Deliverable 5.3

Development of a new common port database concept and structure

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1 Introduction

Reliable nautical and commercial port information is the foundation for efficient and safe port calls. The activity described in this deliverable will focus on improving the exchange of information between accurate stakeholders as well as with organisations by facilitating the automatic flow of information within and between ports and their surroundings.

Standardised templates and reporting forms together with techniques for single reporting will streamline the information flow to ensure efficient exchange of data. This will, at the same time, reduce the time spent preparing and executing the data exchange and thereby reduce the administrative burden.

The EfficienSea 2 (E2) project will develop vital changes in today's way of achieving port safety. Port logistics and access to information will be establishing an easily accessible platform for the industry, building on the Maritime Cloud concept for e-solutions. This will help the shipping industry remain competitive compared to other modes of transport.

The majority of ship collisions and groundings happen when ships are approaching or sailing within port areas due to increased traffic density and navigational constraints. Thus, improved access to information, not only in terms of the content of information, will aid the decision-making.

Apart from the apparent navigational advantage, commercial advantages are of course also related to the acquisition of reliable information prior to the port call. The aim of the work in E2, work package 5 (WP5), is not to deploy a sophisticated e-solution, but to use readily available solutions under the current framework of e-navigation. The e-solution builds upon a "new common port database and structure" that relies on the distribution of information storage among many sources. The use of a so-called machine-to-machine concept (M2M) will allow users in both "ends" to use already established software platforms bound together through a common and unified registry. Such a solution will benefit and be acceptable for most stakeholders as, initially, no new technology will need to be purchased when/if the e-solutions are implemented.

The report has been written so that it is understandable for people without prior shipping knowledge. We have used simple terms and language to explain our concept in order to increase the readability of the report.

1.1 Interaction with current platforms

The development of this E2 WP5 tool aims to interact with three important platforms:

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1) The developing National Single Window (NSW) both under the auspices of the IMO and at EU level[1]. The NSW aims to streamline the communication between ship and shore and between the EU Member States.

The development of the EU NSW prototype started in the beginning of 2013 as part of an Integrated Maritime Policy (IMP) project. It is promoted by the European Maritime Safety Agency (EMSA), in cooperation with five EU Member States: Bulgaria, Greece, Italy, Malta, Romania, as well as Norway.

The components of the National Single Window (with web and machine-to-machine interfaces) were developed to:

- Provide a service for the ship to report to shore;
- Implement the National Single Window application and its interfaces with the ship data providers, other national systems, and the central SafeSeaNet (SSN) system (see below);
- Implement the common functionalities (e.g. clearance, acknowledgement, data quality checks) of the NSWs;
- Provide services related to the reference databases (e.g. geographic locations and ship particulars); and
- Test the compilation of ship positioning data with the relevant reporting formalities and distribution of the combined data to the various authorities via a graphical interface.

2) SafeSeaNet is a central player in the NSW. SSN is the EU maritime information and exchange system established to enable the exchange of ship and voyage related information between EU Member States, as well as to provide the European Commission with the relevant information in accordance with EU legislation. Finally but not least, to support EU Member States in satisfying their operational information needs.

One of the objectives of this action is to evaluate and demonstrate how SSN could support the Member States' obligation to set up a single window at national level for reporting and exchanging formalities in accordance with Directive 2010/65/EU.

Directive 2010/65/EU establishes that Member States must accept the fulfilment of reporting formalities in electronic format and their transmission via a single window. These requirements entered into force on 1 June 2015. The single window is to be the place where all information is reported once and made available to various competent authorities and other Member States.

[1] EU Directive 2010/65/EU – on reporting formalities for ships arriving in and/or departing from ports of the Member States.

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The overarching objective of the SSN system is, however, to support activities for the purpose of maritime safety, port and maritime security, marine environment protection and the safety and efficiency of maritime traffic.

3) Within this project, the so-called Maritime Cloud plays a vital role, supporting both public information and commercial products in an easily accessible way.

   This deliverable will describe the concept of combining and integrating the NSW with selected e-solutions available via the Maritime Cloud.

Although many more platforms are available, like Port Management Systems and Port Community Systems, the three platforms (above) are described later in this report.

2 Objectives of WP 5.1-2

The E2, Work Package 5, subtasks 1 and 2, aims to develop a prototype application that promotes information exchange and reduces administrative burdens with regards to reporting and collecting information during port calls.

The main objectives are:

- Identification of the data requirements of users.
- Development of a data specification.
- Development of the general registry to include the required port reporting feature definitions (like IHO for navigational matters and EDIFACT for commercial data exchange).
- Technical development, technical testing, consideration of human factors, user test and validation of the draft product specification within the S-100 framework.
- Development of an efficient port database structure in accordance with the international recommendations of the International Harbour Master's Association, providing validated nautical information.
- Development of a framework for data transfer between various stakeholders in the port information chain.
- Test of the WP5 framework, using open source information and restricted information via the Maritime Cloud.

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3 Structure of this report (D5.3)

Currently, more than a dozen research projects and consortiums are developing e-navigation and e-solutions. They all have a slightly different approach and scope, and this project will use the lessons learned.

From the previous projects, we know that e-solutions for shipping require several developmental steps. The steps of the process include the development of an architecture, gap analysis and cost benefit analysis as well as the creation of a detailed implementation plan. This report only covers some of the steps, which will be described in the following, and the remaining items will be described in later WP5 deliverables.

3.1 Process

During the development of this report, we have been inspired by the IMO established implementation plan and structure for e-solutions.[2]

3.1.1 User needs

In order to capture the user needs, a structured (and a phased) approach is required. This task includes:

- Identification of users.
- Definition of the primary functions and needs among stakeholders.
- Identification of functions and services.

3.1.2 Gap analysis

Technical gap analyses, comparing the capabilities and properties of existing systems with the architectural requirements, to identify any technology or system development that might be needed, based solely on user needs.

Furthermore, regulatory gap analyses, particularly identifying gaps in the present frameworks that need to be filled, e.g., in the provision of services in international waters.

This task includes:

- Regulatory gap analyses – if any.
- Gap analyses of common registry standards.
- Operational gap analyses.
- Identification of existing systems and solutions.
- Technical gap analyses.

3.1.3 Concept and architecture

The definition of the integrated e-navigation system architecture and concept of operations should be based on consolidated user needs across the entire range of users, taking into

[2] MSC 85/26/Add.1 - Strategy For The Development And Implementation Of E-Navigation.

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account all possible economies of scale. The architecture should include the hardware, data, information, communications and software needed to meet the user needs.

- Definition of concept and architecture.
- Simplified cost-benefit and risk analysis.
- Training needs analysis.

3.1.4 Implementation

The implementation plan should identify the responsibilities of the appropriate parties, such as the IMO, other international associations, flag and port States, users and industry as well as timelines for implementation actions and reviews.

- Will be elaborated during the future WP5 work.

3.1.5 Review lessons learned

The final phase of the iterative implementation programme will review the lessons learned and re-plan the subsequent phases of the plan. It is important to understand that e-navigation is not a static concept, and that the development of logical implementation phases will be ongoing as user requirements evolve and as technology develops enabling more efficient and effective solutions.

- Pending future WP5 work.

3.2 Structure of the approach

In this deliverable, we link three complementary approaches, taking three complementary perspectives into account. Each approach is linked closely together with the others. The linkage is driven from the need to understand the user needs and capture the processes in order to derive a service interaction logic, enabling a service-oriented approach.

