Activity 2 – Defining Sea Traffic Management

The Current Situation

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1 General Information

MONALISA 2.0 is a project with 39 private, public and academic partners from 10 different countries. Its overall objective is to strengthen efficiency, safety and environmental performance in maritime transportation. Coordinated by the Swedish Maritime Administration, the project is co-financed by TEN-T under the Motorways of the Sea Programme and is part of the EU’s e-Maritime initiative. MONALISA 2.0 follows on from the MONALISA project (2010-EU-21109-S) and also incorporates results and experiences from the SESAR (Single European Sky Air Traffic Management Research) programme in the aviation sector. MONALISA 2.0 is divided into four Activities: Activity 1, STM Operations and Tools; Activity 2, STM Definition; Activity 3, Safer Ships; and Activity 4, Operational Safety.

This report is a deliverable from Activity 2 of the MONALISA 2.0 project. The objective of Activity 2 is to outline a framework for Sea Traffic Management (STM), elaborate its target concept, and develop a plan for further development and deployment. Activity 2 is divided into 7 sub-activities:

- **SA2.1 Current Situation Analysis** describes today’s maritime transport industry, focusing on information sharing. It highlights its strengths, weaknesses, and current development, as well its needs. The results of this analysis are presented in this report D2.1.1 STM The Current Situation.

- **SA2.2 STM Performance Target Development** is an analysis and elaboration of a performance framework including: performance targets, key performance areas, vision and goals. Its results are presented in report D2.2.1 STM Performance Framework.

- **SA2.3 STM Target Analysis** develops the target concept(s) of Sea Traffic Management based on the current situation analysis and performance targets. The results of this work are summarised in the report, D2.3.1 STM - The Target Concept.

- **SA2.4, 2.5 & 2.6 STM Strategic Roadmap and Master Plan Development and Work Programme for Development Phase** is a combination of three sub-activities that together establish a shared vision of the overall transition sequence for implementing the STM Target Concept. Results are described in report D2.4.2/D2.5.1/2.6.1 STM Master Plan.

- **SA2.7 Port CDM Demonstrator** developed and demonstrated initial versions of some information sharing services used in the Port CDM concept. Results are presented in the report D2.7.1 Port CDM Report.

This report summarises the results from sub-activity 2.1 - Current Situation Analysis.
2 Executive summary

The aim of this document is to describe and analyse the current situation for areas impacted by the Sea Traffic Management (STM) concept. STM is intended to serve as a set of systems and procedures to guide and monitor sea traffic similar to the existing Air Traffic Management. STM is not yet established, and it will be defined within the framework of the project.

Historical and regional factors such as local regulations, traditions in the region, and local selection of system manufacturers and providers, stem the development of STM at a European level. Presently, the existing STM-related services are highly fragmented, localised and not optimised.

The maritime business is itself strongly affected by globalisation and the development of the world economy. That result in a need for new standards that will improve the maritime transport efficiency and creates new challenges for all actors involved. Nevertheless, generally speaking, the maritime industry is highly fragmented today and the IT-systems adopted in Europe are insufficiently integrated. It is still common that organisations and public bodies, such as customs, port authorities and marine safety agencies use standalone systems, whereas implementations of collaborative ICT solutions are uncommon. With particular reference to the navigation systems, the use of information exchange technology to establish a more efficient cooperation between the ship and the parties is often lacking.

Currently STM is not as mature as Air Traffic Management and the rapid growth of the number of ships, more than 500,000 ships in European Seas, causes congestion and also has a strong environmental impact. Consequently, the maritime industry needs an alignment of the ship traffic similar to that which has taken place for air traffic. This is especially true for high traffic areas such as the North Sea area and Mediterranean area.

To obtain a full panorama view on current practices, the work has been focused on describing the legal framework, the actors involved in maritime practices and the related processes.
3 Introduction

3.1 Scope and purpose

The overall objective of MONALISA 2.0 is to strengthen maritime transport efficiency, safety and environmental performance. As a result, the actors within the industry will experience a decreased administrative burden as well as an increased economic performance.

This document constitutes the 3rd iteration D2.1.1, reporting the Work Package 1 - Current Situation Analysis. In this work package, the current situation of maritime transportation is analysed with a particular focus on information sharing within the maritime domain. This analysis provides a ‘snapshot’ of today’s sea transport industry and also highlights strengths, weaknesses, needs and recommendations.

This document aims to provide an understanding of how the current maritime ecosystem's framework operates.

This work package includes analysis of current:

- Legislations and regulations
- Management structures and decision making mechanisms
- Safety regulations
- Existing business models
- Value chains and market
- Key stakeholders and their involvement and collaboration
- Legacy systems
- Information management and information sharing enablers
- Aspects of the role played by humans.

3.2 Methodology

The results shown in chapters 5, 6 and 7 have been achieved by research, a contribution by the WP1 partners, by consulting paper archives and online sources, besides previous studies developed in MONALISA 1.

Each information source has been analysed with a critical eye and compared with the other ones in order to obtain a complete and homogeneous framework.

3.3 Structure of the document

This document is structured according to the following sections:
Chapter 1  General information about Activity 2 of the MONALISA 2.0 project.

Chapter 2  Executive summary showing why this report is written and with a focus on what has been accomplished and what challenges have been faced.

Chapter 3  Introductory section defining scope and purpose of the documents, the adopted methodology and structure of this report.

Chapter 4  References to the used terms and definitions.

Chapter 5  Definition of the maritime framework by introducing the maritime ecosystem and its key actors.

Chapter 6  Objective description of current shipping practices from a business, institutional, operational and technical perspective.

Chapter 7  Current situation analysis based on the description presented in chapter 6 according to shipping operations, ship operations, traffic monitoring and management and port operations.

Chapter 8  Conclusions and recommendations.

Chapter 9  Reference documents.

In addition, some texts are appended to the report:

Appendix I  List other relevant reports and studies.

Appendix II  Lists the MONALISA 2.0 Activity 2 deliverables.
## 4 Terms and definitions

<table>
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<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AIS</td>
<td>Automatic Identification System</td>
</tr>
<tr>
<td>ATA</td>
<td>Actual Time of Arrival</td>
</tr>
<tr>
<td>ATD</td>
<td>Actual Time of Departure</td>
</tr>
<tr>
<td>B2B</td>
<td>Business To Business</td>
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<tr>
<td>BIMCO</td>
<td>The Baltic and International Maritime Council</td>
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<tr>
<td>CLL</td>
<td>International Convention on Load Lines (also LOADLINE and CLL)</td>
</tr>
<tr>
<td>COLREGS</td>
<td>International Regulations for Preventing Collisions at Sea</td>
</tr>
<tr>
<td>COPE</td>
<td>Compensation for Oil Pollution in European waters fund</td>
</tr>
<tr>
<td>CPB</td>
<td>Control Border Police</td>
</tr>
<tr>
<td>CUSREP</td>
<td>Customs Conveyance Report Message</td>
</tr>
<tr>
<td>DPR</td>
<td>Dynamic and Proactive Route Planning</td>
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<tr>
<td>DSC</td>
<td>Digital Selective Calling</td>
</tr>
<tr>
<td>EEZ</td>
<td>Economic Exclusive Zone</td>
</tr>
<tr>
<td>EMSA</td>
<td>European Maritime Safety Agency</td>
</tr>
<tr>
<td>ETA</td>
<td>Estimated Time of Arrival</td>
</tr>
<tr>
<td>ETD</td>
<td>Estimated Time of Departure</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>GT</td>
<td>Gross Tonnage</td>
</tr>
<tr>
<td>HF</td>
<td>Human Factors</td>
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<tr>
<td>HMI</td>
<td>Human Machine Interface</td>
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<tr>
<td>IALA</td>
<td>International Association of Marine Aids to Navigation and Lighthouse Authorities</td>
</tr>
<tr>
<td>ICLL</td>
<td>International Convention on Load Lines (also LOADLINE and CLL)</td>
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<tr>
<td>ILO</td>
<td>International Labour Organisation</td>
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<tr>
<td>IMO</td>
<td>International Maritime Organisation</td>
</tr>
<tr>
<td>INTERTANKO</td>
<td>International Association of Independent Tanker Owners</td>
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<tr>
<td>ISM</td>
<td>International Safety Management Code</td>
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<tr>
<td>LOADLINE</td>
<td>International Convention on Load Lines (also ICLL and CLL)</td>
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<tr>
<td>LNG</td>
<td>Liquid Natural Gas</td>
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<tr>
<td>LRIT</td>
<td>Long-range identification and tracking</td>
</tr>
<tr>
<td>MARPOL</td>
<td>International Convention for the Prevention of Pollution from Ships</td>
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<tr>
<td>MF-HF</td>
<td>Medium Frequency – High Frequency</td>
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<tr>
<td>MLC</td>
<td>Maritime Labour Convention,</td>
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<tr>
<td>NOR</td>
<td>Notice of Readiness</td>
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<tr>
<td>Acronym</td>
<td>Definition</td>
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<tr>
<td>NSA</td>
<td>National Supervisory Authority</td>
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<td>NSW</td>
<td>National Single Window</td>
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<tr>
<td>PSC</td>
<td>Port State Control</td>
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<tr>
<td>SAR</td>
<td>Search and Rescue</td>
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<tr>
<td>SMS</td>
<td>Safety Management System</td>
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<tr>
<td>SOF</td>
<td>Standard of Fact</td>
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<tr>
<td>SOLAS</td>
<td>Safety of Life at Sea</td>
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<tr>
<td>SOP</td>
<td>Standard Operating Procedure</td>
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<tr>
<td>SPOC</td>
<td>Single Point Of Contact</td>
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<tr>
<td>SRS</td>
<td>Ship Reporting Systems</td>
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<td>SSN</td>
<td>SafeSeaNet</td>
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<tr>
<td>STCC</td>
<td>Sea Traffic Coordination Centre</td>
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<tr>
<td>STCW</td>
<td>International Convention on Standards of Training, Certification and Watch keeping for Seafarers</td>
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<tr>
<td>STM</td>
<td>Sea Traffic Management</td>
</tr>
<tr>
<td>SW</td>
<td>Single Window</td>
</tr>
<tr>
<td>TBD</td>
<td>To Be Defined</td>
</tr>
<tr>
<td>TEU</td>
<td>Total Equivalent Unit</td>
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<tr>
<td>TOS</td>
<td>Terminal Operating System</td>
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<tr>
<td>TSS</td>
<td>Traffic Separation Scheme</td>
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<tr>
<td>VDR</td>
<td>Voyage Data Recorder</td>
</tr>
<tr>
<td>VTMS</td>
<td>Vessel Traffic Management Systems</td>
</tr>
<tr>
<td>VTS</td>
<td>Vessel Traffic Services</td>
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<tr>
<td>WASDIS</td>
<td>Waste Disposal</td>
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<td>WASP</td>
<td>Weather Analysis Service Provider</td>
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5 The maritime framework

This section discusses the maritime sector as a cohesive maritime ecosystem and provides an in-depth definition of a number of key stakeholders.

5.1 Maritime ecosystem perspective

Commercial shipping is a network of interdependent firms, government entities and individuals who cooperate in order to achieve an efficient transport chain of goods from exporters to importers. Such arrangements are often labelled ‘ecosystems’ because they have a lot in common with ecosystems found in nature. While the members of an ecosystem typically act out of self-interest, particularly if they are for-profit businesses, their interdependence means that they must cooperate in order to maximise the total value and to enable each member to get their share.

An ecosystem typically has a central figure whose existence is critical to the survival of the entire system. In the maritime industry the ship holds this central position. Without ships there simply is no commercial maritime ecosystem. Services such as piloting, berthing and unloading exist as a result of the presence of ships. In many ecosystems, the central figure is typically able to extract much of the value that is created by the ecosystem, particularly when it can create competition among the service providers. For example, harbours might compete by lowering fees to attract ships to use their facilities. They can also leverage competition among the harbour’s service providers by for example engaging multiple tug companies. Cost saving in an ecosystem can also ultimately benefit the region that is served by the ecosystem. An optimised maritime ecosystem in Europe can spill over to benefit actors outside of the maritime industry.

5.1.1 Maritime Community

Commercial shipping is a complex system involving several actors. The diagram below depicts some of these actors and examples of how they interact.
Some of the key actors are described in more depth below:

**Ship Owner**
The ship owner is the legal owner of the ship, but it is not necessarily the same company that operates the ship. Owner and operating conditions may be complex in shipping. For example, the ship can be owned by a Swedish company, operated from Denmark and registered on the Bahamas with a crew from the Philippines and a number of other countries.

