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DOCKSTHEFUTURE
defining the concept of "Port of the Future"

Desktop analysis of the concept including EUPolicies

Deliverable 1.1

Date: 28th August 2018

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Table 2: Document history

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DOCKSTHEFUTURE
defining the concept of "Port of the Future"

Co-funded by the Horizon 2020 programme
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Executive summary

1 Executive summary

This report is the deliverable 1.1 of DockstheFuture project's Work Package 1 Port of the Future concepts. It reflects the results of the desktop analysis of diiferent types of inputs, such as studies, (other project deliverables), papers, etc.

In the project proposal 3 key deliverables are defined for Work Package 1. While the desk top study is only the first task of WP1 much information is already contained in this report.

Project proposal	Report D1.1	Reference
Preliminary "Port of the Future" concept (PoFc)	An initial definition of the Port of the Future concept	Section 5 on page 24
Port of the Future Topics (PoFt)	A definition of entity topic	Section 11.1.1.2.4 page 111
	Updates of the topic list compared with the topic list of the proposal	Section 11.2 page 130
	A description topic by topic	Section 8.3 page 37
	A detailed list of topics	Section 11.6.2 page 153
Preliminary Projects and Initiatives of Interest (PoFpp)	This is given a general name "Inputs" to be assessed	
	A definition of the entity Input	Section 11.1.1.2.1 page 109
	A definition of the entity Assessment	Section 11.1.1.2.2 page 110
	A summary of the results	Section 8.1 page 35
	The complete list of inputs and assessments	Section 11.6.1 page 139

Table 3: Key work package 1 deliverables contained in this report

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.

A long list of over 340 inputs 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, 297 have been processed and analysed as potentially relevant for DTF, whilst currently 43 have been fully assessed.

More information about the desk top study is available than what is included in this report. In order to allow a detailed analysis a DocksTheFuture database was developed. Please find an overview of reports and queries from that database in Section 11.5 on page 137.

All partners participated in the desk top study, PortExpertise was leading the Work Package and performed on this deliverable by means of its reviews of the assessments, enquiries on the database, and processing feedback from partners and external parties.

Although a total number of fourteen main topics were identified, two main topics are omnipresent and draft the shape of the port of the future by 2030: sustainability and

digitization, digitalization and digital transformation in all its aspects. Especially the environmental dimension of the sustainability topic has very concrete measures and objectives often as results of international, national regulations, of which it is certain they will shape future ports characteristics. Ports that do not fully embrace the 'growth with green' concept, will find it increasingly difficult to get their activities approved by society. This aspect also reveals the rather hidden dimension of the port-city relations. Ports only recently (re-) discovered the importance of maintaining good relationships with society, and its connected city as such.

The other two aspect of sustainability, economic and societal, are less developed, but bound to gain importance the next decade. Expansion of port activities are increasingly subject to cost benefit analysis approaches, in which – among others – modal split frameworks need to be integrated, alongside emission control levels, alternative energy, job creation, in short spending of tax money needs to be well accounted for, if any expansion of a port area wants to get realised. Surprisingly, or not, well developed port models succeed in passing on the environmental requirements – and the related costs - to the port clients, by means of a variety of tools (pricing, concessions contracts, penalties, monitoring, modal split requirements). A ports contribution to a country's GNP, has become one of the many KPI.

On the society point of view, ports are aware of keeping to a good, elaborated communication plan with the public. To this aspect increasing cooperation is made with city municipalities with regards to events, job creation, investing in social infrastructure (public transport, cycle paths, residential areas, green buffer zones …). Togheter with partner AIVP (Association Internationale des Villes Portuaries) a high number of ready-to-use inputs were identified and analysed on the way to improve port/city relations, including regenerations of port areas.

Digitization, digitalization and digital transformation are here to stay the next decades. After decades of investment focus on port infrastructure and the superstructure, the reality today is that bottlenecks are persistent and remain difficult to solve on a structural basis, even when the 'physical' barrier was already addressed. A previously less attended barrier came to the forefront, namely the lack of data- and information sharing along the supply chain. In many cases it remains the cause in explaining why certain forecasted targets remain unmet, such as modal split remaining far too low in some ports, with 'king' road still comfortably at a 60% or more share, despite various efforts on the infrastructure side.

A more mature stage of information sharing among the supply chain has many, already often repeated advantages, but its progress is slow, especially related to the public authorities lagging behind, non-existing standards and different procedures on the same logistics activities in and between member states. Interestingly in the Motorways of the Seas Detailed Implementation Plan, an inquiry among short sea operators revealed that easing customs procedures among others was on top of their agenda. The negative impact on the current classic supply chain jobs, is only addressed moderately and needs more concrete action plans to facilitate the change to the more analysis, monitoring and managing aspects of the logistics activities.

Also in digitization insights grown. In various topics such as hinterland connections, maritime traffic, the E-reporting silo's between transport modes, and economic sectors remain. The initial idea of one application (central network) covering all data, gradually become more realistically adjusted into connecting and federating the existing platforms between public, private economic actors in a federated architecture as was also proposed by the DTLF.

Alongside digitization, security aspects became apparent with real life examples affecting directly the shipping world (Maersk, Port of Rotterdam,). Ports co-operate also on this topic to share knowledge and insight into building up their defence mechanism.

A port of 2030, has a well advanced, accountable, sound sustainable attitude, and is well connected along its supply chain across its borders.

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3.3 Abbreviations and acronyms

Abbreviation or acronym	Description
AEO	Authorised Economic Operator https://ec.europa.eu/taxation_customs/general-information-customs/customs-security/authorised-economic-operator-aeo_en
AIVP	Association Internationale des Villes Portuaires www.aivp.org
ALICE	Alliance for Logistics Innovation through Collaboration in Europe https://www.etp-logistics.eu/
APP	An application, especially as downloaded by a user to a mobile device.
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
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/
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
CIM	Contract de transport international ferroviaire des marchandises
CMNI	Central Commission for the Navigation of the Rhine
CMR	Convention Relative au Contrat de Transport International de Marchandises par Route
CO_2	Carbon dioxide

Abbreviation or acronym	Description
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 Move	Commission department for EU policy on mobility and transport https://ec.europa.eu/info/departments/mobility-and-transport_en
DTA	Decision Tree Analysis
DtF	DockstheFuture http://www.docksthefuture.eu/
DTLF	Digital Transport and Logistics Forum
DCF	Discounted Cash Flow
EBDA	Ecosystem-Based Design Approach https://repository.tudelft.nl/islandora/object/uuid:5aa8c5bd-37ef-47f1-8fdd-20114ecc576e/
ECDIS	Electronic Chart Display and Information System http://www.ecdis-info.com/about_ecdis.html
EEDI	Energy Efficiency Design Index
eFTI platforms	Electronic Freight Transport Information https://ec.europa.eu/info/law/better-regulation/initiatives/com-2018-279_de
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/

Abbreviation or acronym	Description
EU	European Union https://europa.eu/european-union/index_en
FAMOS	For future navigation in the Baltic Sea and beyond http://www.famosproject.eu/ /
FERRMED	Promotion du Grand Axe Ferroviaire de Marchandises Scandinavie-Rhin-Rhone-Mediterranee Occidentale http://www.ferrmed.com
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
HAROPA	les ports du Havre, de Rouen et de Paris http://www.haropaports.com/en
HPA	Hamburg Port Authority
HUL	Historic Urban Landscape http://www.historicurbanlandscape.com/index.php?classid=5357&id=35&t=show
IATA	International Air Transport Association
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
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

Abbreviation or acronym	Description
	https://cordis.europa.eu/project/rcn/79327_en.html
ITU	Intermodal Transport Unit https://definedterm.com/intermodal_transport_unit_itu
IWW	Inland Water Ways https://ec.europa.eu/transport/modes/inland_en
KET	Key Enabling Technologies
KPI	Key Performance Indicator
LHV	Longer Heavier Vehicles
LKW	Lastkraftwagen (German)
LNG	Liquefied Natural Gas
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
OECD	Organisation for Economic Co-operation and Development
OPS	Onshore Power Supply http://www.onshorepowersupply.org/
PoFc	Preliminary "Port of the Future" concept
PoFpp	Preliminary Projects and Initiatives of Interest
PoFt	Port of the Future Topics
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 http://stmvalidation.eu/activity-item/activity-1-port-collaborative-decision-making/

Abbreviation or acronym	Description
PM10	Particulate Matter 10 micrometres or less in diameter
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
SECA	Sulphur Emission Control Area http://www.imo.org/en/OurWork/Environment/PollutionPrevention/AirPollution/Pages/Sulphur-oxides-(SOx)-%E2%80%93-Regulation-14.aspx
SMART	Specific, measurable, attainable, relevant, timely See section 11.4 Smart tactical objectives on page 135
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
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

Abbreviation or acronym	Description
UIC	Union Internationale des Chemins de fer
UN SDG	United Nations Strategic Development Goals https://www.un.org/sustainabledevelopment/sustainable-development-goals/
VTMS	Vessel Traffic Management System http://emsa.europa.eu/implementation-tasks/visits-and-inspections/136-vtmis.html
UN/CEFACT	United Nations Centre for Trade Facilitation and Electronic Business https://www.unece.org/cefact/
USA	United States of America
WCO	Wolrd Customs Organisation
WPCI	World Ports Climate Initiative http://wpci.iaphworldports.org/
WSV	Wasser- und Schifffahrtsverwaltung des Bundes https://www.wsv.de/
XML/XSD	Extensible Markup Language /XML Schema Definition

Table 4: Abbreviations and acronyms

Introduction

4 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.