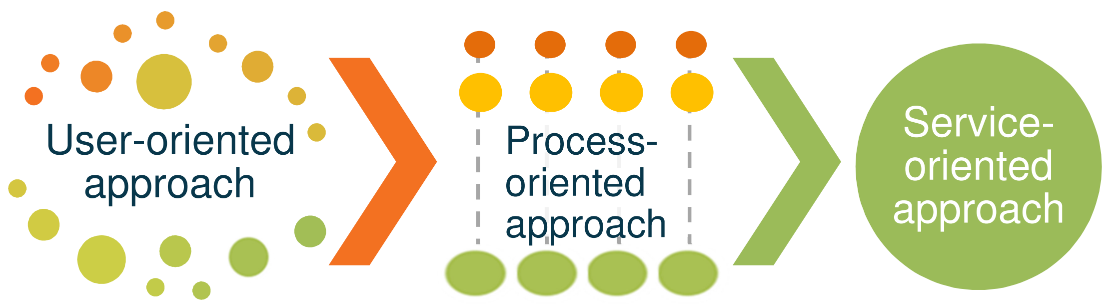

Figure 1, Structure of the approach

3.2.1 User-oriented approach

In order to gain a better understanding of the e-solutions, we have identified the various stakeholders' involvement in the exchange of information. Subsequently, we have structured the user contribution by developing a set of scenarios.

This is done in section 5 and section 5.1-5.5.

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3.2.2 Process-oriented approach

By looking at the scenarios and the possible e-solutions from a process-oriented approach, we have identified which data and processes need to be included in the e-solution. Certainly, some solutions are simpler than others.

This is illustrated in section 5.6.

3.2.3 Service-oriented approach

Finally, we have examined the set of scenarios from a service-oriented perspective in order to gain a better understanding of which services should be provided and combined. This was done for the various solutions and scenarios.

The individual architecture is outlined in detail in section 9.

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4 Identification of users

Commercial shipping is a complex system involving several actors. Figure 1 below depicts some of these actors and provides examples of how they interact.

The logic in the figure is the grouping of the stakeholders. The colour of the box indicates which service group the stakeholder “belongs” to, although it may be placed under another group. E.g., “Customs” and “Immigrations” are both a “Statutory Authority” (red), but they are positioned under the group called “Port Services” as they are part of the routine port service during the port call. “Surveys” is, however, something which is part of the logistic planning.

The figure shows e.g. “Bunkering” as a stakeholder. In this case, the bunkering is not considered a service, but rather as the bunkers provider, as the end-user.

Data providers and chart agents and similar stakeholders are not included in this grouping. The main reason is that these services are associated stakeholders, whereas the ones depicted below are end-users (sender and receiver of the information exchange) – the M2M end-points.

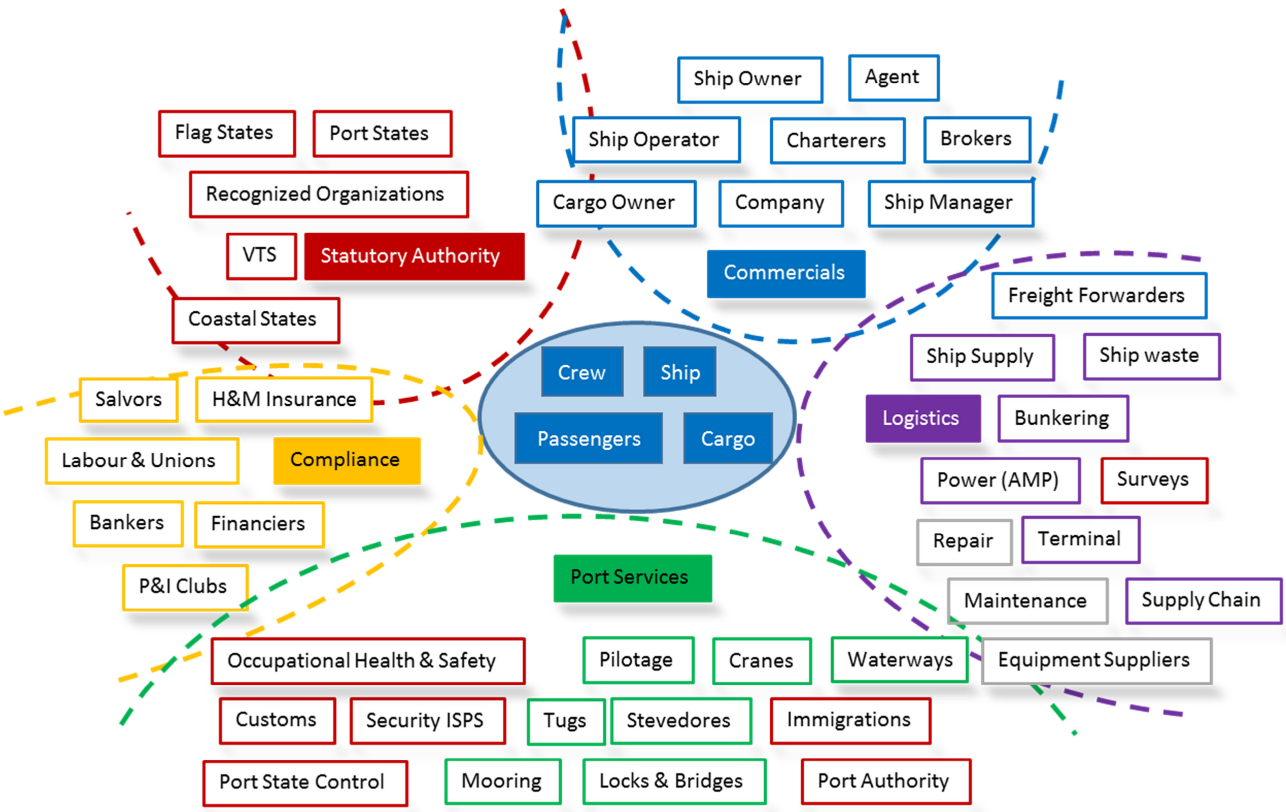

Figure 2, Interactions between stakeholders

The individual stakeholders are explained in brief and simple terms in Appendix 1. More strict definitions can, however, be found in various regulations and legal interpretations.

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4.1 Stakeholder information exchange and interactions

All the maritime stakeholders interact in order to optimize their business. Figure 3 below has been developed within WP5 and provides a simplified mapping of how stakeholders may interact. Although simplistic, it provides an overview of who may interact with whom. Moreover, it illustrates the high number of users in the communication.

The map does, however, not give an overview of WHAT kind of information is exchanged between the stakeholders and how often they are in contact. Neither does it show how many stakeholders are connected in a given communication at the same time.