**Shipping Company**
The shipping company refers to the party that uses ships to transport freight or passengers. In other words it provides the maritime transport process. There are different kinds of shipping companies, which either use their own ships or charter ships from other subjects.

**Vessel Operator**
The vessel operator is responsible for managing the ship's performance and works in close collaboration with the on-board shipmaster and with the charterer and ship owner.

**Charterer**
The charterer can either be a person or a company. Most commonly it is a large organisation whose mission is to transport goods that needs a ship in order to do so.

A charterer can also have access to a ship but may not have any own cargo for transport. In this case the charterer can contact a shipbroker in order to find suitable cargo for the ship or to find another subject who wants to hire the ship.
Shipbroker
The shipbroker is an expert of finding suitable ships or cargo and negotiating the terms between the charterers and ship owners. Shipbrokers can work with different kinds of brokerage. In case they work for the owner they are called owner’s brokers, and are appointed by the owner to find cargo charterers for their ships. They may also be a charterer’s broker and work to find tonnage to secure the charterer’s cargo interests. There are also independent brokers that provide their services to both charterers and owners (FONASBA, 2014).

Shipping Agent
A shipping agency or a shipping agent is the organisation or person that is responsible for handling shipments and freight at ports on behalf of shipping companies. There are several categories of shipping agents such as port agents, liner agents and own agencies. The type of service they render depends on the shipping company that they represent.

Shipping agents take care of all the regular routine tasks of a shipping company. They provide supplies, manage crew transfers and make sure that customs documentation and waste declarations are reported the port authorities without delay. Quite often they also provide the shipping company with updates and reports on activities at the destination port so that the shipping companies at all times have access to updated information whilst the goods are in transit.

The agent provides every actor that is interested in the port call with information about the ships latest estimated time of arrival (ETA), berthing prospects, expected turnaround time and also assists the ship in booking of pilots and tugs services.

Agents are usually recruited based on required skills and competences within national legal frameworks.

5.1.2 Partners and Value Proposition

Stakeholder partnerships

- **Exporters** partner with **cargo ship operators** to deliver cargo to importers according to an agreed schedule at a competitive price, while complying with all legal, contractual and safety obligations, and preventing accidents and environmental damage.

- **Governments** partner with **ship operators** and **ports** to facilitate economic growth by promoting export, importing essential goods, and to enhance tourism. It ensures regulation compliance in order to increase the level of safety of shipping-related operations and to prevent accidents and environmental damage.

- **Ship owners** partner with **ship operators** to provide shipping services to exporters and importers.

- **Excursion providers** partner with **cruise ship operators** to provide a satisfying the passengers with a satisfying experience ashore while the ship is in port.
Customers

- **Importers** receive cargo at the port or through **freight forwarders**.
- **Passengers** are transported safely between ports and participate in desired excursions offered by **excursion providers**.

Key Resources

- **Ship operators** transport cargo or passengers using **ships**, **fuel**, and **crew**.
- Agents, port services, navigation services, and terminal services operate using **ports**.
- The **International Maritime Organisation** (IMO - see chapter 6.2.2) and **other associations** set regulations that ships and ports use to guide their activities.

Key Activities and Channels

- Ship operators use account representatives or freight forwarders to obtain cargo shipment contracts. Cruise ship operators recruit passengers through travel marketers.
- **Ship’s crew** and **terminal services** are involved in the loading and unloading of goods, and in embarking and disembarking passengers on and off a **ship**.
- **Ships** transport cargo or passengers between ports using **fuel**, **crew**, and **navigation services**.
- **Ship’s crew** and **terminal services** unload cargo or passengers at a **Port**.
- Ship, navigation services, terminal services, port services and agents comply with IMO, industry association and other government regulations.

Cost Structure

- **Ships** cost capital to acquire and consume **fuel**. They are operated by **labour** and have **maintenance- and repair costs**.
- Ports have operating costs for port services, navigation service, and terminal services.
- Emissions generate a cost to society.

Revenue Streams

- **Importers** pay **ship operators** and **ports** for cargo delivery.
Cruise companies pay ship operators and ports for their passage.

5.1.3 Classes of interdependencies and consequences

There are two broad classes of interdependencies: persistent and episodic. When the interdependencies are persistent, such as in the automotive industry, the central figures will establish processes to enhance the efficiency. For instance, a persistent interdependency has driven the development of data exchange standards, such as EDI, that enables efficient and fast sharing of essential data for close integration of activities and plans.

Episodic interdependency occurs when the central figure of an ecosystem has infrequent interaction with the other members of the system. Understanding the nature of this interaction is key to understanding how appropriate data exchange can enhance efficiency.

While a ship can visit multiple ports in a year, it might berth at a particular port at most annually. So even when a firm, such as a tug operator, offers services across multiple ports a ship might still only use their services a few times a year. This infrequency of repeated mutual interaction between the same specific entities limits the ability of the central figure to enforce cross-industry standards. This problem is further exacerbated by the global nature of shipping. As a result the data exchange standards that are under development are not likely to be implemented unless there is a strong external cause that promotes their usage.

The commercial maritime ecosystem has a common goal of efficient episodic tight coupling of joint activities and such coupling can be greased by data. Development of data exchange standards and policies will enhance the efficiency, safety, and environmental sustainability of the ecosystem.
6 Maritime Transportation: Processes and Actors

The aim of this section is to provide an objective description of the current maritime transport practices of maritime transport. It is divided into the following main operations:

- **Shipping**, representing a holistic view of maritime transport including not only ship operations but also the entire logistics process relating to maritime transport;
- **Ship operations**, covering ship specific issues like voyage planning and navigation;
- **Traffic monitoring and management**, covering methods for holistic traffic management;
- **Port Operations**, covering port activities.

Each operation is considered from the following perspectives:

- Business
- Institutional
- Operational and technical.

6.1 Business Situation

A current situation analysis of the business situation of shipping and port operations.

Maritime transport is one of the oldest means of transport and plays an essential role in economic and social development. Figures from the United Nations Conference on Trade and Development’s (UNCTAD) indicate that around 80% of global trade by volume, and over 70% by value is transported by sea and handled by ports worldwide.

For Europe, maritime transport has been a catalyst for the region’s economic development and prosperity. Sea transport has enabled trade and interaction between nations in Europe and has also been the main vehicle for European imports and exports to the rest of the world. Almost 90% of the EU external freight trade is seaborne. Short sea shipping represents 40% of intra-EU exchanges in terms of ton-kilometres.

6.1.1 Passenger and Ro-Ro Traffic

In 2012 the total passenger and passenger ro-ro cargo fleet for ships of 300 GT and above was 4,077, resulting in a total of approximately 35 million GT in 2012. At this time 131 ships with 3.2 million GT were on order, equalling 9.2% of the trading fleet.

While cruise passengers only represented 3.6% of the total number of passengers in EU-28 ports in 2012, they are still important to the ports they visit. Five countries, Italy, Spain, the UK, Germany and Greece, accounted for more than 85% of the reported cruise passengers.

The top 20 passenger ports accounted for about 38% of the total number of embarking and disembarking passengers in the countries reporting data in 2012, which is a slight
increase from 2011. Dover in the UK, situated in the Channel, remained the largest passenger port in Europe in 2012, despite a decrease of 6.5% in the number of seaborne passengers passing through the port facilities. The Spanish port of Algeciras recorded the largest increase in number of passengers in 2012 (+7.7 %), while the Greek port of Piraeus recorded the largest year-on-year decrease (-13.7 %).

<table>
<thead>
<tr>
<th>Year</th>
<th>North America</th>
<th>Europe</th>
<th>Other</th>
<th>Worldwide Passengers Carried</th>
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<tr>
<td>2014</td>
<td>12,966,000</td>
<td>5,820,000</td>
<td>2,770,000</td>
<td>21,556,000</td>
</tr>
<tr>
<td>2015</td>
<td>13,266,000</td>
<td>6,016,000</td>
<td>2,922,000</td>
<td>22,218,000</td>
</tr>
<tr>
<td>2016</td>
<td>13,593,000</td>
<td>6,192,000</td>
<td>3,073,000</td>
<td>22,868,000</td>
</tr>
<tr>
<td>2017</td>
<td>13,881,000</td>
<td>6,377,000</td>
<td>3,230,000</td>
<td>23,488,000</td>
</tr>
<tr>
<td>2018</td>
<td>14,196,000</td>
<td>6,568,000</td>
<td>3,392,000</td>
<td>24,146,000</td>
</tr>
</tbody>
</table>

**Figure 2. Worldwide Cruise Traffic Evolution and Forecast, Period 1990-2020 - Sources: Cruise Market Watch’s proprietary Cruise Pulse™ and Port Pulse™ databases, Royal Caribbean Cruises, Ltd., Carnival Corporation and plc, NCL Corporation Ltd., Cruise Lines International Association (CLIA), The Florida-Caribbean Cruise Association (FCCA) and DVB Bank.**

### Container Traffic

Containerized trade accounted for 65% of ‘other dry cargo’ in 2012. (That's nearly two thirds of the 2.28 billion tons of dry cargo that remains after removing dry-bulk commodities.) Containerized trade increased by 3.2% in 2012, down from 13.1% in 2010 and 7.1% in 2011.

The sharp deceleration is a result of decreased volumes on the main lane East–West trade, and is particularly pronounced for the Asia–Europe trade route. Data from Containerisation International indicate that European import volumes once again have fallen below the pre-crisis level with volumes on the head haul route from Asia to Europe dropping by 2.6% in 2012, compared with a 6% positive growth in 2011.
The contraction is indicative of the severe pressure weighing down on European economies, especially in the Mediterranean. The growing deployment of increasingly larger ships have forced the main operators to continue cascading their older ships to secondary and regional routes. Nevertheless, during 2012 the market saw the arrival of the largest ships to date (+16,000 TEU and Triple-E container ships of 18,300 TEU).

Table 1. Ranking of Northern and Southern European Ports, TEUs Volume. Years 2011 and 2012
### Table 3: Top 10 ports: Northern Europe

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>Port</th>
<th>Country</th>
<th>Teu 2012</th>
<th>Teu 2011</th>
<th>Teu +/-</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>Rotterdam</td>
<td>Netherlands</td>
<td>11,865,916</td>
<td>11,876,900</td>
<td>-10,984</td>
</tr>
<tr>
<td>2</td>
<td>14</td>
<td>Hamburg</td>
<td>Germany</td>
<td>8,863,896</td>
<td>9,014,165</td>
<td>-150,269</td>
</tr>
<tr>
<td>3</td>
<td>15</td>
<td>Antwerp</td>
<td>Belgium</td>
<td>8,635,169</td>
<td>8,664,243</td>
<td>-29,074</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>Bremen/Bremerhaven</td>
<td>Germany</td>
<td>6,115,211</td>
<td>5,915,487</td>
<td>199,724</td>
</tr>
<tr>
<td>5</td>
<td>37</td>
<td>Felixstowe</td>
<td>UK</td>
<td>3,700,000</td>
<td>3,400,000</td>
<td>300,000</td>
</tr>
<tr>
<td>6</td>
<td>51</td>
<td>Duisburg</td>
<td>Germany</td>
<td>2,600,000</td>
<td>2,500,000</td>
<td>100,000</td>
</tr>
<tr>
<td>7</td>
<td>56</td>
<td>St Petersburg</td>
<td>Russia</td>
<td>2,524,680</td>
<td>2,365,174</td>
<td>159,506</td>
</tr>
<tr>
<td>8</td>
<td>60</td>
<td>Le Havre</td>
<td>France</td>
<td>2,306,000</td>
<td>2,215,000</td>
<td>91,000</td>
</tr>
<tr>
<td>9</td>
<td>70</td>
<td>Zeebrugge</td>
<td>Belgium</td>
<td>1,953,000</td>
<td>2,206,000</td>
<td>-253,000</td>
</tr>
<tr>
<td>10</td>
<td>87</td>
<td>Southampton*</td>
<td>UK</td>
<td>1,675,510</td>
<td>1,563,040</td>
<td>-82,470</td>
</tr>
</tbody>
</table>

