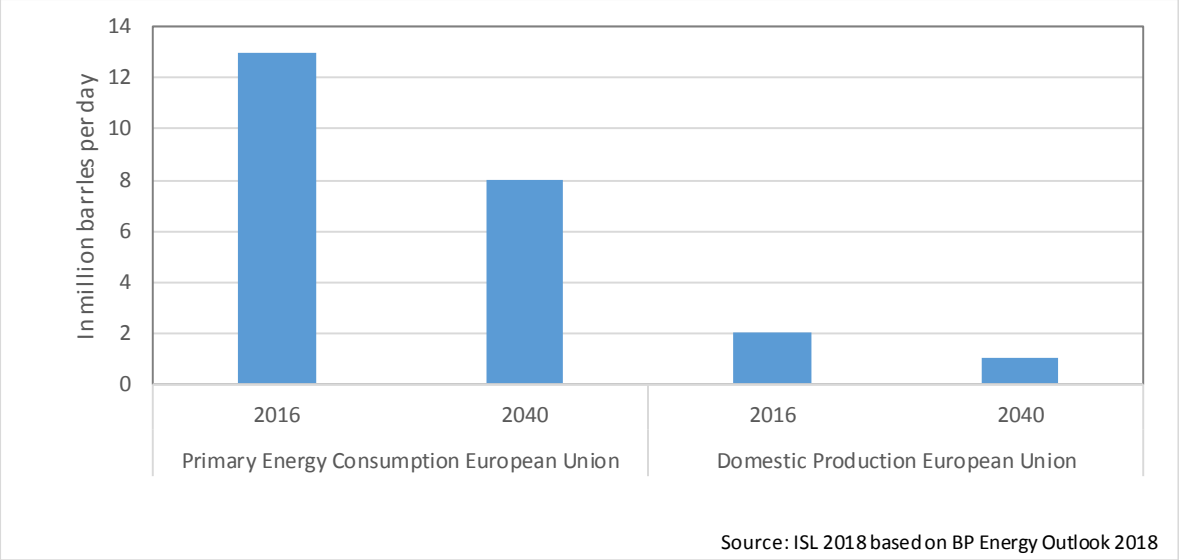


Figure 39: Oil consumption and domestic production, European Union 2016 / 2040

For several years already, there is a decline of refinery capacity observable and the most realistic assumption is that this trend will continue. As a result, there is no evident shortage of capacity for the import of crude oil. Unlike coal, this commodity is not expected to decline as aggressively but rather gradually as refineries are likely to close one by one as investments to replace the plants is deemed uneconomical in face of a declining consumption.

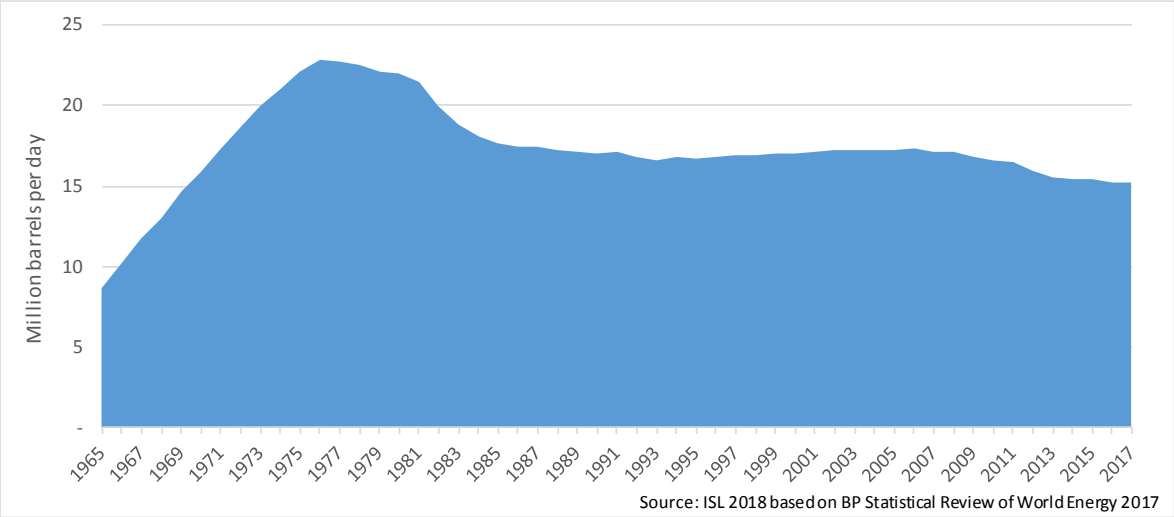


Figure 40: Development of refinery capacity in Europe 1965-2017

When it comes to the handling of oil products, the picture is more complex and while a long run decline of crude oil consumption will equal a long run decline of domestic oil product production, the demand assessment is rather difficult here and depending on a lot of individual factors. Normally, Western Europe has shortage of diesel fuel and a surplus of gasolines. This imbalance is met by imports and exports from Russia to the U.S. or via the world market in general. With the ongoing decline of oil in heating and recent dispraise of diesel fueled cars by insecure consumers, this general trade demand could also falter. However, these trend towards gasoline fueled cars could prove to be short-lived and it is by no means clear which propulsion technology will ultimately win over the consumers. Additionally, jet fuel consumption is expected to increase and shipping as a whole might have to resort to distillate fuels in larger amounts in the future – e.g. with regard to the Sulphur cap by IMO in 2020. The implication is that wherever possible, tank storage facilities with licenses to store clean and dirty products should at least be maintained to have a reasonable amount of buffer storage available for sudden demand swings, which may no longer be met by the decommissioned domestic refineries in the future.

The “other liquid” cargoes could and will likely comprise the occasional petroleum product considered by some of the reporting ports to be a chemical substance or vegetable oils as well as chemical acids. There is a niche market for the transport of juice and wine but the lion’s share of these volumes are likely to be vegetable oils and acids, produced or consumed in local European industries. Here, similarly to the iron ore trade it is reasonable to assume that these chemicals have reached a mature volume, reflecting the demand of the mature economies of Europe as a whole. Capacities should be maintained at the given levels hence.

6.4.3.3.2 Chemicals

While the oil market is relatively easy to asses based on assumptions about the future demand and supply, the oil products market is already harder to analyse as it is to some extent supply driven and much of the trade is depending on the location of the refineries. Still, as both markets are reasonably large and the demand for standardized petroleum products is large in

volume and by number of customers. Compared to this, the market for liquid chemicals transported in tankers is a much more delicate issue as these trade flows originate from a wide range of industrial plants from e.g. ore processing plants via food processing plants and refineries to straight forward chemical companies.

The list of possible destinations for European chemical trade is equally diverse. Furthermore, there are effectively two trading patterns. In the first pattern, the import or export of chemicals will often be a key aspect of the respective trading partners' business model. Here it will be quite normal to find suitable import/export-storage facilities adjacent if not directly on site of the industrial plants producing or consuming the commodities. This is different for oil products, where it makes sense to run large independent tank storages, as there is a well-developed market with few products in large quantities with a large number of multinational buyers. With chemicals however, the parcels will regularly be very small and the list of potential customers is rather narrow (for any one of the transported substances). Hence, it is quite normal for the enterprises to comprise the landside elements of the maritime logistics chain. These enterprises normally will discuss their respective needs for e.g. quay-maintenance with local authorities and will very likely fly well below the radar of any EU port governance. Very similar to ores, it is argued here that the demand has effectively peaked with the maturing of the industries in Europe. In addition, that the occasional additional import or export demands resulting from a new producing/consuming industrial plant will be rather the exception than the norm.

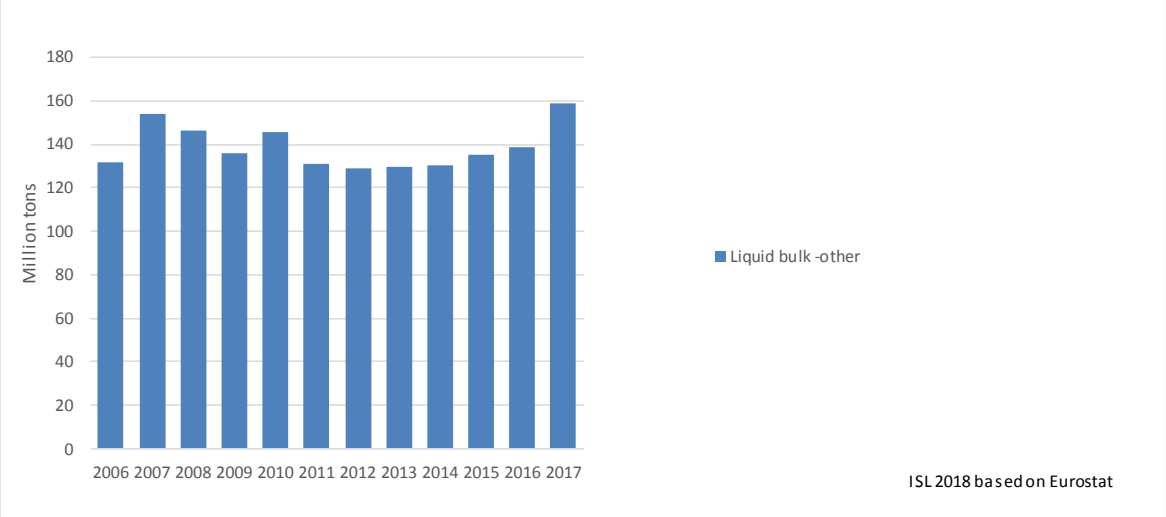


Figure 41: Handling of "other" liquid bulk cargoes in European Ports 2006-2017

Next to the small-scale chemical cargo imports and exports of companies with access to the ocean, there exist large scale chemical clusters e.g. in Rotterdam, where the maintenance of tank storage even for "un-easy" (= hazardous) chemicals would be an option for independent operators as the sheer size of the surrounding industries could make for a viable business case based on regular import and export demand. While the European market as a whole is matured and it is not expected that these clusters expand in size, the tank storages may on occasion be sought after rather feverishly if interests from outside Europe show an increasing demand to aggregate transshipment cargoes while expanding their own terminals. This kind of transshipment could also make sense during the winter season when ice-class vessels could shuttle chemicals from Baltic Sea countries to ice-free North Sea ports for aggregation/transshipment.

The known unknown in this sector is the future of energy used in transportation. If for example, at any time in the future the offshore wind energy will be used to produce synthetic organic fuels

or if bio-fuels will at some point appear to be the right solution going forward, tank storages could become scarce abruptly. In these cases, however, it seems likely that decommissioned oil refineries will see an upgrade of their own tank storages wherever the persisting cargo restrictions seem unfit for the then required cargoes (e.g. ethanol instead of heating oil).

6.4.3.3.3 LNG, LPG and chemical gases

The market for liquefied gas consists of several segments with sometimes strict and sometimes weak borders. By far the most important market of the next decades to come will be the market for the import of liquefied methane commonly referred to as LNG. This is effectively the only fossil fuel where demand within the European Union is expected to increase in the future, as it will replace coal in electricity generation due to its cleaner combustion, and relatively better CO2 emissions per unit of energy produced.

However, methane (or CH4) remains a fossil fuel and will most likely be a bridge technology towards the more intense use of renewables, which is expected to show significant growth in the long run. Along the entire European coast, port authorities and administrations as well as energy companies are eying potential sites for the import and regasification LNG. The huge import potential however does not so much originate from a significant increase in demand but more from a decline of domestic production. Whilst some large import terminals already exist and are in operation on Europe's coasts, it is still not entirely clear where the industry is headed as a whole and which type of supply chain will ultimately be dominant (shore-based storage and regasification or floating storage and regasification units). Whilst the LNG trade is expanding rapidly on a global level, it remains an intransparent industry in terms of supply chain costs or let alone a global pricing mechanism. When the oil price collapsed in 2014/2015, this has somewhat dampened the industry's enthusiasm to go ahead and push for the implementation of new terminals. In terms of volumes however, LNG imports will very likely show the highest absolute and relative growth performance as shortfalls in domestic production will have to be met with increasing imports in the long run. The dynamic is hard to gauge and will depend effectively on the competition by renewables and political pressure to abandon coal and partially oil.

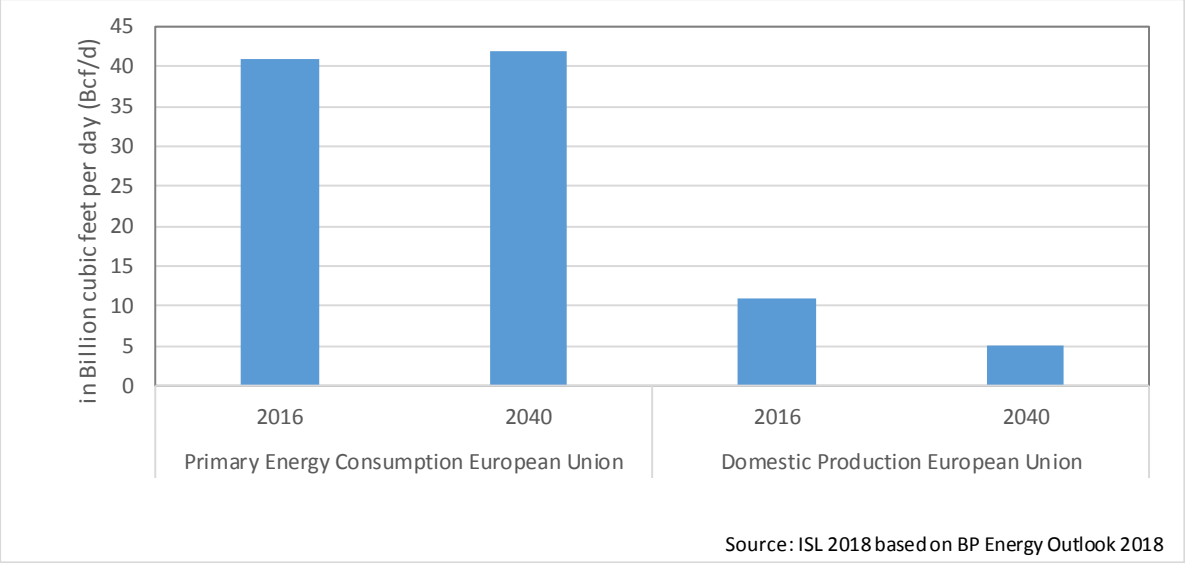


Figure 42: Gas consumption and domestic production, European Union 2016 / 2040

LPGs are a by-product of the oil refining process as well as of the production of crude oil or methane from conventional sources (i.e. underground deposits which are available without the

application of hydraulic fracturing). They are used in industrial processes, for heating and transportation purposes (e.g.: cars regularly rely on propane/butane rather than methane for propulsion). With the expected ongoing decline of the European refinery capacity, fewer of these products will be produced domestically, which could create an additional import demand in the long run. As a result, where possible, LPG import facilities should be maintained and where handling shortages are reported by operators already, theses facilities should be upgraded.

The last and smallest group is chemical gases. These are produced and consumed in selected industries where it seems reasonable that there will not be any additional demand yet but also no noticeable decline.

6.4.3.4 Noncontainerised cargoes

6.4.3.4.1 RoRo

Accompanied and unaccompanied trailers account for the lion's share of the RoRo traffic. This segment still possesses some growth potentials, which are occasionally realized with the help of EU funding. With ship emissions becoming smaller through slow steaming and cleaner through stricter emissions regulations, while the truck fuel emission optimization potentials are wearing thin, we could reasonably see additional growth of around 1-2% p.a. for this particular market. Where the mature European economies are already reasonably well connected and fixed links (e.g. the Fehmarn Belt fixed link) might have a detrimental impact on local volumes, markets are likely to grow slower, particularly as trailers are in constant competition with European shortsea container shipping. However, where the economies are not equivalently mature or where connections lead to less developed economies within (or without the EU), growth of RoRo cargoes could potentially outperform the above-mentioned range of 1-2% p.a.

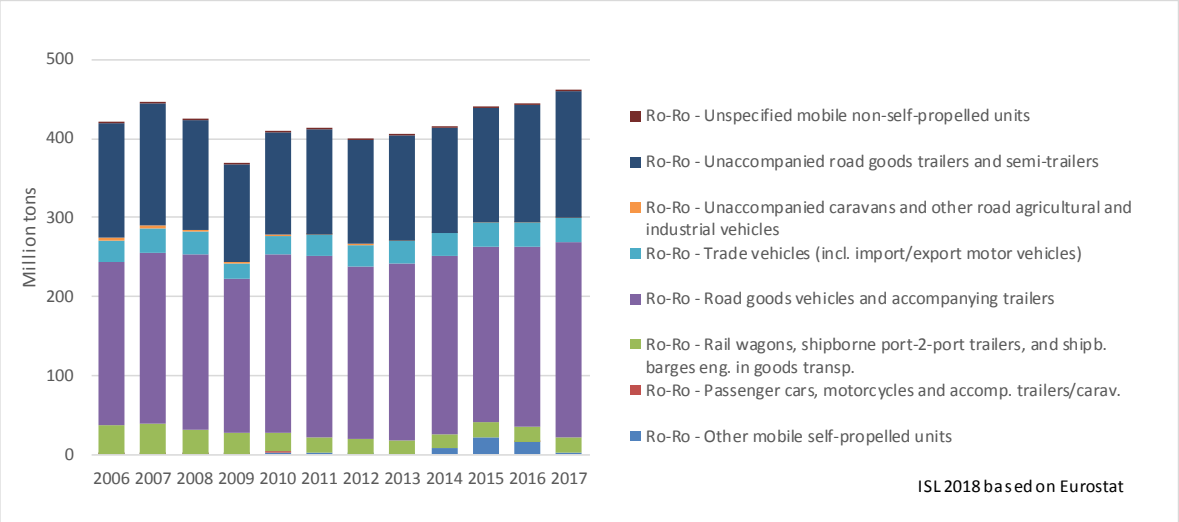


Figure 43: RoRo Cargo Handling in European Ports 2006-2017

A persistent challenge of the analysis of the project cargo markets is that the goods are well hidden in multinational port statistics, as is already discussed above under "other dry bulk cargoes". The RoRo cargo section for example will often comprise cargoes that effectively rolled onto the vessel by itself (e.g. large machinery used in agriculture) or which potentially could "roll on" by itself but have been loaded with a crane instead. In lack of any hard data and given the notoriously mercurial nature of these trade flows, it is close to impossible to identify these trade flows or asses their growth correctly, as will be discussed in the next section on "general cargoes" as well.

6.4.3.4.2 General cargo

"General cargo" was once the standard way of transporting anything that was not a bulk commodity. Since the container captured or rather conquered these markets, even captivating some bulk commodities, the amount of general cargoes handled in European ports has become almost negligible in volume. The three remaining types of "general cargoes" normally fall into either one of the three following categories:

6.4.3.4.3 Reefer cargo

Despite the impressive expansion of global trade flows during the last 20 years, the reefer fleet has been stagnating during the same time as more and more reefer cargoes previously thought to be un-containerizable ended up in containers. With a few rare exemptions, this industry is declining and the facilities in Europe have often turned partially or entirely from unloading refrigerated cargoes from reefer vessels to importing reefer containers and managing the inland distribution. This decline is expected to continue.

6.4.3.4.4 Neo-bulk or "break-bulk"-cargo

These will often be forest products, effectively handled individually but transported in bulk carriers. Additionally, large homogenous shipments of e.g. pipes (effectively project cargoes) as well will often be referred to as either general or "break-bulk" cargoes. These are either not feasible for container transport or may actually employ specialized ships (e.g. forest product carriers). Where these trade flows belong to the "project cargo"-spectrum, the trade flows are generally hard to predict. Unfortunately, there are no binding definitions and one ports' break-bulk-cargoes may be another ports' project cargo or general cargo. Likewise it seems plausible that a share of the "iron and steel" products listed in Eurostat's database are not merely standardized steel coils but are effectively very sophisticated project cargoes instead.

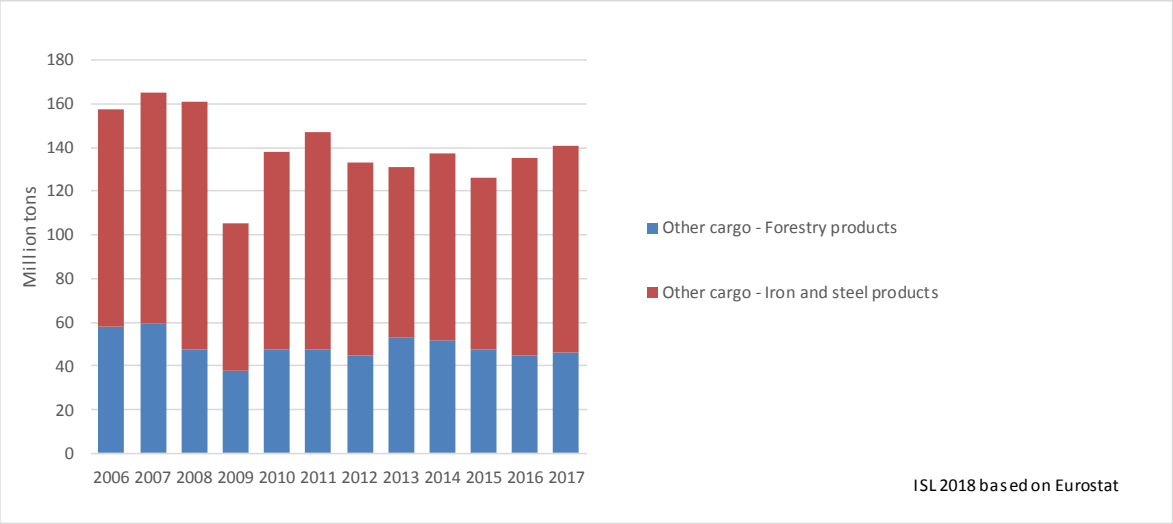


Figure 44: Handling of Forestry and Iron and Steel products in European Ports 2006-2017

6.4.3.4.5 Project cargoes

With the exception of the above mentioned standard steel products or agricultural products and refrigerated goods, the remaining cargoes handled in European ports should all belong to the project cargo sector, which is notoriously light in volume but heavy in workload and added value.

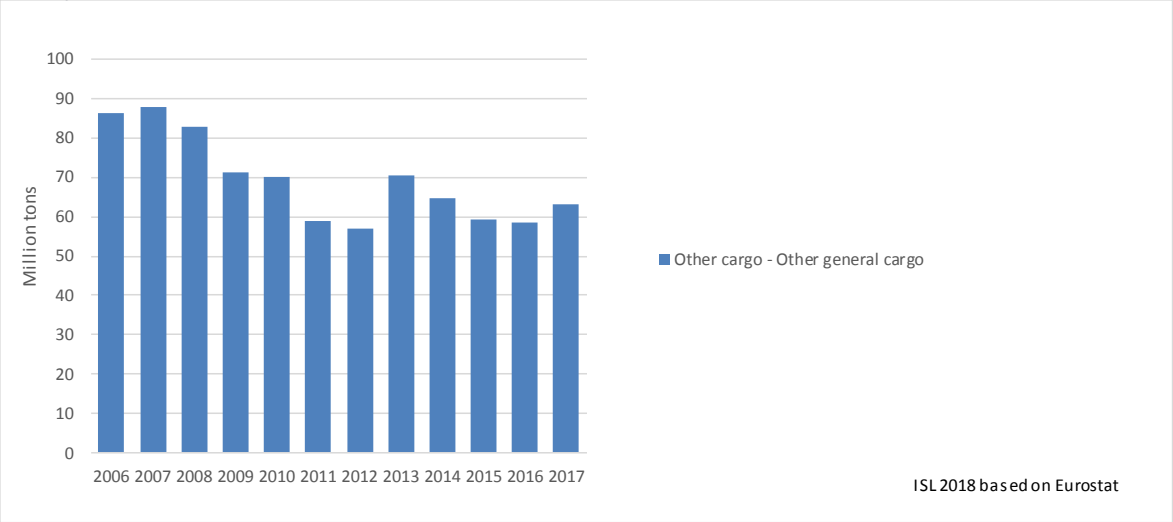


Figure 45: Handling of Forestry and Iron and Steel products in European Ports 2006-2017

The chart above is likely to represent both the impact of the financial crisis on the project cargo market, which hit with somewhat of a delay, as well as the ongoing decline of (conventional) refrigerated cargoes, not represented anywhere else in Eurostat figures. The project cargo industry is particularly hard to gauge since there are no regular trade flows and importers and exporters are very diverse. Before the 2008/2009 economic downturn, it was argued that this market would benefit from the long run increase of economic activity in emerging markets. There, additional growth would lead to additional raw material consumption from ores to coal and this would in turn call for example for more investment in global mining facilities – and in turn generate more project cargo shipping demand. With the demise of the coal industry and China's appetite for iron ore turning out to be somewhat overestimated, these growth prospects have vanished. In addition, new companies from said emerging economies have started to ramp up their own production of industry goods which would travel as "project" cargoes, effectively cutting the growth potential of European exporters. Currently the demand is likely going to be stable going forward with the future installation volumes of offshore wind energy being the known unknown.

6.4.3.5 *The impact of Brexit*

The most important change regarding the traffic volume will be induced by the end of the UK's EU membership. Among the 1,382 ports with maritime traffic (Eurostat), 144 are in the UK. In 2016, they handled close to 500 million tonnes, one eight of the EU in total. As regards passenger traffic, the weight of UK ports is less important (roughly 7% of the EU total), but includes the largest passenger port in the EU, namely Dover.

The impact of Brexit will hence be asymmetrical in the different segments. Within cargo traffic, some segments will be more affected than others. The database will provide segment-specific filtering options and hence the adequate assessment of the impact on transferability.

6.4.4 Developments in port-city relations and international port cooperations

This section covers issues with regard to port-city relations (Section 6.4.4.1 on page 143) and international port cooperations (Section 6.4.4.2 on page 145) that are expected as essential for the future developments of ports. Concerning port-city relations, the relevant policies and related areas for future relations between ports and their cities are explained. The section on

international port cooperations refers to individual forms of cooperations and the reasons why horizontal and/or vertical cooperations are assumed to appear.

6.4.4.1 Developments in port-city relation

This topic on port-city relations has been an issue for a number of decades when ports and cities started to lose their mutual interdependence and their developments since then has influenced each other.

The maritime transport sector, i.e. shipping and ports evolved like e.g. in terms of vessel developments, transport and ICT technologies, required terminal infrastructures and stacking areas, increasing volumes in port handling and pre- and oncarriages, sea-side access, hinterland infrastructures, and port adjacent logistic services. The developments have been necessary to maintain ports' competitiveness in a fast changing environment which has been heavily influenced by the demand side for port services. In addition to these factors which have driven ports' development in the recent past, a consequence of advanced ship and port technologies has been a decline in jobs for port workers.

In the meantime, urbanisation in port cities advanced. Populations in cities have grown and thus more living space has been required. Here, revitalisation of non-used older port areas has been only a part-solution to create new modern living quarters but also leisure facilities and commercial services, which only partly have links to the port business.

Hence, port-city developments can be characterised as an increasing rivalry for limited land resources and in parallel by a decrease in benefits from ports for their port cities (e.g. in terms of employment) and an increase in negative consequences from port operations like environmental impacts and traffic congestions.

This picture on the development from the recent past and the related conflict potentials can be also assumed as a reflection of the prevailing future trends in port-city relations.

Particularly environmental impacts from port operations on cities have become essential issues in the past which will even enhance in the future. The reduction of exposures from emissions and noise is a key issue here - particularly the reduction of emissions like SO_x, NO_x and PM as these emissions have strong local impacts on health, well-being and thus on quality of life of populations in and around port cities. Relocations of port areas or terminals and settling of new terminals outside from urban areas is one ongoing trend to relieve port cities from pollutions caused by port operations. The relocation of the intermodal terminal from the inner city in Gothenburg to the outsided port area in 2018 is one example here that serves for both purposes, i.e. reduction of air and noise emissions from 200 trucks and twelve block trains daily and provisions of space for urban development of the inner city.

Contrary to the newbuilding of a port, relocations of existing ports or terminals require certain framework conditions like available space in these more remoted port areas, accessibility from the sea side as well as from the land side - particularly hinterland infrastructures in terms of efficient rail and road connections as hinterland transport is a decisive competition factor for ports , e.g. not only among ports along the North range between Antwerp and Hamburg but also between the North range port and ports in Southern European for Europe-Asia trades. Thus, further promoting a modal shift by inceasing the share of environmental friendlier rail and inland waterway transports will remain a trend to lessen environmental conflics in port-city relations. However, as road transport will have also in the future significant shares in the modal split, it will remain an essential challenge for ports and port cities to improve road transport's environmental performance by increasing its efficiency – in addition to new technologies from the truck industries like autonomous vehicles. Here, technology solutions togther with spatial plannings are to be used, like e.g. truck-appointment-systems and pre-gate-systems which are joint issues of port authotities and urban development departments.

Since 2010 vessels are required already to use only fuels with less than 0.1% sulphur content in ports and port access which has lowered already SOx emissions from vessels operating in ports. Additional measures will be required here to reduce local emissions in port areas affecting also port city populations. Provision of facilities to use alternative fuels is and remains a future issue in port cities to achieve further emission reductions. Here, provision of LNG bunker facilities and the extension of shore-side electricity ('cold-ironing') have to be achieved as an increased suppply of these infrastructures on the port side are expected to trigger also a higher demand from the shipping side (i.e. through rising newbuildings eqipped for these alternatives or through retrofitting of vessels). Besides the aim to tackle the issue of local emissions, port-city relations will have to cope also in the future with challenges deriving from climate change. Predicted increasing number of natural disasters like e.g. extreme rainfalls, high floods, winds and a rising sea level will affect also ports and port cities and needs joint measures to develop required port infrastructures. Hence, developments to reduce environmental impacts from ports will be also crucial drivers for port-city relations.

Spatial planning is closely related to environmental challenges for port-city relations and mutual benefits and rivalry are immanent here. Linking to burdens that port cities have to bear from port operations, transport and traffic planning is an essential issue for spatial planning in order to optimise port-related traffic with regard to competitive hinterland structures but also considering impacts of port-related traffic for cities. An essential challenge for spatial planning in port cities is the use of port areas that are not fully used for port business activities and offer opportunities for urban developments like housing. However, often there are legal obstacles that do not allow having port service companies and living spaces at close quarters. Here, regulations are to be adapted in a way that interests and rights of both sides, i.e. port companies and residents are sufficiently considered and former purely port areas can be used commonly.

Relocations of port areas remain therefore also a task in spatial planning in order to provide revitalised space exclusively available for urban developments. The above-mentioned relocation of a terminal of the Port of Gothenburg is a good example here but there are many. Taking an example from Asia, the Port of Singapore Authority announced in 2013 that port activities at the Tanjong Pagar Terminal will be relocated to a new location in Tuas. This process is expected to be finalised by 2027 and shall provide required land for the further spatial development of urban area in Singapore. Therefore, spatial planning against the background of port-city relations will have to tackle the challenge to balance out interests and requirements from the port and the urban city in order to achieve a required efficient functioning of the port and the city.

Taking the changes in the port-city relation into account, i.e. alterations in port operations mainly caused by external factors and the requirement that urbanisation entails, there are opportunities that offer benefits for port and cities as well. The development of economic clusters taking advantage not only of the ports but of the overall adjacent maritime business provide the chance to create mutual benefits between ports and cities and will essential for port-city relations. Tourist activities like event tourism, leisure sailing, historical museums and gastronomy or new marine business like offshore wind farms with production site and adjacent logistic services using benefits that port areas provide are two examples for economic clusters benefiting ports and cities.

As environmental impacts from port operations, the provision of efficient port infrastructures and traffic systems, revitalisation of port areas or the development of new economic clusters and the balancing of interest and needs of ports and cities are complex issues and often interfering each other, governance involving port authorities and port stakeholders and the concerned is a key for sustainable port-city relations.

6.4.4.2 Developments in international port cooperation

The development of port volumes in 2017 was positive in terms of container and bulk volumes and based on the positive trends in global trade and thus maritime transport. However, the global port sector has experienced an increasing competition among ports in recent years. Growing market power by alliances, pressure on infrastructure developments to accommodate increasing vessel sizes, the need to follow technological advances (e.g. autonomous vehicles), and stricter environmental framework conditions has put the pressure on ports to re-define their roles within global logistic chains. Ports have to react by improving their services through adapted strategies and corresponding port development plans in order to comply with benchmarks and with aims stipulated by international organisations as well as by the demand side for port services. Therefore, port stakeholders like port authorities, terminal operators, governments, bunker operators, logistic service providers, are challenged to identify appropriate measures to enhance operational, economic and environmental service performances. In the following different forms of cooperations will be outlined that are also expected to take place in the maritime sector with regard to the future.

6.4.4.2.1 Forms of international port cooperations

International port cooperations have been an issue for a long time in the port sector but with an ever-growing importance in recent years. There are different reasons triggering port cooperations such as the need for financial means for investments in port infrastructures and superstructures, enhancing complying with environmental regulations and setting standards for environmental protections, improved hinterland transports or provision of capacity extensions. Hence, as ports are immobile nodes in global supply chains, international port cooperations provide the potentials to contribute to strengthening port performances within these global supply chains and their changing requirements. Envisaged synergy effects through port cooperations can be achieved though on two different levels, i.e. through horizontal cooperation and vertical cooperation. Horizontal port cooperation is understood as cooperation on the level of ports, i.e. between two or more ports – subject to different reasons and with forms of cooperations. Vertical cooperation refers to a cooperation between ports and other stakeholders within the supply chain, either seaside or landside-related.