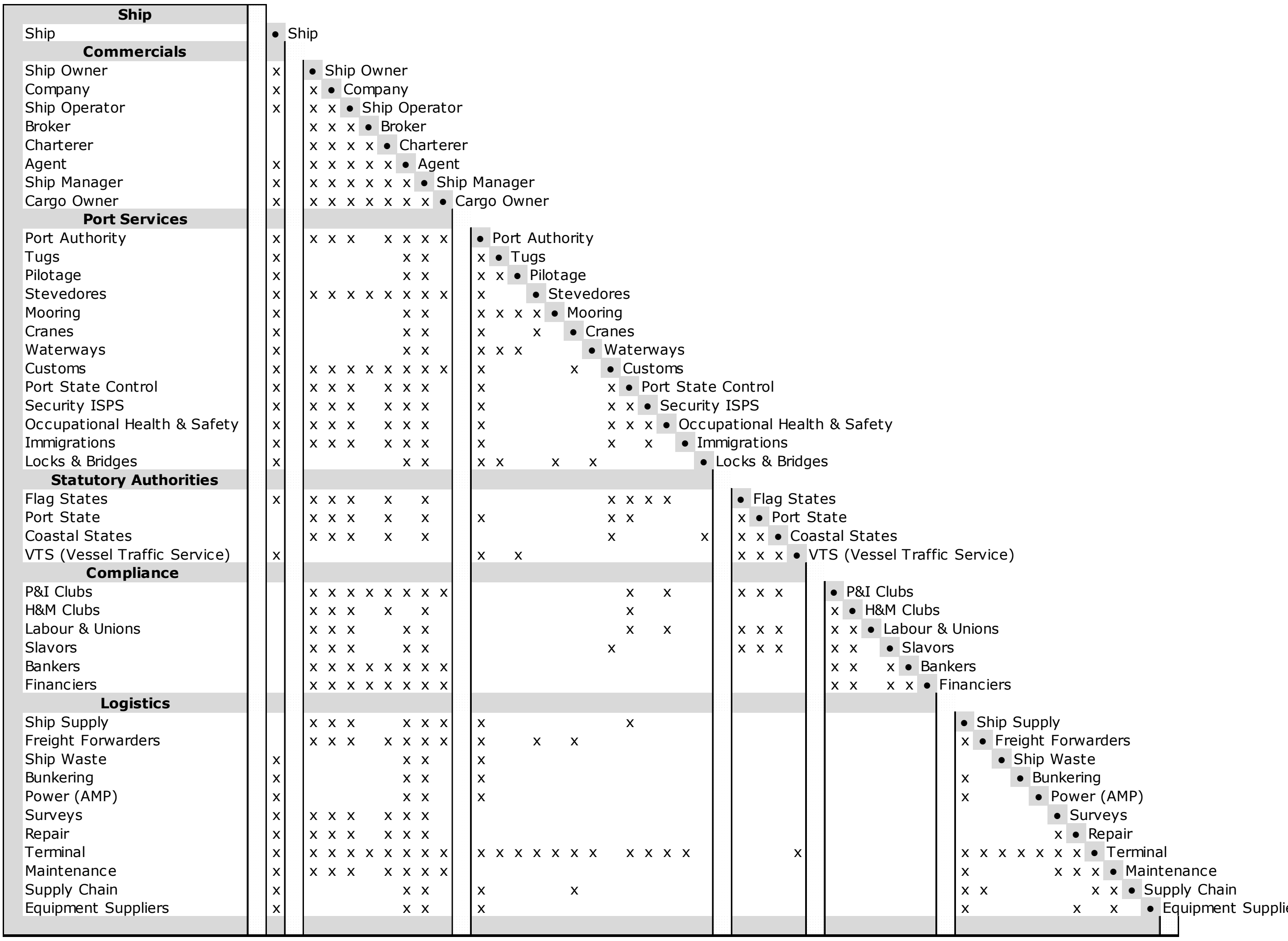

Figure 3, Information exchange between stakeholders

To provide a better understanding of the connections between the stakeholders, and gain a basis of the mapping, the WP5 has used the mapping to identify a few likely scenarios. The scenarios are well-known to the shipping industry as they are “used” on a daily basis.

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Furthermore, they are also likely to contribute to the daily administrative burden imposed on, e.g., the seafarers.

The scenarios will be used as templates when testing the e-solutions later in the E2 project.

- Scenario 1: Exchange of information between ship and port.
- Scenario 2: Port information for fine-tuning the voyage plan.
- Scenario 3: Seafarers' licences and STCW documents.
- Scenario 4: Coordinating the port call.
- Scenario 5: Emissions information shared with authorities, ports and potential third parties.

All five scenarios will be described in the following chapter.

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5 Information exchange of today

In the above chapter, the five scenarios have been listed along with a number of maritime stakeholders. These stakeholders have explained different cumbersome scenarios related to the handling of information when using the technology of today.

In the following, we want to elaborate a bit on the scenarios in order to find better ways and improvements compared to the current information flow through an e-solution. E-solutions for the five scenarios are elaborated in section 9.

5.1 Scenario 1: Exchange of information between ship and port

While being well aware that port calls and pre-arrival documents are a result of the national implementation procedure, it is necessary to keep in mind that shipping is a global business and truly international systems are therefore necessary to alleviate the administrative burdens imposed on seafarers.

On board the ship, one of the most cumbersome administrative tasks is the preparation of the port documents and pre-arrival documents caused by the amount of copies and the lack of standardization of the content. A common international solution for a uniform reporting platform, like the IMO Single Window, would accommodate this problem. Until this has been fully implemented world-wide, the ships will continue to overcome this administrative burden.

- The port documents are handed over on arrival. Most of the documents are handed over to the agent, but in some ports various authorities attend – typically the immigration, customs and health (quarantine) authorities.

  All port documents are to be signed and stamped with the official ship stamp. Without this stamp, no business!

  The port documents contain information such as the crew list, passenger lists (if relevant), bonded stores and provisions list, vaccination lists, port of call lists, WHO health declarations, etc. Below is an example of a list of documents which have to be submitted to a particular port in Asia.

Table 1, List of documents to be submitted

Certificates	Number of copies
Crew certificates	10
Passenger certificate	10
Stowaways	10
Tobacco / spirits / personal effects	4
Stores	4
Arms and ammunition	3

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Health documents or certificate	3
Certificate of Deratting	1
Load Line Certificate	1
Tonnage Certificate	2
Certificate of Nationality	1
Safety Equipment Certificate	1
Cargo Gear Certificate	1
Bill of Lading	1
Transit Cargo Manifest	3
Manifests (freighted)	5
Manifests (un-freighted)	5
Dangerous goods	1
General declaration for departure	2
Certificate of insurance for passenger ships	1
Safety Radio Certificate	1
Safety Construction Certificate	2
Passenger Ship Safety Certificate	2
International Ship Security Certificate	2
Certificate of Registry	2
Certificate of Insurance or other Financial Security in respect of Civil Liability for Oil Pollution Damage (CLC92)	1
Certificate of Fitness (ships carrying liquid bulk dangerous substances only)	1
IOPP Certificate	1
ISM Code with approved DOC and SMC	2

In this connection, it is worth noting that each port has its own requirements regarding the papers to be submitted on arrival. This does not mean that the same documents are to be submitted at the next port of call as this port may have other requirements – even within the same region and country. Sometimes the port even has requirements with regard to the language used. E.g. the ship currency declaration must be in Polish in the Port of Gdansk, whereas the same declaration must be in French in Le Havre.

- The pre-arrival documents are sent to various entities within given time limits prior to arrival. The different deadlines for submission are often 72, 48 or 24 hours prior to arrival. For some ports, the agent takes care of the reporting, whereas for other ports the ship (captain) communicates directly with the authorities.

  In the Port of Zeebrugge in Belgium, the documents can be handed over by the agent. In the Port of Aarhus in Denmark, the arrival crew and passenger lists are handed

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over to the police as well as to the port authority. The waste declaration must, however, be handed over via the agent.

In Sweden, in the Port of Gothenburg, the paper forms are handed over to the coastguard, whereas in the Port of Bremerhaven the same forms must be submitted as XML computer files to the police.

The waste reporting is one of the forms which creates most concern as many ports have their own waste declaration forms; often in their own language, and not always translated. A review of 16 European ports revealed that 15 ports have special waste forms!

Feedback from the ships has shown that port and pre-arrival documents, even when submitted by e-mail prior to arrival, do not exempt the ship from submitting the very same document in hard copy to the same authority on arrival.

Furthermore, the port authority expects the captain to know all these details and to comply with them accordingly. And if not, ships may be delayed and sometimes even fined.

The seafarers, rightly, often find it difficult to see the rationale behind manual handling of information which is already available in digital form or could easily be handled in a digital format. At the same time, the seafarers highlight the differences in formats and forms used in different countries and ports when, essentially, it is the same data that is being handled.

Seafarers often find that the procedures concerning port calls and pre-arrival documents in particular are a burden. Many authorities have developed their own procedures and forms and, as a result, there is no consistency and common standard.

As an example, the following is the list of documents that are required, as a minimum, by the Danish authorities. (The FAL forms are documents which were originally intended to harmonize and limit reporting requirements although practice has shown that many other requirements are added by each individual country).

LIST OF DOCUMENTS

1. FAL form 1: General Declaration
3. FAL form 3: Ship's Stores Declaration
4. FAL form 4: Crew's Effects Declaration
5. FAL form 5: Crew List
6. FAL form 6: Passenger List
7. FAL form 7: Dangerous Goods
   - A1. Notification for ships arriving in and departing from ports of the Member States
   - A2. Border checks of persons
   - A3. Notification of dangerous or polluting goods carried on board
   - A4. Notification of waste and residues

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- A5. Notification of security information
- A6. Entry summary declaration.