### Table 4: Top 10 ports: Mediterranean

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>Port</th>
<th>Country</th>
<th>Teu 2012</th>
<th>Teu 2011</th>
<th>Teu +/-</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>Valencia</td>
<td>Spain</td>
<td>4,469,754</td>
<td>4,327,371</td>
<td>142,383</td>
</tr>
<tr>
<td>2</td>
<td>33</td>
<td>Algeciras</td>
<td>Spain</td>
<td>4,114,231</td>
<td>3,602,631</td>
<td>511,600</td>
</tr>
<tr>
<td>3</td>
<td>42</td>
<td>Ambarlı (İstanbul)</td>
<td>Turkey</td>
<td>3,097,464</td>
<td>2,686,000</td>
<td>411,464</td>
</tr>
<tr>
<td>4</td>
<td>46</td>
<td>Piraeus</td>
<td>Greece</td>
<td>2,745,012</td>
<td>1,680,133</td>
<td>1,064,879</td>
</tr>
<tr>
<td>5</td>
<td>47</td>
<td>Giolà Tauro</td>
<td>Italy</td>
<td>2,721,104</td>
<td>2,305,000</td>
<td>416,104</td>
</tr>
<tr>
<td>6</td>
<td>54</td>
<td>Maarssevek</td>
<td>Malta</td>
<td>2,540,000</td>
<td>2,360,489</td>
<td>179,511</td>
</tr>
<tr>
<td>7</td>
<td>66</td>
<td>Genoa</td>
<td>Italy</td>
<td>2,064,806</td>
<td>1,847,102</td>
<td>217,704</td>
</tr>
<tr>
<td>8</td>
<td>77</td>
<td>Barcelona</td>
<td>Spain</td>
<td>1,756,429</td>
<td>2,034,693</td>
<td>-278,264</td>
</tr>
<tr>
<td>9</td>
<td>95</td>
<td>Mersin</td>
<td>Turkey</td>
<td>1,263,495</td>
<td>1,126,588</td>
<td>136,907</td>
</tr>
<tr>
<td>10</td>
<td>96</td>
<td>Las Palmas</td>
<td>Spain</td>
<td>1,253,205</td>
<td>1,349,968</td>
<td>-96,763</td>
</tr>
</tbody>
</table>

Source: “Top100 Container Ports 2012”. Containerisation International

#### 6.1.1.3 Bulk Traffic

The crude oil tanker market is currently suffering from a very depressed situation with an abundance of tonnage. Growth in demand will predominantly come from non-OECD countries.
Figure 4. World Seaborne Trade in Cargo Ton-Miles by Cargo Type, Period 1999-2013 - Source: Review of Maritime Transport 2013, UNCTAD

Liquid bulk goods accounted for 39% of the total tonnage of cargo handled in the main EU-28 ports in 2012, followed by dry bulk goods, containerised goods and Ro-Ro mobile units.

At the beginning of 2012, the total tanker fleet was comprised of 12,902 tankers totalling 547 million DWT, thereof 10,194 oil tankers and oil-products tankers with 497 million DWT, 1,144 pure chemical tankers and 1,564 liquid gas tankers. The total tanker fleet increased by 4.5% in terms of tonnage from 2011 to 2012. Looking at the period 2008-2012, the total tanker fleet tonnage increased on average by 5.7% per year.

Bulk carriers dominate the world merchant fleet. The bulk carrier fleet grew by 14.7% in 2011. The past year was a record year for the delivery of new bulks carrier ships; at least 1,195 ships with a tonnage 99 million dwt were delivered. Removals amounted to 24 million DWT, which also marks an all-time high. Meanwhile, the world bunker carrier fleet has exceeded the 9,000-ship mark. Bulk carriers contributed nearly two-thirds to the world fleet tonnage delivered in 2011. With an increase of 14.7%, the dry bulk sector again witnessed a staggering year-on-year growth.

The demand for LNG is on the rise and new LNG plants are being built in many countries. LNG carriers are enjoying a surge in consumption, resulting in a positive outlook for the LNG ship segment.

The LNG market is dependent on the gas price and on environmental pressure to use cleaner fossil fuels. We are likely to see a continued growth in demand in this market between 2015-2020, and even more so beyond 2020. Based on this, a rapid expansion of LNG bunkering-networks is expected.
6.1.2 Ports

This section aims at presenting how the ports could be categorised in relation to the services they offered to the shipping industry.

The UNCTAD has identified four different generations of ports according to the services offered to the shipping industry (see “Multimodal Innovation for Sustainable Maritime and Hinterland Transport”):

- **First-generation**, ports “whose facilities, behaviour and strategy are concentrated to offering basic port services to ships such as sheltered waters, nautical services and cargo handling services through generic port terminals and generic handling means”.

- **Second-generation**, ports where “specialisation in operations is of growing relevance, having strategies oriented to the specialisation of terminals and the use of optimised mechanical equipment for each operation, seeking also improvements in their management capacities within the port boundary”.

- **Third-generation**, ports “whose activities are not exclusively focused on providing ship and cargo-handling services but they are enlarging their service scope to transform into effective logistics platforms for trade beyond the port boundary”.

- **Fourth-generation**, ports that are “characterised by diversification and internationalisation of their activities, automation of activities, strong cooperation between the port community and complementary ports in view to increase its competitive advantages and transform into a networked port, perfectly integrated in the logistics chain and in global supply chains where the handling and distribution of information is a cornerstone”.

Figure 5. Crude Oil Tanker Fleet vs. Crude Seaborne Trade Evolution and Forecast Source: Shipping 2020 - DNV
6.2 Institutional Situation

This section describes the current institutional situation within shipping and port operations.

6.2.1 Legislative Situation

The legislative and regulatory aspects of shipping have their foundation in the international law of the sea. In the current codified form it is reflected in the United Nations Convention on the Law of the Sea (UNCLOS), particularly in relation to the various maritime zones of a coastal state, and also the high seas where freedom of navigation is a right that is enjoyed by all states.

Similarly, on the high seas the flag state jurisdiction over its ships is virtually exclusive except where the International IMO Convention applies or where the laws under UNCLOS relating to piracy apply. This provides for universality of jurisdiction and in cases of hot pursuit under UNCLOS the coastal state jurisdiction also applies within certain limitations. IMO regulatory conventions are basically flag state agreements; even though the practical application of SOLAS, MARPOL and STCW is generally carried out by single ports.

Since flag state jurisdiction is predominant on the high seas, including cases of collisions involving both civil and criminal jurisdictions, any state that attempts to exercise jurisdiction over a ship on the high seas is likely to face insurmountable obstacles under the international maritime law as it currently prevails.

“Search and Rescue” (SAR) practices are a maritime safety aspect that is closely related to SOLAS and COLREGS. SAR is both an international as well as a regional concern and is governed by the IMO SAR convention. SAR is also connected to “salvage”, given that both these activities are frequently caused from shipping accidents such collisions, groundings, fire, oil spills. Salvage at sea is regulated by the International Salvage Convention, 1989 adopted by the IMO.

6.2.2 International Maritime Organisation

IMO describes itself as a specialised agency of the United Nations, which represents a ‘global standard-setting authority for the safety, security, and environmental performance of international shipping’. IMO’s main role is to create a regulatory framework for the shipping industry that is fair and effective, universally adopted and universally implemented. As a consequence IMO ‘measures cover all aspects of international shipping including ship design, construction, equipment, manning, operation and disposal’.

6.2.3 European Maritime Safety Agency

The European Maritime Safety Agency (EMSA) is based in Lisbon; the Agency provides technical assistance to the European Commission in the development and implementation of EU legislation on maritime safety. It has also been given operational
tasks in the field of oil pollution response, satellite monitoring and in the long-range identification and tracking of ships.

EMSA primarily undertakes a number of preventive task, but also reactive ones in certain key areas in order to meet its objectives.

Firstly, the Agency has been assigned to assisting the Commission in monitoring the implementation of EU legislation that, among others, relate to ship construction and planned maintenance, ship inspection and the receiving of ship waste in EU ports, certification of marine equipment, ship security, the training of seafarers in non-EU countries and Port State Control.

Secondly, the Agency operates, maintains and develops maritime information capabilities at an EU level, through the SafeSeaNet (SSN) system.

According to the EMSA website, marine pollution preparedness, detection and response capability have been established at a European level. This goal has been reached through a European network of stand-by oil spill response ships as well as through a European satellite oil spill monitoring and ship detection service (CleanSeaNet). Both systems contribute to an effective system for protecting EU coasts and waters from pollution by ships.

6.2.4 Ship Operations and Traffic Management

In order to reduce the economic and administrative burdens, IMO 39th FAL Committee Conference stated that all data exchange should be transmitted in an electronic format. Additionally, the EU Directive 2010/65 anticipated this issue in all EU Member States by introducing a similar regulation.

According to the above-mentioned directive, “parties involved in trade and transport should be able to lodge standardised information and documents via an electronic single window to fulfil reporting formalities. Individual data elements should only be submitted once” (point 9 of the premise) and “Member States shall accept the fulfilment of reporting formalities in electronic format and their transmission via a single window” (Art. 5).

Currently neither standard practice nor standard electronic messages are fully implemented. In some countries data have to be transmitted to the national maritime single window systems, while in other countries ports are acting as gateway. In some countries UN/EDIFACT FAL Form is accepted, in other countries specific formats have been defined. The situation is still in evolution and dedicated projects (see AnNa

Ship Operations and Traffic Management processes are characterised by a strong ashore-on board information flow requiring hard work towards its harmonisation and standardisation. Simplification will be an additional goal to achieve.
National Single Window project) are working on it. In order to prevent or reduce the risk of accidents, hazards to human life in the marine environment, SOLAS introduced a set of ship monitoring and controlling systems such as:

- Ships’ Routing Systems
- Vessel Traffic Service (VTS)
- Voluntary / Mandatory Ship Reporting Systems (SRS).

Today traffic flows can be controlled in a static way via stationary Mandatory Ship Routing Systems. Examples of these types of systems are: Separation Zones, Traffic Separation Schemes (TSS), and Restricted Areas. The European Union has adopted several legal instruments including the Vessel Traffic Monitoring Directive 2002/59/EC (EU, 2002). Its aim is to establish a ship traffic monitoring and information system “with a view to enhancing the safety and efficiency of maritime traffic, improving the response of authorities to incidents, accidents or potentially dangerous situations at sea, including search and rescue operations, and contributing to a better prevention and detection of pollution by ships” (EU, 2002). To achieve these objectives, in 2001 the European Commission launched the development of a European network, SSN, for maritime data exchange between maritime administrations.

This was decided in order to make all the flows of information electronic since that will increase the level of control. In addition, the initiative would benefit the industry since it would decrease the administrative burden.

Some practices, usually related to port operations, are actually part of traffic management due to their execution during the ‘last mile’ navigation. These ship operations are also called ‘technical-nautical services’:

- Pilotage
- Towage
- Mooring

For each of the above-mentioned services data must be provided according to each specific port regulation framework.

### 6.2.5 Port Operations

The European Commission has a general definition for a Port Authority as ‘the entity, which, whether or not in conjunction with other activities, has as its objective under national law or regulation the administration and management of the port infrastructures, and the co-ordination and control of the activities of the different operators present in the port’.
However, port authorities may also vary in: their size, the kind of traffic they manage, their political, social and geographical environment, their main objective, the way they approach their functions and the role and strategies they adopt. All these factors will influence directly the way port authorities approach ICT and their likelihood of adopting e-maritime solutions.

Those port authorities with more interest in maximising the ports value-add will be more interested in offering better e-maritime solutions for the overall port community. Those ports more focused in maximising profit or handheld tonnage will seek for corporate solutions that assist them in achieving those targets.

Typical Port authorities functions are:

- **The landlord function:** management, maintenance and provision of infrastructure and facilities as well as conception and implementation of policies and strategies.

- **The regulator function:** controlling, supervision and policing to ensure safety and security of cargo operations.

- **The port operator function:** port services such as physical transfer of goods and passengers between sea and land and ancillary services (provision of water, provision of electricity, provision of bunker, waste disposal or warehousing and logistics services).

In Europe, port authorities provide ancillary and technical nautical services themselves and act as community managers rather than just logistics operators.

### 6.3 Operational and Technical Situation

In this section ship operations, traffic monitoring and management as well as port operations are described.

#### 6.3.1 Ship Operations

Processes related to ship operations must be analysed from both operational and technical perspectives.

- **6.3.1.1 Operational situation**

  A ship needs a voyage plan to follow between the departure from one port to the arrival at another. There is both dynamic and static information. Dynamic information is for example weather, draft, cargo and tide. Static information is for example length, width and height of the ship, also from navigational- and cargo related aspects.