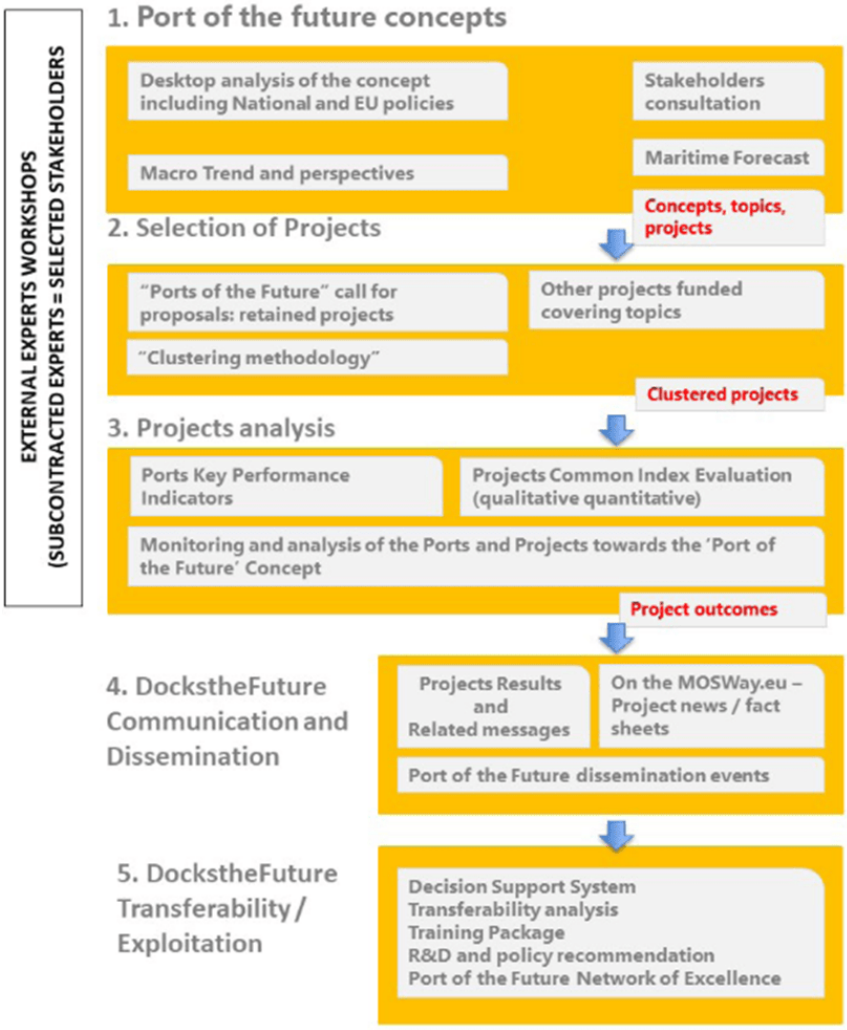

Figure 1: Overview of the Work Packages and their interrelation

1. **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;

2. **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);

3. **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;

4. **WP4: Dissemination and Exploitation**:
   To create higher level of awareness and demand from stakeholders and target audience;

5. **Exploitation of results**:
   The aim is to define how to transfer results and in the most effective way, delivering a number of related tools;

6. **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[1]'. The other work packages will elaborate the concept into among others tools for evaluation and transferability of Port of the Future solutions.

This report is deliverable D1.1 of WP 1. Next to this deliverable all other 'intermediate' deliverables of this work package contribute to the work package final deliverable 'Deliverable D.1.6. Port of the Future concepts, topics and projects consolidated version. The methodology and tools developed to execute the desk top study (See section 11.1 Assessment methodology on page 107) can be reused for other tasks of WP1 and for othe work packages.

To be very clear on the words used in this document

1. A document, video, database, website, etc. that is the result of a project or any other initiative that is proposed to be included in the desk top study is called an **input**;

2. The act of performing the desk top study on an input is called assessing and the results produced by the assessor are **assessments**.

[1] Oxford and Merriam-Webster dictionary

Figure 2: Overview of Work Package 1 deliverables

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 (more than originally budgeted) 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

5 Ports of the future defined

In order to arrive to a definition of port of the future, the authors had to operate within the project's framework as defined in the grant agreement. A clear definition of a port was not supplied in the project proposal but to allow a focused desk top analysis, the following definition of a port was used:
"*An area on both land and water, whether on the sea or river, that provides facilities for shipping vessels to load and unload their cargo or to let passengers embark or disembark*". It is of course the intention at the end of WP1 to come to a clearer definition.

Further on the scoping of the literature review in this WP, following criteria were used:

1. Maritime port areas are the main scope;
2. The horizon in this '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;
3. Hinterland topics are considered in their connection to the port area;
4. Considered transport modes are maritime, road, rail and inland waterway transport;
5. Based on an initial 'input' list that was enriched by input from partners to the project being AIVP (Association International de Villes Portuaires - FR) and TU Delft (NL) – Lloyds Register.

Section 11.1.1 The information model on page 107 defines what kind information is gathered during the desktop study and how this information is structured. We could state that this information model is actually a conceptual model of Ports of The Future.

EU policies

6 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 updated and assessed to what is releant for Ports of the Future 2030.

1. EU Directives, regulations and policies
    a. COM (2018)279 - Electronic freight transport information;
    b. 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);
    c. Directive 2005/44/EC on harmonized river information services;
    d. Regulation 414/2007 Technical guidelines for the planning, implementation and operational use of river information systems;
    e. 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);
    f. 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;
    g. Directive 2010/65/EU on reporting formalities for ships calling in or departing from the EU ports;
    h. 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;
    i. Directive 2014/94/EU on the deployment of alternative fuels infrastructure;
    j. Directive 2005/65/EC security in port perimeter and physically separate port from surrounding area
    k. Directive 2000/59/EC, on wast collection from ships and Proposal for a directive - COM(2018)33/DOCUMENT-2017-85277
    l. The following laws and regulations apply to occupational health and safety in port labour:
        i. Bulk Terminals Directive (Annex II, Art. 1-4)
        ii. 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
        iii. 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);
    m. 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).

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

o. Communication on a Eurpean Ports Policy, Communication from the Commission, COM(2007)616 final

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

ii. 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;

ii. 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. Their work 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. There is therefore 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.

Methodology summary

7 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 11.1 Assessment methodology on page 107 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. See section 11.1.1.2.1 on page 109 for a definition of inputs and Table 34: List of inputs on page 153 for the complete list of inputs;
   b. 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. See Table 35: List of topics on page 158. Table 31: Updated topic list on page 132 explains why and how the topic list from the project proposal has been changed.
   c. Additional entities
      i. Some “Aims” became “Measures”. See 11.1.1.2.6 on page 113 for a definition of measures and table
      ii. Addition of strategic objectives to group together tactical objectives
   d. 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.
   e. 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

8 Results

This section is structured according information model defined in section11.1.1 on page 107. To support the desktop study, a DocksTheFutured database has been developed. Most if not all data in this section is coming from that database. It is important to note that the DocksTheFutured 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 11.5 on page 137 the current list list of reports and queries from the DocksTheFuture database.

8.1 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 (*See section 11.1.1 The information model on page 107*) and that consequently the DocksTheFuture information model would be a suitable instrumnet 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 connetions, T30.30 Multi and synchromodality 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 may be one of the possible solutions to conect 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 bandwith as an “external factor”, a precondition, for ports of the future.

8.2 Inputs and assessments

Inputs are the work products that are proposed by the DocksTheFuture partners and their subcontractors to be assessed. Ther are 340 inputs proposed of which currently 44 have been assessed. Table 34: List of inputs on page 153 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.

Type	Number of inputs
Project	7
Report	6
Article	5
Port Strategy	3
Analysis	3
Scientific paper	3
Best practice	3
Book	3
Master thesis	3
Study	2
Proceedings	2
Case study	2
Implementation plan	2

Type	Number of inputs
Action plan	1
Other	1
White paper	1
Research project	1
Strategic vision	1
Website	1
National research program	1

Table 5: Number of inputs by type

8.3 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 31: Updated topic list on page 132 contains a mapping between the topic list of the project proposal and the current topic list with an explanation what these updates are 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 11.3 on page 133 for more info on that checklist;

2. We used the 17 UN SDG as a checklist for sustainability (See Table 27: UN sustainable development goals on page 115).

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

Number and name topic	Number of assessments
T60.10: Environmental sustainability	22
T120: Governance	13
T100: Port city relations	13
T60: Sustainability	12
T10.30: Other port infrastructure	10
T40: Standards and legal instruments	9
T10.40: Hinterland connections	9
T10: Infrastructure	9
T110.20: Education and training	8
T60.20: Economic sustainability	8
T70: Safety	8
T10.60: Industrial areas	8
T10.50: Logistic areas	8
T90: Digitization, digitalization and digital transformation	8

Table 6: Top 10 topic assignments

The following sections contain the main result of the assessments described by main topic.

8.3.1 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.
Number of inputs	8
Input ID and name	• 80: Unmanned ships on the horizon/Remote and autonomous ships - the next steps; • 110: The future of ports in 2060;

Topic	T10: Infrastructure
	• 1150: COMMISSION STAFF WORKING DOCUMENT on the implementation of the EU Maritime Transport Strategy 2009-2018; • 1210: Sustainable port infrastructure, practical implementation of the green port concept; • 1240: The Greening of Ports: A Comparison of Port Management Tools Used by Leading Ports in Asia and Europe; • 1400: Socio-ecological trans; • 1500: Securing a port's future; • 3250: Schipper Sustainability assessment.
KPI's	• See also sustainability on dredging; • Adjusted terminals to large container vessels; • Wi-Fi network; • 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;
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;
Trends	• Greening of energy sources, transport activities; • Better use of existing capacity through data sharing;

Topic	T10: Infrastructure
	• Completing TEN-T network; • Critical Infrastructure Protection.