The range of actors participating in port cooperations refer to public entities and private companies – either involved together in types of cooperation or involved individually. Public entities comprise port authorities presenting generally local or regional governments. Private actors as potential partners in cooperations cover terminal operators as well as shipping companies, forwarders, barge and train operators, logistic providers as well as cargo owners.

However, the organizational port landscape is not that homogeneous. Different organisational forms of port governance exists whereby the landlord form is prevailing in Europe, i.e. in general with a public owned and financed infrastructure, private owned superstructures and also private port operations. Other port organization forms, i.e. tool ports, public service ports, corporate ports and private services ports are declining, inter alia as the strategy behind EU ports policy has been supporting a move towards the landlord form. As ownerships, organisation and administration of ports have been different in the EU applying different forms of port organisations, the EU port policy has been aiming at the harmonisation of financial flows between the public purse and private industry, i.e. between port authorities, port operators and the users of the port infrastructures, superstructures and related services. The aim is to avoid distortion of competition among ports by subsidizing port services with public investments. Hence, a level the playing field for the port sector has to be implemented allowing transparent and efficient investments in ports. As a result, financing of port infrastructures has been done with an increasing share of participation by the private sector resulting from the fact that

relevant port authorities – either on a local, regional or national level - have been more focused on their landlord role and the financing and operation of port facilities that are relevant for services of public interest. These services refer inter alia to development and construction of port infrastructures, organization of nautical services, planning of port developments, organization and administration of safety and security in ports. Hence, despite the fact that the roles and tasks of port authorities are subject to the organizational form determined by the responsible local, regional or national government, a number of characteristics are in common for port authorities.

While port authorities are the main actors in port cooperations on the public side, terminal operators take the prevailing role for the private side. Core business of terminal operators is the handling and storage of cargo including operations of hinterland transports and complemented by value-added logistic services. In principle, terminal infrastructures are leased out by the responsible port authority while the terminal operator is responsible for the investment and operation of port superstructures.

In the following section, the different forms of horizontal and vertical cooperations relevant for future trends in the port sector are outlined.

1. Cooperation agreements, e.g. through a 'Memorandum of Understanding' as horizontal cooperation refer in principle to information exchanges aiming at increases in port handling volumes. However, growing handling volumes are here not directly achieved but indirectly through a number of different measures that foster trade links between the ports and the port countries concerned. Possible measures comprise information exchanges on hinterland, strategic marketing, environmental protection measures or exchanges and training of staff for mutual learning benefits (e.g. application of new technologies). Additional measures included in a 'Memorandum of Understanding' as administrative issues such as custom clearance procedures and safety and security standards have to be considered within the framework of international agreements or organisations like the EU, e.g. common custom clearance procedures in the EU need to be considered in case of bilateral port cooperation agreements
2. A more on operational focused form of horizontal port cooperation is the coopetition as one of upcoming cooperation strategies in order to comply with market requirements. The term consists of cooperation and competition as ports do both in this cooperation form, i.e. they compete and cooperate – and driven by common aims. Hence, through coopetition the involved ports concentrate on the advances while trying to minimize drawbacks from their weak points in order to develop joint assets allowing enhancing their competitiveness towards other ports. Measures have a stronger binding character than in the form by 'Memorandum of Understandings' and comprise also financial implications such as joint marketing initiatives, qualification and employment of staff, buildup and use of equipment pools or investment in port facilities or services.
3. Next level of horizontal port cooperation is the port merging leading to the full integration of the concerned ports which may refer also to ownerships. The operational business and thus revenues from port operations are divided according to the contractual agreements as base for the port cooperation. The Copenhagen Malmö Port is a well-known example here, which was established by a merger of Copenhagen Port and Malmö Port in 2001 as response to operational and economic challenges following the completion of the Öresund Bridge between Copenhagen and Malmö. Port cooperation forms on a vertical level involve actors along the supply chain and thus have in general a more business or operational character. Existing cooperations are between seaports and inland ports with the strategic aim to expand the hinterland and to improve the existing hinterland connections increasing or maintaining port handling volumes for the benefit of both cooperation partner. Land-side related vertical cooperations refer also to terminal

operators on one hand and rail and barge operators on the other hand - either based on common business contracts in order to ensure efficient and reliable hinterland services or on the basis of joint ventures which gives terminal, operators also the ownership in hinterland transport services. Vertical cooperations between terminal operators and ship operators are seaside related and are based on business contracts (e.g. dedicated terminals) or joint ventures.

6.4.4.2.2 Reasons for future port cooperations

The described forms of international port cooperations will further on play an essential role for the future development of the EU ports in a globally changing market environment. The portfolio of port cooperation forms vary from low-binding agreements to joint ventures but within and at both ends the strategic goal is the increase of port handling volumes as the basis for core as well as value-added port services in order to enhance the overall competitiveness of a port.

Joint marketing activities show the lowest barrier for ports to cooperate. Normally, driven by port authorities, marketing cooperations offer all relevant port actors the opportunity to participate, including hinterland transport operators and other logistic providers linked to port operations. As benefits are obvious in terms of optimising resources and cost savings (e.g. shared fair costs), joint marketing will remain a future option for port cooperations in order to present and sell services of ports having similar interests but intend to cooperate on a competition-neutral level without any uncertainties in terms of problems in financing or operation.

Given the increasing market power of the shipping side, 'coopetition' as horizontal cooperation form is assumed as a remaining option for ports to react on bargaining power. A number of essential drivers for coopetition are to be considered. The distance between ports is important as the closer cooperating ports are, the higher the competition between them is to be assumed. In this respect, the relevant hinterland and its characteristics of the concerned ports is important. The scopes of natural port hinterlands have been decreased as constructions of efficient hinterland transport connections and port infrastructures and facilities allow competing ports to attract volumes as well. An example is the upcoming importance of South European ports for Europe-Asia container trades with destinations e.g. in Austria and Eastern European countries – and which have been belonging clearly to the hinterland of the North range. Other drivers for coopetition are the organisational form of port governance, the technology level applied in the port and the level of correlation of the port services (e.g. are similar commodities handled in ports).

Provided that drivers allow going for a coopetition, there are a number of reasons for ports which could bring benefits from cooperation on a horizontal level. Strategic reasons are very essential in this respect as they refer to the business strategy of ports and long-term benefits. In an increasing competitive environment, coopetition offers port the opportunity to build up supply-driven market power. Currently, container ship operators are driving port investments in infrastructures and superstructures through increasing vessels sizes to gain economics of scale. Discussions have been initiated whether ports have to play the game according to ship operators' rules or if port can oppose these developments through cooperation. Financial reasons are also essential as ports as profit-oriented industries have to reduce costs where appropriated. Hence, cost sharing for new investments, lower need for investment capital and faster rate of return are clear benefits for ports. Economical reasons derive from aiming at economics of scale or benefits from knowledge sharing. Knowledge sharing and feasible technology investments (e.g. through cost sharing) provide opportunities for operational improvements or for remove of existing operational problems and capacity constraints.

With regard to cooperation trends in the EU ports sector, horizontal coopetition is assumed to provide benefits for ports but this is subject to individual situations of potential ports and has to be decided on a case-by-case basis.

The latest approach by the port authorities of Hamburg, Barcelona, Antwerp, Los Angeles, Long Beach, Vancouver and Rotterdam to work jointly on challenges from climate change presents a good example for a future trend with regard to coopetition. Although there is a strong competition among the ports of Rotterdam, Antwerp and Hamburg, common goals facilitated cooperation among these ports. Here, a number of issues that will be addressed jointly were agreed:

1. Increasing efficiency of supply chains using digital tools;
2. Accelerating development of in-port renewable power-2-ship solutions and other zero emission solutions;
3. Accelerating the development of commercially viable sustainable low-carbon fuels for maritime transport and infrastructure for electrification of ship propulsion systems;
4. Accelerating efforts to fully decarbonize cargo-handling port facilities.

All efforts are planned to lead to reduce emissions from maritime transport in order to limit global warming to well below 2 °C as cooperating ports are concerned that ports can perform significant contribution. For such a purpose, the coopetition aims to work together with stakeholders in the maritime sector and beyond. Considering the relevance of environmental protection measures, particularly this area is suitable for port to cooperate through 'coopetition' by addressing challenges here.

Environmental challenges may also support cooperation between ports using joint ventures. So called 'wider benefits' could trigger joint ventures in order to achieve essential environmental related aims. A possible example might be the operation of a LNG vessel offering bunkering to vessels. As there is still a lot of discussion about the shipping fuel of the future within the maritime community, it is not clear yet whether LNG will be the final solution. As fixed LNG bunker terminals in ports are highly cost–intensive, joint operations of LNG bunker vessels serving ships calling the cooperating ports might be a future option. However, if joint ventures like the Copenhagen Malmö Port will occur in the future – e.g. following the Fehmarn-Belt-Link - is not foreseeable.

Vertical port cooperations will be seen also in the future. Vertical cooperation between ship operators and port operators has been a trend since decades – particularly in the container shipping sector. Cooperation has taken place either by joint ventures, i.e. joint financing of terminals by ship and terminal operators or by contractual assignments of dedicated terminals and semi-dedicated terminals. Reasons for ship operators were and still are inter alia to ensure handling of vessel at the time the vessel is calling, reduction of port costs and controlling of supply chain. On the other hand, main benefits of terminal operators refer to reduced costs and a guarantee of the terminal capacity use to the contractual agreed extent.

Also, land-side related vertical cooperation will be a future issue in port cooperation. As given the immobility of ports and their assets, it is of vital importance for ports to gather control about hinterland transports to the extent possible by operating own rail and barge services or alternatively, cooperating closely with rail and barge operators – as well as with inland barge and rail terminals.

Likewise the International Transport Forum of the OECD stated in its latest report 'Container Port Strategy' from October 2018 that it is necessary to enhance and trigger cooperation between stakeholders in the maritime logistics chain. The performance of maritime supply chains are clearly depending on nodes between the different stakeholders. Here, inefficiencies

occur due to lack of effective communication, coordination and alignment. In order to remove these problems, it is essential to enhance the cooperation of actors along the supply chain.

6.5 Task4: Macro trends

This section covers the outputs and outcomes of WP1 task4 « Analysis of macro trends and perspectives in the maritime sector », resulting in deliverable D1.4

6.5.1 Introduction

This secion provides a survey on the most essential macro-trends on a global level and hence, not focussing on the maritime sector but which are assumed to have probably impacts also on ports and shipping. Therefore this section is complementing section 6.3 Task 2: Stakeholders consultation on page 109 which refers to foreseeable developments in the ports and shipping sector.

Shipping and thus port operations depend as diverted demand from international trade and its need for transport and handling facilities. Therefore, the further development of global macro-trends having impacts on international trade are supposed to affect also the future development of ports and shipping. These trends occur of course from different thematic areas, like e.g. changes in economic patterns, environmental framework conditions or disruptive technologies. In order to gather those relevant macro-trends, the main thematic areas have been identified:

1. Economic trends (Section 6.5.2.1 on page 149);
2. Environmental trends (Section 6.5.2.2 on page 150);
3. Society trends (Section 6.5.2.3 on page 151);
4. Technological trends (Section 6.5.2.4 on page 152);
5. Governmental and political trends (Section 6.5.2.5on page 153).

In each of theses ections the most essential trends will be identified and described in order to gain a survey about what is expected to happen by 2030. It is assumed that thematic overlaps of macro-trends will likely occur as trends interrelate and moreover reinforce each other with regard to their impacts. Macro-trends are supposed to refer to a global level but the influences on regional level are of course different depending on factors like economic developments, societal frameworks or governmental structures.

6.5.2 Macro-trends

6.5.2.1 Macro-economic trends

Macro-economic trends will furthermore base on an ongoing globalisation in terms of international trade and international capital movements. Expected developments are an increase in trade by about 4 to 5% p.a. and investments and more complex trade and investment relationships. However, these processes will be accompanied by uncertainties or counter acting developments like the implementation of new trade barriers or reduced trade liberalisation following certain national policies (e.g. introduction or raising of import tariffs by the U.S government and follow-ups by other countries, like China or trade blocks, like the EU) or by cascading economic problems from a national or a sectoral level to an international level, like the crisis in 2008. However, these uncertainties will not affect the overall framework of globalisation and reduce volume of trade but might influence expected growth rates.

The global GDP is expected to grow by factor three from 2010 to 2030 with impacts on the global demand and supply for raw materials, semi-finished and manufactured goods and

services. Based on a the OECD Economic Outlook (2014), OECD countries will have a share of about 56% in the global GDP while non-OECD economies will show for 44% in 2030 – compared to 67% for OECD countries and 33% for non-OECD countries in 2010.[17] Reason for this significant change are strong economic developments in these non-OECD countries particularly in China and India as both here are assumed to strongly increase their GDP leading to a 31% share in the global GDP and showing moreover a 35% share in global population. These strong economic developments will take place also in Brazil, Russia, South Africa, Mexico or Indonesia – and also driven by population growth and interlinked areas like technology developments or societal changes. In 2030, China, India and Brazil are expected to be ranked top-five in the national GDP listing.

In addition to the trend in the GDP development, the GDP per capita will develop stronger until 2030 compared to 2010 than in the periods before. Even if the high-developed countries still will show the highest GDP per capita, a strong increase will derive from medium and low-income countries like China, India, Vietnam and Indonesia – with consequences on consumption, infrastructures, trade and transport developments.

With regard to trade developments, intra-regional trade will gain higher importance. Already nowadays, intra-regional trade is bigger than on an inter-regional level. Currently, intra-EU trade has a share of about 70% in total EU trade, while intra-Asia trade has about 53% and intra North America trade about 49% of total trade volumes. Until 2030 it is expected that these intra-regional trades will double. On a global level, exports from Asia will double to 39% compared to 2013.[18]

In this respect, the trend towards an increase of regional trade blocks is assumed to be pursued having impacts on the above-mentioned trend in the development on intra-regional trades. Most essential reason for an ongoing development towards regional trade blocks is the aim to lower or abolish trade barriers on a regional level. However, the degree of strength in the development and role of regional trade blocks will depend on the situation on a global trade field and whether national protection strategies (like the 'America First' or national protection policy) will get followers or if global trade will develop around or despite these protectionism policies.

From an economic view, the growing significance of cities will continue. From the beginning of the industrialisation, cities were a cradle for trade, financial flows, consumption, infrastructure and technology developments. Comparable to the changes in the GDP ranking, also here cities in current high-industrialised countries will drop behind cities in emerging countries. It is expected that New York and Tokyo will still lead the GDP ranking but other big cities from the U.S, Japan and Europe will fall behind rising cities from China, India and cities from Latin America until 2030. The development until today has led to the fact that more than 50% of the richest cities are port cities and this trend will further intensify towards 2030.

6.5.2.2 Macro-environmental trends including energy

Macro-trends from an environmental perspective are dominated by climate change and resource stress covering availability and use of natural resources. The climate change, which has taken place due to greenhouse gas emissions, will be a further essential issue towards 2030 and in the decades afterwards – and hence required appropriate activities to cope with this challenge. Looking at the sources for GHG, the production and consumption of energy based on fossil energy sources provides the biggest share of GHG (78% in 2015). The Paris agreement in 2015 reconfirmed the aim of limiting global temperature rise well below 2 degrees Celsius, while pushing efforts to limit the rise to 1.5 degrees. Under this Paris Agreement, the EU

[17] OECD Economic Outlook, Volume 2014/1, OECD, Paris.
[18] Global Marine Trends 2030, Lloyd's Register, a.o., London, 2015

confirmed the goal to reduce GHG by at least 40% below 1990 levels until 2030. This global challenge requires efforts in improving energy efficiency, strengthening the use of renewable energy and developing international and national strategies and policies that facilitate market-based mechanisms and financial instruments to accelerate investments in sustainable clean energies.

The second significant environmental macro-trend is the future demand for natural resources until 2030 and the diverted stress on these resources, i.e. on water, nutriment, land and energy that will derive from pressures from ongoing economic growth, urbanisation, demographic development and requirements from climate change.[19] Major changes in worldwide productions and consumption will cause further strain on limited natural resources. With regard to demand for nutriments, an increase in world population from 6,9 billion in 2010 to about 8,6 billion until 2030 will require a step-up of about 50% in production of nutriment. Looking at future water demand and supply, there will be a discrepancy of 40% in 2030 leading to a worsening of the situation today of worldwide access of people to water resources. Energy demand is expected to grow by 40% compared to 2010 whereby the growth in OECD countries is likely to be marginally, while in contrast about 75% in developing countries.

Fossil fuels will still play a key role in in energy production in 2030 and beyond as adapting the world energy system to alternative sources requires time and moreover, fossil fuels still provide large reserves that can be economically exploited. Crude oil is expected to support easily the matching with the increasing energy demand and its supply will grow by 38-63% until 2030. The same is valid for coal where reserves currently are about 140 times the annual production in 2011 and a forecast growth in production by more than 100% until 2030 with China as the leading coal producer.

6.5.2.3 Macro-societal trends

From a societal view, demographic development presents an essential macro-trend with strong impacts on the future.[20] It is expected that on a world-wide level by 2030 about 1 billion people will be 65 years old or older that means about 19% of the total population compared to 8% in 2016. The ageing of the global population by increased live spans and a decline in birth rates will pose big challenges on global societies, particularly on their fiscal and social welfare systems and also employment markets.

In 2030, the total world population will be around 8,6 billion people with India as the country with the biggest population (18%) followed by China (17%). The European Union will have a share of about 6% in the total population and among other individual countries with single-digit shares around 2-3% are Pakistan, Indonesia, Nigeria, Russia and Bangladesh.

On a global level, 5.2 billion people will live in cities representing a share of about 60% of the total population (55% in 2018) – a trend that is expected in all countries, but the highest increase rates for urbanisation will be in Asia and Africa. Main reason is that cities provide better economic and social prospects (e.g. job opportunities) which in turn will require that an increased demand for infrastructures, energy and water will have to be met by an adequate supply. The number of megacities with inhabitants above 10 million will increase from 20 in 2016 to 37 or higher in 2030. Many of the mega and also major cities are in Asia, Latin America and Africa with locations in or close distance to sea or inland ports allowing a good access to maritime transport services.

[19] Future State 2030: The global megatrends shaping governments, KPMG, Zurich, 2016
[20] A growing and ageing population - Global societal trends to 2030: Thematic report 1, RAND Corporation, Santa Monica, California/Cambridge, UK, 2015

Another trend having impacts on global societies is the so-called 'rise of the individual' which is caused by better access to education for a much larger part of the global population than today. The advance in information and communication technologies will play a vital role here. As consequence from better education, higher salaries accompanied by higher lifestyle expectations are estimated and moreover the ongoing of the process towards equal treatment of women in most countries.

Around 60% of the global population will belong to the so-called middle class compared to merely 27% in 2009 whereby 80% of the middle class will live in developing countries against 58% in 2010.

6.5.2.4 Macro-technology trends

The development of technologies has played an essential role for the global societies in the past and will do so in the future until 2030 and beyond, inter alia in sectors like science, engineering, health, manufacturing and transport. Technology aims at solving specific problems of modern societies as well as creating the future global framework drive technology development.[21]

An essential macro-trend here is the ongoing development of information and communications technologies, inter alia through blockchains, digitalisation, autonomous machines, sensible sensor systems, big data applications, internet of things (IoT) and artificial intelligence systems. These technologies will have impacts on processes and products, e.g. utilisation and management of energy and natural resources, development of new markets and new value chains, shifts in worldwide trade patterns and international competitiveness.

Global impacts from a significant technology trend derive also from the development of additive manufacturing. Here, 3D printing is the most known trend that is expected to have impacts on digital transports, warehousing, manufacturing of products, use of manufacturing materials, waste handling and logistic processes. However, a final time horizon for market maturity is still not fully clear as a number of problems are to overcome like suitable materials for the processing, standards or industrial ownership rights.

Blockchains is a disruptive technology assumed as having fundamental impacts on the electronic business communication. Decentralised stored blockchain technology is considered as fail-proofed and offering a higher availability compared to conventional centralised systems. The integrity of blockchains like any potential subsequent manipulation of data is ensured through an applied cryptographic interlinking which leads to an improved and simplified transaction security in non-centralised systems. Blockchains are based on the operational applications of the electronic currency Bitcoin and have been used also in a closed environment in the banking sector. Meanwhile, a number of pilot projects have been launched like in the energy, trade and transport sectors. Based on blockchain technology cost savings of up to 20% in the overall logistic costs of supply chains are estimated by substituting conventional creatings of trade documents and their physical transportation. However, blockchain has still not achieved market maturity and the current ongoing pilot projects are expected to provide rather no strategic results on the transferablility of benefits from blockchain technology for a larger share of comnaies and sectors. Hence, market penetration of blockchains in the different industries will depend on a number of factors like standards, regulations, technology maturity, type of assests and the degree of cooperations among companies (being often also competitors).

Trends in biotechnology are also assumed as having a macro-character with high impacts. Important areas in such a framework are genetics and genomics, biology informatics or molecular biology. Impacts are expected in a number of different areas tackling nowadays

[21] The Ocean Economy in 2030, OECD, Paris, 2015

important issues like global warming and cutbacks in nature, sustainability in many sectors like energy, transport, economics and agriculture and also global health.

Trends in nanotechnology will have significant impacts on economical processes in many areas but also on environmental and social challenges as they will change characteristics of materials and products, i.e. being stronger, cheaper, faster, lighter or more energy efficient.

6.5.2.5 *Macro-governmental and political trends*

Governmental- or political-related macro-trends can not clearly separated from other macro-trends. Hence, some trends have been described already like e.g. the increasing significance of emerging and developing countries and the changes in economic and consequently political power. Another example for these overlaps is environmental related trends and challenges where governments and policy need to act accordingly like on climate change or a sustainable use of natural resources.

An additional macro-trend on a governmental level is the development towards a further increase in public debts – mainly caused by the 2008 crisis - as these have in turn significant impacts on policy and fiscal options with regard to other areas with governmental responsibility like responding to environmental and societal challenges, guiding economic developments or supporting new technologies.[22] The ageing of the population will require about 4.4% of governmental spending for health and pensions in developed countries from their GDP and 3.2% of the GDP in developing countries. With regard to infrastructure costs caused by an increasing urbanisation, it is expected that around 41 trillion US$ are required in the period between 2005 and 2030. Further public financial risks are expected by natural disasters, like increased floodings, droughts, extreme weather events and polar melting causing large financial burdens for all waterborne sectors. A projection until 2050 forecasts that these costs due to natural disasters could run up to 1% of the global GDP per annum.

Public debts in developed countries have raised from about 46% in 2007 to roughly 78% in 2013 and will further increase to about 95% or above of the global GDP under the assumption that current trends will continue.

Public debts are also an issue for China with regard to its 'Belt &Road Initiative' (BRI). China issued long-term loans to mostly underdeveloped or developing countries which dispose of natural resources or other properties functioning as kind of guarantees or incentives for China to act as lender. Among the countries benefiting from China as lender for most investments in infrastructures and public services, there are a number of countries which show the risk to get debt distress, e.g. due to potential economical setbacks caused by natural disasters. This in turn leads to a mutual vulnerability between China and the borrowing countries. This would bring economical risks to China and its economy and hence to the global economy reflecting the current and future role of the Chinese economy.

6.5.3 Potential impacts from global macro-trends on the maritime sector

Direct potential impacts on ports until 2030 deriving from these macro-trends are hard to assess as port developments depend on ports of call strategies decided by ship operators and on volumes handled in ports based on vessel calling. However, some of the macro-trends will indirectly impact shipping and port via a reduced growth of international exchanges of goods. Hence, in the following part assumptions with regard to impacts of macro-trends on ports are made where maintainable.

[22] Future State 2030: The global megatrends shaping governments, KPMG, Zurich, 2016

The current and future economical growth in especially developing countries will still have positive impacts on the development of international trade – among regional trade blocks but also on a global level. The increasing demand for consumer as well as for investment goods for a longer period will be covered by supply from the currently developed and emerging economies. On the other hand, the developed economies are expected to experience a further slowdown in consumer demand, economics growth and consequently demand for imported goods. Reasons for this trend can be seen in the saturation of larger parts of the population with respect to container volumes and other sea transports related consumer goods, the over-ageing of population leading to reduced shares of income spending for consumption and the ongoing trend towards service-oriented economies. These assumptions, if compared to past experiences, could lead to an under-proportionate growth of world trade and consequently seaborne cargo transport. This has of course impacts at least on the speed of demand growth for international shipping and hence ports services as derived demand. While during the last decades the relation between growth rates of global GDP and global trade showed a ratio of about 1:1.6 it is expected that this ratio will be smaller in the period until 2030. Demand for container shipping and port handling services in the past decades grew even faster, i.e. the ratio between GDP and container handling growth rates was 1:3. This over-proportionate growth will become also significantly slower as a result of the reduced growth rates of international trade on the one and the limited potentials for a further containerization of current general cargo trade flows on the other hand.

In general, the macro-trend with regard to changes in populations and population structures will also influence the structures of global trades. In China the one-child-policy resulted in a reduced growth of population, increases in average ages and finally in shortage of workforce with the effect of rising salaries and labour cost. Of course, this on the one hand fosters rising demand for imported consumer goods and on the other hand makes outsourcing of production for developed economies less attractive. Consequence will be a change in global trade structures with impacts on the demand for ports services. Shipping and thus ports might be affected also by trade restrictions imposed by the U.S. as there may be a shift of trade relations from the transpacific trade towards the Asia-Europe trade.

A counter-acting trend on a global level might be the further growing of the middle class with better education, higher salaries and accordingly changing lifestyle expectations and consumption, which will lead to increasing seaborne transports of raw materials, semi-manufacture and manufactured commodities, including related logistic services. Here, shipping and hence ports as interfaces between shipping and land-based transport flows to industry sites, trading firms or final consumers will further benefit from these trends leading to a rising demand for maritime logistics but less significant compared to the past. Here, in the past a 1% growth in world trade lead to a 1% growth in maritime transport and to about 3% growth in container transport. However, these correlations are not expected to continue meaning that the impact on growth rates in global trade will have fewer impacts on maritime trade and container trades. Here, particularly container trades have been subject to saturation effects (e.g. due to already high degrees in containerization) which will continue also in the future.

With regard to the expected growth in the global population, the growing demand for nutriments, clean water and related technological products will also benefit ports and shipping as the cost advantage of shipping transports is here of particular significance for transports and logistics of clean water, nutriments and fish farming.

As with regard to environmental trends, the global economic and societal development will lead to an overall upwarding demand for energy. In order to meet the demand within the time horizon until 2030, it is expected that fossil sources will play further on an essential role for the production of energy, even if alternative energy sources will gain an increased importance over the years to come. However, main sources here are at sea which is why exploitation will move

furthermore to offshore production sites facilitated by higher oil prices and technological developments coping with environmental challenges. In addition, also alternative energy sources will continue to enhance market shares like offshore wind farms and other sea-related energy sources like technologies using the energy of waves and tidal currents, e.g. in combination with additional approaches like aquaculture to solve food related issues. Positive impacts are expected for ports from production and handling sites for offshore platforms and other equipments and bases for related logistic services like maintenance and supply. Expected world wide growing volumes in alternative fuels like LNG or methanol for transport and production will cause also a demand for handling and bunker capacities in ports.

With the irreversible force and trend to reduce emissions also from shipping there will be additional challenges for the ports on a global level – particularly with regard to port-city relations and the need for public acceptance of port operations and their consequences. Local emissions from ship operations have negative impacts not only on ports but also on populations living in port regions. According to the OECD about 230 million people who are living in the area of the top 100 ports in the world are directly affected by local emissions from shipping operations, like NO_x, SO_x and PM. Looking at the ten ports with the highest pollution from SO_x emissions on a world-wide scale, approximately 40 million local residents are struck here – meaning that here about 22% of SO_x emissions from global shipping operations are generated here. The SO_x emissions can not be reduced by relying merely on low-sulphur HFO – inter alia due to potential constraints in the supply of low-sulphur HFO - which means that a higher share of vessels will have to be equipped with (dry) scrubbers. Here, ports will be affected as they have to provide the necessary infrastructures to supply calcium and to dispose the residual gypsum.

Hence, the role of ports in the reduction of emissions from shipping and ports operations will further increase. As done in the recent years, ports will have to initiate emissions reduction measures like infrastructure developments, incentives and regulations relevant for ship operators when calling a ports but also for terminal operators and logistic providers involved in port and hinterland processes (e.g. pre- and on-carriage by trucks). Provisions of infrastructures for alternative fuels (like LNG or Onshore Power Supply) and for efficient hinterland processes (e.g. pre-gate systems), development of port-emission-reduction-strategies (e.g. by aiming at 'zero-emission terminals') as well as introductions of incentives for vessel operators to enhance their environmental performances of vessels (e.g. rebate systems in port charges like ESI) will be ongoing challenges for ports to contribute to local and global environmental improvements of the maritime sector.

An ongoing example with regard to port triggered CO2 measures represents for future ports activities here us the initiative of the port authorities of Antwerp, Barcelona, Hamburg, Los Angeles, Long Beach, Rotterdam and Vancouver who agreed in the framework of the Global Climate Action Summit to develop and perform joint 'climate protection' projects. The basic concept of the involved port authorities is that ports play a crucial rule in reducing emissions from the maritime sector to achieve the climate goal from the Paris Agreement to keep global warming significantly below 2 °C. Hence, it has to be clearly expected that ports will become furthermore active in responding to ongoing emission-related problems and challenges.

According to the OECD environmental performances of European and Asian ports have been already relatively good considering that they show for about 70% of total port calls with being responsible for roughly 50-60% of ship-related emissions due to high port handling efficiencies (e.g. through efficient berth times) compared to ports on the American and African continents. However, even if further emission reductions measures in EU ports will have fewer impacts than in other parts of the world, it remains clearly important to further tackle these measures – moreover against the background that local emissions reductions are essential for port-city relations.

The ongoing climate change is expected to lead to more natural disasters in the future like extreme rain overflows, droughts and the ongoing melting of the polar ice caps. The port sector will be clearly affected by high floods, winds and a rising sea level which then clearly requires adapting port infrastructures to cope with these developments. Ship-related impacts like the reduction of GHG emissions from shipping transports based on IMO decisions affects ports again as they need to provide relevant bunker facilities (cold-ironing or LNG bunkering) – and moreover, drive also ports to reduce emissions from port operations.

Societal trends with regard to the development of the global middle class, a more enlightened and ageing population, better global health conditions and better education will have impacts on a global attitude towards environmental challenges and also on the main actors here like the global maritime sector, particularly shipping operations. Impacts from environmental damages and existing labour conditions will enhance the public pressure on ports and shipping to comply with environmental and social requirements, standards and legal framework conditions, e.g. by implemented GRI standards. Ports are assumed to continue their efforts to reduce emissions from port operations but also from ship operations, e.g. by setting incentives to ship operators to lower emissions from the shipping side – but also with regard to safety and security standards in port workers environment.

Technology trends, particularly in ICT will also have impacts on ports. Here, digitalization will influence and change port internal operational processes as well as along the whole logistic chain. The development towards autonomous ports which is significantly based on digitalization has been seen already nowadays and will continue as automation in port operations, but also autonomous vessels or trucks in hinterland transports is further emerging.

The internet of things could change global logistic chains as intelligent devices are increasingly organizing logistic flows independently. It has been an ongoing process that ports have tried to increase their influence on the logistic chain through extending their services also to hinterland operations (e.g. by building and operation of train services) or by offering dedicated terminals or owned-ship operator terminals to bind shipping services to the respective ports. Independent decision process may change here the structure of building business process and relations putting ports again back to their roles merely as interfaces in logistic chains but with less impact on the design of logistic chains. Therefore, efficient port systems including optimized hinterland transport infrastructures for all modes are expected to become even more vital than today in order to maintain or gain competitveness in supply chains organized by autonomous intelligent devices.

The impact on ports deriving from blockchain technologies is depending on the degree of implementation of blockchains in the shipping sector – and so the corresponding time horizon. In the shipping sector the use of electronic data transactions is still very low and hence, most processings use paper documents. There are technical, operational and legislative reasons why the use of electronic documents in shipping is still underdeveloped – particularly compared to air transport. Expected benefits from the use of blockchain technolgies are significant improvements of the efficiency of operational processes like an enhanced digitalisation and an end-to-end visibility of supply chains. Within the maritime sector, it is assumed that enhanced operational logistic processes will lead to significant cost savings – particularly in the container market - and in turn to an increase of up to 15% in global trade. To what extent blockchains can prevent cyber attacks, e.g. with regard to past cyber attacks against Maersk in 2017 by against ransomware attack, is still uncertain. Challenges do also exist with regard to legislative issues like issues on contracts (e.g. stakeholders-authentication by digital signatures), liabilities or data protection. In current available information on pilot projects in the maritime sector, the issue of migration of conventional systems to blockchain system is not covered and relevant aspects of IT security are only covered marginally. Moreover, sharing business data is still a sensible issue and reluctance by the relevant actors needs to be overcome. Hence, even with a medium or

long-term market penetration of blockchain technology, relatively long transition periods are assumed to be required in which traditional EDI based port communications and new blockchain technologies do exist in parallel, e.g. with regard to mandatory notifications to authorities (e.g. customs) – and which will require migration strategies. Here, particularly operators of port community systems with services concerning centralised databases and communication systems will need to prepare for new structures communications along supply chains and for new business models.