  Navigational issues such as depth, water, current and safety information is the main focus for the captain and the officer on the watch (OOW). But the most complex
planning operations on board concern issues related to cargo, by managing information like ETD from port and CTA of next port of call. IMO issued a specific guideline document according to Resolution A.893 (21) adopted on 25 November 1999. The Objectives of the guidelines are:

1. The development of a plan for voyage or passage
2. The need for voyage and passage planning applies to all ships
3. Voyage and passage planning appraisals

The operational procedure is normally divided into sequences and firstly the voyage order will come from the owner or the charterer containing port of loading and discharging. That will set the geographical route for the voyage. A route can be obtained from a general route library and adjusted according to the premises of the static data of a specific ship. After that the related dynamic conditions must be applied in order to safely and soundly navigate the ship along the passage plan, continuously adjusting for issues such as weather, tide and passing canals and locks.

The planning includes the following processes:

- **Appraisal** - The process of gathering relevant information for the passage and a first assessment of the voyage;
- **Planning** - Detailed planning of the passage from berth to berth
- **Execution** - When the Estimated Time of Departure (ETD) and Estimated Time of Arrival (ETA) have been set the final tactics of the execution of the voyage can be made;
- **Monitoring** - The process of monitoring that the ship is proceeding according to the plan.

If the ship receives new orders regarding the destination, a new voyage plan needs to be created for that part of the voyage. The ship should not proceed towards the new destination until a new plan has been established and approved by the master.

The monitoring phase includes the execution of the voyage. It can be divided into the following sub-phases: port manoeuvre, pilotage leaving port, coastal navigation, open sea navigation, landfall, coastal navigation, pilotage entering arrival port, and finally port manoeuvring. Above listed sub-phases represent an ocean passage.

It is has to be underlined that a structured validation process of the route does not exist. In international areas the route validation is under the responsibility of the shipmaster but in specific areas such as high intensive traffic areas, narrow channels, and so on there is a need of specific rules to regulate this process.

### 6.3.1.2 Technical situation

**Navigation systems**

There is no standard within the maritime industry and the planner’s environment varies greatly as different actors take on different approaches to the same issues. Today the
typical voyage planning tool for the officer on the bridge is interfaced towards the ECDIS system and normally provides the following support:

- Navigational Charts
- ECDIS (Electronic Chart Display and Information System)

**Communication systems**

Several radio communications systems are used to ensure consistent and effective communication ship-to-ship, ship-to-shore and shore-to-ship in compliance with international, national and local regulations, safety and environmental protection, and participation in search and rescue activities. The introduction of GMDSS (Global Maritime Distress and Safety System) - has made a number of innovations in radio communication procedures between ship - ship and ship - shore station.

**Voyage Data Record (VDR)**

According to Directive 2002/59/EC, member states are required to ensure that data from VDR systems are used in an investigation and are properly analysed.

**Information management situation**

Even though most of the information in shipping today flows via e-mail, fax and in some cases telex, not codified information sharing principles still exist, such as VHF vocal communications, which are not based on standard defined glossary nor properly traced.

**6.3.2 Traffic Monitoring and Management**

Traffic monitoring systems make it possible to achieve a potential real time situation based on several sources of complex data, such as voyage data, consumption data, pax and goods data that is related to traffic and ship overview. It also makes is possible to monitor sailed routes in critical areas. Nevertheless such data is not usually available in a timely fashion due to different refresh frequencies or updating obligations for data related to some events.

Authorities need improved tools to manage issues such flow management, which for example will allow them to set up provisional no navigation areas and search and rescue management. Operational situation

SOLAS introduced a set of systems such as:

- Vessel Traffic Service (VTS);
- Ships’ Routing Systems;
- Voluntary / Mandatory Ship Reporting Systems (SRS).

Ship traffic can be monitored by shore-based and space-based assets establishing a traffic image. Today traffic flows can be monitored in a static fashion by stationary mandatory ship routing systems.
Vessel Traffic Service (VTS)

In 1985 IMO adopted resolution A.578 (14) Guidelines for Vessel Traffic Services (VTS), (IMO, 1997) VTS is defined by IMO SOLAS chapter V Regulation 12. The purpose of VTS today is to provide active monitoring, information service, traffic organisation, and navigational assistance for ships in confined and busy waters. Today, there are some 500 VTS operating globally (IALA, 2002).

Ship Reporting System (SRS)

A Ship reporting systems is a tool established to improve the safety at sea and increase the level of efficiency of navigation, and/or increase the protection of the marine environment. Mandatory SRS are defined by IMO SOLAS in Chapter V Regulation 11 (IMO, 2003).

Ships Routing Systems

The general provisions of a ship’s routing are established in Regulation 8 Chapter V SOLAS where the purpose ‘is to improve the safety of navigation’ in converging areas and in areas where (IMO, 2003):

- The density of traffic is great
- Freedom of movement of shipping is inhibited by restricted sea room
- The existence of obstructions to navigation
- Limited depth
- Unfavourable meteorological conditions.

In 2008 there were 144 ship routing systems adopted by IMO, while 120 had a non-adopted status (IMO, 2010).

From a technical point of view, ship traffic is monitored by a shore-based radar network and AIS (Automatic Identification System) base stations networks. Shore-based systems have coastal coverage in the order of 30 NM and as a complement satellite based systems have been developed. Space AIS and LRIT are two types of target monitoring possibilities at open water. SRS centres, VTS centres and to some extent Port control centres perform the actual monitoring of the ship traffic. Typical examples of navigation monitoring services are provided by Marine Traffic website (www.marinetraffic.com). Data such as voyages identification, route tracking, general ship information such as IMO number and technical characteristic are made public via AIS systems.

Most of the times the ships’ routes are only known aboard the ship and are loaded into the ECDIS system or Integrated Navigation System. However, some shipping companies use advanced Fleet Management systems for route monitoring and route optimisation. ECDIS are today mandatory and will be phased in to 2018.
In the context of vessel monitoring, information can be classified according to:

- **Dynamic data**
- **Voyage data**
- **Static data**
- **Meta data/pictures**
- **Alerts and warnings.**

Further discussion of these below:

**Dynamic data** contains information that continuously changes during the voyage. Examples of this type of data are position, speed, course/heading and rate of turn. Currently dynamic data is acquired via shore-based AIS base stations along the coast. This type of information can also be acquired via the satellite system's long range identification and tracking.

**Voyage data** contains information that is static during the voyage but change between voyages.

**Static data** represents information of the target that stays constant over long time periods such as ID, name, call sign and ship particulars.

Area information such as temporary or permanent restrictions, prohibitions, fuel-mandatory-use is usually transmitted by maritime authorities in broadcast mode and has to be well known by masters.

The following transmission channels are used:

- VHR radio message (sometimes also transmitted via radiotelegraphy)
- FM public radio communications
- Navigational warnings paper bulletin, issued previous subscription at official sources
- Automated medium frequency direct-printing service like Navtex (Navigational Telex), is an international system for delivery of navigational and meteorological warnings and forecasts, as well as urgent marine safety information to ships. Note that Navtex is a major element of the Global Maritime Distress Safety System (GMDSS). International Convention for the Safety of Life at Sea (SOLAS) mandated certain classes of ships must carry Navtex, starting August 1, 1993.

**6.3.3 Port Operations**

The current situation of port operations is described from an operational- and technical point of view with a focus on information management.
6.3.3.1 Operational situation

In general there are no guidelines for the implementation of standard processes, leaving to individual operators and individual ports to define what information is to be exchanged between the ship and the land and the organisation of operations.

Below there is a brief description of some of the important actors in the port approach process:

Pilotage

A pilot is a manoeuvring expert with good knowledge of the local waterways. It is often compulsory to use a pilot when berthing at a jetty in a port or manoeuvring in restricted coastal areas. The pilot is also able to provide effective communication with shore, such as the port officer, and the tugs that are assisting during berthing (IMO1, 2014).

Pilots are usually employed by the maritime administration of the country or by the local port and they provide their services to the ship in exchange for a fee (IMO1, 2014).

The pilot is able to provide effective communication via VHF with shore, such as with the port officer, when berthing and with tugs assisting during berthing, since they generally are native speakers of the language used and have long experience of close collaboration with the port and the towage companies within the port.

Towage

Depending on the port regulations it can be compulsory for some ships to use one or more tugboats during berthing. In some cases the captain of the ship or the pilot prefer to use a tugboat for berthing depending on circumstances such as weather conditions and in some cases the operator of the ship has a company policy that establishes that a tugboat should assist during berthing to increase the safety.

In some ports it is compulsory for certain ships to use escort tugs when approaching a port. In Gothenburg for example escort tugs are compulsory for loaded tankers over 30,000 dwt and for ships over 30,000 dwt in ballast conditions and not gas free, with flashpoint below 60°C (Port of Gothenburg, 2014 & SMA3, 2014).

The captains of the tugboats are experts on local conditions and have a long experience of close collaboration with the pilot, VTS and the port.

Mooring

Assist with mooring of the ship in port when ship is berthing and sailing.

The mooring is carried out according to the loading/unloading measures that affect how to fasten of the ship; this operation is often carried out by external providers; sometimes supply ships are used. The ropes are then recovered on board manually or by machine and pulled.
6.3.3.2 Technical situation

Nowadays, to support the modernization of the ports and trade facilitation are under development models like the “National Maritime Single Window” (NMSW) and the “Port Community System” (PCS).

On the one hand, UN/CEFACT defines a Single Window (SW) as ‘a facility that allows parties involved in trade and transport to lodge standardised information and documents with a single entry point to fulfil all import, export, and transit-related regulatory requirements. If information is electronic, then individual data elements should only be submitted once.

On the other hand, the International Port Community Systems Association (IPCSA) defines the Port Community System (PCS) concept as a neutral and open electronic platform enabling intelligent and secure exchange of information between public and private stakeholders in order to improve the competitive position of the sea and air port’s communities. Moreover, this entity adds that these systems optimise, manage and automate port and logistics processes through a single submission of data and connecting transport and logistics chain.

At the port there are also systems for the planning of, and coordination of, port approaches. The Port authority and the port control have their own systems and different port operators, such as tug operators, terminals, and linemen organisations, have their own systems. Unlikely there is not a common approach among the different ports about their systems: different systems still offer different solutions to the same issues.

Telephone calls, emails and even paper format are still important modes of communication in the port approach process. In that sense it can be stated that SW and PCS are tools that support specific parts of the whole process.

6.3.3.3 Information management situation

Most of today’s information management/information sharing related to port approaches is conducted on a one-to-one basis. This means that interaction occurs between the one party that needs/should have information and the one that has information/should be informed. This has created a situation in which many actors ‘sniff around’ to find out when their services are needed for planned approaches.

The port authority has the role to build and consolidate its ‘community’ also through the development of ICT systems or PCSs.
7 Analysis of current situation: maritime transport

This section analyses the current situation of maritime transport by:

- Identifying strengths with regards to efficiency, safety, and the environment
- Identifying weaknesses with regards to efficiency, safety, and the environment
- Identification of initiatives that address these areas
- Conclusions based on strengths, weaknesses and current development and identification of how the needs can be addressed.

The same structure has been used as was introduced in chapter 3:

- Shipping
- Ship Operations
- Traffic Monitoring and Management
- Port Operations.

7.1 Shipping

This paragraph looks at various aspects of shipping as a whole.

7.1.1 Strengths

Today shipping is an important and successful mode of transportation that shows a positive trend in several areas. Below there are two examples within safety and environment, respectively.

There are many factors influencing maritime safety such as design of (ship, port, waterway); education and training; voyage frequency, routes, ship type and size; navigation aids; operation instructions; organisational influence; regulation; human integration into systems and automation and managing. The international shipping industry has begun to move from a reactive safety approach to a proactive one. Therefore, following the international and European regulation, several initiatives have been deployed to increase the level of safety at sea.

On the environmental side, international regulation such as MARPOL and European ones such as directive 2005/35/EC on ship source pollution, or Bird and Habitat Directives in estuaries and coastal zones, provide guidelines with particular focus in finding the right balance between environmental protection and maritime development. Moreover EMSA provides a system named CleanSeaNet (see related website) aimed at monitoring the pollution that is derived from hazardous mineral oil and noxious substances. This tool locates illegal oil discharges, identifies polluters, sends dedicated oil spills alerts (via email and phone) and monitors accidental spills based on the analysis of satellite radar images. The images are transferred to the coastal states in close to real time. EMSA also provides a network of stand-by oil spill response ships.
and expertise. EMSA “CleanSeaNet” measures can be improved by the sea traffic management system that could provide accuracy in the identification of polluters.