Table 7: 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.

Infrastructure:

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.

Not only the superstructure need 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 methanation plants. Linking up to energy networks connecting industrial entities within the port area, or even with the city also is identified as an element of a future ports sustainability performance.

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.

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.

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.

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.

8.3.2 T20: Means of transport

Topic	T20. Means of transport
Description	For the moment this topic has only one child topic T120.10 so always attribute the child topic.
Number of inputs	4
Input ID and name	• 1510: A relationship between port profiles and policies regarding the circular economy; • 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; • 2020: Port-development-plan2025; • 3270: World Bank Group Low-carbon infrastructure.
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;

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

Table 8: 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.

In Europe in the first half of 2015 the modal split was divided as per underneath table in 41.6 % barge, 46.2% [2]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
Rotterdam	46.2	12.2	41.6

Table 9: Modal split of certain ports in Hamburg Le Havre range

[2] 2015 figures, source Port Statistics

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.

8.3.3 T30: Accessibility

Topic	T30: Accessibility
Description	Accessibility of all transport means to and from the ports
Number of inputs	5
Input ID and name	• 1950: Rotterdam Port Vision 2030; • 1970: Final II MOS DIP 2018 WEB; • 2020: Port development-plan2025; • 3250: Shipper Sustainability assessment; • 1100: The Blockchain Potential for Port Logistics;
KPI's	• Monitoring;

Topic	T30: Accessibility
	• Employment rate; • Volume growth; • Air quality (emissions GHG, NOx, Sox, PM10); • 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 10: 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[3] 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] Antwerp, Dar es Salaam, Hamburg, Ho Chi Minh, Istanbul, Los Angeles, Melbourne, Rotterdam, Shanghai, Valparaiso.

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.

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
Sensitive ecosystems/ Marine biodiversity	Sediment quality Marine biodiversity	Mapping Ballast Water treatment	

Subject	Example of sustainable measure	Performance Indicator	Examples of concerned ports' measures
			• Air pollution management • Flemish Environment Agency Air quality Monitoring
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
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;	• Monitoring traffic congestion density • Improving infrastructure and sustainable modes

Subject	Example of sustainable measure	Performance Indicator	Examples of concerned ports' measures
		• Modal split.	• Improve and mitigate accessibility

Table 11: Actions undertaken by ports to obtain sustainable social, environmental and economic goals,

8.3.4 T40: Standards

Topic	T40: Standards
Description	All standards and legal instruments concerning certain topics are grouped together under this topic
Number of inputs	11
Input ID and name	• 890: Cassandra D9.1 Final report; • 410: The grand challenge pathways towards climate neutral freight corridors 145119; • 450: BENEFIT investments in transport infrastructure; • 1080: Concept-Note-Short-sea-shipping; • 1100: The Blockchain Potential for Port Logistics; • 1150: Working Doc on the implementation of the EU Maritime Transport Strategy 2009-2018; • 1400: Socio-ecological trans; • 1240: The Greening of Ports: A Comparison of Port Management Tools Used by Leading Ports in Asia and Europe; • 1970: Motorways-of-the-Sea-DIP-2018.compressed; • 2020: port-development-plan 2025; • 2070: IHATEC Projektsteckbrief MISSION formatiert.
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- (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; • Updated international / EU standards by each member state.
Co-related topics	• T10 Infrastructural standards; • T20 Standards about the means of transport;

Topic	T40: Standards
	• 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 12: Assessment results for topic T40 standards

The European Union contributes 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.

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.

8.3.5 T50: Integration in the supply chain

Topic	T.50: Integration in the supply chain
Description	The cooperation of all actors in the supply chain.
Number of inputs	6

Topic	T.50: Integration in the supply chain
Input ID and name	• 10: The future of port logistics, meeting the challenges of SC integration for ING; • 20: RISCOMEX; • 30: CoRISMa; • 40: E-navigation for inland waterways 2017; • 1100: The Blockchain potential for port logistics; • 2020: Port Development Plan to 2025.
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 13: 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.

8.3.6 T60: Sustainability

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 eople 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"
Number of inputs	10
Input ID and name	• 10: The future of port logistics, meeting the challenges of SC integration for ING; • 1230: A Study on role of green port implementation and 'greencollar' workers in port facilities; • 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; • 1530: Comparative Study with Implications to Suez Canal Corridor Project; • 2020: Port Development Plan to 2025; • 3230: Doctoral dissertation Tanjera; • 3240: Historic urban landscape; • 3250: A sustainability assessment of ports and port-city plans; • 3380: Ecosystem-based port design as an approach to sustainable development.

Topic	T60: Sustainability
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; • 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; • 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;

Topic	T60: Sustainability
	• 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 14: 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.

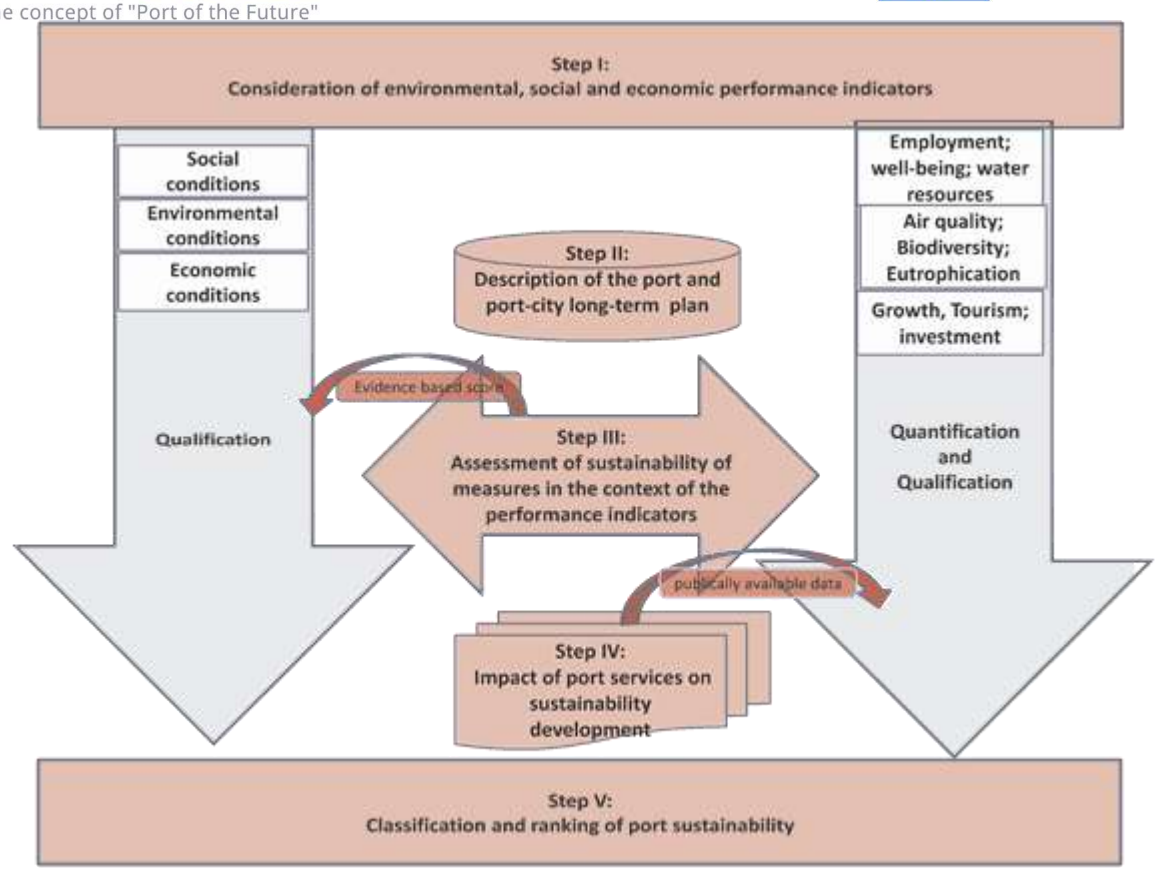

Figure 3: Port assessment methodology

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.

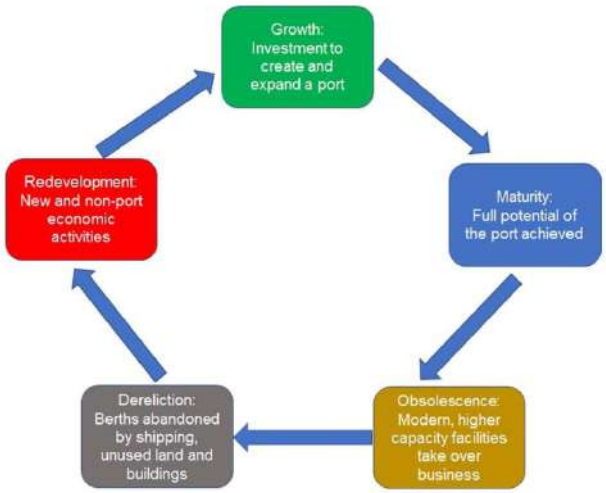

Figure 4 Port Facilities life-cycle concept

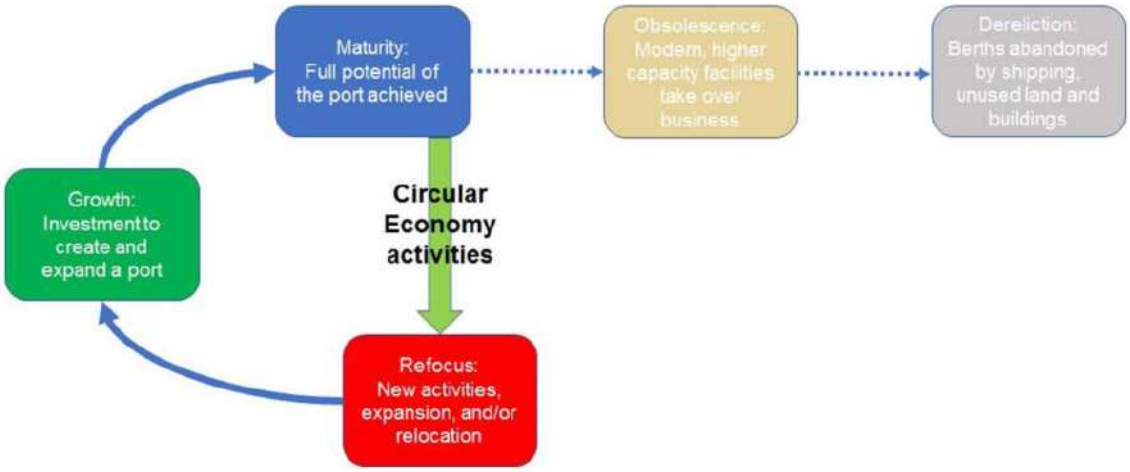

Figure 5: Revised port life cycle and circular economy approach

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], on a port development project in Tema. The focus is though 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.