Furthermore, the trend towards 3D printing will have impacts on global logistics like on transport of raw materials and semi-manufactured and manufactured goods, production processes, warehousing provided that market maturity will be achieved, including certifications and liabilities of 3D printed parts and cyber security issues. These developments affect global logistic chains, including shipping and hinterland transport and ports as nodes in these global chains. It is expected that 3D Printing will increase transport of raw materials as material input while less semi-final and final products will be transported and production will move closer to final consumption sites. Hence, transported container volumes are supposed to decrease – with consequences for handling of container volumes in ports. Furthermore, 3D printing could increase onshoring activities of the industry provided that benefits from 3D printing (e.g. logistic costs, product quality, transaction costs) will outbalance potential rises in labour costs.

In this context, an essential issue is also the protection against cyber attacks following an ongoing digitalization. As recent examples have shown, cyber security is and will be an essential issue also for ports until 2030 and beyond. Logistic chains and the related IT are so complex in the meantime that disturbances in the flow of information and in the operational systems of ports and shipping lines can lead to complete breakdowns with impacts not only within the ports and the lines themselves but on the downstream production processes. Therefore, cyber resilience will become an essential asset for ports in order to protect internal port operations, port as intermodal nodes and the concerned overall logistic chains.

The described development towards a further increase in public debts on a global level and the potential economic consequences bear also risks for the port and shipping sector. Here, clearly China inter alia with its 'Belt&Road Initiative' (BRI) poses a risk for the global economic development. While China supported its own economy as well as the world economy after 2008 through a debt-financed stimulus package, since then the increase of China's debt have been above its economic growth. This led to the second highest level of public debt globally and presents potential economic risks to China's economy as well as to the global economy. Due to China's current and growing significance for the global economy, particularly through its demand for raw materials, machineries and equipment and consumer goods, any economic downturn in China will have strong impacts on the development of the world economy and lead to subsequent consequences for the shipping and port sector that depend on global trade.

6.6 Task 5: Thematic workshop with experts

This document will be reviewed during the meeting with experts, which will take place in Oporto the 29th and 30th of October 2018. The workshop consists of plenary sessions and 10 breakout sessions on 5 subjects.

The high level objectives of the thematic workshop in general and more specific of the breakout sessions are:

1. To review this document on its accuracy, completeness, correctness, consistency and relevance for the "ports of the future" concept;
2. To come to a general agreed and actionable definition of ports of the future, including among others the key characteristics of a port of the future (See section 4 on page 29)

3. To give your opinion on whether or not WP1 can be closed and other DocksTheFuture work packages depending on it can be initiated;
4. As DocksTheFuture team we would like to learn as much as possible from the practical cases you are involved in.

The output of each breakout session is among others a review report in which the experts advise the DocksTheFuture team on further improvements on their work. The DocksTheFuture team will then consider relevant and feasible recommendations to update document D1.5 to *D1.6 Port of the Future concepts, topics and projects – consolidated versions*, which is the final delivery of work package 1 and serves as the baseline for all the other DocksTheFuture work packages.

The 5 subjects for the break out sessions will be discussed in 2 rounds, with in each round different persons around the table.

Breakout session title and description	**Topics**
Digitalization and digital transformation In the information model, topic T90 is actually called Digitization, digitalization and digital transformation but we consider the the "Digitization" part less relevant for the discusssion	**T90** and its subtopics T40 T50 T70 T80.20 T110
Sustainability This topic covers all aspects of the traditional 3P perspective on sustainability and consequently topic T60 has 3 subtopics: • Planet is about environmental sustainability; • Profit is about economic sustainability; • People is about social sustainability.	**T60** and its subtopics All other topics
Port city relations This is how the port infrastructure and port activities can be integrated with the city and its surroundings. This topic covers many subjects already covered in other topics, however looked at from the perspective on how the port activities affect the city and its surrounding. This consists of infrastructure and spatial organisation, sustainability, safety, security, human element and financing.	**T100** T10 and its subtopics T60 and its subtopics T70 T80 T110 T120.10
Infrastructure, means of transport and accessibility • Topic T10 is about the physical infrastructure, the spatial organisation of the infrastructure, about the services to maintain the infrastructure but not about the services that use the infrastructure. It also includes smart infrastructure. This topic has 4 subtopics respectively for sea side infrastructure, maritime terminals, other port infrastructure and hinterland connections (rail, road, inland waterways, pipeline); • Topic T20 is about the means of transport, currently limited to seagoing ships. • Topic T30 is about accessibility of all transport means to and from the	**T10** ***and subtopics*** T120.10, T60 and subtopics T100 T20 with subtopic **T20.10** **T30** and subtopics T70 T80

Breakout session title and description	Topics
ports. It also covers TEN-T networks, smart traffic management and multi and synchro modality. This topic has strong links to infrastructure to make ports accessible, to sustainability, safety, security, and digitalization and business to governance processes to get clearance for access.	T90 T110
Competition , cooperation and bridging R&D and implementation This breakout session covers most topics however from the perspective of cooperation or competition.	**T900 and subtopics** **T901** **T910** T10 and subtopics T30 and subtopics T40 T50 T60 and subtopics T70 T80 T90 T110 T130

Table 30: Breakout sessions subjects

There are roles defined for the breakout session:

1. Experts are invited to give their professional opinion on D1.5, advise on how to improve the work in the DocksTheFuture project and enrich the work with some best practices from their own sector or profession;
2. The moderator guides the review process and structures and visualises ideas, suggestions and remarks proposed by the experts by using the appropriate tools;
3. The scribe takes note of all the discussion by filling out the review report. The scribe will also prioritize the proposed actions and focus on interdependencies between topics, measures and tactical objectives. At the end of the breakout session the scribe presents a summary of the review report to make sure that the essentials of the breakout session are captured;
4. The rapporteur is one of the experts who will together with the scribes and moderators prepare a presentation for the plenary sessions. While the review report captures the details of the breakout session, and the recommended actions to improve D1.5, the presentation for the plenary will be more a helicopter view and a vision for the future by 2030.

A checklist will be used to guide the discussion. The report is the review checklist filled out and the actions prioritized.

7 Conclusions and recommendations

After the detailed description of the content retained from the assessed inputs, and relevance to/for the topics related to the port of the future, this chapter is to draw the first conclusions on those topics that may/should be part of a port of the future 2030 concept.

In order to classify the retained topics into a familiar setting, the 3P model (or TBL model) was used. This model appeared in various vision documents of other large industries and was

adopted by port authorities. The model is well known and succeeds in keeping a good balance between a ports various focus points being economical (profit or covering part of their costs), social (motivation on use of tax money, relations with city, contribution to GDP), and - increasingly in the last decades – 'grow with green' / environmental, respecting its environmental constraints and assuring the impact on nature and people at least remains limited and is compensated.

As such following performance areas are worth being considered in the concept of the port of the future.

Planet (Living with – or together – with environmental limits):

1. Renewable energy
   Topic 60.10 Environmental sustainability and subtopics Alternative Fuel and Power Supply, gave good examples of initiatives that will shape further the concept:
   a. Green infrastructure and low impact development;
   b. Alternative energy infrastructure;
   c. Wind farms, solar panels, hydrogen, OSP, LNG;
   d. Use flat roofs of the many port warehouses as platforms for solar panel parks.
2. Building design.
   The same topic 60.10 Environmental sustainability gave solid answer to the 'green' dimension in the realisation of infrastructure, including tools to assess a port's plan.
   a. Sustainable Port Design;
   b. Eco Based Design Approach.

Related to a port's own buildings, good examples exist on energy management, installation of renewable energy sources, and reporting through various ISO standards, 'green' performance indexes, accreditations (Sustainable Integrated Condition Index/SICI Accreditation e.g. Green Port ' EcoPort or ISO 14001;)

One input identified this topic as the best elaborated, due to international and national regulations being imposed such as national regulations, European regulations;

1. Replenishing resources.
   This part is covered under the section sustainability and contains renewable energy sources (solar, wind), re-use of water, use of rainwater.
   Circular economy models were also identified in port areas generating new economic activities (recovery of ships parts, battery reconversion, re-use of collected waste);
2. Logistics and Transport
   A main topic as it concerns one of the core activities in a maritime port environment. Almost all topics in this paper address this to some extent, such as Infrastructure, means of transport, accessibility, integration in the supply chain, digitization, incident management and cooperation.
   Measures are affluent available though often still too centred on the physical aspect (infrastructure bottlenecks, imposing transport mode mix on port terminals). Still ports struggle to obtain a more sustainable transport mix on the total cargo volume handled.
   Actions with regards to digitization have started by means of 'Single Windows', 'Platforms', but still lack the interconnectivity aspect between 'windows' and 'platforms';
3. End of life disposal;
4. Waste management.
   Both issues are rather well developed in maritime port areas, partially due to existing regulations. Ports, despite having a limited set of tools, succeed though in imposing restrictions on its clients with regards to waste. These contain pricing, licencing and

monitoring. Waste Reception facilities become part of an integrated, sometimes self-sustained Port Waste Management plan.
Reporting on this topic is part of CSR from the maritime port authorities point of view, but shipping lines are already longer used to reporting waste to port authorities;

5. Emission and pollution
Under the same topic as in the previous sections, this part is well developed being surrounded by a long list of monitoring activities, regulations and KPI's under the form of a continuous reduction or by means of an index, to be compared with other ports;
6. Sustaining diversity.

People (a fair society):

1. Education and development.
Though well-equipped and described in topic 110.Human element (including labour market and education and training), the current measures remain limited to the current situation. Though the negative impact of the digitization wave is recognized, measures remain at a generic level in case they are mentioned at all;
2. Locality and communities
Topic Port city relations has an excellent list of best practices, collected throughout the world on good Port/City initiatives. The implementation of some of these practices though still seems to reflect rather an ad hoc approach, and are not part of for example a 'Port/City contract' or any other formalization of the topic;
3. Health and wellbeing
Partially covered by the same topic as under Human Element, it is reflected in various other topics as well, such as in air/water/surface pollution and safety procedures. Topic Maritime and Port Incidents also deals with this topic;
4. Relieving poverty.
Not addressed as such, but indirectly present under the section Cooperation, and Human Element. To this aspect several European ports do assist many non-European ports (African, Asian) in their organisation. Often this is linked to existing cargo streams between the cooperating ports. More locally the focus is on job creation;
5. Safety and security.
From regulatory SafeSeaNet and securing trade lanes regulations are applicable such as Authorised Economic Operator, C-TPAT. Security wise the IMO regulations ISPS are the best developed KPI's to be attended;
6. Ethics and governance
Maritime ports adapt more to current (large) business practices and have a well-developed ethics policy.

   Governance has become more compliant to standard business reporting rules (financial reports, non-financial reports), and by means of the many 'neutral' certifications held, such as ISO standards;
7. Privacy and equality and human rights.
Both relate to topics Human Element, described before.

Profit (a sustainable business)

1. Competitive advantage;
2. Profitable growth;
3. Investor returns;

4. Enterprise partners;
5. Good employer;
6. Creativity and innovation;
7. Business model;
8. Efficient processes.

Maritime ports increasingly shift to a commercialised entity under the form of a public limited company, or an independent public body. The consequence is that the more 'classical' business topics are now better attended. With increasing public and political pressure maritime ports have to justify their use of the public funds allocated to them. This is reflected through various aspects in reporting obligations, permission procedures (such as CBA for infrastructure), revenue generating aspect of investments, and the aforementioned reporting on environmental impact.

Business models of ports also adapt to the changing market conditions, and gradually shift from the classic landlord model to the more entrepreneurial business model, in which the port authority undertakes an active role in attracting companies to fit in the existing clusters policy, invest in fore-and hinterland economic actors (other ports, hinterland terminals, railway companies), and recently also in digitization (appointment of Chief Digital Innovation Officer Officers, IT companies, applications, ...).

A persistant contradiction that remains stubbornly alive is the issue of project financing. While we all may agree with building the Port of the Future, someone has to pick up the bill attached to it. All stakeholders confirm the need for more funds. And yet, never in history this much money was available for projects (including transport). Yet, especially the transport sector compared to other sectors is not (yet ?) making use of these financial resources. Of course, when combining both public and private financing, the project has to meet certain financial and economic (environmental, ...) goals, which may pose a problem to some initiatives. Should these remain getting financed if they fail for example the test of a Cost Benefit Analysis. ?

Bibliography

8 Bibliography

ID	Reference
	Bibliography from section 6.2 Task 1: Desktop analysis on page 40 The ID's reference to the unique ID's of the inputs assessed.
10	1. T. Notteboom (Applied Economics, University of Antwerp) and K.Nevers (VIL) for ING (2017). The future of port logistics meeting the challenges of supply chain integration, ING Bank, University of Antwerp and VIL;
20	2. Christoph Plasil, Therry van der Burgt, Giovanni Huisken, Lea Kuiters, Michael Brunsch, Jörg Dittmar, Peter Bresseleers, Max Nilles (2015). Functional and technical requirements study for a European FIS and TIS Register and Portal; SuAc 2.3 Functional and technical requirements study for a European FIS and TIS Register and Portal, CoRISMa Ten-T Ris Enabled Corridor, co-financed EU project deliverable; 3. EU Directive (2005). DIRECTIVE 2005/44/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 7 September 2005 on harmonised river information services (RIS) on inland waterways in the Community, European Union, Brussels; 4. EU Regulation (2007). COMMISSION REGULATION (EC) No 414/2007 of 13 March 200; 5. concerning the technical guidelines for the planning, implementation and operational use of river information services (RIS) referred to in Article 5 of Directive 2005/44/EC of the Europea; 6. Parliament and of the Council on harmonised river information services (RIS) on inland waterways in the Community, European Union, Brussels; 7. Willems C (2011). PIANC RIS Guidelines 2011 Edition 3, Smart Rivers Conference 2011, PINAC RIS Working Group & Rijkswaterstaat Ministerie van Infrastructuur en milieu; 8. Expert group of the International Navigation Association (PINC) (2004), Guidelines and recommendations for river information services Edition 2.0 05.02.2004, PIANC; 9. IALA International Association of Marine Aids to Navigation and Lighthouse Authorities (2013). IALA Recommendation V-120 on Vessel Traffic Services in Inland Waters Edition 2, December2013, Saint Germain en Laye, France;
30	10. Thomas Wagner (main author), Christian Lüpges, Mario Kaufmann, Therry van der Burgt, Tony Daems, Alsic, Peter Oudenes, Piet Creemers, Mario Sattler, Thomas Zwicklhuber, Silviu Apostol (2017). Corridor RIS Concept, RIS COMEX co-financed Eu project;
40	11. WG ReportN°156-2017 E-Navigation for inland waterways 2017 (2016). The world association for Waterborne Transport Infrastructure;
50	12. Various authors under the direction of Yann Alix, Nicolas Mat and Juliette Cerceau (2015). Économie circularie et écosystèmes portuaires, éditions ems management & société Les Collection Océanides, Cormelles-le-Royal, France;
60	13. Various authors under the direction of Yann ALIX, Claude COMTOIS, Bruno DELSALLE (2014). Port-City Governance, Port City Governance, société Les Collection Océanides, Cormelles-le-Royal, France;

ID	Reference
70	14. ESPO. Tends in EU ports governance 2016;
80	15. Mäkinen Mikael, (2016). Ship Intelligence : Autonomous ships The next step, Ship Intelligence Marin, Aalto/VTT (technical research of Finland), Tampere University of Technology – University of Turku, Abo Akademi;
90	16. Olaf Merk. How to go about Greening Terminals, Port Technology Edition 68 – The Mega Terminals Edition;
110	17. Kalmar (2017). The Future of Ports in 2060, video on porttechnology.com;
410	18. Doll, C., J. Köhler, M. Maibach, W. Schade, S. Mader (2017): The Grand Challenge – Pathways. Towards Carbon Neutral Freight Corridors. Working paper 2 within the study "LowCarb RFC –Low Carbon Rail Freight Transport in Europe". Fraunhofer ISI and IML, INFRAS, M-Five, University of Antwerp. Karlsruhe, March 2016;
430	19. Esser Anton, Sys Christa, Vanelslander Thierry, Verhetsel Ann.- De toekomst van de arbeidsmarkt in de haven van Antwerpen Antwerp, University of Antwerp, Department of Transport and Regional Economics, 2017, 136 p;
450	20. Various authors (2016). Deliverable: D5.1: Potential of Investments in Transport Infrastructure, BENEFIT Business Models for Enhancing Funding & Enabling Financing for Infrastructure in Transport, co-financed EU project;
460	21. Authors: Genevieve Giuliano, Geraldine Knatz, Nathan Hutson Christa Sys, Thierry Vanelslander, Valentin Carlan With thanks to Claudio Ferrari, Alessio Tei, Rosario Macário, Vasco Reis, Lam Siu Lee Jasmine and Athena Roumboutsos for the data collection of port related innovation cases, Led by the BNP Paribas Fortis Chair in Transport, Logistics and Ports from the UA - University of Antwerp - TPR: Department of Transport & Regional Economics (unknown date): Decision-making for maritime innovation investments - the significance of cost benefit and cost effectiveness analysis, University of Antwerp.
610	22. Enrique Martín (CENIT), M. Ángel Dombriz (FGC), Gisela Soley (IDP): Intermodel EU, project GA: 690658
620	23. Fundacion Tecnalia Research & Innovation (TECNALIA) Project Coordinator | FEHRL - Lead Partner (Catherine Birkner, Communication Officer) - Document Lead Partner: LGI Consulting, France: RAGTIME D3.6 Stakeholder assessment and business models characterisation in the transport infrastructure sector v 1.0 (2017).
880	24. ECOSSIAN - European COntrol System Security Incident Analysis Network, project, various authors, (2017), ECOSSIAN cyber incident management system for European interconnected critical infrastructures, 607577.
890	25. Gerwin Zomer, Yao-Hua Tan, Wout Hofman (2014). D9.1 CASSANDRA Final Report, Cassandra common assessment and analysis risk in global supply chains, co-financed EU project.
920	26. MESA project 604857 (2017) 604857 - Assessment MESA - Maritime Europe Strategy

ID	Reference
	Action – FOSTER WATERBORNE.
1030	27. Francesca Tassara and Alice Consilvio (2017). Collaborative Innovation Clouds 2017 Logistics Report.
1070	28. European Commission Directorate-General for Mobility and Transport Directorate D – Logistics, maritime & land transport and passenger rights (December 4, 2014). European Sustainable Shipping Forum 3rd Plenary Meeting, Final Report Submission from ESSF Sub-Groups, Brussels;
1080	29. Mikael Lind, Michael Bergmann, Sandra Haraldson, Richard T. Watson, Jin Park, José Gimenez, Trond Andersen (2018). Port Collaborative Decision Making (PortCDM): An enabler for Port Call Optimization empowered by international harmonization, co-financed EU project; 30. Mikael Lind, Terje Rygh, Michael Bergmann, Richard T. Watson, Sandra Haraldson, Trond Andersen (2018). Balancing just-in-time operations – Coordinating value creation STM Sea Traffic Management, concept note #6, co-financed EU project; 31. Mikael Lind, Michael Bergmann, Sandra Haraldson, Richard T. Watson, Michalis Michaelides, Herodotos Herodotou, Sotos Voskarides (2018), Port-2-Port Communication Enabling Short Sea Shipping: Cyprus and the Eastern Mediterranean STM Sea Traffic Management, concept note #5, co-financed EU project; 32. Mikael Lind, Terje Rygh, Michael Bergmann, Richard T. Watson, Sandra Haraldson, Trond Andersen (2018). Enabling Effective Port Resource Management: Integrating Systems of Production Data Streams, STM Sea Traffic Management, concept note #3, co-financed EU project; 33. Mikael Lind, Terje Rygh, Michael Bergmann, Richard T. Watson, Sandra Haraldson, Trond Andersen (2018). Creating a mature data sharing regime - Thriving in the connected ecosystem, STM Sea Traffic Management, concept note #7, co-financed EU project; 34. Mikael Lind, Michael Bergmann, Sandra Haraldson, Richard T. Watson, Jin Park, José Gimenez, Trond Andersen (2018). From concept to implementation - an interplay between research and practice STM Sea Traffic Management, concept note #4, co-financed EU project; 35. Unknown (2016). STM Validation project HOW-TO Get started with STM and SeaSwim, co-financed EU project; 36. Rydlinger Anders (2012). MONALISA 2.0 – Activity 1.3 STM Voyage exchange format and architecture Document No: MONALISA 2 0_D1.3.2, MONALISA Co-finance EU project;
1090	37. AIVP (2015). Plan the city with the port: guide of good practices. Association Internationales des Villes Portuaires, Le Havre.
1100	38. Marissa Oude Weernink, Willem van den Engh, Mattia Francisconi, Frida Thorborg (2018). The Blockchain Potential for Port Logistics, Global Maritime Hub.
1110	39. Prof. Dr. Michaël Dooms (2017). PORTOPIA-Observatory set-up guidelines. SST.2013.6-2 Towards a competitive and resource efficient port transport system.
1150	40. EU (2016). Commission Staff Working Document on the implementation of the EU

ID	Reference
	Maritime Transport Strategy 2009-2018. European Commission SWD(2016) 326 Final;
1160	41. Duin H, Goridt C, Hauge J.B., Thoben K-D (June 2014). Work process oriented competence development for the port of the future, 2014 International Conference on Engineering, Technology and Innovation (ICE);
1170	42. Rick M.A. Hollen, Frans A.J. van den Bosch and Henk W. Volberda (2014). Strategic levers of port authorities for industrial ecosystem development, © 2015 Macmillan Publishers Ltd. 1479-2931 Maritime Economics & Logistics Vol. 17, 1, 79–96;
1180	43. Prem Chhetri, Gaya B. Jayatilleke, Victor O. Gekara, Alex Manzoni, Brian Corbitt (2016), Container terminal operations simulator (CTOS), European Journal of Transport and Infrastructure Research (EJTIR) - Issue 16(1) 2016, pp. 195-213, ISSN: 1567-7141, tlo.tbm.tudelft.nl/ejtir
1190	44. Ville Hinkka, Jenni Eckhardt, Antti Permala, Heikki Mantsinen (2016). Changing Training needs of port workers due to future trends, 6th Transport Research Arena April 18-21,2016, Elsevier Transport Research Procedia;
1210	45. Bostjan PAVLIC , Franka CEPAK, Boris SUCIC, Marko PECKAJ,Bogomil KANDUS (201). Comparative thermal performance of static sunshade and brick cavity wall for energy efficient building envelope in composite climate, Thermal Science PY – 2014 VL – 18 IS – 3 SP – 925 EP – 934 PT- Article;
1230	46. Alkan G., Kara G, Nas S, Kara Emecen E.G., Yildiz M (October 24-25, 2016). Conference Proceedings Book II.Global Conference on innovation in marine technology and the future of maritime transportation, T.M.M.O.B. Gemi Makineleri Isletme MÜhendisleri Odasi, Bodrum, Mugla, Turkey;
1240	47. Jasmine Siu Lee Lam & Theo Notteboom (2014) The Greening of Ports: A Comparison of Port Management Tools Used by Leading Ports in Asia and Europe, Transport Reviews, 34:2, 169-189;
1250	48. Pallis, Athanasios A., Papachristou, Aimilia A., Platias, Charalampos (2017). Environmental policies and practices in Cruise Ports: Waste reception facilities in the Med, SPOUDAI - Journal of Economics and Business [ISSN:] 2241-424X [Volume:] 67 [Year:] 2017 [Issue:] 1 [Pages:] 54-70
1261	49. Fancello, Gianfranco & Claudia, Pani & Serra, Patrizia & Paolo, Fadda. (2014). Port Cooperation Policies in the Mediterranean Basin: An Experimental Approach Using Cluster Analysis. Transportation Research Procedia. 3. 10.1016/j.trpro.2014.10.049;
1310	50. Nuria Nebot, Carlos Rosa-Jimenez, Ricard Pie Ninot, Ricard Pie Ninot (2016), Challenges for the future of ports. What can be learnt from the Spanish Mediterranean ports?, Ocean & Coastal Management, Elsevier.
1350	51. Dr Fernando Caldeira-Saraiva (2015).ECOHUBS - Environmentally COherent measures and interventions to debottleneck HUBS of the multimodal network favoured by seamless flow of goods, Project ID: 314786

ID	Reference
1400	52. Nicolas Mat, Juliette Cerceau, Lei Shi, Hung-Suck Park, Guillaume Junqua, Miguel Lopez-Ferber (2014), Socio-ecological transitions toward low-carbon port cities: trends,changes and adaptation processes in Asia and Europe, Journal of Cleaner Production Volume 114, 15 February 2016, Pages 362-375;
1500	53. Carpenter Angela, Lozano Rodrigo, Sammalisto Kaisu, Astner Linda (2018). Securing a port's future through Circular Economy: Experiences from the Port of Gävle in contributing to sustainability, Marine Pollution Bulletin, Volume 128, March 2018, Pages 539-547;
1510	54. Vermeulen Susan (2016). A relationship between port profiles and policies regarding the circular economy, A policy study of a selection of ports in Hamburg - Le Havre range. Erasmus School of Economics, - Erasmus University Rotterdam, Netherlands;
1520	55. Karimpour, Reza, "Circular economy modelling to accelerate the transition of ports into self-sustainable ports: a case study in Copenhagen-Malmö Port (CMP)" (2017). World Maritime University Dissertations. 591. http://commons.wmu.se/all_dissertations/591;
1530	56. Mustafa Doğru, Cem Oktay Güzeller, Tuna Gencosman, Dilara Saka (2016). Development of Scale of Attitude Toward Social Sustainable Development Awareness, European Journal of Sustainable Development (2016), 5, 4, 509-522, ECSDEV, Rome, Italy;
1630	57. Andrzej Montwiłł (2016). The impact of the development of seaport objective functions for a cargo logistics system in urban areas, illustrated with an example of the Szczecin Metropolis, 2nd International Conference "Green Cities - Green Logistics for Greener Cities", 2-3 March 2016, Szczecin, Poland, Transportation Research Procedia 16 (2016) 366 – 377;
1680	58. Jacqueline Boulos (2016). Sustainable Development of Coastal Cities-Proposal of a Modelling Framework to Achieve Sustainable City-Port Connectivity, Urban Planning and Architecture Design for Sustainable Development, UPADSD 14- 16 October, Procedia - Social and Behavioral Sciences 216 (2016) 974 – 985;
1790	59. MITIGATE Multidimensional, IntegraTed, rIsk assessment framework and dynamic, collaborative Risk ManaGement tools for critical information infrAstrucTurEs Project Deliverables EU co-financed project;
1930	60. Ministère de l'écologie, du développement durable et de l'énergie; Ministère délégué aux transports, à la mer et à la pêche, Strategie national portuaire.
1940	61. Bundesministerium für Verkehr und digitale Infrastruktur (2015-). National Strategy for Sea and Inland Ports (2015), Berlin.
1950	62. Port of Rotterdam (2011). Port Vision 2030 Port Compass Direct the Future. Start Today, Port of Rotterdam;
1970	63. Motorways of the Sea (2018). Detailed Implementation Plan Based on three key pillars, Environment, The integration of maritime transport in the logistics chain, safety,

ID	Reference
	human element and traffic management. European Commission – Directorate General for Mobility and Transport Directorate B – Investment, Innovative & Sustainable Transport Unit B1 – Transport Networks; 64. Motorways of the Sea (2018). Detailed Analysis of ports and shipping operations Annex to Motorways of the Sea Detailed Implementation Plan. European Commission – Directorate General for Mobility and Transport Directorate B – Investment, Innovative & Sustainable Transport Unit B1 – Transport Networks;
2020	65. Hamburg Port Authority (2012). Hamburg is staying on Course The Port Development plan to 2025, Free and Hanseatic city of Hamburg – State Ministry of Economic Affairs, Transport and Innovation Hamburg Port Authority;
2070	66. ISETEC II (2007). Innovative Seehafentechnologien Definitionsphase Voruntersuching/Programmbericht, Bundesministerium für Wirstschaft und Technologie;
2090	67. DNV-GL various authors (2016) - Energy Transition Outlook 2017, A global and regional forecast of the energy transition to 2050.
2100	68. Various authors (2017) ESPO, ECOPORTS FP7 Rapid Exchange System+, PPRISM Governance Fact Finding Study. PORTOPIA – European Port Industry Sustainability Report 2017.
2130	69. European Sea Ports Association ESPO (2016). ESPO Code of Good Practices for Cruise and Ferry Ports, European Sea Ports Organisation (ESPO) vzw/asbl, Brussels;
2630	70. Michele Acciaro, Thierry Vanelslander, Christa Sys, Claudio Ferrari, Athena Roumboutsos, Genevieve Giuliano, Jasmine Siu Lee Lam & Seraphim Kapros (2014) Environmental sustainability in seaports: a framework for successful innovation, Maritime Policy & Management, 41:5, 480-500,
3210	71. Dr. Cor A. Schipper, MSc. Sophie Vergouwen, Dr. Martijn de Jong, MSc. Heleen Vreugdenhil, Dr. Mark de Bel, MSc. Femke Schasfoort, MSc. Stijn Minderhoud (2015) Port of the future Exploratory Study, (Deltares).
3220	72. Pianc (2014). Report n°150 -2014 Pianc Sustainable Ports A guide for port authorities – The World Association for Waterborne Infrastructure – Brussel 2014;
3230	73. Poonam Taneja (2013). The Flexible Port Proefschrift the Next Generation Infrastructure Foundation, Delft, The Netherlands;
3240	74. Fusco Girard Luigi (2013). Toward a Smart Sustainable Development of Port Cities/Areas: The Role of the “Historic Urban Landscape” Journal Sustainability, 5, 2013, number 10, pages 4329—4348;
3250	75. Schipper, Cor & Vreugdenhil, Heleen & P C De Jong, M. (2017). A sustainability assessment of ports and port-city plans: Comparing ambitions with achievements. Transportation Research Part D Transport and Environment. 57. 84-111. 10.1016/j.trd.2017.08.017;

ID	Reference
3270	76. Deblina Saha (2018). Low-carbon infrastructure: an essential solution to climate change? The World Bank blog article;
3280	77. de Vriend H, van Koningsveld M, Aarninkhof S, 'Building with nature: the new Dutch approach to coastal and river works', Institution of Civil Engineers, ICE Publishing, volume 167 Issue CE 1, February 2014.
3330	78. Judith K. Mol, Wiebe P. de Boer, Tiedo Vellinga, Jill H. Slinger, Victor Beumer (2018). Exploring potential climate change impacts and adaptation strategies for seaport operability, PIANC-World Congress Panama City, Panama.
3340	79. Jorrit van den Houten (2017), A System Dynamics Exploration of Port-City Development the Case of Tema, Ghana
3370	80. S.J.Sangster (2015). Sustainable Port Infrastructure : An interdisciplinary design study of nature friendly banks made of residual material to enhance biodiversity in a port. Thesis for degree of Master of Science in Civil Engineering at Delft University of Technology.
3380	81. Eslie-Fleur Vrolijk (2015). Ecosystem-based port design An approach for sustainable port development MSc thesis, he Delft University of Technology, Delft, The Netherlands.
3480	82. Soner ESMER, Hong-Oanh NGUYEN, Yapa Mahinda BANDARA, Kazim YEN (2016). Non-Price Competition in the Port Sector: A Case Study of Ports in Turkey. The Asian Journal of Shipping and Logistics 32(1) (2016) 003-011
3490	83. Florin Nicolae, Marius Bucur, Alexandru Cotorcea (2018). Port performance evaluation. Case study: Ports in the Black Sea basin. IOP Conf. Ser.: Earth Environ. Sci.172 012004
3500	84. Florin NICOLAE, Rosen IVANOV, Cătălin POPA, Filip NISTOR, Alexandru COTORCEA (2017). The relations between the port business framework and the qualified manpower competencies – literature review and proposed guidelines. "Mircea cel Batran" Naval Academ y Scientific Bulletin, Volume XX – 2017 – Issue 1
3510	85. EU Investment plan booklet, The Investment Plan For Europe – state of play (2018). European Commission.
3530	86. De Meirleir M, Location Location Location A plant Location and Site Selection Guide (2006). Business Location International, Brussels.
3540	87. IBM Global Business Services Plant Location International (2008). Improving private sector land access Site Availability – Perspective from the investor. Presentation.
n/a	Bibliography from section 6.3 Task 2: Stakeholders consultation on page 109
n/a	88. Dooms, M., Verbekeb, A. & Haezendoncka, E., 2013. Stakeholder management and path dependence in large-scale transport infrastructure development: the port of Antwerp case (1960–2010).. Journal of Transport Geography, Volume 27, p. 14–25.
n/a	89. FREEMAN, R. E., 1984: Strategic management: A Stakeholder Approach. London:

ID	Reference
	Pitman. ISBN 0-273-001913-9
n/a	90. GRIMBLE, R. et al., 1995: Trees and trade-offs: a stakeholder approach to natural resource management. London: International Institute for Environment and Development. Gatekeeper Series 52
n/a	Bibliography from section 6.5 Task4: Macro trends on page 149
n/a	91. A growing and ageing population - Global societal trends to 2030: Thematic report 1, RAND Corporation, Santa Monica, California/Cambridge, UK, 2015
n/a	92. Future State 2030: The global megatrends shaping governments, KPMG, Zurich, 2016
n/a	93. Global Marine Trends 2030, Lloyd's Register, a.o., London, 2015
n/a	94. Medium and Long-Term Global Economic Outlook, Mitsubishi Research Institute, Inc., Tokyo, 2017
n/a	95. OECD Economic Outlook, Volume 2014/1, OECD, Paris
n/a	96. Shipping Emissions in Ports, Discussion Paper 2014, International Transport Forum, OECD, Paris, 2014
n/a	97. The Ocean Economy in 2030, OECD, Paris, 2015
n/a	98. Global Trends 2030, The European Strategy and Policy Analysis System (ESPAS),
n/a	99. Working Paper: Clean Air in Ports, NABU, Hamburg, 2014
n/a	Bibliography from section 9.1.7 Study on sustainability on page 238
n/a	100. N. Asgari, A. Hassani, D. Jones, H. Nguye 205 Sustainability ranking of the UK major ports: Methodology and case study 206 Transport Res E-Log., 78 (2015), pp. 19–39 207 http://dx.doi.org/10.1016/j.tre.2015.01.014
n/a	101. Balzarova, M.A. and Castka, P. (2012), "Stakeholders' influence and contribution to social standards development: the case of multiple stakeholder approach to ISO 26000 development", Journal of Business Ethics, Vol. 111 No. 2, pp. 265-279.
n/a	102. Biermann, Frank, Kanieb, Norichika and Kima, Rakhyun E. (2017) Global governance by goal-setting: the novel approach of the UN Sustainable Development Goals. Current Opinion in Environmental Sustainability Volumes 26–27, 26–31. doi: 10.1016/j.cosust.2017.01.010
n/a	103. Cheon, S.H.and Dwakin, E.,"Supply Chain Coordination for Port Sustainability, "Journal of Transport Research Board, Vol.2166, No.2, 2010, 10-19.
n/a	104. Chia, Raymond, and Arun Kr Dev. "Need for an Integrated Sustainable Shipping Index."37th Annual Journal 2017/2018 of Society of Naval Architects and Marine

ID	Reference
	Engineers Singapore (SNAMES) (2018)
n/a	105. Dinwoodie, J., Tuck, S., Knowles, H., Benhin, J. and Sansom, M.,"Sustainable Development of Maritime Operations in Ports, "Business Strategy and the Environment, Vol.21, No.2, 2012, 111–126.
n/a	106. ESPO,"Green Guide".2012, http://www.espo.be/images/stories/Publications/codes_of_ practice/espo _green%20guide_october%202012_final.pdf
n/a	107. Fenton P (2017) The role of port cities and transnational municipal networks in efforts to reduce greenhouse gas emissions on land and at sea from shipping—an assessment of the World Ports Climate Initiative. Mar Policy 75:271–277. https://doi.org/10.1016/j.marpol.2015.12.012
n/a	108. Font, X., Guix, M. and Bonilla-Priego, M.J. (2016) Corporate social responsibility in cruising: using materiality analysis to create shared value. Tourism Management 53, 175–186
n/a	109. Gibbs D, Rigot-Muller P, Mangan J, Lalwan C. The role of sea ports in end-to-end maritime transport chain emissions. Energy Policy 2014; 64 337–348.
n/a	110. Goulielmos AM. European policy on port environmental protection. Global Nest 2000; 2(2) 189-197.
n/a	111. GRI (2011a). About GRI. Retrieved from https://www.globalreporting.org/information/about-gri/Pages/default.aspx
n/a	112. GRI (2011c). Sustainability Reporting Guidelines G3.1. Retrieved from https://www.globalreporting.org/resourcelibrary/G3.1-Guidelines-Incl-TechnicalProtocol.pdf
n/a	113. GURVITSH, N. and SIDOROVA, I. 2012. Survey of sustainability reporting integrated into annual reports of Estonian companies for the years 2007– 2010: based on companies listed on Tallin Stock Exchange as of October 2011. Procedia Economics and Finance, 2: 26–34
n/a	114. Hahn, R. (2012), "Standardizing social responsibility? New perspectives on guidance documents and management system standards for sustainable development", IEEE Transactions on Engineering Management, Vol. 59 No. 4, pp. 717-727.
n/a	115. Le XQ, Vu VH, Hens L, Heur BV. Stakeholder perceptions and involvement in the implementation of EMS in ports in Vietnam and Cambodia. Journal of Cleaner Production 2014; 64 1-21.
n/a	116. Maurice Jansen, Rob van Tulder & Rikky Afrianto (2018) Exploring the conditions for inclusive port development: the case of Indonesia, Maritime Policy & Management, 45:7, 924-943, DOI: 10.1080/03088839.2018.1472824
n/a	117. Kanie N, Bernstein S, Biermann F, Haas PM: Introduction: global governance through

ID	Reference
	goal setting. In Governing Through Goals: Sustainable Development Goals as Governance Innovation. Edited by Kanie N, Biermann F. MIT Press; 2017. in press
n/a	118. Lun, Y. H. V.,"Green Management Practices and Firm Performance: A Case of Container Terminal Operations, "Resource, Conservation and Recycling, Vol.,55, No.6, 2011, 559-566.
n/a	119. Marine Insight. 2011. Integrating Sustainable Development and Maritime Industry. Marine Insight. (http://www.marineinsight.com/marine/integrating-corporate-social-responsibility-andmaritime-industry/).
n/a	120. Nikolaeva, R. and Bicho, M. (2010), "The role of institutional and reputational factors in the voluntary adoption of corporate social responsibility reporting standards", Journal of the Academy of Marketing Science, Vol. 39 No. 1, pp. 136-157
n/a	121. Peris-Mora E, Diez Orejas J, Subirats A, Ibanez S, Alvarez P. Development of a system of indicators for sustainable. Marine Pollution Bulletin 2005; 50 1649–1660
n/a	122. Pronk, J. and Haq, M. (1992), Sustainable Development: From Concept to Action, UNDP, New York, NY.
n/a	123. Sislian, L., A. Jaegler, A. and Cariou, P. (2016). A Literature Review on Port Sustainability and Ocean's Carrier Network Problem, Research in Transportation
n/a	124. Business & Management, 19, pp.19-26
n/a	125. UNCTAD. 2009. Review of Maritime Transport, United Nations Conference on Trade and Development (http://www.unctad.org).
n/a	126. United Nations General Assembly: Transforming Our World: The 2030 Agenda for Sustainable Development. Draft resolution referred to the United Nations summit for the adoption of the post2015 development agenda by the General Assembly at its sixtyninth session. UN Doc. A/70/L.1 of 18 September 2015.
n/a	127. United Nations https://oceanconference.un.org/commitments/?id=17158
n/a	128. Villalba G, Gemechu ED. Estimating GHG emissions of marine ports — the case of Barcelona. Energy Policy 2011; 39(3) 1363–1368.
n/a	129. Vujicic, A.; Zrnic, N.; Jerman, B.: Ports sustainability: A life cycle assessment of zero emission cargo handling equipment. // Strojniski Vestnik - Journal of Mechanical Engineering. 59, 9(2013), pp. 547-555.
n/a	130. Wang, J. J. and Cheng, M. C.,"From a hub Port City to a global Supply Chain Management Centre: A Case Study of Hong Kong, "Journal of Transport Geography, Vol.18, No.1, 2010, 104-115.
n/a	131. Ward, H. (2011), "The ISO 26000 international guidance standard on social responsibility: implications for public policy and transnational democracy", Theoretical Inquiries in Law, Vol. 12 No. 2, pp. 665-718

ID	Reference
n/a	132. Willis, A. (2003). The Role of the Global Reporting Initiative's Sustainability Reporting Guidelines in the Social Screening of Investments. Journal of Business Ethics, 43(3), 233- 237.
n/a	133. World Commission on Environment and Development (WCED) (1987), "Report of the World Commission on Environment and Development: our common future", available at: www. Un documents.net/wced-ocf.htm
n/a	134. World Port Sustainability Programme https://sustainableworldports.org/
n/a	135. World Shipping Council. 2010. Liner Shipping and CO2 Emissions Policy (http://www.shippingandco2.org/LinerShippingandCO2EmissionsPolicySeptember).

Table 31: Bibliography

Annexes

9 Annexes

9.1 Annexes to task 1 desktop analysis

9.1.1 Assessment methodology

As already mentioned in section 6.2.1 Methodology summary 40 the assessment methodology consists of 3 main elements:

1. The information model defines what kind of data we have, the entities, and what the relations between these entities are. E.g. a “Measure” is something we do, such as making an investment to realize an objective;
2. The work products and tools used during the desk top analysis. One important tool that has been developed is the DtF database. In this database the results of the desk top analysis are persisted. This database can also be used for other WP1 tasks and for tasks of other work products;
3. The workflow starts by making an inventory of inputs to be assessed and ends with writing this report.

9.1.1.1 The information model

The information model consists of the following sections:

1. An overview of the information model with a simplified graphical presentation of the information model and an explanation to it;
2. A more detailed description of the most important entities;
3. Descriptions of the most important relations between entities;
4. A summary in tabular form with a recap of the previous, links to the results in this document and the reports currently available in the DocksTheFuture database.

When applied to the desktop study it is important to note that only information is entered in the information model as far as it is:

1. Mentioned by the author(s) of the input. So the assessor does not “invent” things that are not part of the original input. Where applicable the assessor can and should give its opinion on the information captured from the inputs;
2. About ports. The only exception to this is “External factors and market trends” and only as far as these “External factors and market trends” have a clear impact on the ports;
3. About the future with a horizon 2030. If it is about the past or the current situation, only if it is transferable to another context.

9.1.1.1.1 Overview

The scope of the DocksTheFuture is very comprehensive. Looking at the project proposal, topics as diverse as digitalization, human element and sustainability have been defined. At the very beginning of the DocksTheFuture project an input list has been made and in total 340 projects, studies, strategic port plans, etc. were proposed by the partners and their subcontractors. From this initial inventory more topics were defined.

To conduct a desk top analysis on such a huge curriculum we needed a way of structuring the information, the more since the assessment work was done by persons having a different background.

The information model consists of 2 main items:

1. The different pieces of information are called the “Entities”;
2. The relations between the entities.

The results of the desktop study are registered in a database (Section 9.1.1.2 The work products and tools on page 191).

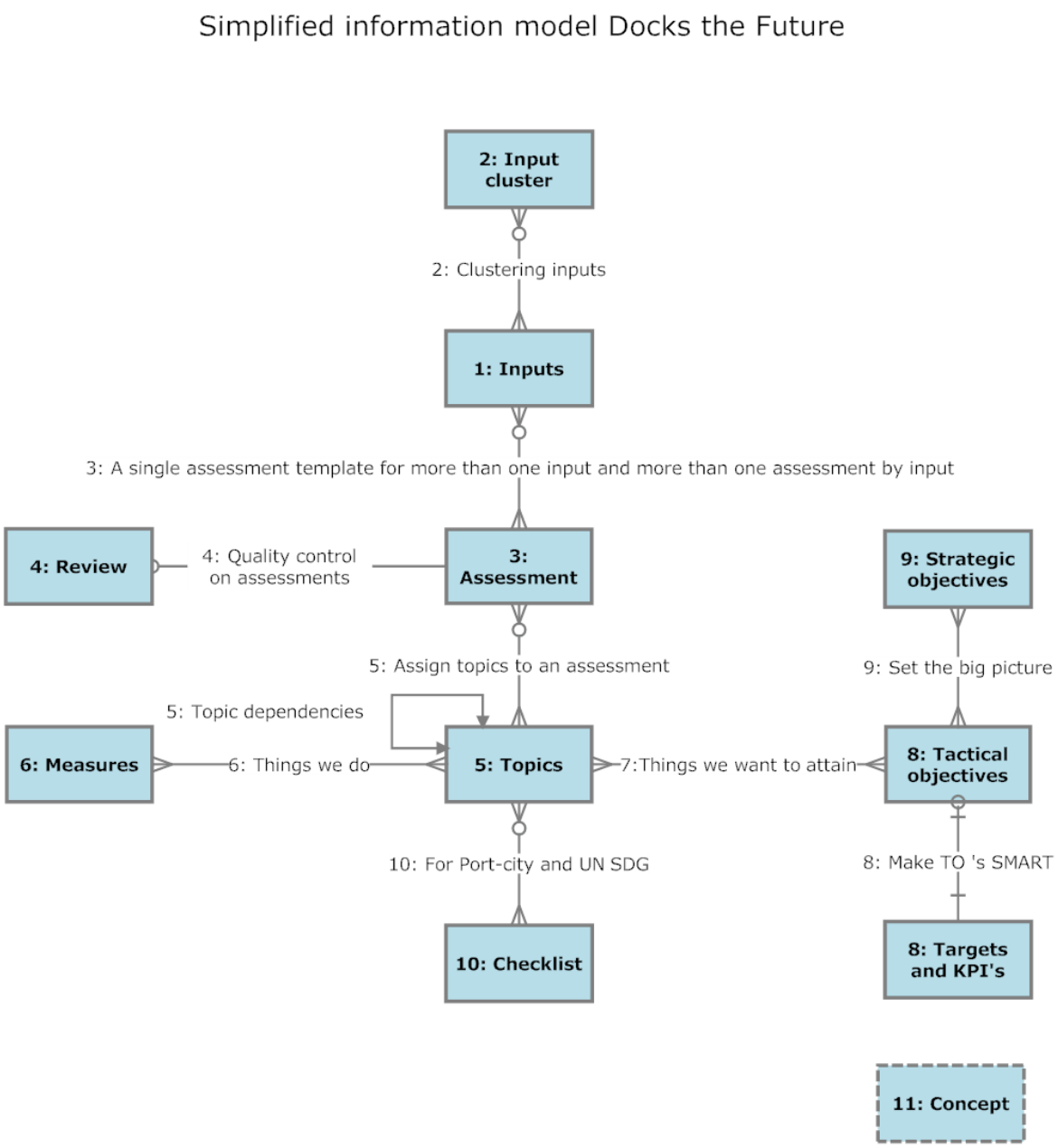


Figure 46: Simplified data model

Simplified information model explained

1. Inputs are the work products we assess. Consider e.g. projects, studies, white papers, EU policies and legislation, doctoral thesis, books collections of articles, best practices, frameworks, as far as they are relevant for DocksTheFuture. An input can contain one or more work products of different formats such as texts, videos, Excel files, etc.;
2. Input clustering is actually WP2 “Selecting and clustering of projects and initiatives of interest” An input can be part of none or more than one cluster. The project proposal states that this clustering will be done for 20 to 30 inputs;

3. An “Assessment” is the result of studying one or more inputs and filling out an assessment template (Section 9.1.1.2 The work products and tools page 191). It is possible to have one only one assessment template filled out for more than one input or vice versa having more than one assessment template for the same input, e.g. assessed by different assessors;
4. The quality of the assessment templates is controlled. This review is a check of completeness, consistency and relevance for DockTheFuture;
5. The topic list is the main categorization of an assessment. As can be seen from table Table 40: List of topics on page 222 there are 16 main topics, some of them having child topics. Of course more than on topic or sub topic can be assigned to an assessment;
6. Measures are the actions we propose for 2030 such as the introduction of new technology, train people, and improve business processes amongst others. As can be seen from Table 42 List of measures on page 237 an initial list of 117 measures has been defined as part of the desktop study. Measures can be “investments” where financing is required , but also soft measures;
7. Of course we do not want to propose any measures unless they are aligned with the tactical objectives we want to realise. Tactical objectives are called “aims” in the project proposal;
8. The defined Tactical objectives are SMART (Section 9.1.4 on page 202) by defining their targets and KPI’s;
9. The tactical objectives are linked to strategic objectives who define the picture of a desired future for the ports by 2030;
10. Certain topics are considered more important than other. In order to go more into the details, AIVP developed checklists for port-city relations and we use the UN SDG as a checklist for sustainability;
11. Defining DocksTheFuture concept cannot be done on the basis of the desk top study alone. However the information model, viewed as a domain model for the ports of the future concept is a substantial element to come to a clear definition of it. The entity instances together with their relations together define the ports of the future concept. In a CA such as DocksTheFuture more focus should be put on the “objectives” part of the equation rather than on the “measures” part.

9.1.1.1.2 Entities

9.1.1.1.2.1 Inputs

As explained before “Inputs” are the work products we assess. All DocksTheFuture partners and their subcontractors proposed inputs to be assessed and these suggestions were put in and input list and in the DocIsTheFuture database.

It is important to note the difference between input (e.g. a project) and work products (e.g. a document). Consider a project where many different documents have been created. The assessor must select from all these documents, the one or those that are most relevant. When assessing an input we do not want to get lost in too many details. The task of the assessor is to extract from the input (here the project) what is most relevant for ports of the future in 2030.

As explained in the workflow (Section 9.1.1.3 on page 194) some of these inputs were attributed to assessment rounds, the first rounds containing the inputs with higher priority

Because it is a very important element of the project, input clustering is foreseen in the data model and in the DocksTheFuture database, however defining the clustering criteria, selecting inputs for clustering and do the clustering is part of WP2

Most reports from the DocksTheFuture have input as selection criteria or group the results on the basis of topic. (Section 9.1.5 on page 203)

9.1.1.1.2.2 Assessments

One assessment is one assessment template filled out and imported in the database. The most important data elements are:

1. Metadata about the assessment file such as the name and version of the assessment template, date imported, about the assessor such as company, person and assessment date;
2. A main summary of the assessment findings;
3. Identifications such as EU proposal ID's, EU call ID's, ISBN numbers, project closure date;
4. An assessment is related to many other structured entities (see next) except for:
    c. Gaps.
    Gaps are problems the authors of the input document propose to be solved. Of course we only hold back gaps that are in scope of DocksTheFuture;
    d. Constraints.
    Constraints define the limitations of the input. E.g. if the input is only about containers then it is constrained by the cargo type;
    e. External factors and trends
    DocksTheFuture is about the ports and not about the wider context in which they operate e.g. Ships are becoming bigger, aging of the population, etc. are not about the ports themselves external factors and trends affecting the ports;
    f. Risks
    E.g. Raising of the sea level is a risk for the ports.
5. Structured entities linked to assessment in a many to many relationship, other than those described in the next sections.
    a. Contacts and contact information about the input. Some are put in the bibliography (Section 8 on page 164);
    b. EU and other funding ;
    c. Languages used in the work products;
    d. Legislation applicable to or referenced in the input;
    e. Different input natures;
    f. Assessors;
    g. Other studies, projects, etc.... referenced in this input;
    h. Hyperlinks.

9.1.1.1.2.3 Reviews

The review of the assessment templates is a formal quality control activity. This review is executed by PortExperise together with the assessors of the input. It consists of 4 steps.

1. Cross reading of the input document. What is this input about and what is the relevance for DtF;
2. Check the completeness, consistency and relevance of the different sheets of the assessment template. The assessment templates consists of at one hand free text entries and on the other hand coded lists for topics, measures, tactical objectives and port-city and UN SDG checklists. Elements checked are amongst others:
    a. Are the free text entries filled out;
    b. Are the assessment results put against the correct codes;

c. Do we not have assessments without any topics assigned to it;
d. Are there no codes selected with no assessment results assigned to it;
e. Are tactical objectives really objectives, are these objectives SMART, have we defined targets and If so are these targets KPI's;
f. Did we not assign a parent code and a child code at the same time;
g. Is the information in the assessment template relevant for DocksTheFuture, in other words is it in scope of ports and is it for 2030;
h. For coded lists, the template allows to enter free coded texts that are not in the predefined list. These additional topics, measures and tactical objectives are candidates to update the predefined lists.

3. What are the key elements of these input(s) to be put in the official reports;
4. Question to be asked or themes to be discussed for the expert review.

The review results are store in the DocksTheFuture database. A report from the database is submitted to the assessors, who update the assessment templates that are then re-imported in the database.

9.1.1.1.2.4 Topics

The topic list is a three levels deep taxonomy. A topic is way of grouping together assessment results. As an example consider topic T60 Sustainability. This topic is assigned to different assessments. When the DocksThe Future database is queried on topic T60 we get all the results about "sustainability" from all assessments. An assessment can have more than one topic assigned to it, a topic can be assigned to more than one assessment and an assessment should have at least one topic assigned to it.

Topics are not completely independent of each other. E.g. there is a topic on infrastructure and there is a topic on financing and funding. So the obvious link is that we need the necessary financial resources for new infrastructure but both topics can still be assigned independently.

The topics are part of a predefined taxonomy but it is possible that during an assessment the assessor discovers new topics that do not fit well into the predefined list of topics. That is why we leave the possibility to add in the assessments template additional topics. These additional topics are reviewed after each assessment round and the relevant additional topics are included in the list of predefined topics.

For the sustainability and port-city topics checklists were developed. This is covered in sections 9.1.3 Port-city relation checklist on page 200 and Table 32: UN sustainable development goals183.

A very important element about topics is that there are relations between them. There is the natural relation between the parent topic and a child topic, but there are also relations between topics that are part of a different branch of the taxonomy. As a simple example, consider an investment in infrastructure to improve environmental sustainability. There are at least 3 topics involved in this: T10 infrastructure or one of its child topics, T60 sustainability or one of its child topics and T120.10 financing and funding. Recognizing these interdependencies between topics is probably more important than the topics themselves.

Initial inventory

1. The topic list from the original project proposal has been updated to better fit our needs. This includes a reorganisation of the original topic list and the inclusion of additional topics as a result of the assessed inputs. Nevertheless all topics from the project proposal are covered in the new topic list. Also each topic has a unique ID and description assigned to it. Table 36: Updated topic list on page 199 contains a comparison between the topic

list of the proposal with the one in use, what has changed and the motivation for this change;

2. At the beginning of the project a list of possible inputs has been created. In this list additional topics were proposed and included in the list.

9.1.1.1.2.5 Objectives

Objectives come in 3 flavours: strategic, tactical and operational. The strategic objectives set the long term goals, the overall direction, and the ultimate goal. They are a picture of a desired future. The tactical objectives are the possible ways to reach these high level objectives and the operational objectives are the practical steps to be executed to realize the tactical objectives. DocksTheFuture is a coordination and support action. We will not do any implementation and we therefore consider operational objectives to be out of scope.

To realize the DtF strategic objectives, some tactical objectives are defined. In other words what more specific “Smart” tactical objectives do we have to ultimately realize these higher level and more generic strategic objectives?

The strategic objectives are not part of the assessment template, we only link relevant information from the inputs to tactical objectives. However, as tactical objectives are linked to strategic objectives we indirectly link information from the input to strategic objectives.

Strategic objectives are however part of the DocksTheFuture database and of this report and they are leading principles for the whole project.

The initial list of tactical objectives was derived from the project proposal, the table “Port of the future preliminary topics and targets” on page 10, mainly the column “aims “. However not all “aims” from the project proposal are tactical objectives, some are actually “measures”. Additional tactical objectives were discovered while assessing inputs. After review they were added to the list of tactical objectives.

Tactical objectives have a unique number, a description, a target assigned to it and the source of the target. The targets already defined in the project proposal that are defined “Smart” have been taken over in the DocksTheFuture database. Concerning the source of the targets, there is of course a big difference between “hard” targets that are laid down in legal instruments and “soft” targets defined in the assessed inputs or by the DocksTheFuture project (the targets mentioned in the project proposal as “To be defined in WP1”).

9.1.1.1.2.6 Measures

Measures are the actions we propose that ports of the future do to realise objectives. Measure can be projects, change business processes, develop capabilities, etc. For certain measures financial resources are necessary and then they are called “investments”, for other measures no financial resources are necessary. Certain measures are necessary for legal compliance, other not.

For a coordination and support action such as the DocksTheFuture project the focus must be more on objectives rather than on measures. It is important not to think too quickly in terms of measures especially if these measures are proposing a certain technology that is new now but might be out dated by 2030. The sources of measures are the following:

1. The project proposal. As explained in the section on objectives certain “aims” in the proposal are actually measures and not tactical objectives;
2. The measures from the MOS DIP that are port related;
3. During the assessments additional measures can be proposed.

9.1.1.1.2.7 Checklists

Considering the importance for the DocksTheFuture project we have developed checklists for:

1. Port city relations checklist containing 4 main sections:

a. Spatial organisation;
b. Environmental challenges;
c. Socio economic development strategies;
d. Governance and port city co-construction.

You find the checklist in section 9.1.3 on page 200. The checklist reveals that there is a great deal of overlap between the 4 main categories of questions mentioned before and the topic list. E.g. spatial organisation is closely related to 10: Infrastructure, environmental challenges T60.1: Environmental sustainability. We maintained the topic "Port-city" and the checklist because:

a. The great importance given to the port-city topic in the call, the grant agreement and the project proposal;
b. The sub-contracting by PortExpertise to AIVP;
c. AIVP will be invited to review (a subset of) the projects for which the port-city relation topic is selected;
d. Topics are more or less the same but they are looked from the angle on how they affect the relation between port and city;
e. The port-city checklist contains elements that can be inspirational for the information model. Some questions e.g. about "Marine submersion" are actually threats and the answers to the question are "Best practices"

2. The 17 sustainable development goals as adopted by the UN general assembly.

Figure 47: Sustainable development goals

Number	UN SDG
1	End poverty in all its forms everywhere.
2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture.

Number	UN SDG
3	Ensure healthy lives and promote well-being for all at all ages.
4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5	Achieve gender equality and empower all women and girls.
6	Ensure availability and sustainable management of water and sanitation for all.
7	Ensure access to affordable, reliable, sustainable and modern energy for all.
8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
10	Reduce inequality within and among countries.
11	Make cities and human settlements inclusive, safe, resilient and sustainable.
12	Ensure sustainable consumption and production patterns.
13	Take urgent action to combat climate change and its impacts.
14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
17	Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Table 32: UN sustainable development goals

9.1.1.1.2.8 Unstructured data

This concerns all the data that is free text entry in the assessment template and DocksTheFuture database so without having a code list assigned to it.

1. External factors and market trends.
   The DocksTheFuture project is about the ports and not e.g. about the ships sailing to these ports. That ships become bigger is an external factor having a big impact on the ports, but it is not about the ports, it is about ships. There are many such economic, political, legal, demographic, technological and environmental trends that can have a big impact on ports by 2030. Ship size as mentioned, commodity prices, trade relations, ageing of the population, new emerging markets, introduction of new business models, new technology such as big data and blockchain, etc. all can have a huge impact on the ports, however they are not about the ports.

The market trends part is a qualitative description and should not be confused with Work package 4 task 4 “Analysis of macro trends and perspectives in the maritime sector” while at the same time it can give valuable input to this task;

2. Gaps
   Gaps are problems that need to be addressed. They are the difference between the current situation, the as-is, and a desired future situation for 2030 when the gaps are resolved;
3. Constraints
   If an input is e.g. about containers then this constraint the assessment to only this cargo type and it cannot be extended to other cargo types;
4. Risks
   Risk is all about uncertainty, the probably that it occurs, the impact and the possible mitigating actions. When the uncertainty has a positive impact it is an opportunity we should pursue.

9.1.1.1.3 The entity relations

In the information model the core entity to classify all the other entities is topic. Consider information on the internet that is tagged. A tag is a way to classify search for information. As explained before the topic list is a taxonomy. As there are formal naming, presentation, definitions, properties, attributes, categories, semantics, relations and more we could argue that the information model has some elementary characteristics of an ontology that defines the ports of the future domain, without claiming that we actually developed one.

It is important to note that most relations are not all enforced in the template, because this would make things far too complex for the assessors.

The following table defines the most important functional relations between the entities. Technical relations necessary to make the DocksTheFuture database are not mentioned in the list.

Remark:

1. Assessment template: Is this relation implemented in the assessment template? If yes, the sheet of the assessment template is mentioned;
2. Database: Is this relation implemented in the DocksTheFuture database;
3. Report: Are the dependencies described in this report? If so a hyperlink to the applicable section of the report is entered.

Entity	Entity	Type relation	Assessment template	Report
		Description	Database	
Input	Assessment	Many to many	Yes Input and assessment	SectionTable 39: List of inputs and assessments page 217
		An input can consist of many documents, however we intentionally do not consider document as part of the information model, although theoretically one document can belong to more than one input. One assessment record reflects exactly one assessment template. An assessment can be about more than one input and for one input there can be more than one assessment, e.g. assessed by more than one company.	Yes	
Assessment	Assessor	One to many	Yes Input and assessment	No
	URL	This is all additional information about an assessment where more than one entry exists. E.g. more than one assessor can be involved in an assessment	Yes	
	Nature			
	Reference inputs			
	Language			
	Funding			
	Legislation			
Assessment	Predefined topic	Many to many	Yes Topics	No

Entity	Entity	Type relation	Assessment template	Report
		One or more predefined topics can be assigned to an assessment and a predefined topic can be assigned to more than one input. An assessment should get at least one predefined topic assigned to it.	Yes	
Assessment	Additional topic	One to many	Yes Topics	No
		Besides selecting from a list, the assessor can suggest additional topics. These additional topics can be added to the list of predefined topics if considered relevant	Yes Relevant additional topics are converted to predefined topics	
Assessment	Predefined tactical objectives	Many to many	Yes Tactical objectives	No
		One or more predefined tactical objectives can be assigned to an assessment and a predefined tactical objective can be assigned to more than one assessment.	Yes	
Assessment	Additional tactical objectives	One to many	Yes Tactical objectives	No
		Besides selecting from a list, the assessor can suggest additional tactical objectives. These additional tactical objectives can be added to the list of predefined tactical objectives if considered relevant.	Yes Relevant additional tactical objectives are converted to predefined tactical objectives	
Assessment	Predefined measure	Many to many	Yes Measures	No
		One or more predefined measures can be assigned to an	Yes	

Entity	Entity	Type relation	Assessment template	Report
		assessment and a predefined measure can be assigned to more than one assessment.		
Assessment	Additional measure	One to many	Yes	No
		Besides selecting from a list, the assessor can suggest additional measures. These additional measures can be added to the list of predefined measures if considered relevant	Yes Relevant additional measures are converted to predefined measures	
Assessment	Gaps	One to one	Yes Unstructured info	While in the information structure relations are not enforced, analysing the free text descriptions it turns out that most of them are related to only one topic.
	Constraints	This is unstructured data. If e.g. exactly the same gap would be entered on more than one assessment it would be seen as different gaps.	Yes	
	External factors and market trends			
	Risks			
Assessment	Port city	Many to many	Yes Port-city checklist	The port-city checklist itself, not the assignment of items to an assessment. The relation between topic port-city and the port city checklist items is not enforced. In other words it is possible to check an item from the checklist without selecting the port city topic. However the possible contradictions are reported
		This is about the port-city checklist items. The items from the checklist that are applicable to an assessment can be selected and he same checklist item can be assigned to more than one assessment	Yes	

Entity	Entity	Type relation	Assessment template	Report
Assessment	UN SDG	Many to many	Yes UN SDG	The UN SDG checklist itself, not the assignment of items to an assessment. The relation between topic sustainability topic and the UN SDG checklist items is not enforced. In other words it is possible to check an item from the checklist without selecting the sustainability topic. However the possible contradictions are reported
		This is about the UNSDG checklist items. The items from the checklist that are applicable to an assessment can be selected and he same checklist item can be assigned to more than one assessment	Yes	
Assessment	Review	One to one	No	No, after a review the assessment template is updated an re-imported in the database
		The results of a review of an assessment template	Yes database	
Assessment	Assessment round	One to many	No	No
		This is for planning Assessments are attributed to assessment rounds. The inputs that are more generic in nature are assessed first. See 9.1.1.3 The workflow on page 194 for more info on assessment rounds	Yes	
Input cluster	Cluster	Many to many	No	No, this is not in scope of work package 1
	Input	This is de facto clustering according to the clustering	Yes	

Entity	Entity	Type relation	Assessment template	Report
	Level 1 predefined topics	method and the selection for clustering of related inputs and activities, task 2 of work package 2 "*For each topic a cloud of projects will be identified*". These clouds will only be made for the main topics not for the sub topics. The same input can belong to different clusters for different reasons and a cluster contains at least one input. The input cluster defines on what criteria these inputs are clustered.	The clustering structure is implemented in the database, but the data is not yet entered as the clustering methodology is not defined yet (WP2, task 1)	
Strategic objective	Predefined tactical objective	Many to many	No	No
		Tactical objectives help realising one or more strategic objective and a strategic objective is realised by one or more tactical objectives	Currently not implemented	
Strategic objective	Input	Many to many	No	Will be implemented in D1.5
		Defines the relevancy of an input against strategic objectives.	Implicit relation through relations between assessments and predefined tactical objectives and between predefined tactical objectives and strategic objectives	
Predefined topic	Predefined topic	One to 0, 2 or many.	Yes	Yes
		This implements a taxonomy between topics and sub topics up to 3 levels deep. One parent topic can have none, 2 or more sub topics	Yes	

Entity	Entity	Type relation	Assessment template	Report
		assigned to it.		
Predefined topic	Predefined measure	Many to many	No	No
	Predefined tactical objective	A measure can attribute to the realisation of a tactical objective. So the relation should actually be between predefined tactical objective and predefined measure. However attributing measures to individual tactical objectives would lead to very complex relations. Considering topic as the primary way to classify other entities, the relation is technically implemented between respectively predefined topic and predefined measure on the one hand and between predefined topic and predefined tactical objective on the other hand. Predefined measures and predefined tactical objectives attributed are potentially related to each other. If there is indeed a real dependency between them is a matter of further analysis	No Will be implemented in a next version of the database.	
Input	Quotation	One to many	No	No
		This is only applicable for inputs tagged in Atlas (Section 9.1.1.2 The work products and tools page 191)	Yes	

Table 33: Relations between entities

9.1.1.2 The work products and tools

Several work products has been created and tools used as part of the work package 1 task 1, “Desk top analysis"

1. Several documents, meeting minutes, power point presentations, graphical presentations, etc. to explain the assessment methodology in particular the information model and the assessment template. Elements of these work products have been incorporated in this report;
2. The input list is an inventory of inputs in Excel format that are candidate to be assessed. This list contains some meta data about the inputs such as:
   a. The organisation(s) proposing these inputs for assessment;
   b. A unique ID, the name and a summary of the input;
   c. The topics from the project proposal and additional topics not covered in the proposal;
   d. The nature or natures of the input;
   e. EU or other funding;
   f. Reference information;
   g. The assessment planning, actuals and other status information;

The input list has been imported in the docks the future database and is called there “inventory”

3. The assessment template is an implementation of the information model in an Excel workbook. It is used to enter the results of an assessment in a structured format. The filled out templates are imported in the DocksTheFuture database Table 33: Relations between entities on page 190 defines which entities can be entered in the template. Regular updates of the assessment template have been made. The current version is 1.0. The assessment template contains several features to make it as user friendly as possible, including outlines, easy adding lines, select or unselect a code, a rich search function and help on the selected codes for topics and measures. The template consists of the following sheets.