7.1.2 Weaknesses

Today it is difficult to achieve the level of overview needed to identify common areas of improvement amongst the European sea traffic stakeholders. The lack of a common voyage analysis tool, that would enable improved initial voyage planning and voyage success rate, makes it difficult to improve beyond the planners' idea of 'best practice'.

The point-to-point contact between stakeholders that exist today makes the handling of information quite a tricky business and it is necessary to have some kind of coordination for that process. The information exists in different forms and media due to demands from different authorities and other parties. The flow of information is also restricted and regulated by different time axis from the different parties. For example, the customs in one port wants the ETA and cargo specification 72 hours in advance and sent by fax. The pilot needs info of the ETA 6 hours in advance by telephone call and the cargo terminal needs a mail 48 hours prior to arrival. The needs and variables are almost endless because the prerequisites differ from port to port and country to country. Bringing order to the information flows will make the operation easier for ship agents that are kept busy attempting to consolidate all data to get a clear overview. They are stakeholders not because of interest in the result of the process but of the process itself.

Further, the high traffic navigation level in some marine areas and the presence of even larger ships, may affect aquatic organisms and biodiversity and as a further consequence, negatively alter marine biocenosis.

Maritime activities generate a significant impact in terms of emissions, noise, water and soil pollution and fragmentation of habitats. 20% of all waste discharged into seas come from shippers. Moreover 664 ships were involved in 559 accidents (collision, grounding, fire/explosion and other significant accidents) in and around EU waters during 2010. 48% of the accidents were collisions and 22% were involved in groundings. The number of accident has decreased as a consequence of the economic crisis with fewer voyages per year. Although in the last decade 143.000 tons of oil has been spilled into EU waters and the accident has leading to ship damage, pollution and/or loss of life.

7.1.3 Current Development

The EU Commission proposes to complement the existing international two-tier system on liability and compensation for tankers oil pollution damage by creating a European supplementary fund (“third tier”). This COPE Fund will compensate victims of oil spills in European waters.

The COPE Fund will compensate victims whose claims have been considered justified, but who have been unable to obtain full compensation under the international regime due to insufficient limits of compensation (EUR 200 million). The maximum limit is therefore set at EUR 1 000 million. The COPE Fund will be financed by European businesses that receive more than 150 000 tons of crude oil and/or heavy fuel per year in proportion to the amounts received.
Furthermore, the proposed regulation provides for the application of financial penalties for grossly negligent behaviour on the part of any person involved in the transport of oil by sea.

7.1.4 Needs and Recommendations

From the current business perspective an improved initial voyage planning, that is supported by early identification of influencing factors and information sharing amongst the involved sea traffic actors, will increase the success rate of voyage plans and the fulfilment of established and related performance targets.

We can also foresee some new business models and actors coming into the business with this new concept and probably others that will suffer from the evolution and maybe discover that their part of the process is becoming obsolete.

One of the issues that we have to confront, when introducing a new concept within the shipping industry, is the question of economic implications for all parties concerned including governments, port authorities, pilotage authorities and private sector entities involved in shipping and navigation. The implementation of new concepts involves serious financial considerations. In particular, developing countries may adopt the view that the new concepts being European in origin is one that is undoubtedly affordable by the relatively well-off western maritime interests, but could be a major financial burden for others. The response at these issues could be put forward, in terms of the practical usefulness and benefits of the proposals.

Furthermore, the INMARSAT model can be held up as an example where the financing is largely taken on by the private sector even though the INMARSAT system emanates from an international convention of the IMO. State parties to the INMARSAT Convention obviously have a role to play, but the whole system depends on collaboration and cooperation between the public and private sectors. The implementation of new concepts can be carried out in the same vein. Private sector interests stand to gain commercially from many aspects of new concepts and it is reasonable to expect that commercial entities would be keen to be involved.

There is a need for developing information systems for maritime operations that include geolocation of regulations and local restrictions that apply to the ships that are en route.

7.2 Ship Operations

This paragraph discusses strengths, weaknesses and needs within the field of ship operations, with a focus on some aspects as human factor, recruitment, training, and certificate and social factors.

7.2.1 Human Factors

Human Factors (HF) impacts are related to the analysis of human interaction with devices, the design of system, the team working practices, and various aspects of job and organisational design. (Stanton, 2006) The last point includes social factors, ranging from the organisation and performance of small teams through to the corporate
culture. The maritime industry of today is heavily dependent upon the performance of humans at all different levels.

This section aims at describing the current situation and status of the human role in the maritime domain that is relevant for the Sea Traffic Management (STM). Hence, the wide-range of human centred tasks involved will be discussed looking at current strengths and weaknesses of human factors, training, licensing, and social factors. Future needs will also be identified and should be used in the definition of the target concept.

The main objective of shipping is to transport different types of goods. This activity is a complex process involving several sub-processes such as navigating the ship, port operation, ship operations and management, customs procedures, agents. International and national regulations, labour unions and other policies are affecting all of these processes. Hence, the maritime industry is a complex sector with several stakeholders and roles. The different stakeholders are interlinked in a rather complex way, often described with the ship operator and owner at the centre, (Lützhöft, 2011). The ship operator needs to be in compliance with the classifications regulation such as flag state requirements, IMO STCW regulations and International Labor Organisation (ILO) rules. The fact that a ship can be owned in one country and operated from another and registered in a third obviously complicates the situation.

Shipping faces a number of unique operational challenges:

- Difficult environment (hot, cold, windy and wave motions)
- Relatively isolated during long periods of time
- Operated by a multi-cultural crews
- Complex owner structures.

There are several roles in the maritime domain, such as:

- Staff ashore at authorities, shipping companies, in ports, and at traffic monitoring centres such as VTS and SRS
- Staff on board ships such as ship’s crew, and pilots.

The discussion in this section focus on mission critical staff and will therefore focus on ship’s crew, pilots and VTS operators.

The normal organisation of the ship’s crew is (Sjomanskap, 2012) in three main departments:

- Deck
- Engine
- Service/hotel
These departments consist of different types of staff: the **master** and officers who organise and lead work on board, and support hotel and catering staff. The overall responsibility of the ship's safety, cargo, crew, and the running of the ship is all on the master. The master is assisted with the **chief engineer**, responsible for the engineering department, and the **chief officer**, responsible for the deck department. It should be noted that like any other manager, the master is also responsible for financial budgeting, personnel, and security issues, (Lützhöft, 2011). The chief officer plans and organises and leading deck maintenance work, cargo placement, securing, and ballasting and is responsible for the stability of the ship. The other deck officers perform watch keeping as well as managing the loading and discharging of cargo. Ratings perform general maintenance work and are involved in cargo operations. During bridge watches a rating can function as a lookout and helmsman if the steering system is switched to manual. The chief engineer is responsible for the engine maintenance and the engine crew. The chief engineer is head of safety, including firefighting. Engineering officers plan and perform maintenance work. It is important to note that usually, watches are kept in the engine room, only on passages in restricted waters, when passing locks and entering and leaving port. Engine ratings mainly perform maintenance work and repairs.

The pilot increases the size and level of competence of the team on the bridge. Pilots may be used for several reasons (Anwar, 2008):

- May be required by local regulations
- Provide local knowledge
- Provide expertise in manoeuvring and working with tugs
- Over bridge language barriers.

Some major accidents in shipping have highlighted the human element in the maritime domain, (Lützhöft, 2011). In the last 30 years serious work has been carried out in this area. A report by the U.K. Maritime Coastguard Agency (Rowley, 2006) identified the following human element issues that should be considered:

- Overreliance on automation
- Lack of in-depth understanding
- Suboptimal ergonomic design
- Suboptimal human-computer interface design
- Inherent system latency interfering with error recovery efforts
- Lack of awareness of automation failsafe modes
- Maintenance and calibration errors
- Poor support to the development and maintenance of situation awareness
- Information overload issues
- Display inconsistencies between different manufacturers
- Poor appreciation of automation characteristics and limitations by operators
- Automation not designed around operators’ abilities and limitations
- Standardisation
- Training
- Subsequent changes made to original automated system designs.

An optimal system should integrate the human into the technical system, keeping the operator in the loop with an open and transparent Human Machine Interface (HMI) that shows information at the right level of complexity at the right time. The technical system should, at the same time, actively train the operator in taking part in the operation and also allow the operator to simulate critical situations.

The system should be made to fit to human, rather than adapting the human to the system.

### 7.2.2 Recruitment, training, and certificate

The ship’s crew’s competences, certificates and requirements are detailed in IMO’s International Convention STCW. STCW includes detailed learning objectives broken down for each subject and for each certificate. IMO also has issued a number of guidelines – IMO model courses – providing a detailed curriculum for each course that leads to a particular certificate. Officers are trained at maritime academies typically for a period of three years. The training includes both theoretical studies and practical training in ship simulators. To hold a valid officer license extensive at sea experience is also required.
VTS operators should be trained according to IALA recommendation V-103 on standards of training and certification of VTS personnel. These model courses are intended to provide national members and other relevant authorities with specific guidance on the training of VTS staff. However, this is not yet a mandatory requirement.

If new systems, services or information are introduced on the bridge, engine control or shore side control centres, the training needs have to be analysed in parallel with the development and the training has to be conducted before the actual implementation takes place. Hence, the target concept for STM should include an analysis with regards to training needs. The system HMI should be standardised and be intuitive in order to minimise training efforts and to avoid the system misusing.

7.2.3 Social factors

This section focuses on some aspects regarding maritime safety cultures on board ships.

The maritime domain can be said to have “a rooted, embedded culture following centuries of shipping traditions and its value on traditional behaviour, with norms and practices driven mainly by a set of universal rules and regulations” (Shea, 2005). The last couple of centuries have been characterised by globalisation and many ships today have multinational crews. Today, most seafarers are natives of Asian countries, such as the Philippines, Indonesia, India, China, and Vietnam. There is also a high proportion of seafarers that are recruited from the Baltic States as well as from Poland, Romania, and the former Soviet Union (Warwick Institute for Employment Research, 2005). Therefore a good knowledge of the English language is essential, not for communication between ship and shore but also between crew members aboard the ship. One measure IMO has taken is to introduce Maritime Standard Phrases.
Following the *Herald of Free Enterprise* accident (Sheen, 1987), in 1990 the United Kingdom made a proposal to the IMO regarding a standard for safety management. The Safety Management Standard (SMS) was introduced and in 1998, the ISM Code was made mandatory and included within SOLAS. Regulated by the IMO, this code requires ship operators to implement a formal SMS. One of the main aims of the code is to link every ship to a ship operator ashore. This code applies to and affects most activities carried out on board ships as well as ashore. The ISM Code provided the maritime domain with a measurable safety indicator. Part of the SMS is implemented as Standard Operating Procedures (SOP) and checklists.

The development of a no-blame and safety culture should continue for all mission critical staff. Measures for improving incident reporting should be identified and implemented. Further improvement of the safety cultures also requires further research in the area of human-technical-organisational issues in the maritime domain.

It is important to consider not just the training needs when a system is developed. SOP (Standard Operating Procedure) should also be defined and tested and the users should be involved in the process of establishing these procedures. These individuals are essentially the experts who actually perform the work or will be using the new process. A team approach could also be followed, especially for multi-tasked processes where the experiences of a number of individuals are critical, which also promotes ‘buy-in’ from potential users of the SOP. It is important that the SOPs are written in sufficient detail so that someone with limited experience with or knowledge of the procedure, but with a basic understanding of it, successfully can reproduce the procedure when unsupervised.

Further, SOPs should be validated by one or more individuals with appropriate training and experience with the process. It is especially helpful if draft SOPs are actually tested by individuals other than the original writer before the SOPs are finalised.

**7.2.4 Strengths**

The safety of shipping in European waters is of crucial importance since 90 % of the European Union's trade with countries outside of the region is seaborne. The risk of accidents due to the concentration of traffic in the main European seaways is particularly high in areas where the traffic converges, such as the Strait of Dover or the Strait of Gibraltar. Furthermore, the environmental consequences of an accident at sea, even outside areas of high traffic density, can be disastrous for the economy and the environment of the member states concerned.