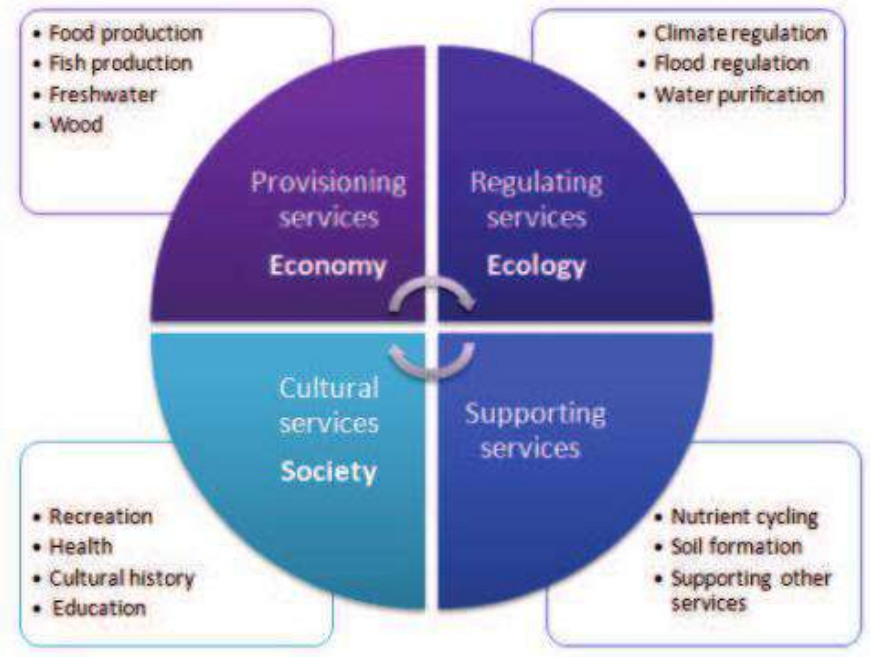

Figure 6: Based on Zakri and Watson [2005]) quoted from EBDA methodology

The sustainable measures include:

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 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.

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, 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?

The APP methodology is then applied to various port infrastructure examples. The steps include:

1. Defining Objectives (criteria and constraints) through client sessions, analyses SWOT/Trend/Expert; Generating alternatives (brainstorm, focus groups, Delphi, etc.);
2. Selecting a set of alternatives (cost estimation tools, trade-off studies, multi criteria analysis);
3. Identifying vulnerabilities and opportunities ((brainstorm, scenarios, focus groups, Delphi's, experts, modelling, simulation);
4. Identifying flexibilities and defining actions to make plan robust (brainstorm, scenario, focus groups, ...);
5. Establishing cost-effectiveness of actions (Discounted Cash Flow, DTA, Simulations, ROA, CBA, ...);
6. Evaluating Alternatives (lifecycle costing, multi-criteria analyses, Robust Decision Making, Scenarios with qualitative methods or EMA, Financial techniques such as DVF, DTA , ROA, CBA);
7. 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).

Some critical driving forces which are relevant to the issue at hand (infrastructure investment decision) may be important in a future beyond 2030:

1. Geopolitics and world trade;
2. Economic growth;
3. Environmental policies and regulations;
4. 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);
5. Costs of scarce natural resources and fossil fuels;
6. Availability of renewable energy sources and extent of their use;
7. Developments in biotechnology;
8. Changes in the role of government;
9. Investment climate.

Other mega trends are:

1. Continuing globalization and containerization which is the driving force behind the need for infrastructural investment, also in emerging economies;
2. Changing functions of a port which imply attention for the entire supply chain instead of a terminal or a port;
3. 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;
4. An increasing awareness for the environment and society;
5. And energy transition.

Societal sustainability:

The Historic Urban Landscape 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;

These 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 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);

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

Subject	Example of sustainable Measure	Performance Indicator	Examples of concerned ports' measures
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 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; • Fines, incentives.
Water	Water treatment	• Water quality	
Soil formation	Dredging	• Erosion; • Sedimentation;	• Relocation of sediments; • Treatment of sediments.

Subject	Example of sustainable Measure	Performance Indicator	Examples of concerned ports' measures
		• Maintenance dredging.	
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 ecotourism	• Cruise passengers • tourism	• Plans (Cruise shipping).

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

8.3.7 T70: Safety

Topic	T70: Safety
Description	Safety and security was a single topic that has been split into T70 and T80 security.
Number of inputs	8
Input ID and name	• 1090: Plan the city with the port guide of good practices full version; • 1190: Changing training needs of port workers due to future trends; • 1400: Socio-ecological transitions toward low-carbon port cities: trends, changes and adaptation processes in Asia and Europe; • 1510: A relationship between port profiles and policies regarding the circular economy; • 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; • 1950: Port of Rotterdam - Port Vision 2030; • 1970: Final II MOS DIP 2018WEB; • 2020: Port-development-plan 2025 (Hamburg).
KPI's	• Number of accidents; • 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;

Topic	T70: Safety
	• 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 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 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.

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 offerings 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. 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 safeties 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).

8.3.8 T80: Security

Topic	T80: Security
Description	Safety and security was a single topic that has been split into T70 Safety and T80. T80 has been divided into 2 child topics.
Number of inputs	7
Input ID and name	• 80 : Remote and Autonomous Ships; • 890: A Cassandra D9.1 Final report; • 1580: MITIGATE - Multidimensional, Integrated, risk assessment framework and dynamic, collaborative Risk Management tools for critical information infrastructures; • 1970: Final II MOS DIP 2018WEB; • 2020: Port-development-plan2025; • 2070: IHATEC Projektsteckbrief Secure Port formatiert; • 3250: Shipper sustainability assessment;
KPI's	• Avoiding, limiting impact of cyber-attacks on critical infrastructure;

Topic	T80: Security
	• Mutual recognitions of cargo regulatory regimes; • Electronic exchange of certificates; • Secured shipment of smart containers.
Co-related topics	• T90 ICT systems to improve security; • T110.20 concerning security training.
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, and Mr. Zamarreño speech on the occasion of 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.

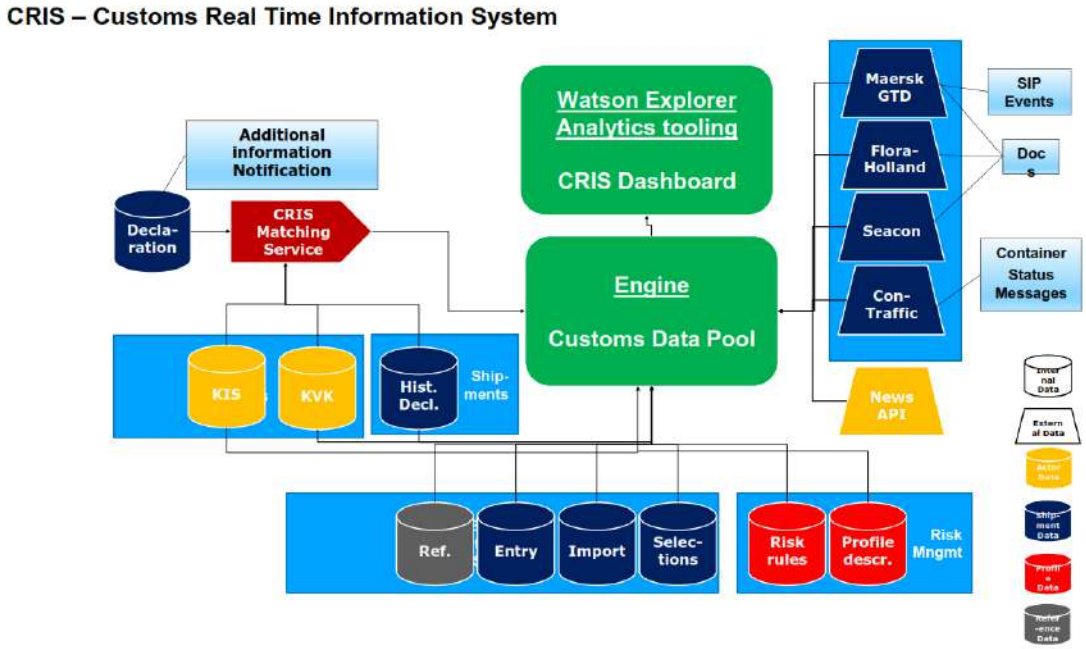

Figure 7: Customs Real Time Information System

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.