Sheet	Content
Input and assessment	All the general information about the assessment such as a summary description, reference to the inputs, applicable legislation and more.
Revision log	Changes to the assessment template content.
Topics	Predefined and additional tactical topics.
Tactical objectives	Predefined and additional tactical objectives.
Measures	Predefined and additional measures.
Unstructured info	Gaps, constraints, external factors and trends and risks.
Port-City checklist	The port-city checklist developed by AIVP.
UN SDG	A checklist for the UN sustainable development goals.
Lookup	Reference data used in certain other sheets.
Help	Help on how to use and fill out the assessment template.

Sheet	Content
Template history	Detailed description of the changes to the assessment template.

Table 34: Assessment template

4. The DocksThe future database.
   The assessment templates are imported in the DocksTheFuture database. This database actually contains +/- 50 tables (entities), the same amount of relations between them, the user interface where the data is entered or displayed (+/-40 forms), reports to show the results and code to make it work. Describing the physical implementation of this database is out of scope of this report, but the graphical presentation of the information model (Figure 46: Simplified data model on page177) can be considered as a conceptual data model of this database. We can consider the DocksTheFuture database as a draft knowledge base for ports of the future and as such defines the ports of the future concept. (Section 4 Ports of the future defined on page 29). When describing an application such as the DocksTheFuture database it is more important to define what we can get from it, the results rather than what goes in it. Table 37: Reports from the DocksTheFuture on page 203 and Table 38: Queries from the DocksTheFuture databaseon page 204 and contains overview of the reporting from the DocksThe Future database. Many results mentioned in this document are based upon the information from in the DocksTheFuture database. The DocksThe Future database will also deliver some of the raw data for the thematic workshop, task 1.5. However this raw data need to be processed and put in a format that is appropriate for the thematic workshops;
5. Certain assessors have been using https://atlasti.com/ for their work. With this software users can assign codes to certain sections of text called quotations. The code lists are the same in Atlas, the assessment template and the DocksTheFuture database. A coding manual has been developed to help the users. The information from Atlas has been exported into the assessment templates, however the assessment template contains more information than what is available in Atlas, so this data is completed in the assessment template. It is important to note that there is a fundamental difference between “tagging”, assigning codes to quotations and assessing which is a value added activity containing among others summarizing, filtering to what is relevant for DocksTheFuture, giving context and giving an opinion on what the authors of the inputs are writing. The following table makes a comparison between tagging and assessing.

	Tagging/coding	Assessing
Tools	Atlas	Assessment template DocksTheFuture database
Unit of work	Quotation	One or more inputs
Parent level	Document	Input cluster
Key objective	Get the details of the texts	Give your opinion, summary, relevant for DtF. Put against code lists so that it can be queried.
Added value activity	No	Yes
Tools	Atlas	Assessment template

	Tagging/coding	Assessing
	A tool of your choice or none at all.	
Licenced	Yes	No
Quotation	Yes	No, unless manual copy-paste.
Co occurrence	At quotation level	Only at assessment level in DtF database.
Enforce relations	No	Assessment template: Limited Docks The Future database: Extensive
Check on required fields	No	Assessment template: No DocksTheFuture database: Limited enforcement but queries to check for missing data and contradictions
Output	Project bundle Data exported from Atlas	Filled-out templates imported in the database
Code lists	Same as assessment	Same as tagging/coding
Entities	Unique ID, topics, measures, TO, certain unstructured data	All entities.
Data flow	Topic, To, measure, → Assessment template Quotations → DocksTheFuture database	Assessment templates → DocksTheFuture database
Review PortExpertise	Quotations to prevent reading input.	Assessment templates before importing into the DocksTheFuture database
Official reports are based on	Quotations	DocksTheFuture database queries Vision, opinion, roadmap
Results available for all partners	Yes	Yes
Re-use in other projects	Yes	No, tailored to DocksTheFuture
Used in thematic workshops	No	DocksTheFuture database reports after processing and lay-out.
Feedback from thematic workshops	Additional inputs Recoding inputs	Additional inputs Re-assessing inputs Update DocksTheFuture database

Table 35: Tagging and assessing compared

9.1.1.3 The workflow

The workflow described in the next picture guarantees high quality desk top analysis and maximum reuse of the results of the desk top study for other tasks of work package 1, other DocksTheFuture work packages and after the project is closed. The steps that are specific to the desk top study are put in full line, the other tasks in dotted line.

Please find a more detailed explanation below, but concerning the desk top study and reduced to the bare minimum the key steps are: the assessor reads an input from the inputs list (1), he or she fills out an assessment template (4), these templates are imported in a database (6) and the database is queried to generate data for this D1.1 report (8)

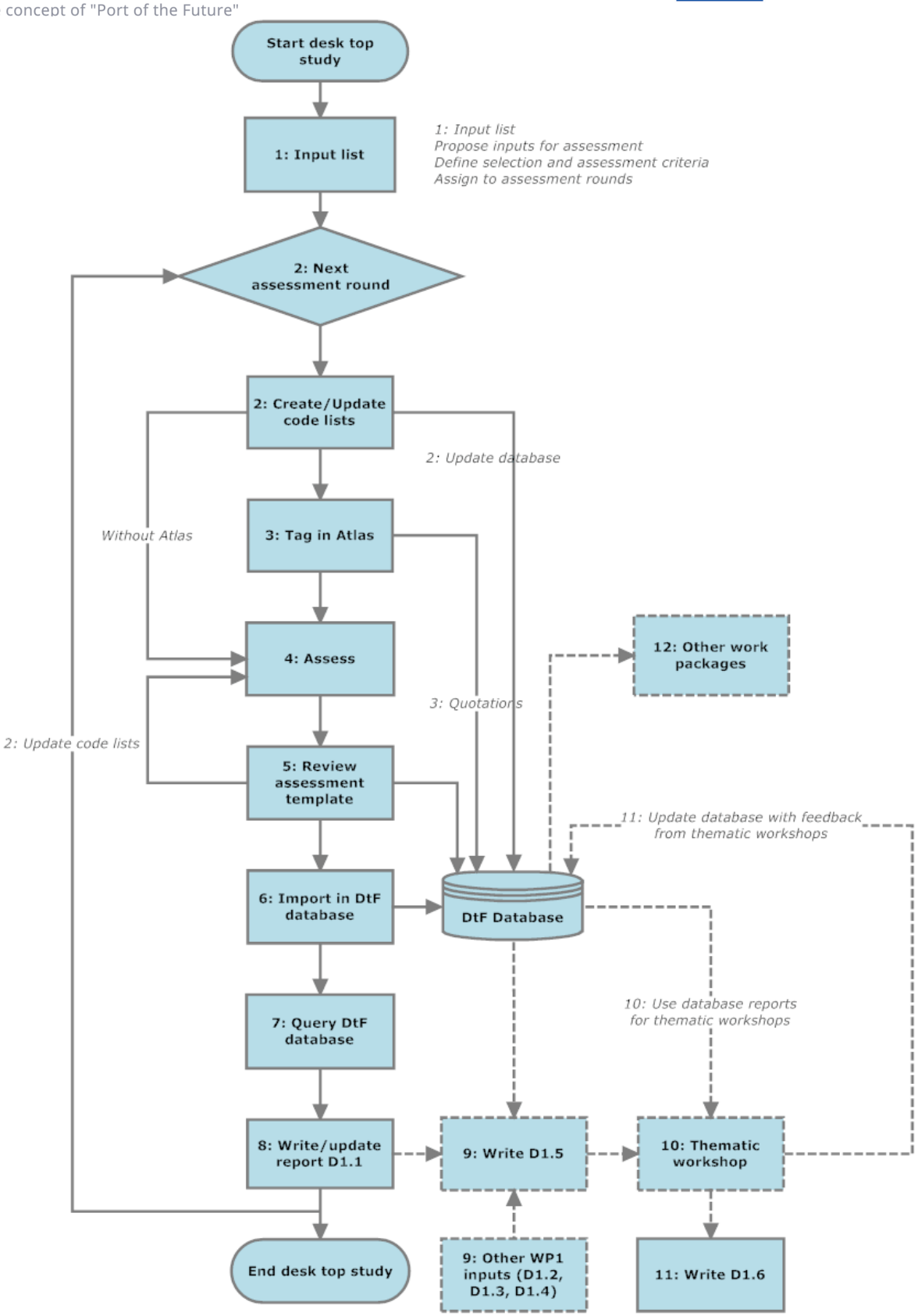


Figure 48: Assessment workflow

1. Input list.
   This is about drafting a list of inputs that might be included in the desk top study. The

inputs were proposed by all DocksTheFuture partners and their subcontractors. Based upon this list some selection criteria and assessment criteria were defined. Finally the inputs were assessed to the DocksTheFuture partners and to assessment rounds;

2. Assessment round
   An assessment round consists of executing steps 3 to 9 for the inputs that are selected for that round. Inputs are logically grouped together. The more important inputs or the inputs with a broader scope are assessed in the first rounds. For the assessments extensive use of is made of predefined code lists, such as the topic list. During the assessment it may come apparent that certain items in the lists are missing. The assessor is not limited to the items in the list but can propose additional items such as new topics as free text entries. After an assessment round these additional items are reviewed and if valid included in the predefined list. So it is important to note that the output of an assessment round is not only the assessed inputs but the updated code lists. This mechanism applies mostly to topics, tactical objectives and measures. The updated lists are imported in the database;
3. From those assessors using Atlas to tag information, the tagged quotations are directly imported in the DocksTheFuture database. The difference between tagging and assessing is explained in Table 35: Tagging and assessing compared on page 193;
4. Certain outputs from Atlas are pushed into the assessment template that needs to be completed with data not coming from Atlas. Those not using Atlas start from an empty assessment template. Details about the assessment template can be found in section 9.1.1.2 The work products and tools on page 191;
5. The filled out assessment templates are reviewed. This is review consists of 3 key elements
   a. The correctness, completeness and relevance of the information entered in the assessment templates against the assessment criteria defined in step 1. The assessor updates the assessment template with the remarks made;
   b. Elements to be included in this report;
   c. Suggestions of themes to be discussed during the expert review.
6. The review results are entered in the DocksTheFuture database and a review report from the database is submitted to the assessor(s);
7. The reviewed and if necessary updated assessment templates are imported in the DocksTheFuture database;
8. Reports and queries are extracted from the DocksTheFuture database;
9. Some results from the DocksTheFuture database are included in this report;
10. Reports D1.1, D1.2, D1.3 and D1.4 and information from the DocksTheFuture database are used to write report D1.5;
11. Report D1.5 and information from the DocksTheFuture database is used for the thematic workshops. This report can be considered of a draft of report D1.6. The DocksTheFuture database is used to select information for a certain expert group. E.g. everything concerning port-city could be reviewed by AIVP;
12. After the thematic workshops the information in the DocksTheFuture database is updated and report D1.5 is updated to become D1.6;
13. Information in the DocksTheFuture database can be used in other work packages (Figure 1: Overview of the Work Packages and their interrelation on page 24).

9.1.2 Updated topic list

In this section we compare the topics defined in the project proposal with the new topic list. We made the topic list a 3 level deep taxonomy consisting of parent topics and (grand) child topics. Furthermore each topic has got a unique ID and description and in what version of the assessment template this topic has been introduced.

Topic according to the project proposal	New topic list	Change description and motivation
Port infrastructure and management	T10: Infrastructure	• Removal of the management part of this topic as it is already covered under T120 governance; • The "Port infrastructure" part is actually about the spatial organisation. We created 6 child topics and 4 grandchild topics, to better deliminate the scope • Aim "Upgrade VTMIS" is a measure not a topic; • European funds and financial instruments. We made "Financing and funding" subtopic T120.10 of "Governance"
Accessibility and European standards	T30: Accessibility T40: Standards and legal instruments	• Accessibility and standards are 2 different things, wo we split in 2 topics; • The "European standards" becomes a new topic "Standards". All standards are important whether European or not, so we just mad it standards; • In many cases standards and legislation go hand in hand so we made it one merged topic.
Integration in the supply chain and intermodality	T50: Integration in the supply chain T30.30: Multi and synchro modality	• Again these are 2 separate topics. One can be perfectly intermodal and completely not integrated in the supply chain. So we made this topic T50; • The intermodality part became subtopic T30.30 Multi and synchro modality of topic accessibility.
Environmental concerns	T60.10: Environmental sustainability	• Sustainability is about People, Planet and Profit. So we made it

Topic according to the project proposal	New topic list	Change description and motivation
Sustainability	T60: Sustainability	one main topic with 3 subtopics: Environmental, economic and social sustainability; • The "environmental concerns" from the project proposal becomes a subtopic of sustainability. • The "environmental concerns" from the proposal is limited to alternative energy and emission reduction. T60.10: Environmental sustainability is scoped wider by giving it 4 subtopics including waste reception and pollution prevention
Safety and security	T70: Safety T80: Security	• As these are 2 distinct concepts we split them in 2 topics; • We made physical security and cybersecurity 2 distinct sub topics of security.
Digitalization – ICT and communication within the port community	T90: Digitization, digitalization and digital transformation T1120.20: Communication	• Digitalization/ICT at one hand and communication at the other hand are 2 separate topics; • Communication becomes a subtopic of governance; • We changed digitalization into "Digitization, digitalization and digital transformation" with 4 child topics and 3 grandchild topics.
Port-city relation	T100: Port city relations	• We have included a checklist on port-city relations from AIVP in the information model. From that checklist it is very clear that there is a great deal of overlap between the port-city topic and other topics. Despite that we have maintained the topic port-city, considering the great importance given to that topic in the call.
Port Governance	T120: Governance	• Port governance becomes governance to avoid the impression that this is only about what the port authorities are doing; • The topic also encompasses the "management part" of the "port infrastructure and management" topic; • "Port governance" gets 4 child topics "Financing and funding", "Communication", "Corporate social responsibility", "Non-financial

Topic according to the project proposal	New topic list	Change description and motivation
		reporting”
Human element	T110: Human element	• Human element gets 2 child topics “Labour market” and “Education and training”
Relationship with Mediterranean and Neighbouring Partner countries	T900: Cooperation T901: Competition	• Maritime is international, so we extended the topic to all forms of cooperation; • Mediterranean and neighbouring partner countries becomes a child topic of cooperation; • We also included cooperation between ports as a child topic; • Competition mirrors cooperation.
Bridging R&D and implementation	T910: Bridging R&D an implementation	• This topic has not changed
-	T130: Incident management	• The topic list from the project proposal is too much focused on the happy flow, so we included a topic on incidents with 2 child topics: maritime incidents and port incidents
-	T20: Means of transport	• This topic has currently only one child topic: sea going vessels

Table 36: Updated topic list

9.1.3 Port-city relation checklist

9.1.3.1 Spatial organisation

1. WHAT TO DO ABOUT THE LACK OF AVAILABLE SPACE?
   a. Redevelop the port within its existing boundaries;
   b. Share the use of the water and waterfront between urban and port functions;
   c. Mix urban and port functions;
   d. Move the city to the water;
   e. Remain flexible, and avoid freezing land uses.
2. WHAT TO DO WITH TRANSITIONAL SPACES BETWEEN THE PORT AND THE CITY?
   a. Highlight the transitional elements between city and port;
   b. Showcase port city landmarks and scenery;
   c. Conceive a type of spatial organization which allows or preserves scenic views of the port and the water;
   d. Create urban / port / green buffer areas.
3. HOW TO DEAL WITH THE ISSUES OF CONGESTION, TRANSPORTATION AND ACCESSIBILITY?
   a. Ensure consistency between urban mobility plans and port connections;
   b. Turn the demand for new connections into an opportunity for creating new spaces;
   c. Rely on - and complement - the existing traffic grid;
   d. Use the waterway as a logistics tool for the urban distribution of goods;
   e. Promote environmentally friendly transport.
4. HOW TO ENLIVEN AND VITALISE THE WATERFRONT?
   a. Promote the temporary use of available structures and spaces;
   b. Put an emphasis on architectural /symbolic elements;
   c. Showcase exteriors, features and spaces;
   d. Carefully choose the location of passenger terminals and promote links with urban centres;
   e. Create walking circuits and promenades.
5. HOW TO SAFEGUARD ARCHITECTURAL AND PORT IDENTITY?
   a. Identify all elements having heritage / historical / scenic value;
   b. Stress the symbolic value of port elements, and make them part of new projects;
   c. Safeguard and reuse the existing port / architectural patrimony.

9.1.3.2 Environmental challenges

1. WHAT TO DO ABOUT THE RISK OF MARINE SUBMERSION?
   a. Combine infrastructure and natural functions;
   b. Make the possibility of marine submersion an integral part of building design.
2. HOW TO DEAL WITH THE PROBLEM OF INDUSTRIAL/PORT NUISANCES?
   a. Compile an inventory of the different types of environmental impact;
   b. Formalize community acceptance of certain nuisances;
   c. Undertake a cooperative approach with all industrial stakeholders;

d. Seek innovative technological solutions in order to mitigate sound pollution;
e. Reconcile port functions and environmental concerns, with a view to improving air quality;

3. HOW TO OPTIMISE ENERGY USE?
   a. Use the potential of the presence of water to meet energy needs;
   b. Apply bioclimatic architectural principles;
   c. Pool resources on the basis of industrial ecology principles;
   d. Imagine the port as a potential energy provider.
4. HOW TO CONSERVE BIODIVERSITY?
   a. Implement biodiversity conservation plans in port areas;
   b. Modify infrastructure or build new facilities to protect ecosystems from the negative effects of port / industrial activities.

9.1.3.3 Socio-economic development strategies

1. HOW TO ATTRACT RESIDENTS, VISITORS AND BUSINESSES?
   a. Establish maritime clusters to maximise city / port competitiveness;
   b. Establish cultural clusters;
   c. Work on a shared port city programme in terms of territorial attractiveness;
   d. Explore new economic challenges for the port assets not necessary linked only to maritime/logistic activities;
   e. Adapt vocational training programmes to include the specific skills required by city/port territories;
   f. Anticipate on the new needs in terms of skills and competences linked to digitalization and adapt training.
2. HOW TO FINANCE DEVELOPMENT PROJECTS AND MAKE THEM PROFITABLE?
   a. Finance development projects through cross-financing between city and port;
   b. Turn the holding of events into a source of funds to invest in development projects;
   c. Think about anticipating all types of socio-environmental externality costs.

9.1.3.4 Governance and port city co-construction

1. WHAT IS THE ROLE OF STAKEHOLDERS, PORT AND LOCAL AUTHORITIES?
   a. Formalise framework agreements regarding urban projects at the interface with the port;
   d. Turn the port into an active player in city life;
   e. Make port activities known to the citizens;
   f. Develop, formalize and incorporate sustainability reporting into your port citizen relationship.
2. HOW TO DEVELOP A PORT CULTURE?
   a. Facilitate dialogue between the city and the port through joint communication structures;
   b. Let the community become involved in designing new projects;
   c. Adopt a long-term approach to projects and achieve citizen support through proactive communication strategies;

d. Develop a port culture among the citizens through edutainment concepts (e.g.: festivals, visits, sport events inside the port…);
e. Promote initiatives and structures adopting the Port Centre Concept with a dedicated educational activity programme on the long term;
f. Unlock human, social and cultural capital through port city crossovers.

9.1.4 Smart tactical objectives

1. Specific:
   a. What is it exactly that we want to attain;
   b. One way to become as specific as possible is by answering all questions one can pose. In English language there are 7 “WH” questions and a few variants: who, what, when, where, which, how.
2. Measurable:
   a. This is where the project proposal states that targets will be formulated in WP1. As we set a target for the future we actually need both a baseline and a target;
   b. Some of the target will be formulated as KPI’s.
3. Attainable
   a. The project proposal formulates this (be it for KPI’s) as observable, achievable, reasonable and credible under expected conditions as well as independently validated;
   b. This criteria probably also contains an element of transferability.
4. Relevant
   a. Relevant for ports of the future. We should probably have a stricter definition of what “ports” in this context means;
   b. Where objectives are defined at a more generic level such as UN Sustainable development goals we should assess which are applicable to DtF.
5. Timely
   a. Where objectives are derived from legal instruments or from EU vision papers the due date is equal to the compliancy date;
   b. Else, it is simple: 2030.

9.1.5 DocksTheFuture database reporting

In addition to the results included in this document there are several possibilities to extract data from the DocksTheFuture database. There are 2 ways to get the results:

1. Database reports have some formatting applied to it and the possibility to select only certain data. The results are sorted and grouped. The outputs can be in pdf or word or any format of choice;
2. Simple queries based on SQL statements. The results are shown in a grid on screen and can be exported to MS Excel.

Putting all the results in this document would make it extremely comprehensive and unreadable. All reports and queries together contain several hundreds of pages. They are most useful when the information that is needed is selected directly from the database. The following table contains a list of reports and queries from the DocksTheFuture database

Selection criteria	Description
	Current length of the full report
Input Company Predefined topic Predefined tactical objectives Predefined measure	By assessed inputs the summary, gaps, constraints, external factors and macro trends and predefined topics, tactical objectives and measures assigned to this assessment
	+/- 120 Pages
Predefined tactical objectives	By predefined tactical objectives the inputs where this predefined tactical objective has been assigned and the assessment results for this predefined tactical objective and this input
	+/- 53 Pages
Input	List of quotations tagged in Atlas
	+/- 100 Pages
Input Company	Reviews of the assessment templates
	+/- 20 Pages
Predefined topics	By predefined topic the inputs where this predefined topic has been assigned and the assessment results for this predefined topic and this input
	+/- 60 Pages

Table 37: Reports from the DocksTheFuture

Queries come in 2 flavours: just reporting data (reporting) or queries that point to contradictions, errors, missing data etc. in other words as a tool to monitor the data quality. That is why they are called “evaluation queries”. These types of queries should not produce a result set and if so there is probably an action to clear the data. The effort to create queries is

much less compared with reports. We can make these queries virtually ad hoc. Currently we have the following queries.

Type	Description
Reporting	A list of all the inputs proposed, including planning -the assessment rounds - and status information.
Reporting	A list of assessed inputs with the name of the input and of the assessment file.
Reporting	Assigned predefined topics with the inputs they are assigned to and the feedback from the assessor
Reporting	Number of assessment templates by partner uploaded in the database
Evaluation	Unassigned predefined tactical objectives. Either remove these tactical objectives or assess more inputs where these tactical objectives are covered.
Evaluation	Additional tactical objectives. These are tactical objectives not in the list of predefined tactical objectives but entered as free text in the assessment template. Investigate which additional tactical objectives should make it to the list of predefined tactical objectives.
Reporting	Port-city. Inputs with at least one item of the port-city checklist checked. These are candidates to be reviewed by AIVP.
Reporting Evaluation	Number of times a predefined topic has been assigned. Select additional inputs to be assessed for those predefined topics that have a too low score or score 0
Reporting Evaluation	Number of times a predefined tactical objective has been assigned. Select additional inputs to be assessed for those predefined tactical objectives that have a too low score or score 0
Reporting Evaluation	Number of times a predefined measure has been assigned. Select additional inputs to be assessed for those predefined measures that have a too low score or score 0
Evaluation	Additional measures. These are measures not in the list of predefined measures but entered as free text in the assessment template. Investigate which additional measures should make it to the list of predefined measures.
Reporting	A list of predefined topics with name and description.
Reporting	Inputs with either an assessment template uploaded or assessed in Atlas.
Reporting Evaluation	Inputs assigned to assessment rounds and where available assessing company and assessor have been defined but not yet assessed.
Evaluation	Predefined tactical objectives with no targets or KPI's defined. Review these predefined tactical objectives and assign targets or KPI's.
Reporting	Assessments with the predefined sustainability topic, its children or its grandchildren selected.

Table 38: Queries from the DocksTheFuture database

9.1.6 Detailed lists

9.1.6.1 List of inputs and assessments

Inputs are the work products we assessed (Section 9.1.1.1.2.1 on page 178) for more information about the inputs and how they are related to other entities of the information model. The following table is the complete list of inputs proposed by the DocksTheFuture partners and their subcontractors. The results of the assessed inputs are either processed in report D1.1 and D1.5 (marked with D1.1) or only in D1.5.

IDInput	NameInput	Report
10	The future of port logistics, meeting the challenges of SC integration for ING - INPUTS: 0010-0 ExecSum; 0010-1 study by ING	D1.1
20	RISCOMEX	D1.1
30	CoRISMa	D1.1
40	E-navigation for inland waterways 2017	D1.1
50	Économie Circulaire et Écosystèmes portuaires	D1.1
60	Port City Governance	D1.1
70	Trends in EU ports governance 2016	D1.1
70	Trends in EU ports governance 2016	D1.1
80	Unmanned ships on the horizon/Remote and autonmous ships - the next steps	D1.1
90	How to go about greening terminals	
100	Autonomous Ship Technology	
110	The future of ports in 2060	D1.1
120	EffienSea2	
130	Universal middleware framework for automatic data integration used in dynamic transport operations (UMFADIDTO)	
140	Research in the field of 'Inland Waterway transport innovation'	
150	NOVIMAR Novel IWT and maritime transport concepts	
160	Cluster 2.0	
170	New elements of competition in container liner shipping industry	
180	Emission reduction shipping	
190	Co-operation cost impacts at seaport container terminals	
200	Oil response information collection	
210	Structure and challenges for Port of Antwerp and competitors	
220	Validation Strategic Freight Model Flanders	
230	Port Capacity: pricing and investment under uncertainty, a game-theoretical real options model in maritime chain	
240	Analysis of future labour market in port of Antwerp: threats, opportunities &	

IDInput	NameInput	Report
	scenarios	
250	Vision matrix of stadsmonitor	
260	Logistics study on cross-border delivery	
270	LowCarb RFC - EU rail Freight Corridors going Carbon Neutral	
280	Nearshoring	
290	Forecasting estimated ship arrivals	
310	Development strategic vision on the ecomonic policy of Province of Antwerp	
320	BRAIN-TRAINS	
330	Port Economic Analysis, particularity with respect to generalized cost modeling of the entire supply chain	
340	Integrated maritime logistics chain decision making	
350	Innovative Logistics in waste management for a Sustainable Environment (ILSE)	
360	RETROFIT	
370	Port Hinterland relations: lessons to be learned from a cost-benefit analysis of a large investment project	
380	City logistics, urban goods distribution and last mile delivery & collection	
390	De binnenvaart: traditionele modus, innovatieve toekomst?	
400	Digital innovation in the port sector: barries and facilitators	D1.1
410	The Grand Challenge: Pathways towards Climate Neutral Freight corridors	D1.1
420	Investigating the Bunkering Choice Determinants: case of Port of Antwerp	
430	De toekomst van de arbeidsmarkt in haven van Antwerpen	D1.1
440	Transport research for a changing and sustainable future	
450	BENEFIT: potential of investments in transport infrastructure	D1.1
460	Decision-making for maritime innovation investments the significance of cost benefit and cost effectiveness analysis	D1.5
470	Impact of scale increase of container ships on the generalised chain cost	
480	Maritime world cities : development of the global maritime management network	
490	TPR Chain Cost model	
500	Rail Baltica	
510	Rail Cube	
520	LNG for shipping and logistics in Europe, outline wide scale roll -out	
540	LNG motion	
550	C-Roads Platform is a joint initiative of European Member States and road operators for testing and implementing C-ITS services in light of cross-border harmonisation and interoperability.	D1.1

IDInput	NameInput	Report
560	DOOR2LNG	
570	Railway connection of 4 freight terminals along the ME corridor spain	
580	AM4INFRA	
590	USEIT	
600	INFRALERT	
610	Intemodel EU	D1.5
620	RAGTIME	D1.5
630	REFINET	
640	Senskin	
650	DB TAF TSI	
660	SUPERGREEN	
670	MEGA-E: Metropolitan Greater Areas - Electric	
680	Zero Emission Valley	
690	Port-Liner, zero emission ships for IWW	
700	NEXT-E	
710	CROCODILE	
720	POR2CORE	
730	Shifting Freight2Rail	D1.1
740	HYBRID-INFRA-RAIL	
750	ECO-GATE	
760	H2Benelux	
770	Nordic Hydrogen Corridor	
780	MedTIS III	
790	CONCORDA	
800	NextGen Link	
810	Nox &Sox compliance demo	
820	Sweden-Poland Sustainable Sea Hinterland Services III	
830	2EUStates2cross	
840	Sharing of train tracking & ETA info	
850	LoNofts 2	
860	BE Logic	
870	TRANSFORMERS	
880	ECOSSIAN	D1.5

IDInput	NameInput	Report
890	CORE	D1.1
900	BRAAVOO	
910	HORIZON	
920	MESA - Maritime Europe Strategy Action - FOSTER Waterborne)	D1.5
930	CARONTE	
940	VIAJEO PLUS	
950	ISOTRACK II	
960	LEANWIND	
970	MUNIN	
980	MINI-CHIP	
990	LOGICON	
1000	Hamburg Hafen 4.0	
1010	Modal shift IWW&Rail	
1020	Port of Los Angeles various environmental actions	
1030	Collaborative Innovation Clouds 2017 Logistics Report	D1.5
1050	Mos DIP Detailed Implementation Plan	
1060	Other port industry and supply chain indicators	
1070	European Sustainable Shipping Forum, 3 rd Plenary Meeting, Final Report Submission from ESSF Sub-Groups	D1.1
1080	STM Validation Project	D1.1
1090	Plan the city with the port: guide of good practices	D1.1
1100	The Blockchain Potential for Port Logistics	D1.5
1110	PORTOPIA-Observatory set-up guidelines	D1.5
1120	European Ports Work 2015	
1130	An explorative study on blockchain technology in application to port logistics	
1140	Workshop: Moving towards a European Maritime SingleWindow environment – what road to take?	
1150	COMMISSION STAFF WORKING DOCUMENT on the implementation of the EU Maritime Transport Strategy 2009-2018	D1.5
1160	Work Process Oriented Competence Developmentfor the Port of the Future	D1.1
1170	Strategic levers of port authorities for industrial ecosystem development	
1180	Container terminal operations simulator (CTOS) – Simulating the impact of extreme weather events on port operation	D1.5
1190	Changing training needs of port workers due to future trends	D1.5