Therefore the aim is for the European Union to acquire the means to monitor and control the traffic off its coasts in a more effective manner and to take more effective action in the event of critical situations arising at sea.
To this end, the Vessel traffic-monitoring Directive provides for:

- Improving the identification of ships in areas of high traffic density by requiring them to carry systems so that they can be automatically identified and monitored by the coastal authorities;
- Making systematic use of electronic data interchange to simplify and harmonise the transmission and use of data on dangerous or polluting goods carried by ships;
- Requiring ships calling at Community ports to carry black boxes (voyage data recorders) in order to facilitate the investigation of accidents;
- Enhancing the powers of intervention of Member States, as coastal States, where there is an accident risk or threat of pollution off their costs;
- Prohibiting ships from leaving ports in weather conditions where there is a serious threat to safety or the environment.

Further, the e-Maritime initiative adopted by EU aims to foster the use of advanced information technologies for working and doing business in the maritime transport sector.

7.2.5 Weaknesses

The current operational situation related to the early planning of a voyage is not adequately supported taking into account the influencing factors and areas of improvements increasing the success rate of a voyage plan. The involved actors in need of sea traffic services are not able to commonly market/share their needs, nor available capacity and resources in the early planning phases. Even though the European network, SafeSeaNet, is in use and amongst other functions already is reducing the burden of administration, it doesn’t encompass the elements of collaboration, displaying or identifying all relevant regulations. Nor does it currently offer any presentation of route alternatives for a voyage between known locations.

The current initial voyage planning is supported by information provided by several planning tools. However, the information provided is fragmented, non-standardised and does not support an overview a voyage plan from ‘birth to grave’. The compliance with existing local legal aspects of maritime law is difficult to achieve in early planning phases.

The lack of harmonisation around the European seas, with regard to routing, control, regulatory aspects and even berthing processes creates a need for coordination of even the simplest task.
These are essential elements that today are not available to make analysis and identify factors where the plans intentions weren’t met and should be improved for future voyages to be improved with regard to effectiveness and safety.

From the safety horizon the main difference of an exchangeable voyage plan with the voyage plan of today, is that today it’s only the own ship that knows about their intentions. Meeting ships cannot know the voyage plan for other ships in advance. The AIS can assist in giving name and number plus port of destination but not the way over the waters ahead. Today it’s necessary to call by VHF to find out the intentions of other seafarers.

### 7.2.6 Current Development

IMO has taken the initiative to develop e-navigation, with the aim ‘to integrate existing and new navigational tools, in particular electronic tools, in an all-embracing system that will contribute to enhanced navigational safety (with all the positive repercussions this will have on maritime safety overall and environmental protection) while simultaneously reducing the burden on the navigator’.

IMO’s e-navigation concept includes a Maritime Service Portfolio (MSP):

- MSP1: Information Service
- MSP2: Navigation assistance service
- MSP3: Traffic organisation Service
- MSP4: Local Port Service;
- MSP5: Maritime Safety (MSI) Service;
- MSP7: Tug Service;
- MSP8: Vessel Shore Reporting.

e-Navigation is broadly used for describing navigation using digital charts and digital navigational communication. The digitalisation of charts and definition of the ECDIS (Electronic chart display and information system) have given vessels' bridges a new tool for navigation with new possibilities. The ECDIS was mandated in 2009 whereas most ships should be covered with this standard no later than 2018. The electronic charts and standardised chart displays systems opens up for new real-time services to be integrated with the on-board support. By automating several manual tasks of information-gathering, plotting and information distribution of positions and intentions, much time can be saved leaving more time for decision-making and safe navigation on the bridge.

Further, the European Marine Casualty Information Platform (EMCIP) is a tool that host and store casualty data and investigation reports notified and summited to the member states according to Directive 2009/18/EC. This system is now connected with the IMO Global integrated shipping information system GISIS to avoid duplication data and it is a tool for the coastal guard.
Also, there are several initiatives to support the maritime safety regionally or with a different objective, which could be useful for a sea traffic management system, as the new National Maritime Single Window, MARE, the Mediterranean AIS regional system, Marylin project, and Spationav project among others.

7.2.7 Needs and Recommendations

The role of the ship will remain as master planner but the old-fashioned way of retrieving data by books, pilot charts, phone calls, fax and mail will be replaced by faster and more reliable means of data exchange. The process of route planning will remain but in a new shape that demands some new tools on board and ashore and that requires investments to be made.

In the future when all stakeholders will have direct access to all information when they need and to use it as they see fit, the role of the ship agents will see enormous changes.

The role of service providers, such as vendors of route optimisation software and services like weather institutions, will remain as is and probably not change that much compared with today. Differences and improvements will be standardised (route exchange format) and thus simplifying the internal process of optimisation without the necessity of interpreters and interfaces that today can clog up or fuzz the voyage info.

For other existing main key players like ports, terminals, pilots, owners and charterers the process of route planning will move from being more of a passive receiver of ETA data from the ship to actually be a more active partner, contributing and refining the result and providing the ship with relevant information in real time.

The ship should not be isolated from the rest of the world and left alone to do their own planning and thereby affecting the involved stakeholders in an unforeseen way. The internal route planning process from the ships bridge and the captain’s private office needs to be placed on a visible open source platform where all involved parties can operate in an entirely transparent way. The results will be available to all authorized stakeholders, and all parties can adjust their business accordingly.

The absence of immediate and updated dynamic information today makes it difficult or impossible to plan ahead, and the ship normally only use known navigational related information. Today all shareholders have to seek out the information they need and the industry operates based on “Need to know” principles rather than a “Need to share” model that we suggest.

7.3 Traffic Monitoring and Management

This section takes a closer look at current ship traffic monitoring practices.
7.3.1 Strengths

Traditionally the maritime sector is the most sensitive of the different modes of transport in terms of safety and efficiency issues both. This is due to the fact that it is ‘human intensive’ and because support that might be needed is far away while the ships are on route. To that aim, SafeSeaNet gives the participant countries rapid and reliable access to all of the important information regarding ships movement and planned routes. They also receive information regarding the precise nature of the cargo on board, if the ship is carrying dangerous or polluting materials, and also “ship particulars” about the ships that pose a potential risk the safety of shipping and the environment.

Further, national SafeSeaNets have been implemented in a satisfactory way at the technical level, although the quantity and quality of the information in the system can be improved. The ship notification should be sent 24h before the departure, or at the time of departure at the latest, when the voyage time is less than 24h. This includes the ship’s identification, position and status, information of the ship itself, hazardous cargo, estimated time of departure and arrival in the different ports and all incident reports if any. A management system could increase the accuracy of the arrival and departure time, the cargo on board and the position of the ship at each step of the voyage.

7.3.2 Weaknesses

With a few exceptions, there is generally no organised cross-national shore-based maritime traffic monitoring. Detection and identification of movements are often executed randomly by different authorities such as the Coast Guard in different countries. Some areas have seen the introduction of SRS, usually operated by coastal VTS systems. SRS are areas outside territorial waters in which a shore-based centre monitors the traffic situation within the SRS-area. Additionally, the use of AIS technologies has been widely spread thanks to the availability of dedicated online services as Marine Traffic and similar ones. There are also so called traffic separation scheme (TSS) areas where maritime traffic is statically separated and controlled by geospatial limitations marked in charts and sometimes enhanced physically with buoys. At times, authorities monitor these areas.

Today, little is done to optimise the traffic flow. However, some examples of traffic coordination can be found in port areas under the control of a Port Control function.

To summarise, the following weaknesses have been identified:

- Increase of the complexity for the onshore equipment required and training
- Lack of best practices sharing information
- Necessity to change international rules if we want to achieve compulsory activities.

In parallel, marine pollution preparedness, detection and response capabilities have been established. This includes a European network of stand-by oil spill response ships
as well as a European oil spill monitoring satellite and ship detection service (CleanSeaNet). Both of them aim to contribute to an effective system for protecting EU coasts and waters from pollution by ships.

Though uncommon today, dedicated tools and practices would be useful to optimise the navigation for just-in-time port calls, to avoid waiting time and allowing low speed navigation, (aimed at consumption and pollution reduction purposes). Usually the port call authorization and berthing services are issued and provided by the port authorities according to availability of piers without any planning.

### 7.3.3 Needs and Recommendations

What development is necessary in order to reach a higher degree of safety, environmental sustainability, and to become more operationally efficient are identified and listed. Currently, an integrated and interoperable management system in the European maritime scenario does not exist. Presently, existing services are highly fragmented, localised and not optimised. These services are provided by VTS centres in some regions, by port control service centres, search and rescue centres and by various other customised solutions. These services are not standardised nor harmonised. To a large extent this stems from the historic and regional factors such as local regulation, tradition in the region, and the selection of system manufacturers and providers.

The legal framework is articulated at an international-, EU- and a national level, resulting in the need for coordination of standards of different origin.

It is important that all the initiatives aimed at improving ship, cargo, and/or pollution monitoring, response to accidents and maritime safety continue to be implemented.

After September 11th the security level was raised for all aspects of traffic, ships and port facilities included. They appeared to be examples of typical areas that would be subject to terrorist attacks. Relatively large areas of ports and terminals require a rather extensive amount of security work to keep protected.

Ships for special cargo have been designed and produced to serve people. However, no producer of such ships took into account that they would need protection from a terrorist attack. ISPS code introduces new procedures in ports and ships aimed at raising the security level. ISPS can be adapted to the situation in the field. Many ports have not reached the level of development to implement ISPS code. For the purpose of better general protection it is necessary to recommend compulsory equipment of ships, and reassign a part of the obligations to coast personnel. This would increase the costs of ships and ports, but with the justified objective of increased security. The present situation and mariners acting as policemen, accompanied by more difficult ordinary tasks have made mariners everyday tasks too demanding. The capability to use data collected from installed equipment like AIS, sensors and reporting systems, may introduce powerful elements to interoperate through new systems.
Within this framework the Blue Belt initiative must be considered: control of goods and ships (where they are coming from, at what time, when they will leave and where), as well as EU CISE initiative (Common Information Sharing Environment). Considering that the internal organisation of the Member States’ authorities varies considerably, it is proposed that under the CISE initiative the User Communities participate in the following ‘functions’:

- Maritime Safety (including Search and Rescue)
- Maritime Security and prevention of pollution caused by ships, under MARPOL 73/78 Convention and related EU legislation frameworks
- Fisheries control
- Marine pollution preparedness and response
- Marine environment
- Customs
- Border control
- General law enforcement
- Defence.

7.4 Port Operations

This section provides an analysis of the current situation in port and port operations.

7.4.1 Strengths

SafeSeaNet helps the development of the THETIS system that supports the new Port State Control inspection regime for the EU and ParisMOU region according to the Directive 2009/16/EC. It provides pre-arrival notifications and information about the actual time of arrival (ATA) as well as departure (ATD) of ships entering or leaving EU ports.

7.4.2 Weaknesses

The coordination of port approaches is highly fragmented since it involves a lot of port actors. It is, however, not said that port approaches are performed in an uncoordinated fashion, but due to the fact that information is not being shared about intentions, desires, commitment, and outcomes, it is hard to achieve an optimised performance.

There are a lot of actors involved in port approaches, and therefore there is a need for coordination on a level that reaches beyond the single actor.

Today, it is extremely hard to foresee when a port approach would be fulfilled. It is a great challenge to predict when a ship would depart from the berth and thereby give space for new approaching ships. Experiences show that expected departure time from
berth varies a great deal depending on what actor provides the forecast. This could for example have its cause in very late assignments on additional services, such as a change of lubrication oil. The challenge is thus to overcome this low ability to predict changes of status leading to non-coordinated realisation of port approaches (arrival, activities at berth, and departure).

7.4.3 Needs and Recommendations

All actors do not share the same definition of operating processes that are to be used. One such dimension of definitions is the definitions of status. The cause for this situation is that:

- different systems in a rather closed and proprietary solution are used to manage information
- operators’ guess is based on multiple information sources on which, and when, manoeuvres have to be conducted
- each operator’s ability to plan for needed capacity (short- and long-term) is low.

Consequently, there is a need to communicate accurate estimates regarding when a certain state is expected to be reached, such as ships’ approach to the traffic area, and consequently when the state is reached. Different actors have a need for an overview of current and coming events of the port and their status.
8 Conclusions

This current situation report covers the major processes and stakeholders of the maritime transport sector. Throughout this analysis it is clear that the industry consist of information silos with separated, vendor specific and mostly proprietary systems. The inefficiencies, which this separation of information creates, allow some individual actors advantages at the expense of the overall ecosystem’s efficiency. The general absence of a common situational awareness is one of the fundamental issues that impede efficiency, safety and further environmental improvements in the maritime industry.