This example is further illustrated in the matrix below, showing the information required by the Danish administration. Denmark has been used as an example because the Danish Maritime Authority is a partner in the WP5.

Table 2, List of documents, including references

IMO FAL no. / EU reporting requirements	1	2	3	4	5	6	7	8	A1	A2	A3	A4	A5	A6
Danish Maritime Authority		B							A					
Danish Nature Agency		B					A				A			
Danish Customs Authority	A	B	A	A	A	A								A
Danish Environmental Protection Agency		B										A		
Danish Transport and Construction Agency		B											A	
Ministry of Justice		B			A	A				A				

A. Mandatory requirement
B. Non-requested information

The National Single Window is still fairly new and has, therefore, not yet fully matured to its full potential. Furthermore, ships will encounter different regimes as, world-wide, a large number of countries still need to establish an NSW. It is foreseeable that the transition period until all the world's countries have implemented the NSW will be very long.

It seems to be a great challenge to harmonize the interaction with all ports world-wide. Rather, there is a need for a solution that promotes an easy adaptation for each port's reporting desires. In order to reduce the administrative burden imposed on the stakeholders, the functional requirement for an interim solution (could be long term) and the goals are captured in the following paragraphs.

5.2.1.1 Functional requirements for the e-solution with regard to scenario 1

In order to fulfil the tasks described in scenario 1, the project will seek to use a generic solution with the ability to report relevant data between the ship and shore using as little communication across water as possible. As the example above shows, data will have to be distributed to different receivers and, furthermore, the needed data may be collected by various sources.

The ship must be able to "release" information, whereby the "receiver" (in this context it is *the shore* entity which is granted access to receive the data) picks the relevant data in the required format.

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If data is to be reported as little as possible across water, a function capable of storing the data is needed to make different competent authorities able to pick the same data and receive the information needed in the format required.

The solution must work together with e.g. STM, PortCDM and the National Single Window (all explained later in this report).

5.2.1.2 Goal for scenario 1

A dedicated reporting template distributed via the Maritime Cloud will (semi-automatically) collect and push the information from the ship via a reporting template and pass it on to the relevant stakeholders ashore given in the reporting template. This information must necessarily come from the ship itself.

5.2 Scenario 2: Port information for fine-tuning the voyage plan

For safe and efficient entry to a port, a ship needs to plan how the ship should pass the port area. This is a part of the voyage planning process, where information is collected in advance to determine both safe access to the port and where to berth and at what time. The navigational information required, such as the water depth, position of navigational aids and tidal conditions, is available from published navigational products (charts including Electronic Navigational Charts, sailing directions or pilots, tide tables, etc.). The information gathered in the mentioned publication provides a picture of the situation on the date when the publication has been corrected. These publications are not normally published by the port, but by central organisations or administrations. Therefore, it would enhance safety of navigation if relevant dynamic information was published by the port about dynamic local port conditions and new regulations. Detailed dredging within the port is not published in the official charts. The port hydrographic survey team may conduct regular surveys of berths and dredged channels and areas of known mobile seabed. So far, this information has not normally been available to ships.

When approaching a port, the ship will check the details in the voyage plan and assess if they are still relevant. Contemporary dynamic navigational information will now be available real-time tidal data (height and current), traffic predictions, changes in markings and weather conditions. In addition, the shore side will provide the ship with details about berth availability and time information about pilots, etc.

The following list indicates the variety of information types required for safe and efficient port entry/exit provided by the port. The list below is, however, static although the ships' need for port information may vary from port to port.

Depth information per section of the port

- Maintained depths or soundings
- Nature of bottom

Admission policy per section of the port and per ship type and size

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- UKC policy
- Maximum draught without over-the-tide operations
- Maximum draught with over-the-tide operations
- Maximum length
- Maximum beam
- Maximum air draught
- Vertical tide restrictions
- Horizontal tide restrictions
- Wind restrictions
- Visibility restrictions
- Speed restrictions
- Passing requirements
- Tug use
- Berthing information

General information

- Developments
- Location
- Limits description
- ISPS level
- Load line
- Maximum ship size
- Time zone
- Local holidays
- Working hours
- Cargo
- Charts
- Shipping announcements
- Legal disclaimer
- General contact information
- Point of contact
- Inter-ship communication
- Real-time weather and tidal information
- Local weather and tidal phenomena
- Pre-arrival reports
- In-port reports
- Pre-departure reports
- Documentation requirements
- Regulations
- Exemptions

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- Emergency coordination
- Emergency response equipment
- Emergency procedure
- Nautical services (VTRS, pilots, tugs, linemen)
- Ship services (repairs, fumigation, hull cleaning, etc.)

In order to ease the uptake of information and to reduce the administrative burden for both the port and the ship, the functional requirement and goal for the scenario are captured in the following paragraphs.

5.2.2.1 Functional requirements for scenario 2

This scenario will ensure that up-to-date port information is available in digital form to be used by the ship and port both before the voyage and during execution. Functional requirements therefore focus on both the data provider and the consumer:

1. Data providers need a system that allows various types of data from a variety of origins to be stored in appropriate formats and be easily maintained. The update interval will be relatively fast for dynamic data, and slow for static data. Data from the individual port must be accessible through a central source providing an agreed registry for the information. As explained further under the description of the Maritime Cloud solution, data needs to be authenticated by the appropriate authorities in order to ensure that the sender and receiver of the information are granted access. Furthermore, the data should be protected from corruption. The aviation industry has made successful use of a similar concept.
2. Data consumers extract data from both ship and shore bases. Data must be searchable by relevant entities in the port by information type. Consumers need to be assured of the information authenticity. Consumers will need to be able to view information on the screen, and it should be made ready for possible downloading of data to be used in onboard systems. The project will not test the downloading of data on such systems, e.g. ECDIS; however, the data format will have to be compatible with internationally agreed formats.

5.2.2.2 Goal for scenario 2

The two e-solutions will use the Maritime Cloud to provide access to the required port information service when it becomes available. The port information will be collected in a semi-automated way and made available on board the ship.

5.3 Scenario 3: Seafarers' licences and STCW documents

Seafarers face a number of requirements to document their qualifications and identity, some of which are internationally adopted requirements by the IMO and the ILO. Documentation includes STCW certificates of competency or proficiency, seafarer medical certificates and identity cards – all of which describe the seafarers' qualifications.

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This represents an administrative burden on ship operators, training course providers and seafarers as many registrations will have to be maintained when signing on and when training is renewed.

The owner or manager responsible for crewing issues has to fill information into his shore-based management system on each of his seafarers in order to keep a record of e.g. the training, certificate of competency, validity, scope/requirements related to the certificate, training plan and reference to the STCW Convention.

The authority will also have to register details about seagoing service, etc.

The world-wide population of seafarers serving on internationally trading merchant ships is estimated to be in the order of 792,500 officers and 728,500 ratings[3]. Hence, the updating of certificates is in total a very time-consuming process.

The following list provides examples of certificates that have to be registered[4]:

- Ship's officer (deck/engine/radio)
- Tanker operation
- ECDIS / Radar
- Firefighting
- Rescue boats
- Security training
- Medical fitness certificate
- Identity card (seaman's book)
- Record of seagoing experience
- Dynamic positioning courses
- Bridge or engine resource management

In order to reduce the administrative burden for the authorities and particularly the ship/manager, an e-solution would be helpful for taking care of this cumbersome work. The functional requirements and goals for the scenario are captured in the following two paragraphs.

5.2.3.1 Functional requirements for scenario 3

In order to perform the tasks of providing the qualifications and personal record for seafarers to the ship operator, port States, training course providers, etc., a standard registry could be created for the exchange of data between various platforms such as crew management systems, systems for port authorities and/or maritime administrations, etc.

[3] BIMCO / ICS Manpower Report 2015.

[4] Please note that some of the mentioned certificates of competency and proficiency may be included in the STCW certificate.