IDInput	NameInput	Report
1210	SUSTAINABLE PORT INFRASTRUCTURE, PRACTICAL IMPLEMENTATION OF THE GREEN PORT CONCEPT	D1.5
1220	INTEGRATED SUSTAINABLE PORT DESIGNFRAMEWORK DEVELOPMENT PORT MASTERPLANMSC THESIS – PUBLIC VERSION	
1230	A STUDY ON ROLE OF GREEN PORT IMPLEMENTATION AND ‘‘GREENCOLLAR’’ WORKERS IN PORT FACILITIES	D1.1
1240	THE GREENING OF PORTS: A COMPARISON OF PORTMANAGEMENT TOOLS USED BY LEADING PORTS INASIA AND EUROPE	D1.1
1250	Environmental policies and practices in Cruise Ports:Waste reception facilities in the Med	D1.1
1250	Environmental policies and practices in Cruise Ports:Waste reception facilities in the Med	D1.5
1260	Port Productivity: A Comparison Analysis Among Strategic Ports	
1261	Port Cooperation Policies in the Mediterranean Basin: an Experimental Approach using Cluster Analysis.	D1.1
1270	AEOLIX - Architecture for EurOpean Logistics Information eXchange	
1280	SECTRONIC - Security System for Maritime Infrastructures, Ports and Coastal zones	
1290	RCMS - Rethinking Container Management Systems	
1310	Challenges for the future of ports. What can be learnt from the Spanish Mediterranean ports?	D1.5
1320	INTEGRITY - INTERMODAL GLOBAL DOOR-TO-DOOR CONTAINER SUPPLY CHAIN VISIBILITY	
1330	SYNCHRO-NET - Synchro-modal Supply Chain Eco-Net	
1340	SMARTCM - SMART Container Chain Management	
1350	ECOHUBS - Environmentally COherent measures and interventions to debottleneck HUBS of the multimodal network favoured by seamless flow of goods	D1.5
1360	Blue Baltics – LNG infrastructure facility deployment in the Baltic Sea Region	
1370	Construction of LNG terminal Krk	
1380	HEKLA - Helsingborg & Klaipeda LNG Infrastructure Facility Deployment	
1390	The role of port cities and transnational municipal networks in efforts to reduce greenhouse gas emissions on land and at sea from shipping – An assessment of the World Ports Climate Initiative	
1400	Socio-ecological transitions toward low-carbon port cities: trends, changes and adaptation processes in Asia and Europe	D1.1
1410	UNITED GRID - Integrated cyber-physical solutions for intelligent distribution grid with high penetration of renewables	
1420	WiseGRID - Wide scale demonstration of Integrated Solutions and business models for European smartGRID	
1430	inteGRIDy - integrated Smart GRID Cross-Functional Solutions for Optimized Synergetic Energy Distribution, Utilization Storage Technologies	

IDInput	NameInput	Report
1440	GOFLEX - Generalized Operational FLEXibility for Integrating Renewables in the Distribution Grid	
1450	Energy cost assessment of shoreside power supply considering the smart grid concept: a case study for a bulk carrier ship	
1460	Using Smart Grids to Enhance Use of Energy-Efficiency and Renewable-Energy Technologies	
1470	Green EFFORTS - Green and Effective Operations at Terminals and in Port	
1480	SMILE - SMart IsLand Energy systems	
1490	INVADE - Smart system of renewable energy storage based on INtegrated EVs and bAtteries to empower mobile, Distributed and centralised Energy storage in the distribution grid	
1500	Securing a port's future through Circular Economy: Experiences from the Port of Gävle in contributing to sustainability	D1.1
1510	A relationship between port profiles and policies regarding the circular economy	D1.1
1520	Circular economy modelling to accelerate the transition of ports into self-sustainable ports: a case study in Copenhagen-Malmö Port (CMP)	D1.1
1530	Sustainable Development of Seaport Cities through Circular Economy: A Comparative Study with Implications to Suez Canal Corridor Project	D1.1
1540	LoCOPS - Low Cost Onshore Power Supply	
1550	MARINET2 - Marine Renewable Infrastructure Network for Enhancing Technologies 2	
1560	Composite index for benchmarking local energy systems of Mediterranean port cities	
1570	SAURON - Scalable multidimensionAl sitUation awaReness sOlution for protectiNg european ports	
1580	MITIGATE - Multidimensional, IntegraTed, rIsk assessment framework and dynamic, collaborative Risk ManaGement tools for critical information infrAstrucTurEs	D1.1
1590	SAIL - ICT System addressed to integrated logistic management and decision support for intermodal port and dry port facilities	
1600	MedRoute - On the route of multiculturalism(s). Marking and hybridizing identities in the late 17th and early 18th centuries Mediterranean port cities	
1610	A sustainability assessment of ports and port-city plans: Comparing ambitions with achievements	
1620	Container Terminals and Port City Interface – A Study of Gdynia and Gdańsk Ports	
1630	The Impact of the Development of Seaport Objective Functions for a Cargo Logistics System in Urban Areas, Illustrated with an Example of the Szczecin Metropolis	D1.1
1640	Conditions for Developing a Port City Transport Infrastructure Illustrated with the Example of Szczecin Agglomeration	
1650	Port-centric cities: The role of freight distribution in defining the port-city relationship	
1660	A systems framework for the sustainable development of a Port City: A case study of Singapore's policies	

IDInput	NameInput	Report
1670	Building a bridge between port and city: Improving the urban competitiveness of port cities	
1680	Sustainable Development of Coastal Cities-Proposal of a Modelling Framework to Achieve Sustainable City-Port Connectivity	D1.1
1690	Policies Applied by Seaport Authorities to Create Sustainable Development in Port Cities	
1691	Picasso	
1700	STM – Sea Traffic Management	
1710	SKEMA – interactive knowledge platform for maritime transport and logistics	
1720	MUNIN – Maritime Unmanned navigation trough intelligence in networks	
1730	EFFICIENSEA 2 - Efficient, Safe and Sustainable Traffic at Sea	
1740	LEANSHIPS: low energy and near to zero emissions ships	
1750	HERCULES-2: FUEL FLEXIBLE, NEAR -ZERO EMISSIONS, ADAPTIVE PERFORMANCE MARINE ENGINE	
1760	MARTEC II: ERA-NET MARitime TEChnologies II	
1770	NEPTUNE: New cross sEctorial value chains creation across EuroPe faciliTated by clUsters for SMEs's INnovation in BluE Growth	
1780	PORT-CITIES: Integrating sustainability	
1790	Portopia - Ports Observatory for Performance Indicator Analysis	D1.5
1800	Innosutra - Innovation Processes in Surface Transport	
1810	Pprism - Port Performance Indicators: Selection and Measurement	
1820	.SuPorts - SUSTAINABLE MANAGEMENT FOR EUROPEAN LOCAL PORTS	
1830	POSEIDON MED II - LNG Bunkering Project	
1840	POSEIDON MED - LNG Bunkering Project	
1850	SUSPORTS - Delivering sustainable energy solutions for ports	
1860	ISMAEL	
1870	ECOPORT - ENVIRONMENTAL MANAGEMENT OF TRANSBORDER CORRIDOR PORTS	
1880	Dual ports - Developing Low carbon Utilities, Abilities and potential of regional entrepreneurial Ports	
1890	Civitas portis	
1900	TRACC - TRansport ACCessibility at regional/local scale and patterns in Europe	
1910	EasyConnecting - Enlarging Seaport's foreign catchment areas a challenge for the future	
1920	The Port of Amsterdam's sustainability objectives and initiatives	
1930	Stratégie Nationale Portuaire	D1.5
1940	Nationales Hafenkonzept 2015	D1.5

IDInput	NameInput	Report
1950	Port of Rotterdam - Port Vision 2030	D1.5
1960	Synchrolog	
1970	Motorways of the Sea - Detailed Implementation Plan	D1.1
1970	Motorways of the Sea - Detailed Implementation Plan	D1.5
1980	NAPA4CORE	
1990	HAROPA - Rapport d'activité 2016	
2000	Rijeka Gateway II	
2010	Stockholm Norvik Port	
2020	Port Development Plan to 2025	D1.1
2030	Digitalization of seaports - visions of the future	
2040	Ports and networks : strategies, operations and perspectives	
2050	Port cybersecurity : securing critical information infrastructures and supply chains	
2060	Climate change and adaptation planning for ports	
2070	Innovative Seaport Technologies (Innovative Seehafentechnologien) - ISETECT II	D1.5
2080	Innovative Port technologies (IHATEC)	
2090	Maritime Energy Transition Outlook (ETO)	D1.5
2100	PORTOPIA - European Port Industry Sustainability Report 2017	D1.5
2110	3D printing: a threat to global trade	
2130	Code of Good Practices for Cruise and Ferry Ports	D1.1
2140	Waterfront and cities. Managing a vital relationship	
2150	The Competitiveness of Global Port-Cities: Synthesis Report	
2160	Innovations Ville Port : pour des projets intégrés Ville Por	
2170	15th World Conference Cities and Ports, Crossovers, Synthesis of works	
2180	Sister Ports 2017 - Summary by Dr. Yann Alix	
2190	Port Center by AIVP: presentation of the concept,	
2200	Maritime Growth Study review (2018), UK Government	
2210	Strategies for the transformation of abandoned port sites, interfaces and intermediaries between the city and the port	
2220	Waterfront Communities Project – The Cool Sea parts I, II and III	
2230	CTUR Thematic Network - Cruise Traffic and Urban Regeneration	
2240	SUDEST - Sustainable development of sea towns	
2250	On the Waterfront: Culture, Heritage And Regeneration of Port Cities	
2260	The Transformation of European Port Cities	

IDInput	NameInput	Report
2270	River Cities – Culture for Waterfronts	
2280	CCP21 Connecting Citizen Ports	
2290	Civitas, innovative and sustainable urban mobility solutions in five European port cities	
2300	JOHANN: Joint development of Small Cruise Ship tourism heritage products in the Southern Baltic Sea Region	
2310	Port of Amsterdam Sustainable Development Plan	
2320	From Cradle to Quay, Investing in our youngsters	
2330	Innovation as an asset: Rotterdam develops an interactive map highlighting the port city's innovation ecosystem.	
2340	The strategic value of the Port of Rotterdam for the international competitiveness of the Netherlands: A first exploration ,	
2350	Port of Rotterdam: opportunities through digitisation and energy transition	
2360	Rotterdam, métropole XXL et réservoir de mutations	
2370	Le Port dans la Ville	
2380	Sustainable Cities and Ports	
2390	Oslo, a new step for the city – port relationship	
2400	Proactive stakeholder management in the port planning process: empirical evidence from the port of Brussels	
2410	Barcelona: City and Port agree to reorganise cruise activity and assess its externalities for the city	
2420	Facilitating start-ups in port-city innovation ecosystems: A case study of Montreal and Rotterdam	
2430	The Port of Marseilles reaffirms its strong interest in a city-port	
2440	Sydney: maintaining and expanding the Glebe Island terminal in the heart of the city is crucial to the local area	
2450	Stockholm Royal Seaport: towards a smart port city model - Interview with Johan Castwall, Chief Executive Officer, Ports of Stockholm – AIVP, August 2017 -	
2460	Port of Vancouver: sustainably addressing the challenges of growth	
2470	"Port and city together should seek compatible activities to bring out these elements of which they can be proud."	
2480	A systems framework for the sustainable development of a Port City: A case study of Singapore's policies.	
2490	Port-City Governance,	
2500	The new Economic Landscape. Economic Performance and Social Progress	
2510	Soft Values of Seaports,	
2520	Ports and Networks : Strategies, Operations and Perspectives,	
2530	Puerto-ciudad: estudio comparativo de buenas practicas : Barcelona, Copenhague,	

IDInput	NameInput	Report
	Genova, Gijón, Hamburgo, Helsinki, Málaga, Marsella, Oslo, Sidney, Valencia, Vigo.	
2540	The Port City of the XXIst Century. New Challenges in the Relationship Between Port and City.	
2550	Hafen und Stadt: Wie gehen Städte mit ihren Häfen um?	
2560	The port and the City – On board diary.	
2570	"... re-engage with the possibilities that have been opened up by the big port cities, a high degree of proximity, where the city and port form an indivisible whole port	
2580	Plan the City with the Port: "The collective interest is the foundation of a fruitful and sustainable City-Port relationship"	
2590	Plan the City with the Port: "No sustainable mix without a shared strategic vision", Interview with Philippe Matthis, President of the AIVP, Deputy General Manager of the Port of Brussels – AIVP, December 2015	
2600	Les métropoles portuaires touchées par l'innovation	
2610	Villes Ports et Territoires : le défi de la prochaine décennie	
2620	Qu'est-ce qu'un port intelligent?	
2630	Environmental sustainability in seaports: a framework for successful innovation	D1.5
2640	Corporate responsibility and value creation in the port sector.	
2650	Governing the European Port-City Interface: Institutional Impacts on Spatial Projects Between City and Port	
2660	The Challenge of the Dutch Port-City Interface.	
2680	Towards a meta-analysis and toolkit for port-related socio-economic impacts: a review of socio-economic impact studies conducted for seaports	
2690	Maritime networks as systems of cities: The long-term interdependencies between global shipping flows and urban development (1890–2010	
2700	Why are maritime ports (still) urban, and why should policy-makers care?	
2710	Approaching the Relational Nature of the Port-City Interface in Europe: Ties and Tensions Between Seaports and the Urban	
2720	Sustainable development in seaports: A multi-case study	
2730	Strategic levers of port authorities for industrial ecosystem development.	
2740	Industrial ecosystems: major opportunities for port authorities.	
2760	The Evolution of a Port (The Anyport Model),	
2780	Beyond the landlord: Worldwide empirical analysis of port authority strategies.	
2790	Governing inland ports: A multi-dimensional approach to addressing inland port-city challenges in European transport corridors	
2800	AIVP Worldwide Network of Port Cities	
2810	Portus - Port City Relationship and Urban Waterfront Redevelopment on line magazine -	
2820	USA - Smart Growth for Coastal and Waterfront Communities – EPA – 2009	

IDInput	NameInput	Report
2830	USA – National Working Waterfront	
2840	The Port City Blog of José Sanchez	
2850	Code of Practice on Societal Integration of Ports – Espo, 2010 -	
2860	FNAU, Club territoires maritimes (2011). Innovations Ville Port : pour des projets intégrés Ville Port	
2870	Il bilancio sociale, documenti di ricerca n. 4	
2880	AA1000 accountability principles standards	
2890	SASB's approach to materiality for the purpose of standards development	
2900	Reporting sociale scatta l'obbligo	
2910	Un passo decisivo verso il bilancio integrato	
2920	Enti di interesse pubblico al test della rendicontazione non finanziaria	
2930	Bes 2017, il benessere equo e sostenibile in Italia	
2940	Business leaders: what you need to know	
2950	Disclosure di infromazioni non finanziarie	
2960	Decreto legislativo 30 dicembre 2016, n. 254	
2970	Non financial reporting overview	
2980	GRI sustainability reporting guidlines e IIRC integrated reporting framework	
2990	Business reporting on the SDGs: An analysis of the goals and targets	
3000	GRI standards 101 foundation	
3010	GRI standards 102 general disclosure	
3020	GRI standards 103 management approach	
3030	GRI standards glossary	
3040	Integrated reporting IR: focus on integrated thinking	
3050	Il framework IR internazionale	
3060	Direttiva 2014/95/UE del parlamento europeo e del consiglio	
3070	Legge 28 dicembre 2015 n. 208, disposizioni per la formazione del bilancio annuale e pluriennale dello Stato	
3080	Libro verde, promuovere un quadro europeo per la responsabilità sociale delle imprese	
3090	Linee guida per il bilancio integrato delle PMI	
3100	Orientamenti sulla comunicazione di informazioni di carattere non finanziario	
3110	Developing a sustainability report in a small to medium enterprise: process and consequences	
3120	Member State Implementation of Directive 2014/95/EU	

IDInput	NameInput	Report
3130	Overview of SGDs in business	
3140	Adozione del Regolamento di attuazione del d.lgs. 30 dicembre 2016, n. 254, relativo alla comunicazione di informazioni di carattere non finanziario	
3150	L'italia e gli obiettivi di sviluppo sostenibile	
3160	The Sustainable Development Goals, integrated thinking and the integrated report	
3170	WICI Intangibles reporting frameworks	
3180	Reporting matters	
3190	RailDataGate	
3200	Sustainability report 2017 port of Antwerp	D1.1
3210	Port of the future (Deltares)	D1.5
3220	Sustainable Ports - A Guide for Port Authorities. PIANC Report 150.	D1.1
3230	Doctoral dissertation Tanjera	D1.1
3240	Historic urban landscape	D1.1
3250	A sustainability assessment of ports and port-city plans	D1.5
3250	A sustainability assessment of ports and port-city plans	D1.1
3260	Site selection and planning for greenfield port sites	
3270	Low-carbon infrastructure as an essential solution to climate change	D1.1
3280	Concept of building and working with nature.	D1.1
3290	Video in which engineering design principles for building and working with nature are distilled.	
3300	Video in which the Ecological Design Principles for Building with Nature (ecosystem-based design) are distilled.	
3310	Video in which the Building with Nature design process is explained.	
3320	Developing climate resilient ports.	D1.5
3330	Climate change impacts on the Port of Ijmuiden.	D1.1
3340	System dynamics model applied to the port of Tema in Ghana.	D1.5
3350	Rail and inland waterway transport for the port of Tema in Ghana.	
3360	Linking ecosystem services to 3P for a sustainable port future.	
3370	Nature friendly banks made of residual material in the port of Rotterdam	D1.5
3380	Ecosystem-based port design as an approach to sustainable development.	D1.1
3390	Site selection for deep sea ports in Mynmar.	
3400	Maasvlakte II	
3410	Smart port	
3420	Energy transition in the port of Rotterdam	

IDInput	NameInput	Report
3430	Decarbonisation pathways	
3440	Smart Infrastructure	
3450	Smart use of of Big data	
3460	Port meta trands	
3470	Sustainable ports on Africa	
3480	Non-Price Competition in the Port Sector: A Case Study of Ports in Turkey	D1.5
3490	Port performance evaluation. Case study: Ports in the Black Sea basin	D1.5
3500	The relations between the port business framework and the qualified manpower competencies – literature review and proposed guidelines.	D1.5
3510	EU investment plan booklet	D1.5
3520	The container transport system: selection criteria and business attractiveness for North-European ports	
3530	A plant location and site selection guide	
3540	IBM Global Business Services Plant Location International	

Table 39: List of inputs and assessments

9.1.6.2 List of topics

Number	Name	Description
T10	Infrastructure	This topic is about the physical infrastructure the spatial organisation of the infrastructure, about the services to maintain the infrastructure but not about the services that use the infrastructure. It also includes smart infrastructure
T10.10	Sea side infrastructure	This sub-topic is about the sea-side infrastructure such as maritime access including dredging, infrastructure in the coastal areas that has an impact on the ports such as windmills, oil-and gas rigs, cables, pipelines, about the spatial organisation of the sea side infrastructure, about the services to maintain the infrastructure but not about the services that use the infrastructure The Docks the Future is about the ports, not about the sea , but the sea side infrastructure can have a direct impact on the ports too.
T10.20	Maritime terminals	This topic is about the terminal infrastructure, quays, docking areas and terminal equipment, storage areas, access gates, etc.
T10.30	Other port infrastructure	This sub-topic is about other infrastructure in the port outside the maritime terminals such as locks, bridges, tunnels, control centres, logistic areas, energy supplies, etc.
T10.40	Hinterland connections	The hinterland and the connections to it are fundamental to the ports of the future. This topic is really about the hinterland connections and not about the services that use this

Number	Name	Description
		infrastructure. The hinterland connections are about both the connections in the port and in the hinterland itself.
T10.40.10	Roads	Roads and road infrastructure including road intelligent transport systems, the spatial organisation and the services to maintain the roads but not the services that make use of the roads
T10.40.20	Railroads	Railroads and railroad infrastructure including railroad intelligent transport systems, the spatial organisation and the services to maintain the railroads but not the services that make use of the railroads
T10.40.30	Inland waterways	Inland waterways and inland waterway infrastructure including River information services, the spatial organisation and the services to maintain the inland waterways but not the services that make use of the inland waterways.
T10.50	Logistic areas	Logistic areas in the port or outside the port if these logistic areas have a strong interaction with the port.
T10.60	Industrial areas	Industrial areas in the port or outside the port if these industrial areas have a strong interaction with the port.
T20	Means of transport	For the moment this topic has only one child topic T120.10 so always attribute the child topic.
T20.10	Sea-going vessels	This topic is about the impact of changes to ship design on the ports and not about these ship design changes themselves.
T30	Accessibility	Accessibility of all transport means to and from the ports
T30.10	TENT-T networks	This is about the realization of TEN-T core and comprehensive networks.
T30.20	Smart traffic management	Initiatives to regulate the flow of traffic by centrally controlled sensors and traffic signals
T30.30	Multi and synchro modality	Multimodal transport refers to the use of different means of transport on the same journey Synchro modal transport is the service which, through informed and flexible planning, booking and management, allows to make mode and routing decisions at the individual shipment level, as late as possible in the transport planning process including the trip itself.
T40	Standards and legal instruments	All standards and legal instruments concerning certain topics are grouped together under this topic
T50	Integration in the supply chain	The cooperation of all actors in the supply chain.
T60	Sustainability	This topic covers all aspects of the traditional 3P perspective on

Number	Name	Description
		sustainability: Planet is environmental sustainability, Profit is the economic sustainability and People are the Social sustainability. In other words initiatives to improve the environment should not have a too negative effect on the economy and on the social welfare The united nation sustainability guidelines have been added. When selecting Sustainability, you may wish to select items from this checklist and items from the port - city checklist from outline "Environmental challenges"
T60.10	Environmental sustainability	Environmental sustainability means that we are consuming our natural resources, such as materials, energy fuels, land, water...etc., at a sustainable rate.
T60.10.10	Alternative fuel	Use of alternative fuel for port activities either maritime or other and supply of alternative fuels to sea-going ships, barges and other transport means. Alternative fuels are fuels other than conventional fuels such as biodiesel, bio alcohol (methanol, ethanol, butanol), refuse-derived fuel, chemically stored electricity (batteries and fuel cells), hydrogen, non-fossil methane, non-fossil natural gas, vegetable oil, propane, other biomass sources, LNG
T60.10.20	Power supply	This is about shore supply
T60.10.30	Waste reception	Legislation, processes, infrastructure about delivery and reception of waste on board of seagoing vessels and barges
T60.10.40	Pollution prevention, reduction and elimination	Prevent, reduce or eliminates pollution preferably at the source.
T60.20	Economic sustainability	Economic sustainability requires that a business or country uses its resources efficiently and responsibly so that it can operate in a sustainable manner to consistently produce an operational profit. Without an operational profit a business cannot sustain its activities. Without acting responsibly and using its resources efficiently a company will not be able to sustain its activities in the long term.
T60.30	Social sustainability	Social sustainability is the ability of society, or any social system, to persistently achieve a good social wellbeing. Achieving social sustainability ensures that the social wellbeing of a country, an organisation, or a community can be maintained in the long term.
T70	Safety	Safety and security was a single topic that has been split into T70 and T80 security.
T80	Security	Safety and security was a single topic that has been split into T70 Safety and T80. T80 has been divided into 2 child topics.
T80.10	Physical security	Protect the physical infrastructure

Number	Name	Description
T80.20	Cybersecurity	Protect systems and networks from theft of damage from their hardware, software or data
T90	Digitization, digitalization and digital transformation	Digitization is creating a digital (bits and bytes) version of analog or physical things such as paper documents, microfilm images, photographs, sounds and more. So, it's simply converting and/or representing something non-digital (other examples include signals, health records, location data, identity cards, etc.) into a digital format. Digitalization is the automation of existing manual and paper-based processes, enabled by the digitization of information. Digital transformation is about changing business operations, business models and even revenue streams and new business opportunities.
T90.10	Business processes	Define the gaps in the current business processes and try to optimize the business processes before digitalize them among others by making business processes more agile.
T90.20	Data sharing	Exchange of data between ICT systems in a standardized and secured way. This includes elements of data governance such as data quality, privacy, labelling, ownership, master data and reference data.
T90.20.10	B2G - G2B	Submission of data by business to governance to fulfil their reporting obligations and clearance back from the government. This strongly relates to the single window principle.
T90.20.20	B2B	Exchange of data between business partners
T90.30	System integration	End to end implementation of business processes running over multiples systems that share the same data structure, semantics, business rules, master data, reference data, process logic, etc. Looked from the outside these integrated systems behave as if they are one system. This goes beyond T90.20 data sharing. There are different architectures possible to integrate systems such as cloud integration, implementation of a middleware system etc.
T100	Port city relations	This is how the port infrastructure and port activities can be integrated with the city, the surroundings
T110	Human element	Labour market and education and training.
T110.10	Labour market	Evolution and developing the labour market towards what is needed in ports of the future.
T110.20	Education and training	Education and training of the workforce so that they are capable to work in the context of the ports of the future
T120	Governance	All governance issues of all private actors and authorities operating in the ports

Number	Name	Description
T120.10	Financing and funding	All financial issues of all private actors and authorities operating in the ports. This includes also funding by local, national, European and international authorities. It covers both the initial investment costs (CAPEX) and recurrent costs (OPEX)
T120.20	Communication	All communication issues of all private actors and authorities operating in the ports. This covers communication with business, with port authorities, with the public etc.
T120.30	Corporate social responsibility	Organizational policies concerning ethics, sustainability, etc. going beyond the interests of the organizations and implemented either by self-regulation or enforced by law. It might include philanthropy, volunteering, etc....
T120.40	Non-financial reporting	To disclose certain information on the way large companies manage social and environmental challenges so that stakeholders such as investors can evaluate their non-financial performance and encourage these companies in a responsible way. Directive 2014/95/EU lays down the rules. The reporting is about environmental protection, social responsibility and treatment of employees, respect for human rights, and anti-corruption and bribery diversity on company boards (in terms of age, gender, educational and professional background.
T130	Incident management	All incidents and accidents either in the port or at sea and in the latter case only if there is an impact on the ports. Legislation, processes, actors, technology, to prevent and manage incidents. This involves both authorities and private actors.
T130.10	Maritime incidents	All incidents and accidents at sea as far as they have an impact on the ports. Legislation, processes, actors, technology, to prevent and manage incidents. This involves both authorities and private actors.
T130.20	Port incidents	All incidents and accidents in the ports. Legislation, processes, actors, technology, to prevent and manage incidents. This involves both authorities and private actors.
T900	Cooperation	Cooperation with other countries and ports
T900.10	Mediterranean and other neighbouring partner countries	Increase harmonization between EU and non EU ports in terms of a common approach to the Port of the Future Topics. Develop efficient links between TEN-T networks and non EU transport networks.
T900.20	Cooperation between ports	This topic has been added because T900.10 is very much about TEN-T and cooperation in the Mediterranean with non- EU countries. However EU ports cooperate in different domains.
T910	Bridging R&D and implementation	Develop transferability mechanisms to facilitate the application of H2020 results in CEF projects
T10.40.40	Pipelines	Pipelines in the port, to the hinterland or to other ports, the

Number	Name	Description
		spatial organisation and he services to maintain the pipelines but not the services that make use of the pipelines
T90.40	Automation	Introduction of technology such as control systems so that a technical processes can be run without or with less human intervention. Automation can be achieved by using mechanical, hydraulic, electric, electronic devices mostly under control of software.
T901	Competition	This topic has been added to mirror the topic T900 Competition

Table 40: List of topics

9.1.6.3 List of tactical objectives

Number	Description	Target
TO10	Increase terminal productivity	
TO20	Improve design and maintenance of the port infrastructure to increase overall resilience	
TO30	Sustainable maintenance, repair and reconfiguration	
TO40	Promote the use of European funds for strategic investment, namely financial instruments	
TO50	Realise the TEN-T infrastructure network	Full completion of the core network by 2030, full completion of the comprehensive network by 2050
TO60	Implementation of the TEN-T Core Network Corridors	
TO70	Work Plans for Ports and of the Motorways of the Sea Detailed Implementation Plan	
TO80	Improve smart traffic and mobility management inbound / outbound.	
TO90	Improve digital support for route efficiency Sea Traffic Management	
TO100	Improve modal shift	Shifting as much as 50% of road freight being transported further than 300 km to other modes of transport such as rail or waterborne transport by 2050
TO110	Increase efficiency and capacity of hinterland	

Number	Description	Target
	connections	
T0120	Multi-modal optimised cost-effective and flexible operations inside the terminal and in the wider port area	
T0130	Develop a synchro-modal transport system	
T0140	Realize LNG Infrastructure	For all ports of the TEN-T core network, by 2025
T0150	Stimulate the use of bio-fuels	
T0160	Increase the use of cold ironing electrification	
T0170	Use of solar power	Generate 20 GWh via solar power by 2018, and 1,000 GWh by 2030.
T0180	Emission reductions	Transport Emission reduction of 60% in 20150 compared to 1990
T0190	Define environmental thresholds	
T0200	Energy transition towards new energy store facilities	
T0210	Optimise renewable energy use including smart grids	
T0220	Increase efficiency in industrial processes	
T0230	Create innovative energy storage systems	
T0240	Support circular economy schemes	
T0250	Develop innovations for increasing sustainability in all transport modes	
T0260	Harmonise safety regime	
T0270	Increase resilience against climate change	
T0280	Increase resilience against and terrorism	
T0290	Optimise and digitalise the logistic chain sharing data between all stakeholders in secure way, with usage of IT data security technology from other sectors.	
T0300	Harmonisation of ports processes and of the related data exchange	
T0310	Identification of real-time indicators to improve the quality of services provided.	

Number	Description	Target
T0320	Harmonisation of port services	
T0330	Encourage harmonised data sharing.	
T0340	ICT and communication: data sharing between all stakeholders including G2B (gov. to business), roadmap to fully deploy reporting directives further (waste reporting, SECA reporting, ...)	
T0350	Realise uniform systems on all European rail and waterways close to ports	
T0360	Advanced and efficient links and integration in the socio-economic industrial and urban surrounding environment	
T0370	Improve the quality of public space in the port	
T0380	Improved integrated port and city common development planning	
T0390	Improve recreational facilities in the port surrounding	
T0400	Organize events to introduce the port to young people	
T0410	Develop tailor human resources management to the age of workers	
T0420	Monitor and forecast the development of port labour market	
T0430	Improve the visibility of port related business in the education	
T0440	Develop harmonised professional and vocational training packages	
T0450	Increase harmonization between EU and non EU ports in terms of common approach to the Port of the Future Topics	
T0460	Develop and efficient links between TENT network and non EU transport networks	
T0470	Develop transferability mechanisms to facilitate the application of H2020 results in CEF projects	At least 50 outcomes coming from H2020 projects implemented in TEN-T
T0500	Long term binding of port related business	
T0510	Build political support for the port	
T0520	Simplify or accelerate approval processes	

Table 41: List of tactical objectives

Co-funded by the Horizon 2020 programme
of the European Union

9.1.6.4 List of measures

Category	Number and name	Description
Digitalization (data)	MS1030: Noise level maps	
Digitalization (data)	MS590: Processes, integration of business processes	
Digitalization (data)	MS540: Optimise and digitalise the logistic chain	
Digitalization (data)	MS350: Hydrographic information, Hydrographic surveys	The measurement and description of the physical features of oceans, seas, coastal areas, lakes and rivers.
Digitalization (data)	MS240: e-Signature	Electronic signature.
Digitalization (data)	MS230: e-Seals	An electronic seal is a piece of data attached to an electronic document or other data, which ensures data origin and integrity.[1] The term is used in the EU Regulation No 910/2014 (eIDAS Regulation) for electronic transactions within the internal European market.
Digitalization (data)	MS200: e-Manifest	Electronic version of a manifest or customs manifest or "cargo document", a document listing the cargo, passengers, and crew of a ship, aircraft, or vehicle, for the use of customs and other officials.
Digitalization (data)	MS1020: Air emission charts	For Sox, Nox, particulates. Example in Flanders based among others upon the IFDM model.
Digitalization (Platforms and systems)	MS660: RTMS	

Category	Number and name	Description
Digitalization (Platforms and systems)	MS1010: Empty container management	To avoid empty return trips.
Digitalization (Platforms and systems)	MS910: VTS systems: VHF, AIS, radar, CCTV	Vessel Traffic Services, Very High Frequency Radio waves, Automatic Identification System, Closed Circuit TV (camera surveillance).
Digitalization (Platforms and systems)	MS890: Voyage management services, voyage planning	Planning of a full trip for a transport mode.
Digitalization (Platforms and systems)	MS880: Vessel Traffic and Monitoring Systems	
Digitalization (Platforms and systems)	MS810: System Wide Information Management	SeaSWIM is about data sharing in the maritime cloud.
Digitalization (Platforms and systems)	MS850: Traffic management	Related to maritime (and potentially) IWW shipping, techniques to monitor movements of ships by means of radars, using new technologies including digitalisation can reduce the risk of grounding and collision.
Digitalization (Platforms and systems)	MS650: Route planning	Optimizing routing with the support of digital systems, standards for route exchange, application services such as route optimisation services
Digitalization (Platforms and systems)	MS630: RIS	River Information Services for Inland Waterway transport related to fairway, traffic and logistic information being managed in several IT applications, using standard messages.
Digitalization (Platforms and systems)	MS620: Reliable online real-time information	
Digitalization (Platforms and systems)	MS550: Optimise renewable energy use including smart grids	A smart grid is an electrical grid which includes a variety of operational and energy measures

Category	Number and name	Description
		including smart meters, smart appliances, renewable energy resources, and energy efficient resources. Electronic power conditioning and control of the production and distribution of electricity are important aspects of the smart grid.
Digitalization (Platforms and systems)	MS410: ITS	Intelligent Transport System. As per 2010/40/EU systems in which information and communication technologies are applied in the field of road transport, including infrastructure, vehicles and users, and in traffic management and mobility management, as well as for interfaces with other modes of transport.
Digitalization (Platforms and systems)	MS250: Flow management services	Optimization of cargo flows.
Digitalization (Platforms and systems)	MS170: Digital Corridor Information Management Systems	
Digitalization (Platforms and systems)	MS100: Consolidation of cargo	In order to maximize the pay load.
Digitalization (Platforms and systems)	MS90: Collaborative network of ICT platforms	
Digitalization (Platforms and systems)	MS70: Cargo logistics system in urban areas	Such as City distribution.
Digitalization (Platforms and systems)	MS50: Big data	Data sets that are so voluminous and complex that traditional data-processing application software is inadequate to deal with them. Challenges include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy and data source.
Digitalization (Platforms and systems)	MS30: Ballast water management system	Technology (filtration ...) to clean ballast water to

Category	Number and name	Description
		avoid contamination of marine environment.
Digitalization (Platforms and systems)	MS870: Truck appointment systems	Similar to airports, a time slot is appointed to trucks when they have to load/unload.
Digitalization (Platforms and systems)	MS780: Single window	The single-window system is a trade facilitation idea. As such, the implementation of a single window system enables international (cross-border) traders to submit regulatory documents at a single location and/or single entity. Such documents are typically customs declarations, applications for import/export permits, and other supporting documents such as certificates of origin and trading invoices.
Digitalization (technology)	MS400: Internet of things	The Internet of Things (IoT) is the network of physical devices, vehicles, home appliances and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these objects to connect and exchange data.[1][2][3] Each thing is uniquely identifiable through its embedded computing system but is able to inter-operate within the existing Internet infrastructure.
Digitalization (technology)	MS40: Beacons	Fire or light set up in a high or prominent position as a warning, signal.
Digitalization (technology)	MS290: Global Navigation Satellite System (GNSS) to improve positioning at sea	Uses satellites to provide autonomous geo-spatial positioning.
Digitalization (technology)	MS480: Mobile	Use of mobile technologies and apps, mobile networks.