This conclusion will present the primary issues this inefficiency leads to for shipping in general, ship operations, traffic monitoring and management and port operations.

8.1 Shipping

The shipping industry will face important challenges in the coming years, including maritime traffic congestions, reduction of its environmental impact, coordination among stakeholders and mitigating the risk of accidents.

The study indicated that the lack of a common voyage analysis tool is a significant shortcoming. There is currently no digital entity that stretches from one berth to the next, which could be followed or supplemented with related information. More fundamentally, standardized formats and interfaces are not being utilized in the shipping industry. Instead, the flow of information seems to be restricted and regulated in different ways depending on the used framework. The effects inhibit coordination with the involved actors in the transport chain.

8.2 Ship Operations

Ship operations have already benefited from sharing information in the past. The AIS information improved the awareness of surrounding ships. However, since the formats were built for a specific purpose a large amount of data and information ships today produce that go unnoticed.

The analytical support tools available on board are limited to the available data. For example, there is currently no format or functionality to share route details continuously in real time. The current lack of harmonisation (with reference to routing, control, regulatory aspects and berthing processes) and collaboration inhibits more effective and safer ship operation.

8.3 Traffic Monitoring and Management

Similar to ship operations, the lack of harmonisation of information in the maritime transport industry, limit the type and scope of traffic analyses possible. With a few exceptions, there is generally no organised cross-national shore-based maritime traffic monitoring. Current practices are positive but there is still a lack of participation from all countries.
Furthermore, the legal framework of reference is complex at an international-, European- and national level, and there is also a need for legal standards of reference for shipping industry harmonisation.

### 8.4 Port Operations

Ports comprise a diverse group of actors and stakeholders, which all depend on accurate and up-to-date information about each other’s actions to use their resources efficiently. The current restricted possibility for collaboration has made it necessary for individual actors to create their own estimates of their related events. Competing versions of the similar information is common and confuse the situation further.

The current lack of open standardised formats stands in the way of effectively managing port operations. The unclear status of key actors in the port make it difficult to predict status changes, such as when a ship will depart from the berth and thereby open up a spot for approaching ships.
9 References


Web page reference

- http://www.globmaritime.com/
- http://www.imo.org/
- http://www.maritimetransportresearch.com/
- http://www.transport-research.info/web/
## Appendix A  Adjacent Projects

Source: D2.0.5 STM Architecture Description 2014-12-20  
Last modified on 2014-05-20

<table>
<thead>
<tr>
<th>Name</th>
<th>Definition and Description</th>
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</table>
| ACCSEAS                   | By looking to harmonise maritime information and how it is exchanged and by offering training provision to support real-world implementation, ACCSEAS will ensure that e-Navigation provision in the North Sea contributes a beneficial and lasting impact on the resilience of the Region’s critical infrastructure in terms of safety, security, economic growth and environmental protection. ACCSEAS will build on the findings of previous and current related regional projects and focus on co-operation in key areas of technology and infrastructure services that underpin maritime navigation and safety – looking to further enhance them. The project will: identify key areas of shipping congestion and limitation of access to ports; define solutions by prototyping and demonstrating success in an e-Navigation test-bed at North Sea regional level.  
Source: http://www.accseas.eu  
Last modified: 2014-12-10 |
| AnNA- Maritime Single Window | Aiming at facilitating and harmonising the implementation of EC Directive 2010/65 in a number of EU Member States. AnNa wants to support integration in Maritime Single Window development within the participating countries and to allow for suitable communication between the national systems, including SSN, based on functional requirements to be further identified.  
(European Single Windows) - MoS  
Source: http://www.annamsw.eu/  
Last modified: 2014-06-07 |
<table>
<thead>
<tr>
<th>Project</th>
<th>Description</th>
<th>Source</th>
<th>Last modified</th>
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<tbody>
<tr>
<td>B2MOS-Business to Motorways of the Sea</td>
<td>It provides measures to allow ports to become efficient gateways for short sea shipping in order to compete on more door-to-door corridors and facilitate the development of TEN-T Motorways of Sea Network connecting Europe. The project intends to demonstrate how the application of emerging technologies sustained by efficient communication procedures among public and private stakeholders.</td>
<td><a href="http://www.b2mos.eu/">http://www.b2mos.eu/</a></td>
<td>2014-11-13</td>
</tr>
<tr>
<td>Baltic Sea Hub and Spokes (2010-EU-21108-P)</td>
<td>The project is an ambitious, contemporary and far-sighted action to create the necessary framework for an integrated maritime transport system, which will promote and support a cost-effective and efficient door-to-door transport solution, link trade to transport and facilitate growth in the entire Baltic Sea Region (BSR). The project also encompasses an activity to integrate port information between the ports. In this activity, close cooperation is established with the current MONALISA project. For further details, please see below.</td>
<td><a href="http://balticseahubspokes.eu/">http://balticseahubspokes.eu/</a></td>
<td>2014-10-07</td>
</tr>
<tr>
<td>Barents Watch – Norway</td>
<td>Norway has to take responsibility for increased safety and emergency preparedness needs in newly accessible areas. New civil monitoring systems must be developed to enable monitoring of ship traffic at all times, as well as coordinated arrangements for emergency preparedness and rescue. For these reasons, the Government has given support to the pilot project “Barents Watch” under the auspices of SINTEF, which provides a basis for further cooperation and establishment of a comprehensive monitoring and warning system for the northern sea areas.</td>
<td><a href="https://www.barentswatch.no/en/">https://www.barentswatch.no/en/</a></td>
<td>2014-12-10</td>
</tr>
</tbody>
</table>
| Blue Belt - EU | The European Commission has set out plans to ease custom formalities for ships, i.e. reducing red tape, cutting delays in ports and making the sector more competitive. On this way, freight forwarders and exporters complain that if they chose to send goods across Europe by short sea shipping, the heavy administrative burden at ports causes additional costs and significant delays, i.e. ships can wait for hours and sometimes days in ports for customs clearance. These make the maritime sector less attractive compared to other forms of transport, especially road, unnecessarily bringing more trucks on our already congested roads. With this project Commission proposals, shipping transport will face less administrative hurdles and therefore be able to be used to its full potential in the EU internal market and beyond.

Thanks to the Blue Belt package the Commission intends to improve the sector’s competitiveness through the reduction of administrative burden and costs and the attractiveness of maritime transport. Moreover, it would stimulate employment and reduce the environmental impact of maritime transport.


Last modified: 2015-07-28 |
| Blast Project - Bringing Land and Sea Together | It was a regional project for better integration of information across the coastal margin in the North Sea region. Over three years, 17 partners from 7 countries, including governmental organisations, universities and private companies, collaborated on the harmonisation and integration of land and sea data.

BLAST was funded by the European Union as part of the Interreg IVB North Sea Region Program. The project started in 2009 and was completed in 2012.

The project’s primary focus is on “Bringing Land and Sea together”, by harmonising and integrating land and sea data. The lack of harmonised data across the land-sea margin poses limitations to good planning and integrated coastal zone management, as well as the handling of acute pollution, accidents etc. Therefore, BLAST has to provide a prototype land/sea interoperable database that is tested by practitioners from multiple sectors.

Source: http://www.blast-project.eu/
Last modified: 2014-11-13 |
| CASSANDRA Common Assessment and Analysis of Risk in Global Supply Chains | This project is based on the needs and demands of intensified security in global container transport movements by companies and by public authorities. To reach this aim CASSANDRA needed to demonstrate an increase in security through the optimal visibility and use of all existing information. To this end 26 partners from ten different European countries concentrated jointly on electronic data traffic, developed a new Data Sharing concept based on a risk-based approach for both sides: businesses and authorities. Identified assumption was that the effectiveness of controls increases when the supervisor enhances surveillance on transports with potentially greater risk whereas more trustworthy movements may be handled more quickly and more cost effectively. This implies optimisation of security demands on transport chains is a great opportunity to expand the evaluation of identified risks.

Source: http://www.cassandra-project.eu/
Last modified: 2015-10-05 |
| CISE (Common Information Sharing Environment) | In June 2013 the European Commission launched a consultation on the implementation of a Common Information Sharing Environment for the surveillance of the EU maritime domain. CISE is since 2009 being developed jointly by the European Commission and European Union / European Economic Area Member States including civilian and military authorities as well as the European agencies operating in the maritime field. It will create a political, organisational and legal environment to enable information sharing across the seven relevant sectors/user communities (transport, environmental protection, fisheries control, border control, general law enforcement, customs and defence) based on existing and future surveillance systems/networks with a view to achieve a fully operational CISE by 2020. The benefits of CISE will materialise directly in enhanced maritime awareness for Member States engaging in appropriate data analysis and, further downstream, in enhanced cross-sectorial cooperation triggering overall more effective and cost-efficient maritime surveillance.  
Source: [http://ec.europa.eu/](http://ec.europa.eu/)  
Last modified: 2014-11-14 |
|---|---|
| COSTA (2011-EU-21007-S) | The COSTA Action aims at developing framework conditions for the use of Liquefied Natural Gas (LNG) for ships in the Mediterranean, Atlantic Ocean and Black Sea areas. It will result in preparing an LNG Master plan for short sea shipping between the Mediterranean Sea and North Atlantic Ocean as well as the Deep Sea cruising in the North Atlantic Ocean towards the Azores and the Madeira Island. The feasibility study results will promote MoS sustainability, contributing to the common effort addressing climate change, in particular in view of the forthcoming requirements with respect to the implementation of the requirements of Annex VI of the MARPOL Convention.  
Last modified: 2015-10-07 |
| **Charlie Papa- HSD (The Hague Security Delta)** | In the Charlie Papa project, public and private organisations involved in security and close protection work together with a university and serious gaming developers to create a virtual reality based “serious game” learning and exercise environment.  
Source: https://www.thehaguesecuritydelta.com/projects/project/24  
Last modified:2014-12-10 |
|---|---|
| **E-Maritime (2010/65/EU)** | The e-Maritime concept aims at promoting the competitiveness of the European maritime transport sector and a more efficient use of resources through better use of Information and Communication Technology (ICT) tools.  
In maritime transport and transport in general, notifications, declarations, certifications, requests and service orders are increasingly submitted, managed and stored in electronic rather than paper format. Modern ICT systems provide undeniable benefits that are not allowed by paper based information as automated information verification and analysis, processing of data and optimisation routines, easy sharing of information already submitted or stored and so on.  
This process is overall used to improve freight transport and logistics with more efficient use and reuse of digitalised information currently produced and stored by many different stakeholders. Such actions would aim to increase sharing of information that allows shippers to choose the transport service most suited to their needs, reduce the time and resources absorbed by compliance with administrative requirements and enable transport and logistic service providers to optimise the management of transport assets in real-time, thus facilitating the establishment of environmentally efficient transport and logistic services for all users.  
Source: http://ec.europa.eu/transport/modes/maritime/e-maritime_en.htm  
Last modified:2015-10-15 |
<table>
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<tr>
<th>E-Navigation- MARNIS (Maritime Navigation and Information Services)</th>
<th>The EC co-funded project 'Maritime Navigation and Information Services' (MarNIS) goes a long way to supporting the EU through providing a substantial and valuable contribution to the E-Maritime concept. The focus is placed on the improved exchange of information from ship to shore, shore to ship and between shore-based stakeholders, both on an authority and business level. The stakeholders may include on the one hand the ship itself, together with the ship owner, operator and agent, and on the other hand shore-based entities, including maritime authorities and commercial parties within the port sector. Its main aims are: improvement of safety and the protection of the environment; improvement of security; improvement of efficiency and reliability; improvement of the economic aspects of sea transport.</th>
</tr>
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| **Tanker Safety project-ENSI (Enhanced Navigation Support Information)** | The objective of the Foundation’s Tanker Safety joint project, established in 2009, is to reduce the risk of oil tanker accidents in the Gulf of Finland. In order to reach this goal, a navigation service was created, utilising existing technologies and structures. The service improves information exchange between ships and vessel traffic control through improved and forecasting vessel traffic management. For the ships, the system will provide navigation information.

The Finnish Transport Agency is the main partner of the Tanker Safety project, and the owner of the ENSI system. The ENSI service is one of the first e-Navigation services in the world to move on to the operational phase. It is incorporated to the authorities’ VTS system, and the aim is to integrate it to the GOFREP (Gulf of Finland Reporting System) system that monitors traffic in the Gulf of Finland.