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The e-solution could be a microchip contained in the seafarers' discharge book (sea service book) and showing all details and records. When the seafarer signs his contract with the company, he brings his discharge book and “swipes” it in front of a scanner, which reads the necessary details or the like. Information related to certificates can thereby be readily available as input into the crew management systems. Such a solution means that information redundancy might occur when the same information is stored both on the microchip and in some other external information source.

5.2.3.2 Goal for scenario 3

A dedicated e-solution based on a standard registry placed in the Maritime Cloud will keep a record of information related to certificates. The registry will allow for easy sharing between software platforms of seafarers' licences and STCW documents.

5.4 Scenario 4: Coordinating the port call

Ships are busiest while in port. However, before a ship calls at the port, a contract needs to be signed (fixed). This scenario concerns the information that has to be checked by charterers in their preparation before they commit themselves by signing the contract. In other words, how to reduce the number of “if only I had known then” situations, which will normally result in costly surprises.

The scenario does not claim to cover all important areas, but aims to provide elementary general information from various sources, including e.g. navigational information; cargo handling information; customs information; information related to necessary documents; meteorological information; as well as port information. The latter also includes financially important aspects such as trading restrictions, sanctions and freight taxes.

In addition to loading and unloading cargo, there are stores to be taken on board, crew changes, inspections and repairs to be made. The list is long and contains information from both ship and shore.

Because each port has unique procedures and vendors for providing services, it would be difficult to call at a port without the help of a local shipping agent. Shipping agents are hired by the owner to provide on-site operations knowledge about the port business.

There is no doubt that good knowledge of the necessary information can make the port call as smooth as possible. Hence, the agent – on behalf of the charterer – needs to have access to as much information from the ship and other stakeholders as possible.

The agent will, in the best case, also reduce the administrative burden imposed on the master if he has access to the necessary information and certificates.

In order to gain the best knowledge of the port(s) before signing the contract, and to reduce the administrative burden for the ship, the functional requirements and goals related to information to be checked before fixing the contract (an agent’s report to the charterer) is captured in the following two paragraphs.

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5.2.4.1 Functional requirements for scenario 4

In order to perform the challenging tasks described above, the basic concept is to develop a generic platform with the ability to report data once from the many stakeholders into one document collected by the agent. Data may have their origin in various data sources. The agent may provide the information to the charterer to allow him to fix the contract.

The stakeholders should be able to “release” information whereby the agent, when granted access to the data, picks the information for further use.

The FAL Compendium with EDIFACT mapping could be used as the basis. The solution should be able to pick the same information as within the STM, PortCDM and the National Single Window (all explained later in this report).

5.2.4.2 Goal for scenario 4

A dedicated reporting template in the Maritime Cloud, a “one-stop-shop”, will deliver relevant information from ship and shore upon the shipping agent's request.

5.5 Scenario 5: Emissions information shared with authorities, ports and potential third parties

Ships operating in an Emission Control Area (ECA) will have to use fuel that does not contain more than 0.10% sulphur from 1 January 2016 onwards. This is required according to MARPOL Annex VI. Switching to Marine Gas Oil (MGO) is currently the most viable option for following the new threshold limit.

Compliance with the sulphur regulation[5] is associated with considerable cost for ship owners, leading to a call for robust enforcement in SECAs. Hence, it is foreseen that ship owners will look for simple e-solutions when showing compliance as well as to limit the administrative

[5] IMO, MARPOL Annex VI regulation on Sulphur Oxide (SOx) and Particulate Matter emissions.

The Sulphur Oxide (SOx) and Particulate Matter (PM) emissions from ships will in general be controlled by the following limit set on the sulphur content of marine fuel oils:

- 3.50% m/m on and after 1 January 2012
- 0.50% m/m on and after 1 January 2020*

* The maximum sulphur content of 0.50% after 2020 is subject to the results of the forthcoming 2018 IMO availability study, which may decide to postpone the entering into force of the 0.50% limit to 2025. For EU waters, the 0.50% limit will enter into force by 2020 notwithstanding the in-alignment with global IMO regulation.

For the Emission Control Areas, including port areas, the sulphur content of fuel oil used on board ships shall not exceed the following limits:

- 0.10% m/m on and after 1 January 2015

It should be noted that compliance can be achieved by alternative fuels or abatement equipment.

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burden related to the reporting of emitted sulphur data. This matter is further elaborated in the achievements of WP5.3 (Deliverable D5.6), describing a voluntary feasible model for this.

To comply with the lower sulphur level requirements, the ship owner can choose to use either low-sulphur fuel or so-called ‘equivalents’ in order to achieve the required SOx emission levels.

Exhaust gas cleaning systems (so-called scrubber systems) are such an equivalent system. Although a scrubber may have associated installation costs, the system is a viable alternative as the ship can continue operate within an SECA by using the much cheaper HFO.

Although a ship is free to use ECA-compliant fuel when operating outside an ECA, the price difference[6] usually dictates otherwise.

Whatever solution the owner may choose, he will have to show compliance with the regulation in place. For the use of low-sulphur fuel oil, the bunker delivery note (BDN) will show the sulphur content in the fuel delivered.

If the ship is operating an exhaust gas cleaning system, MARPOL (Annex VI) allows for two methods of approval: a scheme A or scheme B.

- Scheme A demands initial certification of performance followed by a periodic survey with continuous operating parameters and daily emission checks to confirm performance in service.
- Scheme B requires performance confirmation by continuous monitoring of emissions scrubbers (continuous emissions monitoring systems, CEMS) with daily operating parameter checks. The vast majority of scrubbers being installed are adopting 'Scheme B' – the continuous monitoring of sulphur emissions. This means that scrubber performance is being continuously monitored, providing real-time data that demonstrates not only compliance, but also that a scrubber is working efficiently, thus eliminating any potential for residual build-up in the unit. It also removes any cost concerns, as it is part of the scrubber solution itself.

Regardless of the solution used for complying with the required low sulphur level in the exhaust gas, a system for information exchange based on the voluntary submission of such data to Port State Control surveyors, Coastal States, ports and others is therefore attractive.

Two sub-scenarios could be foreseen as part of the E2 developed e-solutions:

1) Data collection and direct submission of the raw emission data confirming PSC requirements.

[6] As per January 2016, the cost of HFO (3.5% sulphur) equals $125 per ton. The cost of MDO (0.1% sulphur) is around $290 per ton.

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2) Emission data submitted to PSC surveyors and ports/public in a processed reporting format.

Currently, there are no requirements with regard to the format of data. Just as there are no requirements as regards whether it is allowed to submit raw data to the authority to show compliance with the regulation.

The stipulated data-logging rate for the SO_2 and CO_2 monitoring (0.0035 Hz, i.e. approx. every 5 min.) may be used for direct transmission and direct use by the PSC surveyors. The possible use of the EU system THETIS-S may be considered as part of the solution. However, this has an undesirable side effect as CEM data volumes are not readily compatible with the THETIS-S system.

Other options (faster or slower transmission rates) require either some kind of data management or facilities to process the data in an analytical presentation. This must be done either on board or ashore. In the two following paragraphs, the functional requirements and goals for this scenario are captured.

5.2.5.1 Functional requirements for Scenario 5

In order to capture the necessary data, the following parameters should be monitored and recorded automatically:

- Time against Universal Coordinated Time (UTC), and ship position by Global Navigational Satellite System (GNSS) position.
- Exhaust gas SO_2 and CO_2 content.

If an exhaust gas cleaning system is used as an equivalent system, the following parameters may be captured as well:

- Wash water pressure and flow rate at the inlet connection.
- Exhaust gas pressure before and pressure drop across the scrubber.
- Engine or boiler load.
- Exhaust temperature before and after the scrubber.
- Wash water pH, PAH and turbidity.

The SO_2 and CO_2 recording device is required to be robust, tamper-proof and with read-only capability, able to record at a given rate. For this case, 0.0035 Hz (equivalent of every 5 min) is used.

The data should be stored for a period of at least 36 months from the date of recording (similar to the Bunker Delivery Note, BDN).