Category	Number and name	Description
Digitalization (technology)	MS530: Optical character recognition	OCR is the conversion of images of typed, handwritten or printed text into machine-encoded text, e.g. from a scanned document or a photo of a document.
Digitalization (technology)	MS700: Scanners, new scanning technologies	Cargo scanning or non-intrusive inspection (NII) refers to non-destructive methods of inspecting and identifying goods in transportation systems. It is often used for scanning of intermodal freight shipping containers.
Digitalization (technology)	MS720: Seals for containers	Security seals are mechanisms used to seal shipping containers in a way that provides tamper evidence and some level of security. Such seals can help to detect theft or contamination, either accidental or deliberate. Security seals are commonly used to secure truck trailers, vessel containers, chemical drums, airline duty-free trolleys and utility meters
Digitalization (technology)	MS800: Support services	Support services such as authentication, authorization and service discovery.
Digitalization (technology)	MS830: Track and trace.	Automated vessel tracking services to retain community status of goods.
Digitalization (technology)	MS1060: Augmented reality	
Digitalization (technology)	MS1070: Machine learning	
Digitalization (technology)	MS820: Technological innovations: scanners, weighbridges, tracking technology, sensors	

Category	Number and name	Description
Digitalization (technology)	MS60: Blockchain	Block-Chain is used to achieve and maintain integrity in a peer-to-peer-system, that has unknown amount of peers with different reliabilities and trustworthiness.
Energy	MS510: Offshore renewable energy	
Energy	MS20: Alternative fuels	Alternative to classic fuels (mineral), being bio-fuels, wind, solar, LNG, CNG.
Energy	MS191: Electric terminal and transport equipment	
Energy	MS1041: Energy savings	
Energy	MS1050: Energy recovery from sea locks	
Energy	MS1040: Energy management system	Example: For the Port of Antwerp the energy management system is based upon ISO 50001.
Energy	MS960: High pressure steam networks	Steam could be generated among others from waste incineration plants. An example from Antwerp is the Ecluse network.
Energy	MS950: Wind energy systems	
Energy	MS520: On shore power supply	Alternative way to supply electricity to ships while in port area, this ends the need to keep their auxiliary motors running, causing a large negative impact on environment.
Energy	MS490: Off shore wind farms	
Energy	MS120: Create innovative energy storage systems	Example carbon storage, batteries for renewable

Category	Number and name	Description
		energy storage.
Energy	MS260: Fuel types (new)	
Energy	MS521: Floating power plants	
Energy	MS340: Hydrogen	
Energy	MS470: Methanol	
Energy	MS930: Wave Energy systems	
Governance	MS1200: Outsourcing of port related activities	
Governance	MS1220: Port city dialogue	
Governance	MS1210: Port promotion port authority to business	
Governance	MS1240: Waste management plan	
Governance	MS1230: Green procurement	
Policy (directive, regulation, procedures, ...)	MS680: Safety data sheet for handling scrubber additives and chemicals	
Policy (directive, regulation, procedures, ...)	MS570: Port Collaborative Decision Making	A negotiation, consolidation procedure among connected ports (region, cargo flow).
Policy (directive, regulation, procedures, ...)	MS430: Legislation for a common framework for maritime spatial planning	
Policy (directive, regulation, procedures, ...)	MS210: Energy Efficiency Design Index (EEDI) and Ship Energy Efficiency Management Plan (SEEMP)	Index to identify a ship's green performance.

Category	Number and name	Description
Policy (directive, regulation, procedures, ...)	MS130: Customs and phytosanic controls, customs fast corridors	Standard customs activities to control goods flows.
Policy (directive, regulation, procedures, ...)	MS10: AEO	Authorised Economic Operator, similar to USA C-TPAT, a mandatory licence to import/Export goods.
Policy (directive, regulation, procedures, ...)	MS670: Safe procedures for shore power supply	Working procedures for electricity supply from landside to ship.
Policy (directive, regulation, procedures, ...)	MS80: Clearance procedures, cargo clearance procedures for short sea services	An example is faster customs procedures.
Port infrastructure	MS151: LED lighting	
Port infrastructure	MS280: Gates	
Port infrastructure	MS360: Ice breaking capacities in the port and the immediate environment	Introduced in version 0.3, disactived in version 0.4 and reassigned and redefined in version 1.0.
Port infrastructure	MS440: LNG bunkering, supply and distribution chain	
Port infrastructure	MS560: Places of refuge	IMO resolutions A.949 (23), A. 950 (23) a place where a vessel in distress can be safely taken to, in order to prevent further damage or deterioration of the ship.
Port infrastructure	MS920: Port reception facilities	
Port infrastructure	MS150: Develop dynamic lighting for ports and terminals;	Example: lights adapting to road traffic density.
Port infrastructure	MS110: Cranes outreach of container gantry cranes	

Category	Number and name	Description
Port infrastructure	MS610: Re-fuelling (barges, facilities)	Refuelling points for maritime ships (bunkering) by means of bunker ships, or a dedicated terminal.
Predefined financial measures	MS270: Funding and financing	Financial tools by e.g. European Investment bank to initiate financial leverage, or Funding through specific call for projects. Encouraging financing actions, European Ship Plan, Joint Industry Plan, multi financing platforms, financial blending, financing the environmental part of the investment, Eco bonus (incentive for transport buyer) to use climate efficient sea alternatives.
Predefined financial measures	MS320: Higher co-funding rates for outermost regions and islands, EIB new financial instruments, EFSI, Project Bond Initiative, Public private partnerships	Financial tools by e.g. European Investment bank to initiate financial leverage, or funding through specific call -for project, increased funding rates for specific regions, goals.
Predefined financial measures	MS370: Incentives for off-peak traffic	Off-peak hours traffic such as lower road toll fee during night.
Predefined financial measures	MS220: Environmental compensation measures	Compensation of extra costs to increase environmental performance, e.g. Lower port dues based on ranking of Green Shippin index.
Predefined monitoring measures	MS380: Information sharing platforms	Platforms that gather and distribute data to and between relevant stakeholders.
Predefined monitoring measures	MS390: Inspections (Appointment systems for all inspections)	Planning tool for the planning of the work force of controlling authorities.
Predefined monitoring measures	MS760: Ship to shore information exchange	
Predefined monitoring measures	MS580: Port ship interface	

Category	Number and name	Description
Predefined monitoring measures	MS740: Sharing data about accidents and incidents	
Standards	MS840: Trade facilitation	The whole process of aligning procedures between member states, regions: trade related information, simplification and harmonization of documents, streamlining processes, automated processes, Trade facilitation and strengthening connections with our main trade partners.
Standards	MS770: Shore supply, cold ironing, Universal standard for shore supply	Alternative way to supply electricity to ships while in port area, this ends the need to keep their auxiliary motors running, causing a large negative impact on environment.
Standards	MS310: Harmonization of taxes on clean fuel	Different member states have different taxation on fuels, causing clients to shop between Member states.
Standards	MS300: Harmonization of administrative procedures	Different members states have different admin rules e.g. on port call formalities.
Standards	MS160: Developing governance structure	
Standards	MS140: Cyber security	Industry guidelines for cyber security on board vessels. Adequate training on how to respond to cyber security incidents.
Transferability (Training, ...)	MS420: Knowledge networks (creation of, investment in)	
Transferability (Training, ...)	MS690: Safety training	
Transferability (Training, ...)	MS860: Training schemes	Educational and professional training, Adequate

Category	Number and name	Description
		training on how to respond to cyber security incidents, dedicated training for personnel handling migrants search and rescue, safety training.
Transport flow, transport mode related	MS190: Electrical charging stations in the ports	
Transport flow, transport mode related	MS1080: Drones	Example: Used to make inventory of goods in warehouses and on yards.
Transport flow, transport mode related	MS1000: Water bus	To transport employees over water.
Transport flow, transport mode related	MS980: Cycling infrastructure	Promote cycling for commuting employees.
Transport flow, transport mode related	MS970: Pipelines	Pipelines for transport of liquid and gaseous products. An example is the Rotterdam Antwerp pipeline having an equivalent of 1000 trucks a day. Pipelines can help reduce the mobility problems, the energy consumption per kilometre - tonne is only 1/4 of road transport, emissions are very low and it is the safest form of freight transport.
Transport flow, transport mode related	MS730: Sewage water. Facilities available in ports for receiving sewage waters	
Transport flow, transport mode related	MS640: Robotics, autonomous ground vehicle	
Transport flow, transport mode related	MS500: Offload black and grey water in tanker trucks and barges	Ships produce waste water in two categories: grey wastewater from sinks, laundries, and showers and black wastewater containing sewage. New international maritime laws make it illegal to pump this water over the side so it has to be

Category	Number and name	Description
		treated on board, using a water treatment plant.
Transport flow, transport mode related	MS600: Reefers, refrigerated cargo, reefer block trains	Refrigerated shipping container for transporting perishables, having its own stand-alone (self-powered) cooling system.

Table 42 List of measures

9.1.7 Study on sustainability

Considering the importance of the sustainability topic for ports of the future a study has been commissioned by Circle to LRQA Italy. This chapter is a summary of this study. It complements the desktop study on sustainability (Section 6.2.3.6 T60: Sustainability on page 65)

9.1.7.1 Executive Summary

This document presents an overview of the sustainability concept applied to ports, an analysis of the UN 2030 Sustainable Development Goals, The World Ports Climate Initiative as well as a focus on the main accountability practices and standards. This literature review aims at deepening the concept of sustainability at ports as well as analysing the main guide lines the port sector should follow to set a sustainability path and work for next the years on the port of the future vision.

9.1.7.2 The concept of sustainability at ports

The concept of sustainability in a port necessitates the simultaneous pursuit of economic prosperity, environmental quality and social responsibility (ESPO, 2012). As highlighted by Cheon and Deakin, (2010) as port functions change to act as an economic catalyst and take on a central position in industries engaged in international trade, issues of economic stability and corporate responsibility shed new light on port operations. Moreover, the increasing environmental consciousness stimulates ports to improve their operational sustainability within the bounds of the environmental regulations, by accommodating stakeholder expectations (Dinwoodie et al., 2012; Adams et al., 2010). To accommodate the current and future needs of ports and their stakeholders, ports need to find a balance between valuable land, labor and technology, as well as to perform as a multifunctional business center which can produce value-added and growth in their host cities (Lun, 2011; Wang and Cheng, 2010).

In maritime ports and related activities, environmental issues are continuously emerging and becoming a competitive factor. Shipping and ports are essential components of the international trade and goods movement (World Shipping Council, 2010). Shipping represents one of the largest, most difficult to regulate and control source of air and water pollution in the world. Ports are major economic, industrial and logistics centers that also contribute significantly to pollution in coastal urban areas (Marine Insight, 2011)

As stressed by Sislian *et al*, (2016) the concept of port sustainability includes three main perspectives also called the the triple bottom line concept:

1. An economic perspective including returns on investment, efficiency of the use of the port area, and provision of facilities for companies to maximize their performance;
2. A social scope such as the direct contribution to employment in port companies and activities connecting to the port (indirect employment, the interaction and relationship between port and city, the contribution to knowledge development and education, and the liveability of the area surrounding the port)
3. An environmental performance and management including noise pollution, air quality, dredging operations, and dredging disposal (UNCTAD, 2009)

In 1987, the UN conference defined sustainability as those that “meet present needs without compromising the ability of future generations to meet their needs” (WCED, 1987). From the IUCN, UNEP, WWF (1991), sustainability was defined as “Improving the quality of human life while living within the carrying capacity of supporting ecosystems”. Pronk and Haq (1992) suggested that sustainability is to provide a great opportunity to achieve economic growth of

the whole human beings but not for some particular interests groups while not depleting the natural resources and environmental capacity.

The economic strength behind ports and container terminals unfortunately comes with a heavy environmental burden. The growing port activities and the densely populated cities where most ports are located, combined with already pollution-saturated air and water are imposing threats to public health and environment in general. Many ports today are considered to be the largest sources of air pollution in coastal cities and awareness of the necessary action for the reduction of pollution has become the matter of public concern (Vujicic *et al*, 2013).

9.1.7.3 The UN 2030 Sustainable Development Goals

In September 2015, the UN General Assembly adopted 17 Sustainable Development Goals (Figure 47: Sustainable development goals on page 182) as an integral part of the 2030 agenda for sustainable development. These 17 goals were to build upon and broaden the scope of the earlier millennium development goals (MDGs), which expired at the end of that year. The SDGs mark a historic shift for the UN towards one sustainable development agenda after a long history of trying to integrate economic and social development with environmental sustainability. They also mark the most ambitious effort yet to place goalsetting at the centre of global policy and governance. (Biermann et al., 2017). In March 2018, ports around the world signed the World Ports Sustainability Program declaration, which aims to contribute to the sustainable development goals (SDGs), whilst a number of national port (master) plans have started to include social along with environmental standards. Extant studies on partnering and stakeholder inclusion in port development are proliferating but are primarily aimed at environmental rather than social (inclusion) issues (Jansen *et al*, 2018).

The 17 Sustainable Development Goals (SDGs) of the United Nations present a novel approach to global governance where goal-setting features as a key strategy. 'Governance through goals', as exemplified by the SDGs, is new and unique for a number of characteristics such as the inclusive goal-setting process, the non-binding nature of the goals, the reliance on weak institutional arrangements, and the extensive leeway that states enjoy (*ibidem).* While past global governance efforts have relied largely on top-down regulation or market-based approaches, the SDGs promise a novel type of governance that make use of non-legally binding, global goals set by the UN member states. The approach of governance through goals is marked by a number of key characteristics, none of which is specific to this type of governance. Yet all these characteristics together, amount to a unique and novel way of steering and distinct type of institutional arrangement in global governance (Kanie *et al*, 2017).

As pointed out by Biermann, even though the 17 SDGs are supported by 169 more concrete targets, many of these targets remain relatively vague. Most are also purely qualitative, leaving much room for interpretation and hence weak implementation. For this reason, it will now be important to concretize the SDGs as much as possible through appropriate indicators, combined with formalized commitments by governments at the national level.

Not all SDGs will be relevant to every port. It is important to remember not every business can do everything. As stressed during the Green Port Congress that took place in Amsterdam 11th October 2017, ad hoc assessment of the business & operations is required to determine: Relevance of SDGs; and existing alignment between business strategies & SDGs. Unfortunately there are a few studies in the literature in which the impact of sustainability in port management is studied. The main portions of these studies only consider the environmental aspect of sustainability (Asgari *et al*, 2016). Goulielmos (2000), PerisMora et al. (2005), Le et al. (2014), and Villalba & Gemechu (2011) are relevant examples. Gibbs et al. (2014) consider the emission from berths rather than ports. They analyze a set of UK ports in this study. Lu et al.

(2012) consider the case of Taiwanese ports and assess the importance of sustainablity criteria.

On 12 May 2017 the International Association of Ports and Harbors decided to set up a World Ports Sustainability Program. Guided by the 17 UN SDGs the program wants to enhance and coordinate future sustainability efforts of ports worldwide and foster international cooperation with partners in the supply chain. The World Ports Sustainability Program builds on the World Ports Climate Initiative that IAPH started in 2008 and extends it to other areas of sustainable development. The American Association of Port Authorities (AAPA), the European Sea Ports Organisation (ESPO), the International Association of Cities and Ports (AIVP) and the World Association for Waterborne Transport Infrastructure (PIANC) signed up as strategic partners of the World Ports Sustainability Program. By 2018, ten years after the birth of WPCI, the global agenda will have changed a lot. The United Nations 2030 Agenda for Sustainable Development and its 17 Goals was signed by all countries in September 2015 and several months later an important agreement was reached again by all member states at the COP21 meeting in Paris addressing climate change. Clear objectives have been worked out for both issues which require concrete actions of all private and public actors on both local as well as global scale. Ports are the nodal points in the global supply chain and play a crucial role in working to improve the sustainable performance of the supply chain on a local as well as on the global scale. The work performed by the IAPH-PIANC working groups on Sustainable Ports and Sustainability Reporting for Ports emphasizes that corporate social responsibility forms an essential basis for the license to operate. As a testimony to the leading role that ports play regarding the international targets set by the 2030 Agenda and the Paris agreement, the Port Environment Committee over the last couple of years has considered to broaden the scope of the WPCI and to include overall sustainable development and to redefine the objectives originally set regarding climate change.
The Port Environment Committee has decided to create the World Port Sustainability Program (WPSP) as a follow up of the World Port Climate Initiative. WPSP will be set up to fulfil multiple roles which include the creation of knowledge centres for consultation by all involved in supply chain operations. WPSP will also be the think tank where innovative ideas and philosophies on sustainable ports including economic factors influencing sustainability, are translated into practical ways and methods of port design, management, operations, etc.

9.1.7.4 The World Ports Climate Initiative

In 2008, the International Association of Ports and Harbours (IAPH) launched the World Port Climate Initiative (WPCI) in collaboration with regional port organisations. This resulted in the 'World Ports Climate Declaration', in which the signatories committed themselves to taking measures to combat climate change. This Memorandum of Understanding was initially signed by 55 international world ports. Over the years, more ports joined the initiative. The concrete implementation of the measures took shape in various working groups that were monitored by the Port Environment Committee of IAPH. Attention was paid to:

Onshore power supply for sea vessels The' Environmental Ship Index' (a system for assessing the environmental friendliness of ships which is linked to a discount system when calling at the participating seaports) LNG as bunker fuel Drawing up a carbon footprint for port activities and hybrid and electric harbor related equipment.

The WPCI focuses on five principal topics (ocean-going shipping; port operations; logistic chains; alternative energy; and environmental auditing/CO2 inventories) and has led to specific initiatives between ports addressing e.g. intermodal transport, leasing agreements, cargo-handling equipment, LNG-fuelled vehicles, onshore power supply, and the clean shipping index. Moreover, the WPCI ports committed to increasing and strengthening support for its activities

among the world ports community. As pointed out by Fenton (2017), it is unclear to what extent this latter undertaking has been achieved.

The WPCI is one of various initiatives aiming to reduce greenhouse gas emissions and other negative environmental impacts of maritime transport both at sea, in ports, port cities and their hinterlands. Such network governance initiatives appear to be essential and important processes in a world of multi-level governance. The WPCI recognises that ports have a responsibility to act, whilst accepting the need to work collaboratively both within and between sectors, as ports operate within the context of a wider economy and significant environmental impacts of shipping occur outside of the territorial boundaries of cities or even nations.(ibidem).

9.1.7.5 AA1000, GRI and ISO 26000

According to Gurvitsh and Sidorova (2012), there are a few initiatives globally such as: GRI (Global Reporting Initiative) , Accountability 1000 (AA1000) and Social Accountability 8000 (SA8000), which facilitate the disclosure of social and environmental aspects. Moreover, one of the accounting standard setters, International Accounting Standards Board (IASB) has released a framework named Management Commentary which eases the access of companies in preparing and presenting narrative information within annual reports

Account Ability 1000 (AA1000) is an accountability standard, focused on securing the quality of social and ethical accounting, auditing and reporting.

Scope of the AA1000 Assurance Standard is

1. Accepting an engagement where the standard is used;
2. Performing an engagement in accordance with the standard.

It relies on mandatory reference to the AA1000 AccountAbility Principles Standard.

The purpose of the AA1000APS (2008) is to provide organisations with an internationally accepted, freely available set of principles to frame and structure the way in which they understand, govern, administer, implement, evaluate and communicate their accountability. The AA1000 AccountAbility Principles are primarily intended for use by organisations developing an accountable and strategic approach to sustainability. They will help such an organisation understand, manage and improve its sustainability performance. In addition, users of other standards in the AA1000 Series use these principles according to the requirements of the relevant AA1000 standard.

AA1000 standard and principles are relevant because they set the internationally recognised rules that any kind of organization has to follow in order to adhere and be committed toward sustainability. It is globally recognised that any kind of sustainable initiative to be so called has to be structured first upon the principles fixed in AA1000APS.

1. Inclusiveness
2. Materiality;
3. Responsiveness.

These 3 principles represent a mandatory approach for any organization to commit on sustainable development and assure a suitable level of credibility toward it.

Any kind of initiative related to the sustainable development has to fulfil the three principles of AA1000 APS. AA1000 standard are intended to verify the level of conformity toward AA1000 APS.

Recent standards set out by international authorities such as Global Reporting Initiative (GRI) are used as evaluation criteria in order to reveal the utmost efforts made by corporations (e.g. in tourism and finance industries). The GRI, a multi-stakeholder initiative, was established in 1997 as a joint project by the U.S. Coalition for Environmentally Responsible Economies

(CERES) and the UN Environment Programme (Waddock, 2007) Its stated goal is to encourage dialogue between corporations and stakeholders through firms' disclosure of information on economic, social, governance and environmental performance (GRI, 2011a). Firms need to report on: first, their profile (context information on profile, strategy and governance); second, their management approach (how they address relevant topics) and third, a series of performance indicators (comparable information on social, environmental and economic performance) (GRI, 2011c, p. 5). The GRI provides information on the scope and quality of reporting, not the actual performance of CSR. Thus it has developed reporting norms on what to report and how to report, without any binding requirements. It is a voluntary standard, and as Willis (2003) stated "the Guidelines do not represent a code of conduct or a performance standa prrd". By providing reporting guidelines, the GRI aims at promoting organizational transparency and accountability as well as stakeholder engagement. The GRI also provides applicationlevel information, as corporations can self-assess their reports (or get a third party assurance), based on the number of GRI indicators disclosed in their reports. Depending on their disclosure level, corporations are awarded a level A, B or C (GRI, 2011b). This 'grade' can be included in a firm's CSR report

The GRI Standards represent global best practice in sustainability reporting. They are designed to be used as a set by any organization that wants to report about its impacts, and how it contributes towards sustainable development. The GRI Standards are also a trusted reference for policy makers and regulators worldwide; they encourage and enable credible non-financial reporting by the companies under their jurisdictions. The GRI Standards represent global best practice for reporting publicly on a range of economic, environmental and social impacts. Sustainability reporting based on the Standards provides information about an organization's positive or negative contributions to sustainable development. The modular, interrelated GRI Standards are designed primarily to be used as a set, to prepare a sustainability report focused on material topics. The three universal Standards are used by every organization that prepares a sustainability report. An organization also chooses from the topic-specific Standards to report on its material topics – economic, environmental or social. Preparing a report in accordance with the GRI Standards provides an inclusive picture of an organization's material topics, their related impacts, and how they are managed. An organization can also use all or part of selected GRI Standards to report specific information.

The need to ensure that CSR practices are material to stakeholders, and that those stakeholders are engaged in shaping and delivering the CSR practices of any given firm, is not new. In line with the firm's CSR strategy, the range of stakeholders to be taken into consideration, and the dialogue and attitudes towards them, will be directly dependent upon its motives for engagement in CSR and its social and environmental reporting (Font et al, 2016). Sustainability reporting "is a process that assists organisations in setting goals, measuring performance and managing change towards a sustainable global economy e one that combines long term profitability with social responsibility and environmental care" (GRI, 2013a:85). Initially, the goal of the GRI was to develop and promote guidelines for sustainability reporting. Having achieved this, the GRI currently strives to make sustainability reporting a standard practice for all organizations (GRI, 2013a). One of the major characteristics of GRI is the multi-stakeholder process, which became part of the GRI's identity (Nikolaeva and Bicho, 2010)

GRI has also actively participated in the international multi-stakeholder ISO 26000 development process from the beginning, and supports this first ever non-certifiable ISO standard on (Corporate) Social Responsibility. (Chia and Dev, 2018). ISO 26000 was published in November 2010 and provides guidance on how businesses and organisations can operate in a socially responsible way. Both ISO 26000 and the GRI Guidelines cover the most common economic, environmental and social issues and impacts. However, while ISO 26000 is intended to give guidance on the actions and expectations for organisations to address each of these

topics, the GRI Guidelines provide guidance on what to report for each of these issues specifically (ISO, 2010). ISO is one of the most internationally prominent, standard setting organisations, and the development of the ISO 26000 guidance standard is ISO's first attempt to develop a standard with multiple stakeholders (Balzarova and Castka, 2012). It aims to help organisations deal with the ambiguities resulting from the pressures of society on private enterprises (Hahn, 2012). ISO 26000 has been recognized as a "milestone in the history of global cooperation" (Ward, 2011). The goal of ISO 26000 is to provide guidance on managing social responsibility in the areas of human rights, labour practices, environment, fair operating practices, organisational governance, community involvement and development and consumer issues. The main achievement of ISO 26000 is the agreement on several CSR definitions developed by 450 multi-stakeholder experts. Being a guidance standard, it does not require third-party certification.

9.2 Annexes to task 2 stakeholder consultation

9.2.1 Rationale behind stakeholder engagement

Stakeholder's engagement is a continuous and systematic process by which an organisation establishes a constructive dialogue and a fruitful communication with its key stakeholders. The purpose of involvement is to contribute both for decision makers' expectations and interests of stakeholders, so that the former can take the gathered inputs into account in decision making. Ports, indeed, represent areas where different conflicting interests (environmental, social and economic) meet. Ports are not just an organisation by themselves, separated from their environment, but are also is embedded in the local, regional, national and international environments and this has to be reflected in the stakeholders' engagement. Stakeholders are not static entities. They change over time and space (Dooms, et al., 2013). They are also embedded in complex environments that shape e.g. their visions and values. Their actual knowledge, resources, needs and interests, for example, can differ from their knowledge, resources, needs and interests in just a short period of time.

Stakeholder analysis, as highlighted by Freeman (1984) deals with the identification and prioritisation of stakeholders as individuals or stakeholder groups. Stakeholder analysis represents "an approach for understanding a system by identifying the key actors or stakeholders in the system, and assessing their respective interests in that system" (Grimble et al. 1995)

Stakeholder engagement in the DocksTheFuture project can be diverse, as the definition of the vision of the Port of the Future requires involvement of a wide range of practitioners: from researchers to funders, from ministerial policy makers to port authorities, and from the industry to cities.

The consortium partners have all been active in the transport and maritime domain for a number of years and have developed a wide network of transport stakeholders across (and beyond) the EU, including Member States authorities and EU and international policy makers.

During the stakeholders' engagement stage, the consortium identified the stakeholders which may be able not only to contribute to the project but also to motivate them to become involved. In order to identify all the interested parties, it was essential to deliberate all people, or group of people who may affect or/and can affect, or/and may have an interest in the project However, the stakeholder identification process should be reassessed frequently throughout the project, in order to be ensured that no groups or individuals have been missed. This means that it might be required to identify new stakeholders that need to be engaged through the project duration or as stakeholder needs and priorities change over the course of project implementation. The

stakeholder mapping process aimed at identifying which stakeholders need to be engaged, in order to achieve the highest impact for the project. The stakeholder's selection was carried out having as a basis the content, the expected results and the impacts of the project, as well as the available resources, the objectives of the engagement, and the willingness or the ability of the stakeholders to engage and to be involved to the project.

Other methods used for identifying key stakeholders were:

1. Brainstorming and consulting with project partners and with other organisations that have been involved in similar activities;
2. Utilising existing stakeholder lists and databases of the project partners in order to identify other groups, networks and agencies.

9.2.2 Survey method

The stakeholders' consultation was carried out through an online survey based on the Google forms platform.

The online survey was launched the 14th September 2018 and remained open until the 1st of October. After the first launch, a second reminder was sent on the 26th of September. The official survey was preceded by 5 interviews that were aimed at testing the stakeholders' answer. The interviews were partially close to the current survey since they were mainly based on open questions. After this "testing phase", the consortium decided to administer an online survey, made up by both open and closed questions, a smaller number of open questions and a greater adherence to deliverable D1.1 Desktop analysis of the concept including EU Policies, that, in the meantime, was submitted and completed.

To reach out a larger community of interested stakeholders, the link to the web-based survey has been disseminated using:

1. The official project website

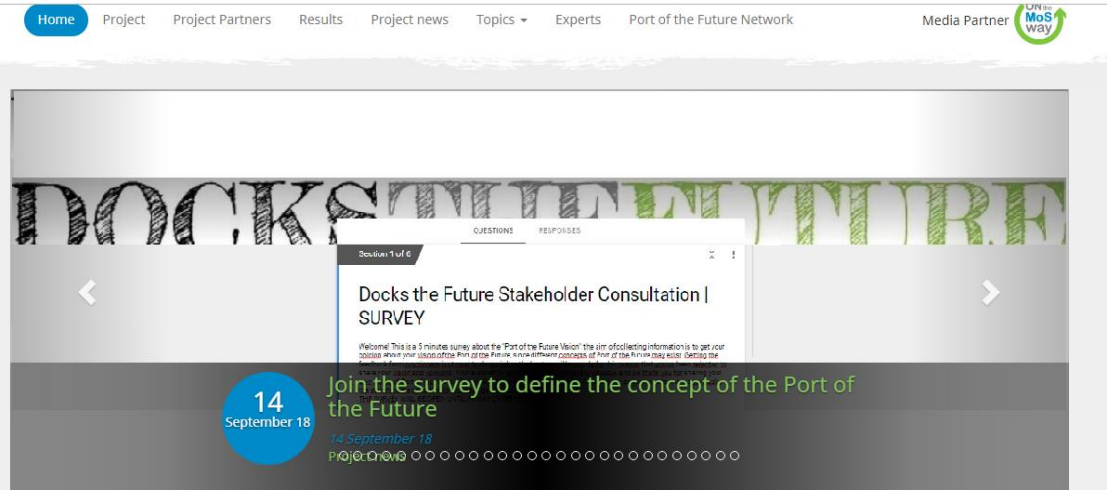


Figure 49: Survey published on the official website

2. The official project newsletter


www.docksthefuture.eu

DOCKSTHEFUTURE
defining the concept of "Port of the Future"

Docks the Future Stakeholder Consultation | SURVEY

Make sure you do not miss the chance to have your say and share your views on the Ports of the future!
Just more 5 days to participate!