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.

8.3.9 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.

Topic	T90: Digitization, digitalization and digital transformation
	Digital transformation is about changing business operations, business models and even revenue streams and new business opportunities.
Number of inputs	7
Input ID and name	• 410: The grand challenge pathways towards climate neutral freight corridors; • 430: Toekomst arbeidsmarkt haven antwerpen 2017; • 890: A Cassandra D9.1 Final report; • 1100: The Blockchain potential for port logistics; • 1970: Final II MOS DIP 2018WEB; • 2020 Port-development-plan2025; • 2070 IHATEC Projektsteckbrief SecurePort formatiert;
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;

Topic	T90: Digitization, digitalization and digital transformation
	• 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; • 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

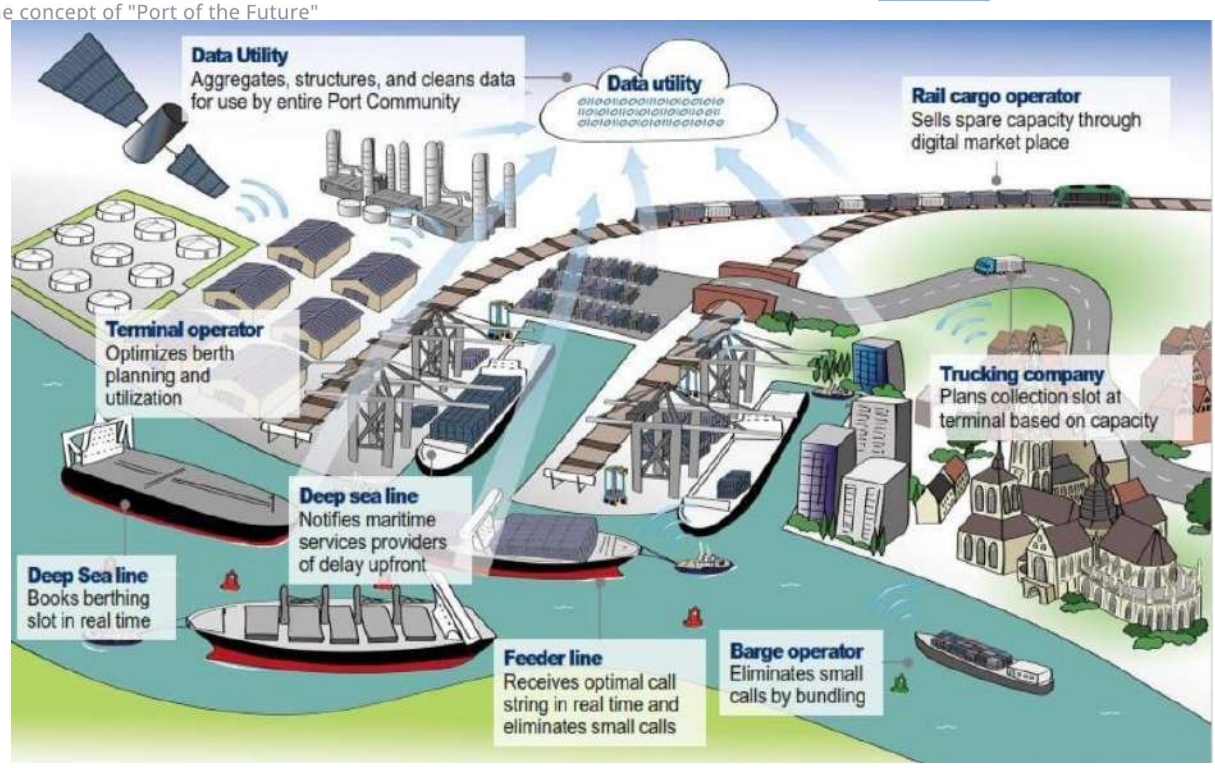

Figure 8: Some identified opportunities of digitization in maritime port areas (courtesy NxtPort)

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.

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.

2. 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 Unions 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.

3. 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.

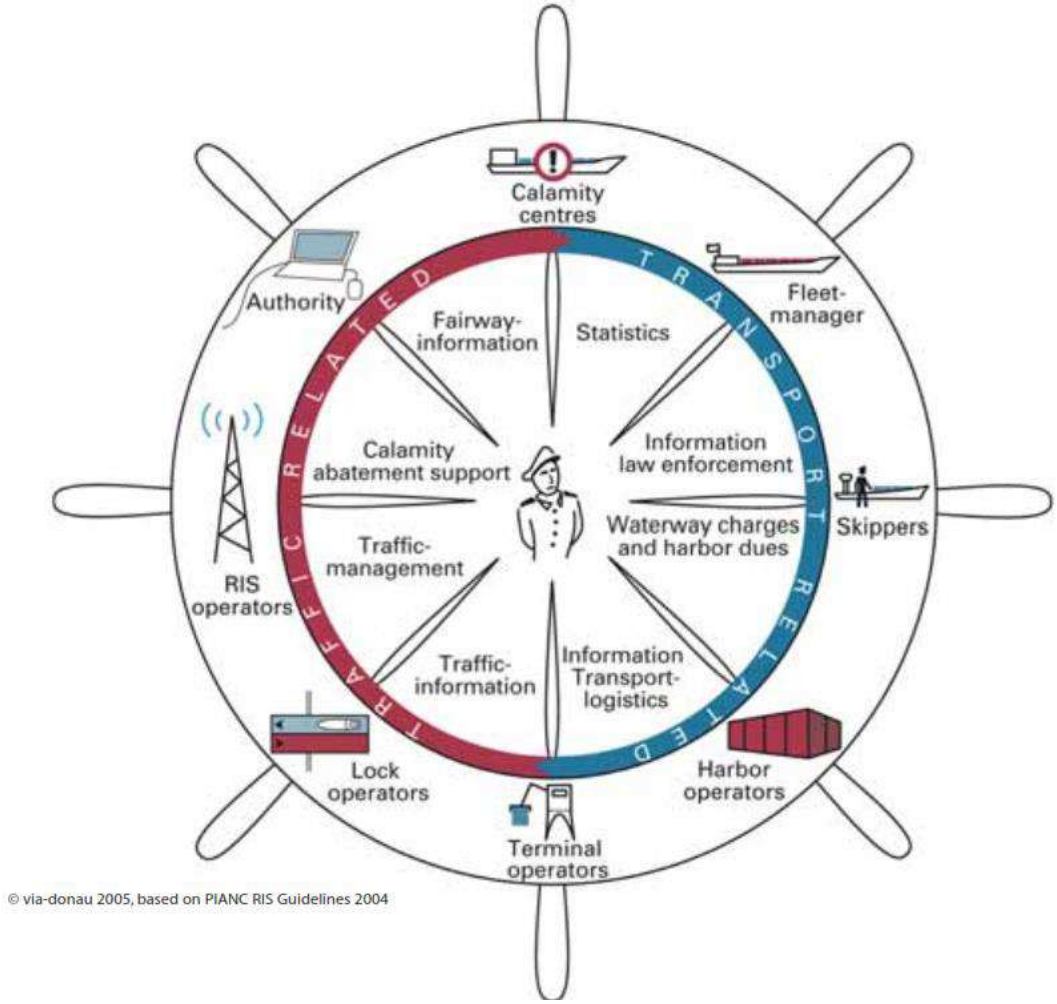

Figure 9: Overview of RIS services[4]

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

[4] via-Donau, 2005

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:

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 state (proposal phase).

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.

8.3.10 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
Number of inputs	4
Input ID and name	• 50: Économie circulaire et ecosystèmes portuaires;

Topic	T100: Port City Relations
	• 60: Port City Governance; • 1090: Port City Best Practices; • 2130: ESPO Guide of good practices for cruise and ferry ports.
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); • 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.

Topic	T100: Port City Relations
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 'band' 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 realistic policy options.

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

8.3.11 T110: Human element

Topic	110: Human Element
Description	Labour market and education and training.
Number of inputs	4
Input ID and name	• 1950: Rotterdam Port Vision 2030; • 1970: Motorways-of-the-Sea-DIP-2018; • 2020: Port-development-plan 2025; • 3250: Shipper sustainability assessment.
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; • Labour market events (job days,); • Learning platforms; • Jobs created; • New sector jobs (blue and green); • Number of accidents.

Topic	110: Human Element
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.

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.

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 touch-down 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.

As side effect to the growing wave of digitization, 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.

8.3.12 T120: Governance

Topic	T:120: Governance
Description	All governance issues of all private actors and authorities operating in the ports
Number of inputs	10
Input ID and name	• 70: Trends in port governance; • 90: A Cassandra D 9.1 Final report; • 1080: Lind-et-al-Concept-Note-Collaborative-Port-Call-Optimization; • 1100: The block chain potential for port logistics; • 1170: Strategic levers of port authorities for industrial ecosystem development; • 1240: The Greening of Ports: A Comparison of Port Management Tools Used by Leading Ports in Asia and Europe; • 1400: Socio-ecological transitions toward low-carbon port cities: trends, changes and adaptation processes in Asia and Europe; • 1510: A relationship between port profiles and policies regarding the circular economy; • 1790: Portopia - Ports Observatory for Performance Indicator Analysis; • 3250: Schipper sustainability assessment.
KPI's	• Active Port cluster; • CSR reporting.

Topic	T:120: Governance
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 that they 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 concept, 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.

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).

8.3.13 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,

Topic	T130: Incident management
	actors, technology, to prevent and manage incidents. This involves both authorities and private actors.
Number of inputs	1
Input ID and name	• 2020: Port-development-plan 2025.
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.