5.2.5.2 Goal for Scenario 5

A dedicated e-solution in the Maritime Cloud will deliver relevant sulphur emission data from the ship to the appropriate authority. The e-solution will be capable of:

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1) Pushing raw data to the authority.
2) Preparing an automated report, showing the emitted sulphur level at a given time and position.

5.6 Overview of the five scenarios – in a process-oriented approach

The different scenarios show a need for information sharing between different stakeholders. In the figure below, the key scenarios are related to the main stakeholders that interact in the different scenarios.

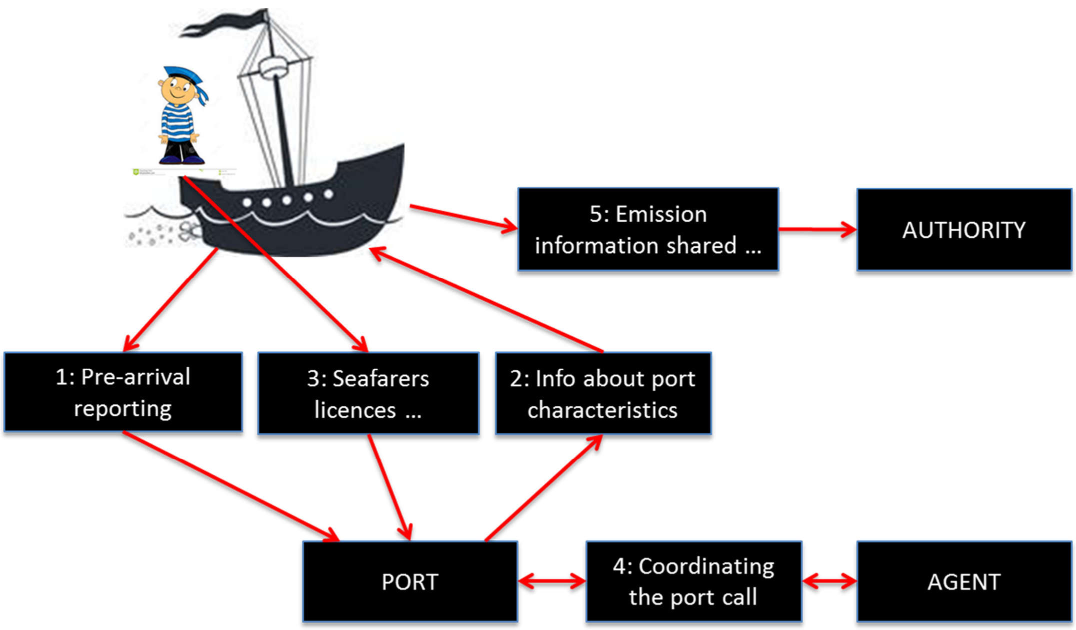

Figure 4: Overview of the scenarios

An overview of the characteristics of the information sharing in the five scenarios is given in the table below. The overview is divided into two: one related to the lines of communication when submitting information (table 3), and one related to the lines of communication when receiving information (table 4).

Both tables have been established based on a process-oriented approach, which explains the steps (processes) to be considered when submitting and receiving data/information. This will form the basis for the concept description of the architecture of the e-solutions when exchanging data (chapter 11).

The process-oriented approach provides a good indicator of the services to consider – and include in the final solution.

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Table 3, Lines of communication, submitting part prior to transmission of the data

(x) various options, an "either-or" solution	"Ship document exchange"	"Port information report"	"Integration with ECDIS"	"Seafarers documentation on qualifications"	"Coordinating the port call"	"SOX raw data push"	"SOX compliance report"
Scenario	**1**	**2.1**	**2.2**	**3**	**4**	**5.1**	**5.2**
Line of communication – Specification for submission of data							
Information supplier							
Ship	X			X	X	X	X
Shore		X	X				
Information source							
Single submitter	X			X		X	X
Multiple submitters		X	X		X		
Input platform							
Company specific platform	X	X	X	X	X		X
Standard equipment system (e.g. ECDIS)							
National Single Window							
Data logger						X	
Data storage							
No data storage (pushed data)						X	
Local data server	(x)	(x)	(x)	(x)	(x)		(x)
Remote data server (service provider)	(x)	(x)	(x)		(x)		(x)
Public information from internet							
Access registry for submitting information							
Registry necessary	X	(x)	(x)	X	(x)	X	X
Not requested		(x)	(x)		(x)		
Information confidentiality							
No classification	(x)	X	X	X	X	X	X
Encrypted	(x)			(x)			
Type of information							
Raw data						X	
Processed data		X	X				X
Interfaced text				(x)	(x)		
Document or file	(x)				(x)		
Transmission frequency							
Very low (once, e.g. as per construction)	(x)				(x)		
Low (once per crew change)	(x)			(x)	(x)		
Medium (once per voyage)	(x)	(x)			(x)		X
High (once a day, e.g. noon report)	(x)	(x)			(x)		
very high (continuously)			X			X	
Submission trigger							
Position dependant (coordinates)							
Time dependant (e.g. by noon)							
Automatically submitted						X	
Pushed when ready / upon request	X	X	X	X			X
Exchange of information							

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Table 4, Lines of communication, receiving part post transmission of the data

(x) various options, an "either-or" solution	"Ship document exchange"	"Port information report"	"Integration with ECDIS"	"Seafarers documentation on qualifications"	"Coordinating the port call"	"SOX raw data push"	"SOX compliance report"
Scenario	**1**	**2.1**	**2.2**	**3**	**4**	**5.1**	**5.2**
Exchange of information							
Line of communication – Specification for receiving data							
Receiving trigger							
Position dependant (coordinates)							
Time dependant (e.g. by noon)							
Automatically submitted						X	
Pulled upon request	X	X	X	X	X		X
Receiving frequency							
Very low (once, e.g. as per construction)	(x)				(x)		
Low (once per crew change)	(x)			(x)	(x)		
Medium (once per voyage)	(x)	X			(x)		X
High (once a day, e.g. noon report)							
very high (continuously)			X			X	
Type of information							
Raw data						X	
Processed data			X				
Interfaced output		(x)		(x)	(x)		(x)
Document or file	(x)	(x)			(x)		(x)
Information confidentiality							
No classification	(x)	X	X	X	X	X	X
Encrypted	(x)			(x)			
Access registry for receiving information							
Registry necessary	X	(x)	(x)	X	(x)	X	X
Not requested		(x)	(x)		(x)		
Data storage							
No data storage (pulled data)							
Local data server	(x)	(x)	(x)		(x)	(x)	(x)
Remote data server (service provider)	(x)	(x)	(x)	(x)	(x)	(x)	(x)
Public information from internet							
Output platform							
Company specific platform	(x)	X		(x)	(x)		(x)
Standard equipment system (e.g. ECDIS)			X			X	
National Single Window	(x)				(x)		(x)
Data logger							
Information source							
Single receiver		X	X	X	X	X	X
Multiple receiver	X						
Information receiver							
Ship		X	X				
Shore (various stakeholders)	X			X	X	X	X

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6 Lessons learned about the information exchange of tomorrow

EfficienSea 2 is not the only project that looks into the exchange of information between stakeholders in order to limit the amount of administrative burdens in the daily work. There are more than a dozen different on-going projects. The relationship between these projects and the scenarios are captured in the following table and summarized in the paragraphs below.

There are many more projects than the ones listed below that deal with information exchange. Also research projects in Asia and USA are very relevant. But to limit the scope, we have included projects funded, or partly funded by the EU only. This does, however, not prevent the WP5 partners from making use of the lessons learned from these projects.