This is a few minutes survey about the "**Port of the Future Vision**": the aim of collecting information is to get your opinion about your vision of the Port of the Future, since different concepts of Port of the Future may exist. **The results coming from the survey will feed into the project results**, more specifically

Figure 50: Survey sent through the official DocksTheFuture newsletter

3. Dedicated emails to the selected stakeholders

9.2.3 Survey responses to the port of the future open question

Please describe your idea about the Port of the Future - meant as near future (2030)	Key words	Topics
Zero emissions - adaptation of renewable energy. Online scheduling of truck arrivals. Full connectivity with rail and inland waterway if it exists. Port community system with shared information on all port stakeholders. Circular economy adopted in port operations/asset/waste/water management.	Zero emissions, renewable energy. PCS (Port Community system). Circular economy	• **Sustainability;** • **Digitalisation and digital transformation**
Increased productivity with dramatically less pollution	Less pollution	• Sustainability
Connected, Multi operations, Competitive, Environmentally sensible	Connected; environmentally sensible	• Sustainability; • Digitalisation and digital transformation
Advanced communication and implement IOT to make ports smarter and more efficient implement global SDG standards for example for onshore power supply of vessels to reduce emissions in the port. Rethink if bigger is always better what is the external cost	Advanced communication; IOT, reduced emissions	• Sustainability • Digitalisation and digital transformation
Acceptance as active member of society, bringing wealth to the area	(port) as active member of the society	• Port-city; • Human element.
A port facing challenges related to simplification and digitalisation of processes, emission reduction, energy transition, electrification, smart grids, port-city interface and the use of renewable energy management.	simplification, digitalisation, renewable energy management	• Sustainability; • Digitalisation and digital transformation
The port of the future will be a full automatic place where autonomous ships berth and load discharge by autonomous means.	Full automatization	• Sustainability; • Digitalisation and digital transformation
For me a port of future should be a sustainable port, in which the economic	Sustainable port environmental	• Sustainability

Please describe your idea about the Port of the Future - meant as near future (2030)	Key words	Topics
development could coexist with the environmental protection and ensure the welfare of the neighbour citizens	protection	
The port should offer the fastest and tailored service in a sustainable way and preserving safety and security issues	Sustainable port; safety and security issues	• Sustainability • Safety and security
Until 2030 the Port of the future should be carbon-neutral and get its power-supply from renewable energies. Smart Grid-concepts had made it possible to connect the energy sector with the transport- and the Heat/Cold-sector; port infrastructure Manager and port suprastructure/terminal Manager work closer together in their energy-management to balance their power supply with local production. Mobile engines will be powered by hydrogen or battery or with other alternative fuels (e.g. CNG, LNG, Bio-LNG, and synthetic LNG); in ports are the necessary fuel & power stations. Air emissions are reduced especially GHG-Emission.	carbon-neutral, renewable energies, smart-grid	• Sustainability
Fully digitalised services based on international standardised data sets.	Fully digitalised	• Digitalisation and digital transformation
Zero emissions vessels and operations, clean waters, essential partner in energy transition.	zero emissions, clean waters	• Sustainability
Port of the Future means an scenario in which infrastructure will be more important than infrastructure.	infrastructure	• Digitalisation and digital transformation
Port as a Service	Port as a service	• Performance and quality of service
Shared data and analytics which enable strategic efficiencies and operational excellence. A 'Green' powerhouse, utilising infrastructure and seabed resources to provide energy to create a self-sustained eco port	Green powerhouse, eco port, data analytics	• Sustainability; • Digitalisation and digital transformation

Please describe your idea about the Port of the Future - meant as near future (2030)	Key words	Topics
Un port résilient, inscrit dans un territoire et répondant aux besoins de l'hinterland. Soucieux de réduire l'impact environnemental de ses activités et de contribuer à la réduction des GES en développant les liaisons, y compris courtes.	reduced environmental impact	• Sustainability
A full digitally enabled experience where all stakeholders cooperate according to the physical internet principles	fully digitalized; physical internet	• Digitalisation and digital transformation
The Port of the Future is a sustainable eco-system, serving as a catalyst for regional development in an economic, environmental and social point of view. It is driven by cutting-edge technologies, in order to meet the needs of port users with a greater level efficiency, transparency, and value while at the same time aims at a lower environmental footprint of port operations and reduction of the disturbance to local communities.	sustainable eco-system	• Sustainability
Intermodal port	intermodality	• Hinterland, multi/synchro modality, supply chain integration, modal shift
A transport and logistic hub that is digitalized and is connected to various multimodal hubs for exchanging information between various stakeholders in the logistic chain.	digitalised and connected	• Digitalisation and digital transformation
An intermodal platform where flows of people and goods are governed through seamless technology	seamless technology	• Digitalisation and digital transformation
Sustainable, efficient, connected to European rail and road networks. The prevision is a doubling of the current handling of containers, ships with engines with low environmental impact (LNG), eco-sustainable docks, a lot of automation in port work	Sustainable, efficient, conneced	• Sustainability; • Hinterland, multi/synchro modality, supply chain integration, modal shift
Facilitate conditions for sustainable maritime supply chains	sustainable supply chains	• Sustainability

Please describe your idea about the Port of the Future - meant as near future (2030)	Key words	Topics
Definition of the total environment of the port sector and how it is to evolve over the coming 12 years	port sector	• Performance and quality of service
New settlements and renewed concession agreements will include not only capacity and performaNce goals but also safety, security at work and environmental targets for the operation of the respective site and the services provided by it.	safety, security environmental targets	• Sustainability; • Safety and security
Fully integrated in the logistic chain, at all levels, clean, digital and sustainable.	fully integrated, digital and sustainable	• Sustainability; • Digitalisation and digital transformation
The Port of the Future will use new ICT, data analytics and IoT technologies to optimize traffic flows, operations and safety while operating sustainably within its surrounding environment and hinterland.	ICT, data analytics, IOT technologies, sustainability	• Sustainability; • Digitalisation and digital transformation
Ports as blue economy and technology hubs; New approach - The analysis and treatment of data and big data will be crucial, to anticipate the market trends.	blue economy, big data	• Sustainability; • Digitalisation and digital transformation
Semi-fully automated activities, with the possibility to integrate real time planning and optimization. An integrated Information Exchange platform for all stakeholders to share Information and activities.	semi-fully automated, real time planning and optimization	• Digitalisation and digital transformation
The digital port. By improving efficiency through new technologies (notably AI, IoT, and cargo tracking), negative externalities will be reduced.	digital port, IOT	• Digitalisation and digital transformation
My "port of the future" idea is based on the concept of integration, both functional and social. The port of the future must be sustainable both economically and energy-environmental level (green ports) with opportune studies that integrate these components. A fundamental aspect is the city-port interaction that must be studied in detail from the analysis of the land-use, evaluating the reciprocal impacts between city and port, minimizing them. The	sustainable port, port-city interaction, integration with the hosting territory	• Sustainability and port-city and human element

Please describe your idea about the Port of the Future - meant as near future (2030)	Key words	Topics
port must be integrated with the territory that hosts it at social and cultural levels, valorising the peculiarities. Integration must be the main concept also in the management of port security/safety with approaches and innovative methods. The main integration will be between the different actors of the port community which must operate synergically for a common end.		
In 2030 the port of the future will be more integrated on the maritime leg and especially on the land side of it. This implies a strong integration with the port city, with the logistics activities in the hinterland, both for the physical flows and for the data transmission.	integration with the port city	• Port-city and human element
My idea of the Port of the Future consists in hyper-connected hubs, sharing information with all entities around affecting all their activities. In the Port of The future, advances on machinery should be hand-to-hand with ICT infrastructure, sensoring, controlling, monitoring and process optimization based on newest methodologies.	hyper-connected port, ict	• Digitalisation and digital transformation
A port capable to increase its efficiency and productivity by using technology and by interacting with the other public and private operators, while monitoring and reducing its environmental impact on the surrounding area	environmental impact	• Sustainability
The Port of the Future should be a high technologic and automized multimodal terminal, directly linked via rail to the regional intermodal platforms and international hubs. It should use electricity as the only power to carry on port activities/movimentation as well as lightning and ship power forniture. The energy should be created by green solutions (photovoltaic, eolic..) installed inside or nearby the port.	high technologic port, automised port, green solutions	• Sustainability; • Digitalisation and digital transformation
Real single window between ports, environmental friendly, sustainable, Integration of logistics between landside and seaside, Automatization of processes including regulatory issues	automatisation of processes, sustainability	• Sustainability; • Digitalisation and digital transformation

Please describe your idea about the Port of the Future - meant as near future (2030)	Key words	Topics
Fully automated operations on warf and yard side. New technologies used to minmise the impact of refitting or changing lifting equipment, use of algorithm to optimise container yard space and equipment use. Use of block chains to improve security of e.d.i. messages.	fully automated operations	• Digitalisation and digital transformation
Ports support of reducing the impact of climate change and the environment coming from the port activities; to improve logistics efficiency and integrate the port in the surrounding socio-economic area, focusing on city-port relations and the smart urban development of Port Cities. Incorporate innovative solutions for low-carbon emissions, development of hinterland transport networks, contribute to sustainable Smart Port Cities	reduced impact on the environment, port-city relations, innovative solutions	• Sustainability; • Digitalisation and digital transformation; • Port-city and human element.
The Port of the Future in 2030 will be a completely digitised business, where all the involved information for a port will come in digital format directly from its source in real-time, including documents, sensor-based data, facility and infrastructure data, business events, etc. Each organisation in a Port Community will provide the data they are responsible for in terms of being the origin of the information, and will decide the level of privacy and which specific information is to be shared with each specific stakeholder. This common infrastructure that goes beyond state-of-the-art PCS's will foster new businesses and will allow optimizing operations and activities all along the value chain.	completely digitised	• Digitalisation and digital transformation
Decarbonised and fully interconnected port. Use of electrification and alternative fuels as well as implementation of real-time information exchange technologies, cloud computing and predictive analysis for better decision making. Better intermodal connections, more efficient and faster. Synchronised port calls, just-in-time operations. Circular economy.	decarbonised and fully interconnected	• Sustainability; • Digitalisation and digital transformation
A port fully integrated in its environment and considering/monitoring natural environment	monitoring natural environment	• Sustainability

Please describe your idea about the Port of the Future - meant as near future (2030)	Key words	Topics
The port of the future is smart, interconnected and interoperable. It is aligned with main trends in innovation and sustainability, by reducing the overall impact of port costs on the logistic chain and improving less polluting technologies. The port of the future relies highly on real time monitoring and control of operations, to better plan port development and to assess the impact of port activities on the environment and local economy. The port of the future puts together data, physical flows and infrastructural components as asset for boosting value added activities, not only in relation to logistics, but also in connection with smart manufacturing and circular economy's opportunities.	smart, interconnected, sustainability	• Sustainability and digitalisation and digital transformation
Higher automation, higher share of containers, fewer operators	automatisation of processes	• Digitalisation and digital transformation
Modern, efficient, environmentally friendly, safe, smooth operations	efficient and environmentally friendly	• Sustainability; • Digitalisation and digital transformation.
The port of the future will be fully integrated in th city, with low environmental impacts.	Integrated with the city, low environmental impacts	• Sustainability;; • Port-city and human element.
Port is the node and the gate between the ship and the city. Therefore a common action and planning si need in order to strengthen the activities. Also in relation to big data, energy security and supply chain.	big data	• Digitalisation and digital transformation
A Port of the Future should be an infrastructure created and optimized to deliver services that can raise the standard of port operations to a new standard of efficiency, safety and speed. This means that new solutions and technologies should be developed in order to increase automation and predictability. For instance, the usage of quay LIDARs that could use standard information exchange with ships and thus provide highly accurate positioning information.	New technologies	• Digitalisation and digital transformation

Please describe your idea about the Port of the Future - meant as near future (2030)	Key words	Topics
The Port of the Future will be able to enhance sustainable development and to manage the resources to be invested and their employment for a competitive advantage.	Sustainable development	• Sustainability
Intermodal port	Intermodality	• Hinterland, multi/synchro modality, supply chain integration, modal shift
IoT supported port operations with basic analytical capabilities	IoT	• Digitalisation and digital transformation
Fully automated	Fully automated	• Digitalisation and digital transformation
Customer friendly port that meets with its users, listens to their needs, adapts to the current shipping trends, transparent and environmentally friendly. The Ports should compete between them and stop being publicly owned.	environmentally friendly	• Sustainability
Further consolidation in shipping, more data generation & data sharing	data sharing	• Digitalisation and digital transformation
Seamless & efficient vessel call in a port and throughput of the cargo to local and hinterland destinations	seamless technology	• Digitalisation and digital transformation
Our vision is that by 2030 we will have transformed Dublin Port into a highly land efficient port, an attractive destination in its own right and permeable to the people of Dublin to enjoy and experience the port's heritage in all its diversity from the natural environment, to arts, to local history.	port citu relation	• Port-city and human element
Fast transit	fast transit	• Digitalisation and digital transformation
fully automated	fully automated	• Digitalisation and digital transformation
Provides a seamless integration of information that is shared between shippers, port operations and carriers operating in multiple modes of transport	seamless technology	• Digitalisation and digital transformation

Please describe your idea about the Port of the Future - meant as near future (2030)	Key words	Topics
Efficient and sustainable port with sufficient cargo handling capacity in all directions.	sustainable port	• Sustainability
Increasing degree of automation, not just equipment, but also processes. unchanged logistical processes, and thus, no major changes in equipment types and operating systems	automation	• Digitalisation and digital transformation
Automation, lean procedures, green technologies, tenewable energy resources, efficiency, speed, sustainability	automation, green technologies	• Sustainability; • Digitalisation and digital transformation
Automated, autonomous, connected, and sustainable	automated and sustainable	• Sustainability; • Digitalisation and digital transformation
Serving the nearest hinterland to avoid unfair competition	avoid unfair competition	• Performance and quality of service
More consideration for environment (air pollution, waste, noise, water and soil pollution) and more digitalisation. This will result in more different energy sources (LNG, LPG, methanol, biogas..) that will be used by trucks, ships, equipment. More respect for working conditions and environmental protection (dust prevention, air quality, soil and water protection). Information sharing without sending additional messages. Meaning info on central database and shared (depending on the user rights) between public and private sector.	less pollution and more digitalisation	• Sustainability; • Digitalisation and digital transformation
fully automated	fully automated	• Digitalisation and digital transformation
Sustainable part in the transport chain	sustainability	• Sustainability
Near future 'smart' and 'AI' projects necessitate a Port in which port authorities, shipping companies, shipping agencies, ... are aware of the	automation	• Digitalisation and digital transformation

Please describe your idea about the Port of the Future - meant as near future (2030)	Key words	Topics
Imminent automation processes on hand and sustain this awareness by actively participating and investing in the development of the European Maritime (Single Window) Environment as a benefit for all partners taking an interest in a steady, secure and safe maritime transport		
Automated	automation	• Digitalisation and digital transformation
Seaport as a socio-economic space of the multi-faceted impact on the environment combining the processes of transport, thanks to the technical and technological equipment, the sea to the mainland, which are realized interpenetrating, interdependent and interrelated, objective and spatial functions related to with trade and movement of people.	environment	• Sustainability
Fully automated	automation	• Digitalisation and digital transformation
High degree of digitalisation of documentary processes especially in container trade, but also RORO and eventually also breakbulk and bulk will quickly follow. Money spent in software rather than in human capital, human work as much as possible outsourced to low wage countries.	digitalisation	• Digitalisation and digital transformation
Paperless and data sharing which integrates processes of port stakeholders plus higher level of automation and business analytics	Paperless and data sharing	• Digitalisation and digital transformation

Table 43: Survey responses to the port of the future open question

9.2.4 Survey responses to external factors and market trends question

Please describe the most important external factors and market trends which have an impact on your vision of the Port of The Future	Main categories
Regulatory issues, capacity issues and alignment with city policies.	• **Regulatory issues and policies**
Digitalisation, protectionism, environmental awareness	• **Digitalisation**
Regulatory issues	• **Regulatory issues and policies**
We move from traditional ports to digital smart ports with changes in communication whereby data is the oil of the 21th century trend of building bigger and bigger ships so ports have to follow but ask critical questions do we have to follow this trend if the big vessels only drop/load part of the cargo on board what is the cost for the society as a whole	• **Digitalisation**
Environnemental issues, digitalisation, social acceptance	• **Environmental issues**
Sustainability and renewables	• **Environmental issues**
Robotisation and the need for better productivity/costs	• **Digitalisation**
Economic issues are key for the ports but sometimes they can be a problem for the environmental protection.	• **Economic issues**
Concentration of actor along the supply chain. Forward and backward vertical integration. Increasing international trade with new emerging partners. Energy transition...	• **Environmental issues**
The maritime economy everytime needs a level playing field for all actors. For a sustainable and decarbonisation development we need "real" prices (through introduction of external costs) esp. for fossil fuels as soon as possible. Therefore politicians are needed to work on international agreements to fuel pricing; ship size standards and sustainable reporting. Frontrunners and pilot innovation projects as well as network improvements should be pushed by public subsidies.	• **Environmental issues**
New technologies such as AI, IoT, Blockchain, etc.	• **Digitalisation**
Energy transition, increased transportation of goods, societal awareness	• **Environmental issues**

Please describe the most important external factors and market trends which have an impact on your vision of the Port of The Future	Main categories
4.0 technologies such as blockchain, internet of things, 5G and machine learning	• **Digitalisation**
Port 4.0 and blockchain	• **Digitalisation**
Increased Environmental obligations imposed by regulators on maintenance Dredging for the Port. No clear industry direction from ship owners as to 'what' future green power solution will adopted by the industry. In particular, what a Port has to implement for shore power or vessel feeling that is a 'one' solution for calling ships. Future Environmental legislation to protect communities and residential housing which have clustered around ports ie: 24/7 Operational Noise / Lighting and traffic movements	• **Environmental issues**
Une fiscalité des transports moins favorable à la route qui prenne en compte les externalités.	• **Regulatory issues and policies**
Digital transformation	• **Digitalisation**
Legislation Technology limitations Environmental footprint Societal acceptance	• **Regulatory issues and policies**
Regulatory issues	• **Regulatory issues and policies**
Standarisation of information, multimodal information flows and trust between different stakeholders within those flows.	• **Digitalisation**
Digitalisation - delayering/disintermediation of services to reduce costs/efforts	• **Digitalisation**
Digitalisation	• **Digitalisation**
Digitalisation and near-sourcing	• **Digitalisation**
Technological development (to be incorporated in the port sector), availability of capital for investments	• **Digitalisation**

Please describe the most important external factors and market trends which have an impact on your vision of the Port of The Future	Main categories
The Port of the Future is challenged by a couple of external factors and market trends including the competition between ports and trade lanes where the "internal" and the "external" coincide. Among others the decarbonisation will - already by 2030 - change the type and size of commodities for European import from primary energy and raw material to higher value goods because the first valorisation steps have been carried out already in the export country. Uncertainties in the global trade lanes, the further increase of recycling and a shorter time-to-market will encourage intra-European trade including short sea shipping. On the other hand further signals of climate change (increase of sea-level, higher frequency and intensity of extreme weather (storm, rain, floods, temperature) will call for action to prepare the infrastructure and its operation.	• **Environmental issues**
Sustainability challenges & logistics approach (client driven: low cost, flexible & feasible)	• **Environmental issues**
Environmental policies	• **Regulatory issues and policies**
Digitalization and digital transformation; E-commerce - use of different channels than conventional ones - change of transport unit - door-to-door logistics; Physical products could be transformed into digital content that can be printed on 3D printers anywhere in the world - changing transport networks - reducing stocks;	• **Digitalisation**
Digitalisation of the market	• **Digitalisation**
Ensuring interoperability e.g. through global standards. It will be important to encourage technological innovation, albeit avoiding monopolies.	• **Digitalisation**
Immaterial infrastructure for the management of port community system in order to guarantee more flexibility to a dynamic market and strongly evolvent Tools for the integrated management of urban and port planning systems	• **Digitalisation**
Environmental concerns, world trade and economical trends, technological developments, data management	• **Environmental issues**
Advances in software technology, computation capacity and the possibility to have everything connected.	• **Digitalisation**
Eu and national policies on environment and transport; large-scale economies	• **Regulatory issues and policies**

Please describe the most important external factors and market trends which have an impact on your vision of the Port of The Future	Main categories
IOT - automization	• **Digitalisation**
Regulatory issues across countries	• **Regulatory issues and policies**
Regulatory issues	• **Regulatory issues and policies**
Globalisation, the tourism together with the growth of cruise ship industry, the production and servicing of mega container vessels affect my vision of the Port of the Future	• **Economic issues**
IoT, AI, Big data, blockchain, enterprise data spaces	• **Digitalisation**
Technology maturity, financial feasibility, commitment of the industry	• **Digitalisation**
Climate change as Sea-level rise and other effects	• **Environmental issues**
Internet of things deployment in logistics; New technologies to make the exchange of data smoother and more secure (e.g. Blockchain); increasing automation in logistic and transportation processes	• **Digitalisation**
Shipping line concentration, size of vessels	• **Economic issues**
Automation/digitalisation	• **Digitalisation**
Laws about environmental impacts, hydrocarbure market evolution	• **Regulatory issues and policies**
Awareness, Regulation and Financial barrier.	• **Economic issues**
The most important external factor should be the regulatory aspects that will determine the viability of autonomous ships. The study and development of autonomous tugboats and their control methods, in isolated operations and in swarms should be promoted in order to take advantage of other sector market trends.	• **Regulatory issues and policies**
Adoption of ICT technologies, interoperability of ICT, availability of low cost ICT solutions, external pressure for cost efficiency	• **Digitalisation**

Please describe the most important external factors and market trends which have an impact on your vision of the Port of The Future	Main categories
ICT improvements	• **Digitalisation**
ICT support for ports	• **Digitalisation**
Cybersecurity, digitalisation	• **Digitalisation**
Governments	• **political issues**
Digitalisation	• **Digitalisation**
Technology (data sharing mechanisms)	• **Digitalisation**
Firstly, on external factors, there are three: Air quality mitigation policies and measures; climate change policies and measures; protection and enhancement of habitats. Secondly, on market trends, the big factor is economic growth in Ireland due, in part, to population increase leading to inexorable growth in import volumes of cargo.	• **Environmental issues**
Performance of maritime supply chain	• **Economic issues**
History is one major external factor. Everyone is returning to the history and thereby holds back developments Weather is another external factor. Drawing parallels to airports then in nice weather everything works finds while in nasty weathers there are some troubles. But looking over the whole year cycle it is luckily not bad weather every day	• **Historical issues**
Saturation of western-Europe road network	• **Economic issues**
Trade - Environment	• **political issues**
- digitalisation and automation	• **Digitalisation**
ICT development	• **Digitalisation**

Please describe the most important external factors and market trends which have an impact on your vision of the Port of The Future	Main categories
The so-called digital revolution and rising environmental awareness	• **Digitalisation**
The end of the oil era	• **Political issues**
Economic crises, security incidents and a more 'nationalistic approach" of certain (big) countries can impact the cooperation in data sharing.	• **Economic issues**
1) Digitalisation (port as part of digital logistics chains, less paper, faster transit, better use of space and hinterland infrastructure - how fast can port 'plug in'). 2) Open data (port as generator, owner, provider, manager, miner of data). 3) New technologies such as self driving cars, autonomous ships, 3D-printing, drones (port as laboratory for new technologies and innovation hub, less people on the ground, urgent need for different profiles in the port sector).	• **Digitalisation**
Regulations	• **Regulatory issues and policies**
EES, ETIAS, EMSWe, API, PNR, the (near) future development of the smart borders and the application of AI.	• **Digitalisation**
Digital transformation	• **Digitalisation**
Further development of the electronic data exchange platforms in supply chains using Big Data and blockchain technologies.	• **Digitalisation**
Digital transformation	• **Digitalisation**
further digitalisation, growing automatisation, need for enhanced security, looking for cost saving e.g. by outsourcing	• **Digitalisation**
Availability of new technologies, new entrance of companies from every corner of the globe. Also acceptance and adopting of new technology due to new generation who expect the same benefit from smart solutions as in private use	• **Digitalisation**

Table 44: Survey responses to external factors and market trends question

9.3 Annexes to task 5 thematic workshop

9.3.1 Review checklist and report

Each item of the checklist gets a unique number that will also be used in the review report so that actions can be tracked to it. The review checklist is structured in 3 main sections:

1. **Part I: The same content and structure for each session**. So exactly the same checklist items are covered in each breakout session. This part of the checklist will only covered in round A, so we need 5 results in the review report. The item numbers are in the range 10 to 99;
2. **Part II: The structure is the same but the content need to be customized**. E.g. all breakout sessions will discuss about vision and objectives but the vision and objectives are different in a breakout session about digitalization and digitalization than in a breakout session about sustainability. This part of the checklist will be covered in round A and round B, so we get 10 answers on each checklist items. It is structured as follows.
    a. Current gaps, so in other words what is it that we want to solve. This defines the as-is situation and the gaps;
    b. Tactical objectives and strategic vision. This defines the to-be situation;
    c. Main business trends we need to take into account to define a vision about ports in 2030;
    d. New and matured technology that may have an important impact on ports in 2030;
    e. Risks linked to the to-be situation;
    f. Horizontal issues including funding and financing, human element and international and European legal instruments;
    g. Key message to the EU policy makers;
    h. Best practices from your own experience.

    The item numbers are in the range 100 and 199
2. **Part III: Specific checklist items for a given breakout session**. The item numbers get different numbers by breakout session.

During each breakout sessions we will first cover the general points applicable for all sessions followed by the specific points for that session. Of course your assessment is not just a good or bad but contains concrete suggestions for improvement. Also indicate your priority: either “nice to have” or “need to have”. Be specific and make your suggestions actionable.

Checklist part I applicable to all breakout sessions	
10	How do you assess the quality of D1.5. Quality meaning readability, relevance, completeness, consistency, brevity, etc. Please formulate concrete actions. Be aware however that D1.5 is just an intermediate deliverable of the project to be completed
D1.5 is a merge of the outputs of 4 tasks. Assess each task separately according to the criteria defined under review item 10	
11	• Overall assessment of the quality of task 1, the desktop study (Section 6.2 on page 40)

Checklist part I applicable to all breakout sessions	
	• Section 9.1.6.1 on page 205 contains a long of inputs that have been considered for the desktop study and the once that have actually been assessed. Are there any fundamental inputs that you would like to propose for assessment? Please propose additional projects, books white papers, etc.... that are essential to complete our vision about ports of the future.
12	• Overall assessment of the quality of task 2, the stakeholder consultations (Section 6.3 on page 109)
13	• Overall assessment of the quality of task 3, traffic analysis (Section 6.4 on page 122).
14	• Overall assessment of the quality of task 4, macro trends (Section 6.5 on page 149) • DocksTheFuture is a project for the future, so it is important that we try as much as possible to know where we are heading at. Are there macro trends currently not covered in this section? Are the currently defined macro trends, evident based? Do they as far as possible and as far as needed for DocksTheFuture correctly set the scene for the ports in 2030?
20	Section 4 on page 29 contains a definition of the port of the future. This definition defines the scope of the whole project. • The definition of the geographical and functional delimitation, so the services, of the port? • Are the key characteristics of a port in 2030 complete, specific and actionable? If not, can you update or add missing elements to that definition; • Can you provide us with a definition of ports of the future from literature, academic world or your projects?
30	Work package 1 is the project scoping. Can we on the basis of the work performed so far initiate the next work package(s)? If not what are fundamental corrective actions before we move to the next work packages? (See https://www.docksthefuture.eu/project/ for more info on the next work packages.
40	An information model for the ports of the future has been defined (Sections 6.2.1 Methodology summary on page 40 and 9.1.1.1 The information model on page 176). The results of among others the desktop analysis and have been stored in a relational database. • Do we agree with the statement that this is actually a domain model for the port of the future concept? • Are the information entities and their relations correctly defined and sufficiently populated?
50	Section 5 on page 34 is about “EU policies and legislation”. Please indicate if we are missing some policies or legal frameworks that are fundamental for ports of the future
60	What is your vision about putting the planning horizon for ports of the future in 2030?

Checklist part I applicable to all breakout sessions	
Checklist part II to be customized by breakout session	
100	What are the current gaps, main challenges, preconditions and external factors to be successful concerning *[Breakout session]* Consider legal, technological, financial business processes, human element factors and standardization.
110	Section 9.1.6.3 on page 222 defines a number of tactical objectives linked to topics or subtopics. Be aware that some of these tactical objectives are linked to more than one topic. Tactical objectives are or should be made SMART by defining KPI's or other measures to them. Please review the list of tactical objectives applicable to *[Breakout session].* • Are these tactical objectives really tactical objectives or are they rather solutions? • Are these tactical objectives for 2030 or are they already realised in most of the ports? • Are these tactical objectives generic or specific for certain port profiles (size, cargo type)? • What are the critical KPIs or metrics or at least categories of metrics such as operational, financial, quality, safety etc. that you recommend to measure progress in the ports concerning *[Breakout session]*? • What is the recommend practice for reporting about metrics (static/dynamic, absolute values/benchmark, use of tools and platforms, etc.? • Would the tactical objectives for *[Breakout session]* improve customer satisfaction?
120	What essential elements should be contained in a strategic plan or roadmap for *[Breakout session]*? Be aware that names of these plans differ by *[Breakout session]* e.g. "Strategic ICT plan" for digitalization and digital transformation or "sustainability plan" for sustainability.
121	Change management. What resistance against change do we encounter and what techniques can we use to overcome this resistance.
130	Checklist item 15 about macro trends reviews these trends from a general point of view, so in other terms answers the question what are the main trends? • This checklist item is about the impacts of these trends for a future vision of *[Breakout session].* In other words, in order to fix a vision for the ports in 2030 concerning *[Breakout session]* what trends should we take into account and how important are these trends. Give a score high, medium low.
140	• What are the main technologies that will affect ports in 2030 concerning *[Breakout session]*? Be aware that what is currently new might be completely outdated by 2030. Also what currently is a mature technology is not something we recommend for the future. Referencing Gartner's hype cycle, we should assess technologies that are at the "slope of enlightenment"; • What new technologies might have a disruptive nature? What current jobs or businesses can we expect to be most affected by what technology trends? What opportunities? • What business models will fundamentally change as a consequence of new technology
150	What are the risks of the to-be situation concerning *[Breakout session]*?
160	• Define interdependencies between the topics covered in *[Breakout session]* and all other

Checklist part I applicable to all breakout sessions	
	topics covered in the other breakout sessions • What are the essential human elements concerning *[Breakout session]*. Consider lack of qualified people, resistance against change, training, etc.
170	• What do we expect from the EU concerning *[Breakout session]*? Consider e.g. legislation, funding, architecture frameworks, building blocks, standardization, and B2G/G2B interaction; • Do the current strategic documents from the EU concerning *[Breakout session]* sufficiently cover the needs of the ports in 2030; • What is the key message we would like to transmit to the EU policy makers concerning *[Breakout session]*
180	Define best practices concerning *[Breakout session]*
200: Checklist part III for digitalization and digital transformation	
200.10	Digitalization and digital transformation are not a final goal in itself. On what topics would digitalization and digital transformation have an impact? Consider e.g. smart traffic management, multi and synchro modality, safety, security, sustainability, mobility
200.20	What ICT technologies will mature by 2030 and are most relevant for ports? Consider big data, cloud computing, artificial intelligence, virtual and augmented reality, automated vehicles, business intelligence, internet of things, mobile internet, block chain, advanced robotics, 3D printing, s
200.30	What are the risk of digitalization and digital transformation? Consider cyber security, privacy, disruptive nature and job loss, inclusion, knowledge gaps, etc.
200.40	What is your opinion about the EU digital agenda (digital single market, interoperability and standards, trust and cybersecurity, ultra-fast internet, research and innovation, digital literacy, benefits for the society
200.50	What are the key elements of a “smart port” and/or of a network of smart ports
300: Checklist part III for sustainability	
300.10	Concerning the 17 UN SDG’s, do you consider these all applicable to ports, in other words are they indivisible or can ports only focus on some of them? If they are all applicable, are some more important than other? Do you dispose of a “translation” between these very generic goals for “the whole world” to SMART goals for the ports of the future?
300.20	The horizon of DocksTheFuture is 2030 but the horizon for sustainability planning is much further away. Do you consider this as a risk? Consider e.g. the promotion of technology that is at mid-term the only feasible solution but not a solution at all for the longer term.
300.30	How do macro trends influence port operations and strategic decisions relative to energy use/optimization and environmental footprint?
300.40	Making the business case of sustainable investments. Is it correct that in many cases a sustainable solution would be more costly than a traditional investment and if this is the case how can sustainable projects get financed?

Checklist part I applicable to all breakout sessions	
300.50	What environmental and/or energy investment have the biggest positive impact on both corporate results and environmental footprint
400: Checklist part III for port-city	
400.10	Spatial organisation.
400.20	Environmental challenges.
400.30	Socio-economic development strategies.
400.40	Governance and port-city co-construction.
500: Checklist part III for infrastructure, means of transport and accessibility	
500.10	Is the current planned capacity for container terminals in the EU in line with the forecasted needs?
500.20	What are key measures to shift cargo off the road (modal split)?
500.30	How would the trend for urbanization affect accessibility of ports and cities?
500.40	How can information technology be used to reduce congestion?
500.50	The use of autonomous vessels, automated mooring, platooning, vehicle to vehicle communication, etc.?
500.60	Introduction of River Information Services
600: Checklist part III for competition , cooperation and bridging R&D and implementation	
600.10	Impact of TEN-T corridors
600.20	How can we evolve from a “silo mentality” to working together (change management)
For each of the following questions consider this list of topics T10: Infrastructure; T30: Accessibility; T40: Standards; T50: Integration in the supply chain; T60: Sustainability; T70: Safety; T80: Security; T90: Digitization, digitalization and digital transformation	
600.30	• Is the previous list correct and complete when it comes to cooperation? If not what topics should be added to this?
600.40	• Have small ports, islands and deserted areas sufficient financial and human resources to implement the solutions deployed in the bigger ports? • Should these solutions been tailored to their specific situation and if so, how should this

Checklist part I applicable to all breakout sessions	
	been done?
600.50	• How should the EU or its members states cooperate with other countries? • What about knowledge transfer to and from neighbouring countries? • What countries should the EU cooperate with?
600.60	• Should ports cooperate or compete with other ports on these topics? Differentiate between ports that compete over a common hinterland or not; • From the list above what are the topics that ports rather compete or rather cooperate; • What is the impact of clustering of ports for each of these topics; • Is stimulation of cooperation on these topics a matter for the ports or should this be dealt with at another level (member states, EU)
600.70	• Should the different actors in the supply cooperate or compete on these topics?
600.80	• What H2020 research projects do you know off, the outputs of which could be transferred to a CEF project?
600.90	• What national, European and international organisations, interest groups, standardization bodies, etc. do you know of that stimulate cooperation concerning the topics mentioned above?
600.100	• What financial instruments do you know of to stimulate cooperation concerning the topics mentioned above?

Table 45: Review checklist

DOCKSTHEFUTURE
defining the concept of "Port of the Future"

Circle srl (Italy) ◦ ISL - Institut für Seeverkehrswirtschaft und Logistik (Germany) ◦ Magellan (Portugal) ◦ PortExpertise (Belgium) ◦ University of Genoa (Italy)

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