8.3.14 T900: Cooperation

Topic	T900: Cooperation
Description	Cooperation with other countries and ports
Number of inputs	7
Input ID and name	• 10: The future of port logistics, meeting the challenges of SC integration for ING;

Topic	T900: Cooperation
	• 410: The Grand Challenge: Pathways towards Climate Neutral Freight corridors; • 890: CORE; • 510: A relationship between port profiles and policies regarding the circular economy; • 2020: Port Development Plan to 2025; • 2130: Code of Good Practices for Cruise and Ferry Ports; • 3240: Historic urban landscape.
KPI's	• Active agreements with other associations, ports; • Defined action in 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 show that the CASSANDRA 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 retailer, 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 on good understanding, information, opening terminal to city public, planning of infrastructure strategy plans; between ports with regards to security planning; between authorities on security/planning of cruise/ferry;

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.

8.3.15 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
Number of inputs	4
Input ID and name	• 450: BENEFIT investments in transport infrastructure; • 1510: A relationship between port profiles and policies regarding the circular economy; • 1950: Rotterdam Port Vision 2030; • 2070: IHATEC Projektsteckbrief IRiS formatiert.
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;

Topic	T910: Bridging R&D and implementation
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 24 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.

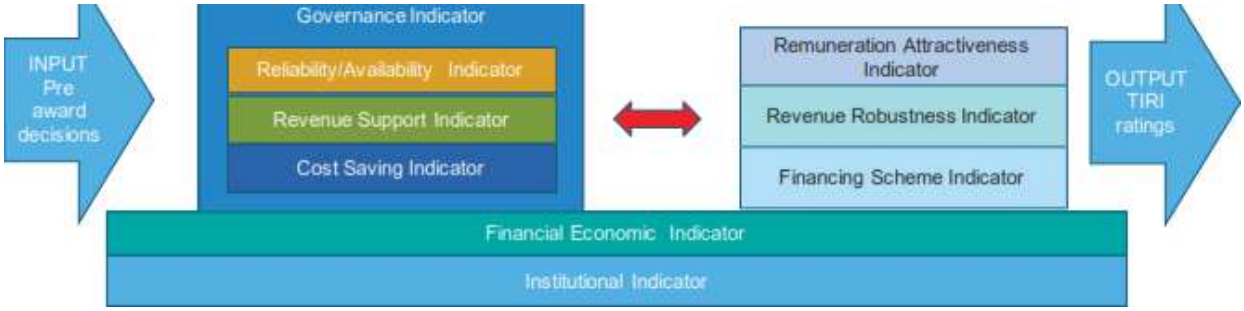

Figure 10: The components of the Transport Infrastructure Resilience Indicator

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 link

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).

8.4 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 what is called “Aims”, however not all aims are indeed tactical objectives, rather measures. See section 11.1.1.2.5 on page 112 for more information about strategic and tactical objectives. See Table 36: List of tactical objectives on page 161 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	16
TO380: Improved integrated port and city common development planning	12
TO240: Support circular economy schemes	11
TO100: Improve modal shift	11
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.	10
TO270: Increase resilience against climate change	9
TO110: Increase efficiency and capacity of hinterland connections	9
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, …)	9
TO360: Advanced and efficient links and integration in the socio-economic industrial and urban surrounding environment	9
TO20: Improve design and maintenance of the port infrastructure to increase overall resilience	8
TO190: Define environmental thresholds	8

Table 25: Top 10 tactical objectives

8.5 Measures

As one of the scopes of this project is also policy support, the typical ingredients were added to measure the presence, and efficiency of such a policy in practice. Only those policies were retained that contribute to the Port of the Future topics.

To this subject the traditional Plan, Do, Act method is used to determine the presence of a mature policy.

1. Plan: Refers to a policy defined, impose;

2. Do: Potential support to implement the policy, which can take the form of financial incentives, support services, workshops, etc.;
3. Check: Monitoring if the imposed policy is actually implemented, and if changes are needed;
4. Act: The actual implementation by the relevant parties, such as authorities, private companies.

For ease of finding the back in Atlas (see section 11.1.2 The work products and tools on page 123) the measures has 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 ...).

The used model:

The main cause for the need to have a holistic/higher level model is that the original list of DtF topics, defined in the proposal, is actually a mix of tools, sub tools, and 'cornerstones' of models. It demands structuring to avoid chaos / rework in the deliverable phase.

Various models were considered, aiming at:

1. A logic classification of the topics;
2. A structure that is familiar to all stakeholders;
3. A structure that allows to capture at maximum level the various characteristics of the stakeholders interest being both commercial and public sector;
4. Include 'future' aspects of governance, social responsibility.

Finally the 3BL model was retained (People, Planet and Profit/Prosperity)

Triple bottom line (or otherwise noted as **TBL** or **3BL**) is an accounting framework with three parts: social, environmental (or ecological) and financial. It assists organisations to evaluate their performance in a broader perspective to create greater business value. Whereas the business model canvas' main drive is the "profit" or "loss", being the results of revenue and expenses, this model adapts to a more 'full accounting principle' – addressing the objections of e.g. environmentalists and social justice stakeholders. For example, if a corporation shows a monetary profit, but their asbestos mine causes thousands of deaths from asbestosis, and their copper mine pollutes a river, and the government ends up spending taxpayer money on health care and river clean-up, how do we perform a full societal cost benefit analysis? The triple bottom line adds two more "bottom lines": social and environmental (ecological) concerns. With the ratification of the United Nations and ICLEI TBL standard for urban and community accounting in early 2007, this became the dominant approach to public sector full cost

accounting. Similar UN standards apply to natural capital and human capital measurement to assist in measurements required by TBL, e.g. the EcoBudget standard for reporting ecological footprint.

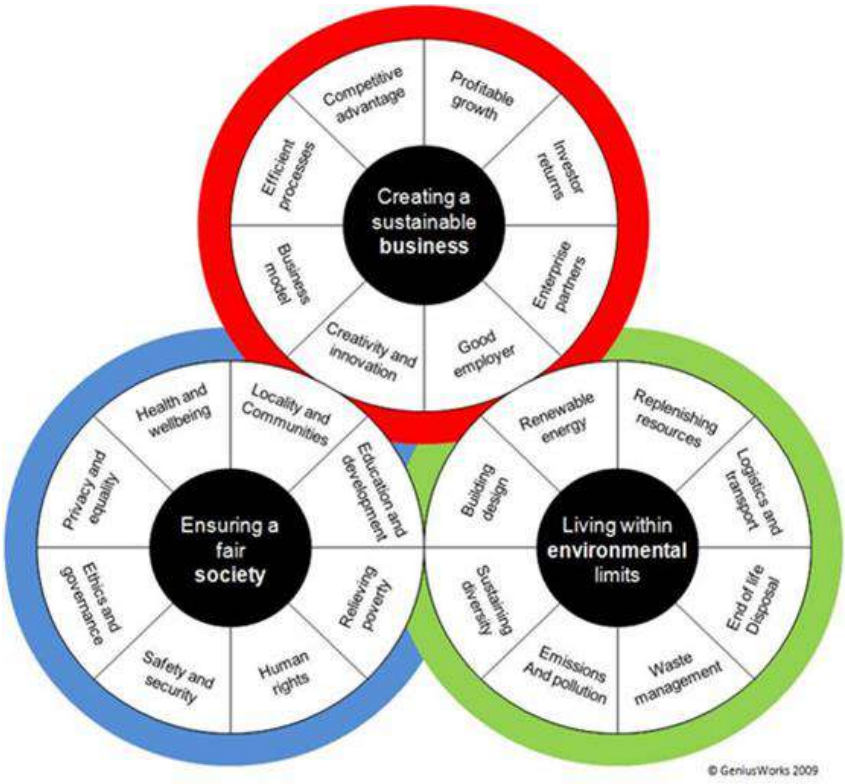

Figure 11: Triple bottom line

Conclusions and recommendations

9 Conclusions and recommendations

After the detailed description of the content derived from the assessed inputs, and its relevance for the topics related to port of the future, this chapter is to draw first conclusions on those topics that 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 port authorities, is well known and succeeds in keeping a good balance between a ports various focus points being economical (it concerns often tax money), social (relations with city, contribution to GDP), and increasingly in the last decades is to grow with green, respecting environmental constraints and assuring the impact on nature and people at least remains limited and is compensated.

As such following performance areas are to be 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 ports 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;

3. 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);
4. Logistics and Transport
   A main topic as it concerns one of the core activities in a maritime port environment. Almost all topics 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';

5. End of life disposal;
6. Waste management.
   Both issues are rather well developed in maritime port areas, partially due to existing regulations. Ports, though having a limited set of tools, succeed 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;
7. 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;
8. 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 on 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,) 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 tights.
   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 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 the use of the public funds. 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 (IT companies, applications, ...).

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Table 26: Bibliography

Annexes

11 Annexes

11.1 Assessment methodology

As already mentioned in section 7 Methodology summary 32 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.

11.1.1 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.

11.1.1.1 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 (See section 11.1.2 The work products and tools on page 123).