Table 5, Relationship between projects and the WP5 scenarios

	Scenario				
	1	2	3	4	5
SafeSeaNet & NSW	X	X	X	X	X
Common NSW	X	X	X	X	X
AnNA	X	X	X	X	X
e-Navigation	X	X	X	X	X
S-100 concepts	X	X	X	X	X
Maritime Cloud concepts	X	X	X	X	X
EfficienSea 2	X	X	X	X	X
STM	X	X		X	
PortCDM	X	X		X	
FLAGSHIP	X	X	X	X	
MONALISA / MONALISA 2.0	X	X	X	X	X
MARNIS	X	X	X	X	X

6.1 SafeSeaNet and National Single Windows

In order to progress the *European Union maritime transport space* towards a space without administrative barriers, the EU Commission intends to evaluate the various reporting obligations in order to seek increased consistency and avoid overlapping of e.g. technical specifications for electronic data transmission and exchange systems required in EU legislation. This will be done through a so-called REFIT evaluation of the VTMIS Directive (2002/59/EC) and the RFD Directive (2009/65/EC) which will run through 2016. In particular this exercise will focus on the level of efficiency, harmonisation, standardisation, simplifications and reduction of administrative burdens (the reporting once principle).

Also the REFIT exercise will focus on the compliance by Member States both in legal and operational terms.

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This work will be linked with existing platforms such as SafeSeaNet and National Single Windows[7]. A successful implementation is likely to reduce delays, increase turn-around times and improve cost-effectiveness, not only for the commercial shipping stakeholders, but also for the various competent authorities who will have to "deal" with the information.

The Single Window concept has been previously defined (and partially implemented on a regional basis), but not yet implemented as an international standard.

As an outcome of this process, the EU Commission is expected to present specific proposals for revised directives in mid-2017.

6.2.1.1 Project relevance for the E2, WP5 work

The outcome from the project is used in/has relevance for:

- Scenario 1: Exchange of information between ship and port
- Scenario 2: Port information for fine-tuning the voyage plan
- Scenario 3: Seafarers' licences and STCW documents
- Scenario 4: Coordinating the port call
- Scenario 5: Emissions information shared with authorities, ports and potential third parties.

6.2 IMO working on a common National Single Window

At least since 2011, the IMO has been working at developing a concept for a Single Window for maritime transport. In 2014 the IMO Secretariat announced its intention to design a prototype of a maritime single window. Previous research had revealed that the majority of IMO Member States have some kind of single window in place related to cargo, but only a few have any single window for maritime transport.

In view also of the general impact of the total amount of administrative requirements, such a reporting window could in fact alleviate part of the burden imposed on all stakeholders, e.g. companies, seafarers and port States and thus contribute to maintaining focus on promoting maritime safety, security and environmental protection.

Financing and the exact timeline for the project are unresolved at this point with various options being considered. What has been carried out is an overall project plan in three phases and the completion of phase 1 which was the identification of criteria that the Single Window had to fulfil.

The following criteria for the project have been identified:

- Integration with other systems is necessary.
- No alternate paper-based storage: Save administration costs.

[7] EMSA NSW project: http://emsa.europa.eu/nsw.html

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- Full electronic history is available for statistical analysis.
- It should support fully automated reporting and clearance.
- Machine-to-machine with standard protocols where possible.
- Also include electronic certificates for port State control.
- Support also for local data formats.
- Must provide manual routines as backup.

Without set dates for delivery, it is difficult to coordinate with the development of E2. When (if) the IMO finishes this project, it will however be advisable to establish a connection to the E2 system allowing the two systems to communicate with each other.

6.2.2.1 Project relevance for the E2, WP5 work

The outcome from the project is used in/has relevance for:

- Scenario 1: Exchange of information between ship and port
- Scenario 2: Port information for fine-tuning the voyage plan
- Scenario 3: Seafarers' licences and STCW documents
- Scenario 4: Coordinating the port call
- Scenario 5: Emissions information shared with authorities, ports and potential third parties

6.3 AnNA – Advanced National Networks for Administrations

EU Directive 2010/65/EU on reporting formalities for ships arriving in and/or departing from ports of the Member States (the so-called "RFD", Reporting Formalities Directive 2010/65/EU) aims to simplify and harmonise the administrative procedures applied to maritime transport by making the electronic transmission of information standard and by rationalising reporting formalities.

To help achieve this, the Directive requires Member States to implement a Single Window for the lodging of the data by the reporting parties and the distribution to various (national) competent authorities and other Member States. The data should be submitted in an electronic format and the information should be reported once.

EU Member States are obliged to include the reporting formalities listed under Part A of the Annex to the Directive, taking account of the internationally recognized IMO FAL Forms (Part B). On the discretion of the EU Member States, additional reporting formalities according to national legislation (Part C) can be included.

In short, EU Member States need to ensure that:

- reporting parties can lodge data electronically to a single window;
- data needs to be reported only once;
- data will be transmitted via the single window to the relevant national competent authorities;

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- relevant data will be made available to other Member States.

The Reporting Formalities Directive 2010/65/EU calls for EU Member States to deepen the cooperation between the competent authorities, such as their customs, border control, public health and transport authorities.

The AnNa project was established to assist EU Member States, neighbouring countries and business to implement the RFD. The AnNa project is about assisting the Member States to realize technical implementation of the Maritime Single Windows (MSW) through pilot projects and lessons learned and not about policy guidance.

The AnNa initiative is an Action under the TEN-T Motorways of the Sea Multi-Annual Programme having 14 Member States as beneficiaries and will run between 2012 and 2015. AnNa has as its key objective to support the Member States in the implementation of the Reporting Formalities Directive, whilst securing the greatest degree of harmonisation and standardisation possible.

6.2.3.1 Project relevance for the E2, WP5 work

The outcome from the project is used in:

- Scenario 1: Exchange of information between ship and port
- Scenario 2: Port information for fine-tuning the voyage plan
- Scenario 3: Seafarers' licences and STCW documents
- Scenario 4: Coordinating the port call
- Scenario 5: Emissions information shared with authorities, ports and potential third parties

6.4 e-Navigation

e-Navigation is an International Maritime Organization (IMO) led concept based on the harmonisation of marine navigation systems and supporting shore services driven by user needs.

e-Navigation, as defined by the IMO (and IALA and other organisations), aims for the harmonised collection, integration, exchange, presentation and analysis of maritime information on board and ashore by electronic means to enhance berth-to-berth navigation and related services, for safety and security at sea and to protect the marine environment.

The e-navigation Strategy Implementation Plan (SIP), which was approved by the IMO in November 2014, contains a list of tasks required to be conducted in order to address 5 prioritized e-navigation solutions, namely:

- improved, harmonized and user-friendly bridge design;
- means for standardized and automated reporting;
- improved reliability, resilience and integrity of bridge equipment and navigation information;

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- integration and presentation of available information in graphical displays received via communication equipment; and
- improved communication of VTS Service Portfolio (not limited to VTS stations).

It is expected that, when completed during the period 2015-2019, these tasks should provide the industry with harmonized standards in order to start designing products and services to meet the e-navigation solutions.

6.2.4.1 Project relevance for the E2, WP5 work

The outcome from the project is used in:

- Scenario 1: Exchange of information between ship and port
- Scenario 2: Port information for fine-tuning the voyage plan
- Scenario 3: Seafarers' licences and STCW documents
- Scenario 4: Coordinating the port call
- Scenario 5: Emissions information shared with authorities, ports and potential third parties

6.5 S-100 concepts

Based on the requirement to provide reports prior to port entry, the various reporting parameters need to be defined and analysed and a data model needs to be developed. This data model will be based on S-100 concepts.

An S-100 type product specification will be developed to provide a standard definition of how the information should be structured. The necessary features will be registered in the IHO feature concept dictionary.

S-100 is the International Hydrographic Organization's (IHO) Universal Hydrographic Data Model. S-100 describes the overall framework of how the standard is implemented. Being based on the ISO19100 series of geographic data standards, S-100 aims for interoperability with non-hydrographic applications. The implementation of S-100 requires the definition of product specifications, such as S-101 for Electronic Navigational Charts (ENCs). An S-100 compatible product specification defines the features within the defined scope of the product specification. Each feature is defined in terms of attributes that describe the feature. Product specification features and attributes are recorded in the S-100 Registry, a central database maintained by the IHO to ensure that a consistent set of unique definitions are used throughout all product specifications.