Last modified: 2014-12-10 |
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| **EfficienSea** | EfficienSea is one of the most important projects in the Baltic Sea region, being both a strategic and a flagship project. The overall aim of EfficienSea is to improve maritime safety in the Baltic Sea region through concise and coordinate actions.

Source: http://www.efficiensea.org/
Last modified: 2012-01-31 |
<table>
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<tr>
<th>Project</th>
<th>Description</th>
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| GreenCranes | Green Technologies and Eco-Efficient Alternatives for Cranes and Operations at Port Container Terminals – GREENCRA NES aims to study and define methods and measures to describe PCTs' energy profiles, analyse different eco-efficient technologies to reduce PCTs' GHG emissions whilst increasing their productivity, carry out pilot deployments of different potential solutions, extract relevant results from the pilot actions to be disseminated to as many PCTs as possible and define standards that support the swift investment in these technologies across Europe. The Action will support the pilot deployment of new technologies and alternative fuels (LNG and Euro 5/TIER 4 Diesel amongst other) thus contributing to sustainable freight transport practices. The final objective is to enable PCTs' managers and investors, policy-makers, EU citizens and industry to understand and decide which technologies generate the best socio-economic value and have the highest potential for rapid deployment across the EU.  
Last modified:2014-11-13 |
| ITAIDE | ITAIDE- Information Technology for Administration and Intelligent Design of E-Government develops a Common Information Model for electronic documents and document mapping software to improve the pan-European interoperability of taxation and customs systems. This interoperability is an essential prerequisite to achieve strategic goals for e-customs such as the introduction of Authorized Economic Operator and Single Window Access service provisioning for businesses.  
Source:[http://www.wi1.unimuenster.de/wi/research/projects/itAide_eng.html](http://www.wi1.unimuenster.de/wi/research/projects/itAide_eng.html)  
Last modified:2014-10-06 |
| LNG in Baltic Sea Ports (2011-EU-21005-S) | The aim of the proposed action is to develop a harmonised approach towards LNG bunker filling infrastructure in the Baltic Sea region. By sharing knowledge between 8 Baltic partner ports from 5 countries and their stakeholders, a more standardised process for planning and constructing LNG infrastructure shall be achieved.  
Last modified:2014-06-07 |
| MIELE (2010-EU-21105-S) | The main objective of the action is to design and to develop a pre-deployment pilot for an interoperable Information and Communications Technology (ICT) platform (the “MIELE Middleware”) able to interface ICT systems (i.e. single windows, port community systems) in Italy, Portugal, Spain, Cyprus and Germany (the “National Vertical Pilots”).  
The MIELE action is Multimodal Interoperability E-services for Logistics and Environment sustainability. The action aims at deploying, as far as MoS are concerned, a pilot concerning the system fostered by European Maritime Directives and Communications. Such pilot system, called MIELE Middleware, will be able to interface all the existing ICT systems in the e-maritime and freight domain and to deliver B2A and B2B services.  
The main obtained results and the acquired knowledge in MIELE action activities will be shared with all the stakeholders involved in MONALISA 2.0. All the ICT solutions studied and adopted in MIELE for interoperability and intermodality purposes will be shared in MONALISA 2.0.  
Last modified:2014-10-07 |
| MONALISA 1.0 (2010-EU-21109-S) | MONALISA aims at improving quality of maritime transport, safety at sea, exchange of maritime data and facilitation of environmental performance of shipping and implementation of e-Maritime relevant applications. The project is expected to deliver:

A new methodology in maritime route planning, similar to air navigation, a new pilot system of automated verification of ship crew certificates. A concept model for an automatic verification system monitoring officer’s certificates and time on watch will be designed.

Re-surveys of the Helsinki Commission (HELCOM) fairways in the Baltic Sea leading to harmonised distribution of survey data and water level information. Re-survey of HELCOM fairways and Baltic Sea port areas will be carried out with modern quality methods to ensure correct depth presented in existing sea charts and improve safe navigation for large ships.

A pilot system for sharing maritime data at a global scale. The related activity aims to develop and test a functional demonstrator system with the final objective to extend the sharing of maritime information to a global scale as well as expanding the scope of maritime information shared between maritime authorities in accordance with their needs.

Source:
Last modified:2014-10-07 |
| MOS24 (2010-EU-21101-S) | The goal is to develop create a “unique ICT multimodal Corridor between northern and southern Europe” by connecting virtually the Priority Project 24 (Railway axis Lyon/Genoa-Basel-Duisburg-Rotterdam/Antwerp) with MedMoS. The Pilot Action will the demonstrator of an interoperability platform (MoS24) for interconnecting existing ICT modules and making them interoperable, and will deliver a service to users through the virtual MoS24 Comodality Promotion Centre.

Last modified:2015-10-12 |
<table>
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<th>Project Name</th>
<th>Description</th>
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<tr>
<td>Northern Europe LNG (2010-EU-21112-S)</td>
<td>The project consists of feasibility studies on LNG filling station infrastructure as well as a full-scale pilot action. The study part of project will create a strategic decision paper relevant for central stakeholders, aiming at developing framework conditions for the use of LNG for ships and will validate a full-scale pilot action aiming at demonstrating the LNG option as competitive fuel from shipping and an LNG supply chain points of view. The project further aims at harvesting positive environmental and climate effects.</td>
<td><a href="https://ec.europa.eu/inea/en/ten-t/ten-t-projects/projects-by-transport-mode/greening-transport">https://ec.europa.eu/inea/en/ten-t/ten-t-projects/projects-by-transport-mode/greening-transport</a></td>
<td>2014-10-07</td>
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| **TrainMoS** (2011-EU-21004-S) | TrainMoS aims at supporting and training the human element of MoS by defining the basis for a future EU virtual open MoS University and by pulling together local competences and knowledge of different EU universities along with stakeholders' needs.  
Last modified: 2014-11-13 |
|---|---|
| **Valencia-Antwerp** | The projects of the ports of Antwerp, Bremen, Dublin, Guadeloupe and Valencia have been shortlisted for the seventh European Sea Ports Organisation (ESPO) Award on Societal Integration of Ports. The jury selected these five applications from a total of 22 submissions. The theme of this year's competition is 'engagement with local schools and universities'.  
The Award will be presented to the port that demonstrates the best strategies in making schools and universities aware of their local port and its activities. The winning project will be one that succeeds in creating the interest of the local schools and universities in the work of the port and stimulate these institutions to work and/or do research on subjects of interest to ports. In doing so, make young people knowledgeable of the port industry and excites them about entering into a career in the port at all levels, which will, lead to a better understanding of the port within its community.  
Source: [http://www.espo.be/](http://www.espo.be/)  
Last modified: 2015-09-09 |
| WINMOS | The WinMos project is an action aiming to further develop efficient maritime transport during winter when sea ice covers large parts of the EU’s northernmost waters. The Action will develop and adapt the winter navigation system for the benefit of all stakeholders involved in trade and maritime transport in the Baltic Sea area. It includes further cooperation between ice breaking authorities, resource planning, as well as upgrading and renewal of the necessary icebreaking resources.  
Source: http://www.onthemosway.eu/winmos-project/  
Last modified:2014-08-12 |
|---|---|
| e-Freight Integrated Project | The e-Freight Integrated Project (European e-Freight capabilities for Co-modal transport) started 1st January 2010 bringing together 30 partners from 14 Member States and Norway for a program of work that will cover 4.0 years, addressing the development, validation and demonstration of innovative e-Freight capabilities. E-Freight capabilities will be developed to support the following four main categories of e-Freight stakeholders: Transport users (shippers, freight forwarders, etc.), transport service providers, transport infrastructure providers and transport regulators.  
Last modified:2014-04-23 |
<table>
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<tr>
<th>Maritime electronic Highway in the straits of Malacca - Singapore</th>
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<tr>
<td>The ultimate goal of this initiative is the use of innovative maritime and environment management technological tools to create network and maintain a marine information infrastructure for enhancing maritime services, improving the safety of navigation and integrated management of the coastal and marine areas of the Straits of Malacca and Singapore. The Marine Electronic Highway (MEH) is an innovative marine information and infrastructure system that integrates environmental management and protection systems and maritime safety technologies for enhanced maritime services, higher navigational safety standards, integrated marine environment protection and sustainable development of coastal and marine resources. The backbone of the MEH is precision navigation and will utilise a network of electronic navigational charts (ENCs) in conjunction with Electronic Chart Display and Information System (ECDIS), Differential Global Positioning System (DGPS) and other maritime technologies.</td>
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<td>Source: <a href="https://sustainabledevelopment.un.org/partnership/?p=1574">https://sustainabledevelopment.un.org/partnership/?p=1574</a></td>
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<td>Last modified: 2014-12-10</td>
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Appendix B  Activity 2 Deliverables

This appendix lists the MONALISA 2.0 Activity 2 deliverables.

- ATM report for MONALISA 2.0, MONALISA 2.0 – D2.0.7, 2015
- Collaboration in the Maritime Transport Ecosystem, MONALISA 2.0 – D2.3.1-12-3, 2015
- Dynamic Voyage Management Concept Description, MONALISA 2.0 – D2.3.1-4.2, 2015.
- Electronic STM Master Plan, MONALISA 2.0 – D2.5.2, http://stmmasterplan.com
- Envisioning Sea Traffic Management 2030, MONALISA 2.0 – D2.3.1-12-4, 2015
- Finding Information in the Maritime Transport Ecosystem, MONALISA 2.0 – D2.3.1-12-2,
- Flow Management Concept Description, MONALISA 2.0 – D2.3.1-4.3, 2015.
- Formal Safety Assessment Case, MONALISA 2.0 – D2.3.1-11, 2015
- Performance Assessment Case, MONALISA 2.0 – D2.3.1-9, 2015
- Port CDM Concept Description, MONALISA 2.0 – D2.3.1-4.4, 2015
- Port CDM report, MONALISA 2.0 – D2.7.1, 2015
- Sea Traffic Management: A Holistic View, MONALISA 2.0 – D2.3.1-4.0, 2015
- Sea Voyage Costs, MONALISA 2.0 – D2.3.1-3.2, 2015
- STM – The Current situation, MONALISA 2.0 – D2.1.1, 2015
- STM – The Target Concept, MONALISA 2.0 – D2.3.1, 2015
- STM Master Plan, MONALISA 2.0 – D2.5.1, 2015
- STM Performance Framework, MONALISA 2.0 – D2.2.1, 2015
- Strategic Voyage Management Concept Description, MONALISA 2.0 – D2.3.1-4.1, 2015
- Target Business Description, MONALISA 2.0 – D2.3.1-3, 2015
- Target Concept Business Case, MONALISA 2.0 – D2.3.1-2, 2015
- Target Human Aspects Description, MONALISA 2.0 – D2.3.1-7, 2015
- Target Information-Systems and Information-Technology Description, MONALISA 2.0 – D2.3.1-6, 2015
- Target Institutional Description, MONALISA 2.0 – D2.3.1-1, 2015
• Target Systems Technical and Technology Description, MONALISA 2.0 – D2.3.1-5, 2015
• Target Transversal Aspects Description, MONALISA 2.0 – D2.3.1-8, 2015
• Understanding the Maritime Transport Ecosystem, MONALISA 2.0 -- D2.3.1-12-1, 2015
39 partners from 10 countries
taking maritime transport into the digital age

By designing and demonstrating innovative use of ICT solutions
MONALISA 2.0 will provide the route to improved

SAFETY - ENVIRONMENT - EFFICIENCY

Swedish Maritime Administration  LFV  SSPA  Viktoria Swedish ICT  Transas  
Carmenta  Chalmers University of Technology  World Maritime University  The 
Swedish Meteorological and Hydrological Institute  Danish Maritime Authority  Danish 
Meteorological Institute  GateHouse  Navicon  Novia University of Applied Sciences  
DLR  Fraunhofer  Jeppesen  Rheinmetall  Carnival Corp.  Italian Ministry of 
Transport  RINA Services  D'Appolonia  Port of Livorno  IB SRL  Martec SPA  
Ergoproject  University of Genua  VEMARS  SASEMAR  Ferri Industries  Valencia 
Port Authority  Valencia Port Foundation  CIMNE  Corporacion Maritima  Technical 
University of Madrid  University of Catalonia  Technical University of Athens  
MARSEC-XL  Norwegian Coastal Administration

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