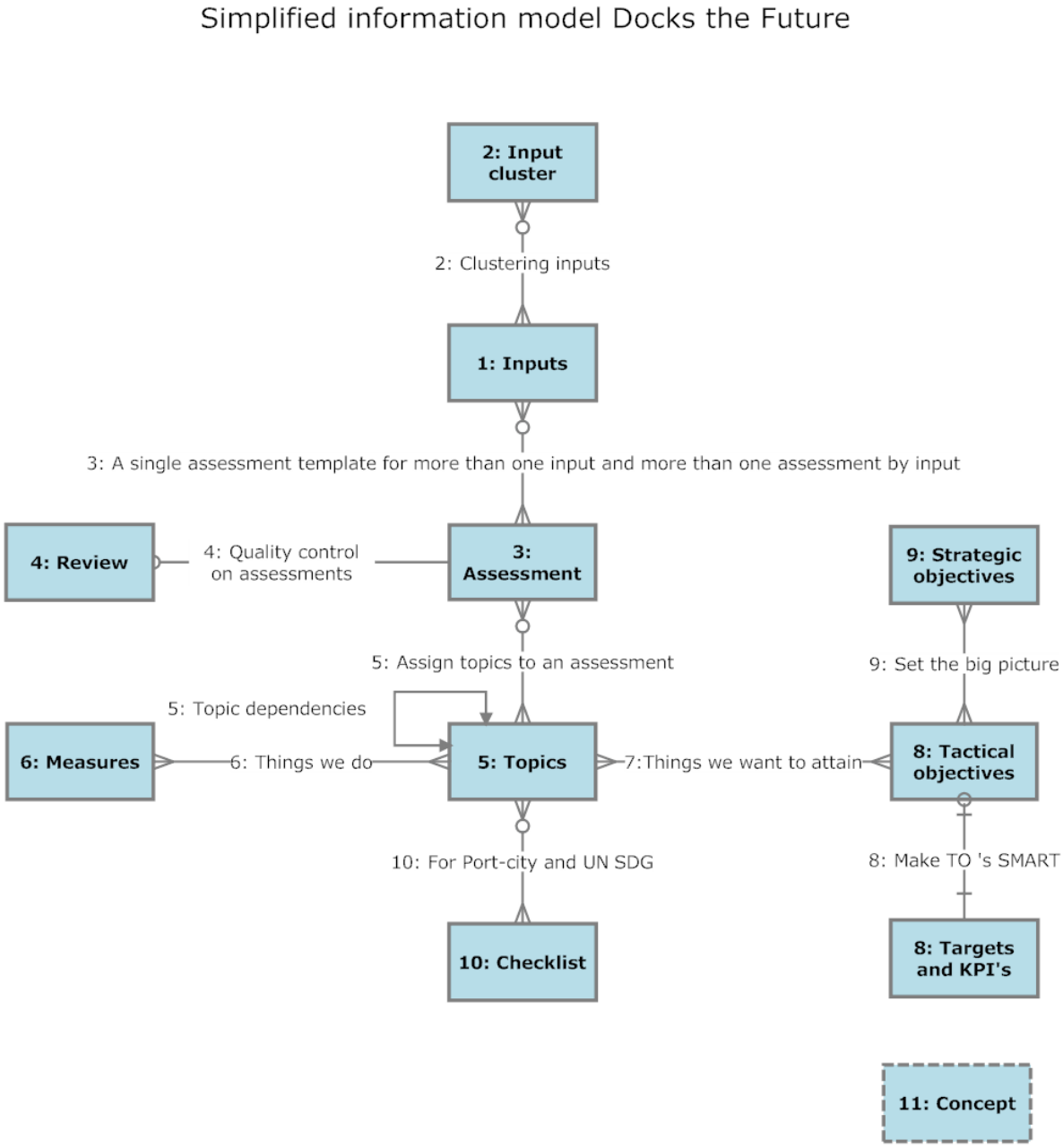

Figure 12: Simplified data model

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 (see section 11.1.2 The work products and tools page 123). 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 35: List of topics on page 158 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 37 List of measures on page 173 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 (See section 11.4 on page 135) 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.

11.1.1.2 Entities

11.1.1.2.1 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 (See section 11.1.3 on page 126) 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. (See section 11.5 on page 137)

11.1.1.2.2 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:
    a. 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;
    b. 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;
    c. 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;
    d. 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 (See section 10 on page 100);
    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.

11.1.1.2.3 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.

11.1.1.2.4 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 11.3 Port-city relation checklist on page 133 and Table 27: UN sustainable development goals115.

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 31: Updated topic list on page 132 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.

11.1.1.2.5 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”).

11.1.1.2.6 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.

11.1.1.2.7 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 11.3 on page 133. 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 13: 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.
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.

Number	UN SDG
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 27: UN sustainable development goals

11.1.1.2.8 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.

11.1.1.3 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 34: List of inputs and assessments page 153
		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
		Description	Database	
		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

Entity	Entity	Type relation	Assessment template	Report
		Description	Database	
		One or more predefined measures can be assigned to an assessment and a predefined measure can be assigned to more than one assessment.	Yes	
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
		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
		Description	Database	
				possible contradictions are reported
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 11.1.3 The workflow on page 126 for more info on assessment rounds	Yes	
Input cluster	Cluster	Many to many	No	

Entity	Entity	Type relation	Assessment template	Report
		Description	Database	
	Input	This is de facto clustering according to the clustering 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.	Yes 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)	No, this is not in scope of work package 1
	Level 1 predefined topics			
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

Entity	Entity	Type relation	Assessment template	Report
		Description	Database	
		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 assigned to it.	Yes	
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 (See section 11.1.2 The work products and tools page 123)	Yes	

Table 28: Relations between entities

11.1.2 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 28: Relations between entities on page 122 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.

Sheet	Content
Lookup	Reference data used in certain other sheets.
Help	Help on how to use and fill out the assessment template.
Template history	Detailed description of the changes to the assessment template.

Table 29: 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 (See Figure 12: Simplified data model on page108) 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. (See section 5 Ports of the future defined on page 24). 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 32: Reports from the DocksTheFuture on page 137 and Table 33: Queries from the DocksTheFuture databaseon page 138 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 tis 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.

	Tagging/coding	Assessing
Added value activity	No	Yes
Tools	Atlas A tool of your choice or none at all.	Assessment template
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.

	Tagging/coding	Assessing
Feedback from thematic workshops	Additional inputs Recoding inputs	Additional inputs Re-assessing inputs Update DocksTheFuture database

Table 30: Tagging and assessing compared

11.1.3 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)

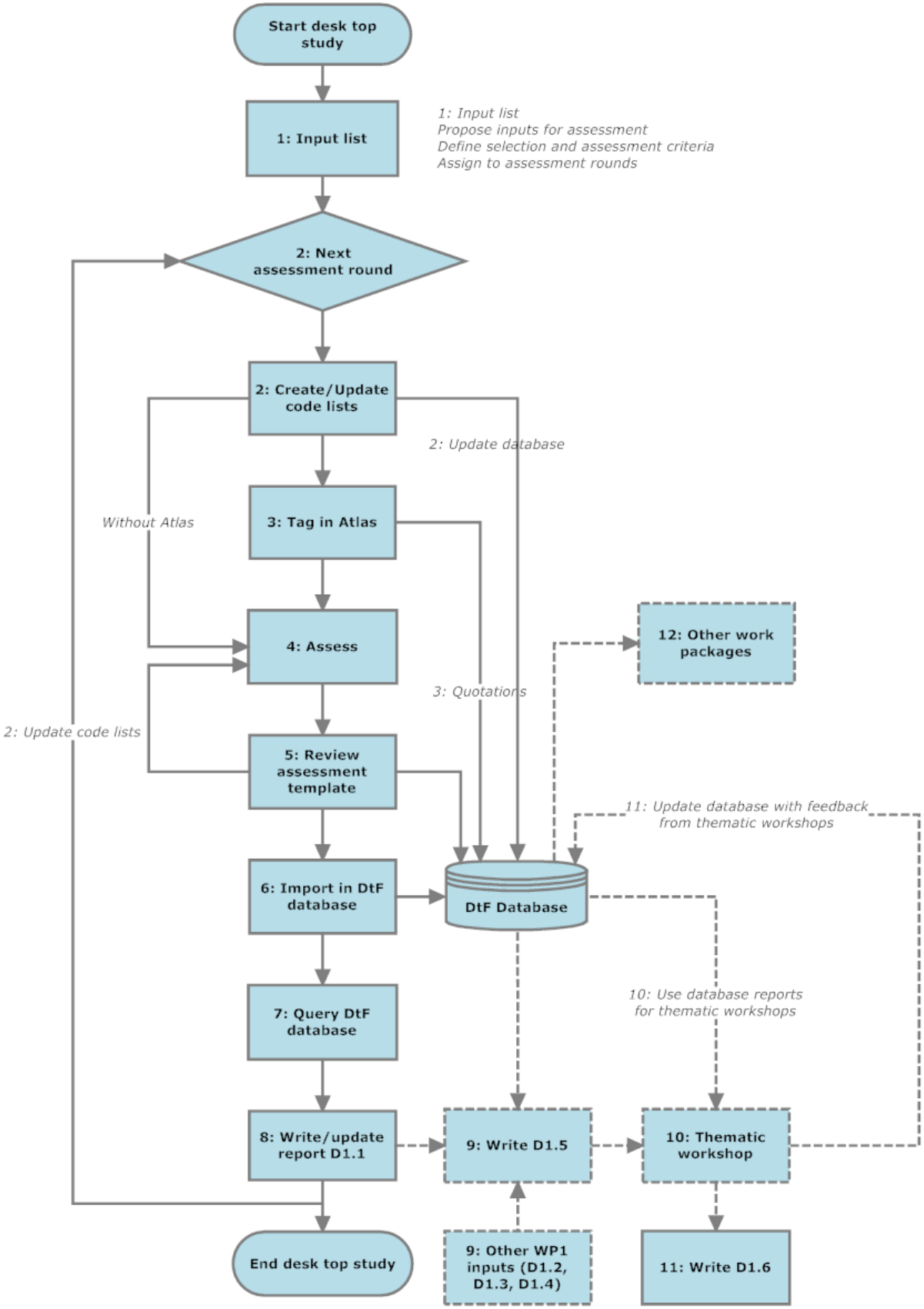

Figure 14: Assessment workflow

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 30: Tagging and assessing compared on page 126;
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 11.1.2 The work products and tools on page 123;
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 (See Figure 1: Overview of the Work Packages and their interrelation on page 19).

11.2 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.

Topic according to the project proposal	New topic list	Change description and motivation
Environmental concerns	T60.10: Environmental sustainability	• Sustainability is about People, Planet and Profit. So we made it 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
Sustainability	T60: Sustainability	
Safety and security	T70: Safety	• As these are 2 distinct concepts we split them in 2 topics; • We made physical security and cybersecurity 2 distinct sub topics of security.
	T80: Security	
Digitalization – ICT and communication within the port community	T90: Digitization, digitalization and digital transformation	• 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.
	T1120.20: Communication	
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;

Topic according to the project proposal	New topic list	Change description and motivation
		• 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 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	• 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.
	T901: Competition	
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 31: Updated topic list

11.3 Port-city relation checklist

11.3.1 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.

11.3.2 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.

11.3.3 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.

11.3.4 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.

11.4 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.

11.5 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 32: Reports from the DocksTheFuture

Queries come into 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 give back a

result set and if they do 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 33: Queries from the DocksTheFuture database

11.6 Detailed lists

11.6.1 List of inputs and assessments

Inputs are the work products we assessed See section 11.1.1.2.1 on page 109 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.

ID	Name	Assessed
10	The future of port logistics, meeting the challenges of SC integration for ING - INPUTS: 0010-0 ExecSum; 0010-1 study by ING	Yes
20	RISCOMEX	Yes
30	CoRISMa	Yes
40	E-navigation for inland waterways 2017	Yes
50	Économie Circulaire et Écosystèmes portuaires	Yes
60	Port City Governance	Yes
70	Trends in EU ports governance 2016	Yes
80	Unmanned ships on the horizon/Remote and autonomous ships - the next steps	Yes
90	How to go about greening terminals	
100	Autonomous Ship Technology	
110	The future of ports in 2060	Yes
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	

ID	Name	Assessed
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 & 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 economic policy of Province of Antwerp	
320	BRAIN-TRAINS	
330	Port Economic Analysis, particularity with respect to generalized cost modelling 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: barriers and facilitators	Yes
410	The Grand Challenge: Pathways towards Climate Neutral Freight corridors	Yes
420	Investigating the Bunkering Choice Determinants: case of Port of Antwerp	
430	De toekomst van de arbeidsmarkt in haven van Antwerpen	Yes
440	Transport research for a changing and sustainable future	
450	BENEFIT: potential of investments in transport infrastructure	Yes
460	Decision-making for maritime innovation investments the significance of cost benefit and cost effectiveness analysis	

ID	Name	Assessed
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.	Yes
560	DOOR2LNG	
570	Railway connection of 4 freight terminals along the ME corridor Spain	
580	AM4INFRA	
590	USEIT	
600	INFRALERT	
610	intermodal EU	
620	RAGTIME	
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	

ID	Name	Assessed
730	Shifting Freight2Rail	Yes
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	
890	CORE	Yes
900	BRAAVOO	
910	HORIZON	
920	MESA - Maritime Europe Strategy Action - FOSTER Waterborne)	
930	CARONTE	
940	VIAJEO PLUS	
950	ISOTRACK II	
960	LEANWIND	
970	MUNIN	
980	MINI-CHIP	
990	LOGICON	

ID	Name	Assessed
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	
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	Yes
1080	STM Validation Project	Yes
1090	Plan the city with the port: guide of good practices	Yes
1100	The Blockchain Potential for Port Logistics	
1110	PORTOPIA- 4 tools to support port performance measurement An introduction to the PORTOPIA service cloud	
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	
1160	Work Process Oriented Competence Developmentfor the Port of the Future	Yes
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	
1190	Changing training needs of port workers due to future trends	
1210	SUSTAINABLE PORT INFRASTRUCTURE, PRACTICAL IMPLEMENTATION OF THE GREEN PORT CONCEPT	
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	Yes

ID	Name	Assessed
1240	THE GREENING OF PORTS: A COMPARISON OF PORTMANAGEMENT TOOLS USED BY LEADING PORTS INASIA AND EUROPE	Yes
1250	Environmental policies and practices in Cruise Ports: Waste reception facilities in the Med	
1260	Port Productivity: A Comparison Analysis Among Strategic Ports	
1261	Port Cooperation Policies in the Mediterranean Basin: an Experimental Approach using Cluster Analysis.	Yes
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?	
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	
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	Yes
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	

ID	Name	Assessed
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	Yes
1510	A relationship between port profiles and policies regarding the circular economy	Yes
1520	Circular economy modelling to accelerate the transition of ports into self-sustainable ports: a case study in Copenhagen-Malmö Port (CMP)	Yes
1530	Sustainable Development of Seaport Cities through Circular Economy: A Comparative Study with Implications to Suez Canal Corridor Project	Yes
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	Yes
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	

ID	Name	Assessed
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	Yes
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	
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	Yes
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	
1800	Innosutra - Innovation Processes in Surface Transport	
1810	Pprism - Port Performance Indicators: Selection and Measurement	

ID	Name	Assessed
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	
1940	Nationales Hafenkonzept 2015	
1950	Port of Rotterdam - Port Vision 2030	
1960	Synchrolog	
1970	Motorways of the Sea - Detailed Implementation Plan	Yes
1980	NAPA4CORE	
1990	HAROPA - Rapport d'activité 2016	
2000	Rijeka Gateway II	
2010	Stockholm Norvik Port	
2020	Port Development Plan to 2025	Yes
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	

ID	Name	Assessed
2070	Innovative Seaport Technologies (Innovative Seehafentechnologien) - ISETECT II	
2080	Innovative Port technologies (IHATEC)	
2090	Maritime Energy Transition Outlook (ETO)	
2100	PORTOPIA - European Port Industry Sustainability Report 2017	
2110	3D printing: a threat to global trade	
2130	Code of Good Practices for Cruise and Ferry Ports	Yes
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	
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	

ID	Name	Assessed
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, Genova, Gijón, Hamburgo, Helsinki, Málaga, Marsella, Oslo, Sidney, Valencia, Vigo.	

ID	Name	Assessed
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	
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.	

ID	Name	Assessed
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	
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	

ID	Name	Assessed
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	
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	Yes
3210	Port of the future (Deltares)	
3220	Sustainable Ports - A Guide for Port Authorities. PIANC Report 150.	Yes
3230	Doctoral dissertation Tanjera	Yes
3240	Historic urban landscape	Yes
3250	A sustainability assessment of ports and port-city plans	Yes
3260	Site selection and planning for greenfield port sites	
3270	Low-carbon infrastructure as an essential solution to climate change	Yes

ID	Name	Assessed
3280	Concept of building and working with nature.	Yes
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.	
3330	Climate change impacts on the Port of Ijmuiden.	Yes
3340	System dynamics model applied to the port of Tema in Ghana.	
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	
3380	Ecosystem-based port design as an approach to sustainable development.	Yes
3390	Site selection for deep sea ports in Mynmar.	
3400	Maasvlakte II	
3410	Smart port	
3420	Energy transition in the port of Rotterdam	
3430	Decarbonisation pathways	
3440	Smart Infrastructure	
3450	Smart use of of Big data	
3460	Port meta trands	
3470	Sustainable ports on Africa	

Table 34: List of inputs and assessments

11.6.2 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

Number	Name	Description
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 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

Number	Name	Description
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 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.

Number	Name	Description
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
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

Number	Name	Description
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
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.

Number	Name	Description
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 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 35: List of topics

11.6.3 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	

Number	Description	Target
T050	Realise the TEN-T infrastructure network	Full completion of the core network by 2030, full completion of the comprehensive network by 2050
T060	Implementation of the TEN-T Core Network Corridors	
T070	Work Plans for Ports and of the Motorways of the Sea Detailed Implementation Plan	
T080	Improve smart traffic and mobility management inbound / outbound.	
T090	Improve digital support for route efficiency Sea Traffic Management	
T0100	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
T0110	Increase efficiency and capacity of hinterland 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	

Number	Description	Target
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.	
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	

Number	Description	Target
TO420	Monitor and forecast the development of port labour market	
TO430	Improve the visibility of port related business in the education	
TO440	Develop harmonised professional and vocational training packages	
TO450	Increase harmonization between EU and non EU ports in terms of common approach to the Port of the Future Topics	
TO460	Develop and efficient links between TENT network and non EU transport networks	
TO470	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
TO500	Long term binding of port related business	
TO510	Build political support for the port	
TO520	Simplify or accelerate approval processes	

Table 36: List of tactical objectives

11.6.4 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.

Category	Number and name	Description
Digitalization (Platforms and systems)	MS30: Ballast water management system	Technology (filtration ...) to clean ballast water to 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.

Category	Number and name	Description
Digitalization (technology)	MS480: Mobile	Use of mobile technologies and apps, mobile networks.
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	

Category	Number and name	Description
Digitalization (technology)	MS820: Technological innovations: scanners, weighbridges, tracking technology, sensors	
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.

Category	Number and name	Description
Energy	MS490: Off shore wind farms	
Energy	MS120: Create innovative energy storage systems	Example carbon storage, batteries for renewable 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	

Category	Number and name	Description
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.
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.

Category	Number and name	Description
Port infrastructure	MS110: Cranes outreach of container gantry cranes	
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	

Category	Number and name	Description
Predefined monitoring measures	MS580: Port ship interface	
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	

Category	Number and name	Description
Transferability (Training, ...)	MS860: Training schemes	Educational and professional training, Adequate 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

Category	Number and name	Description
		pump this water over the side so it has to be 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 37 List of measures

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