The process of product specification definition entails modelling real world features, typically in GML (Geographic Markup Language). Thus to define an S-100 product specification for port information, it is necessary to identify and model all relevant data types.

6.2.5.1 Project relevance for the E2, WP5 work

The outcome from the project is used in:

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- Scenario 1: Exchange of information between ship and port
- Scenario 2: Port information for fine-tuning the voyage plan
- Scenario 3: Seafarers' licences and STCW documents
- Scenario 4: Coordinating the port call
- Scenario 5: Emissions information shared with authorities, ports and potential third parties

6.6 The general concept of the Maritime Cloud

The Maritime Cloud has been defined as a communication framework, which enables efficient, secure, robust and trouble-free exchange of information between each and every authorized maritime entity, using available communication systems. The concept of the Maritime Cloud has emerged as a response to the need to create a common framework to facilitate e-navigation services management and to ensure its security.

Figure 5 depicts a general concept of the Maritime Cloud.

The core of the Maritime Cloud framework is comprised of three key elements, i.e.:

- Maritime Service Portfolio Registry,
- Maritime Identity Registry,
- Maritime Messaging Service.

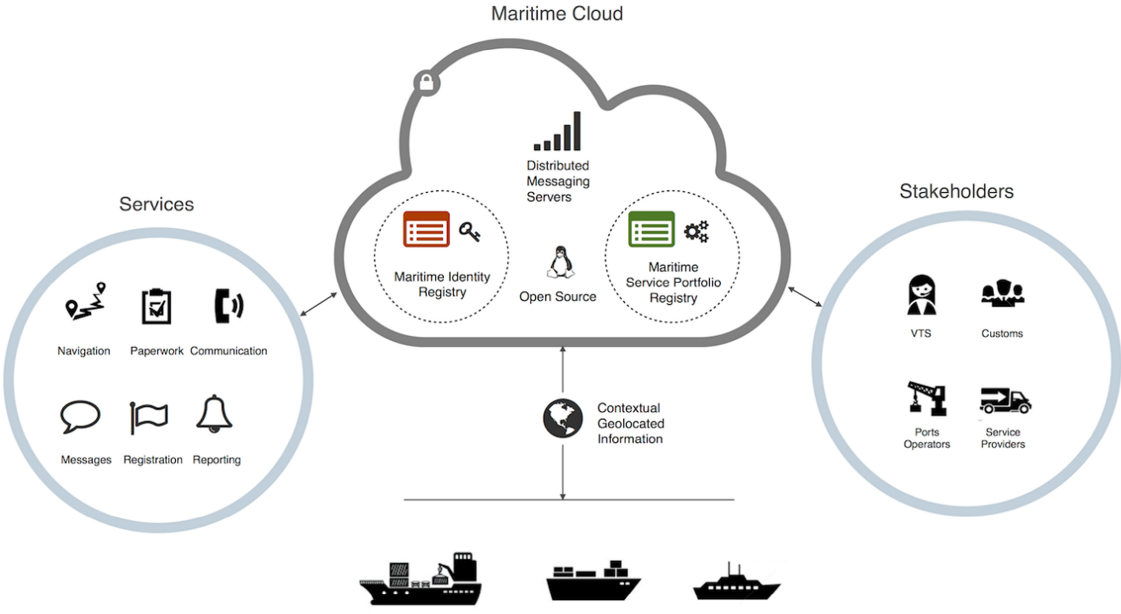

Figure 5, Maritime Cloud general architecture [8]

[8] Project website: https://dma-enav.atlassian.net/wiki/display/MCCT/Maritime+Cloud

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The Maritime Service Portfolio Registry contains a formal description (specification) of the services. The registry is to improve the visibility and availability of maritime information and services.

The ships' identification systems (such as ship's name, IMO number, MMSI number) utilized currently do not consider the need for interaction with actors that are not ships and do not have their own radio station, e.g. shipowners or service providers. The Maritime Cloud will provide a maritime identifier (Maritime Identity) in the Maritime Identity Registry to give access to:

- Certificates for a secure exchange of information with other maritime entities using every channel of communication,
- The Maritime Service Portfolio Registry,
- The Almanac,
- The Maritime Messaging Service.

The Maritime Service Portfolio Registry and Maritime Identity Registry are updated in real time in the central database and those updates are transmitted to the actors.

Every actor has a local copy of the public area of both the Maritime Identity Registry and the Maritime Service Portfolio Registry – which is called the Almanac. The Almanac will act as a "directory" that includes every registered actor and maritime service, and consequently it will enable offline access to the framework services and secure communication. Additionally, using the Almanac, the actors (especially the mobile ones) will be able to reduce the frequency of online searching for contact information – it will be done only to update the required data on-demand and/or only in designated time slots.

Maritime Messaging Service (MMS) is a primary Maritime Cloud service. Its goal is to ensure a seamless information exchange between different communication links. MMS is based on Internet connection, but on the other hand, every alternative communication interface may be switched on and utilized by the MMS via dedicated network gates. Thanks to this approach, for example a message sent by "ship A" connected to the MMS via Inmarsat can be received on "ship B" through an Iridium terminal and through an HF link on "ship C" or it can be received by a VTS operator with a DSL-based Internet access.

Consequently, the MMS can be described as a mechanism that offers communication between actors that are unable to communicate directly, i.e. do not have compatible links, or they do in fact have compatible links, but they are temporarily unavailable. In such a case, the communication is performed via a central server. In case one of the actors is unable to connect, the MMS can keep their message in a queue for a specified amount of time. In figure 6, the communication in the Maritime Cloud using the MMS is presented schematically.

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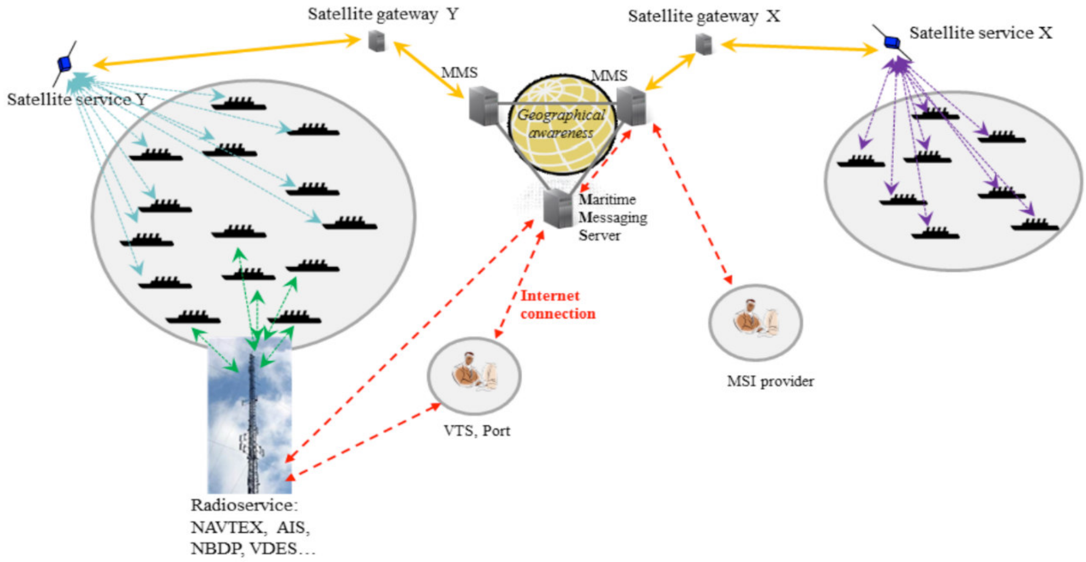

Figure 6, General concept of the MMS service in the Maritime Cloud.[9]

Additionally, the MMS service supports geocasting.

Geo-messaging is a messaging protocol that works on top of the TPC/IP protocol. It makes it possible to send messages to actors (within a certain geographic area – geocasting) based on their maritime identifier. The actors need to monitor (listen to) a specified area defined (and limited) by the technical capabilities of the communication system. The concept of geocasting is presented in figure 7.

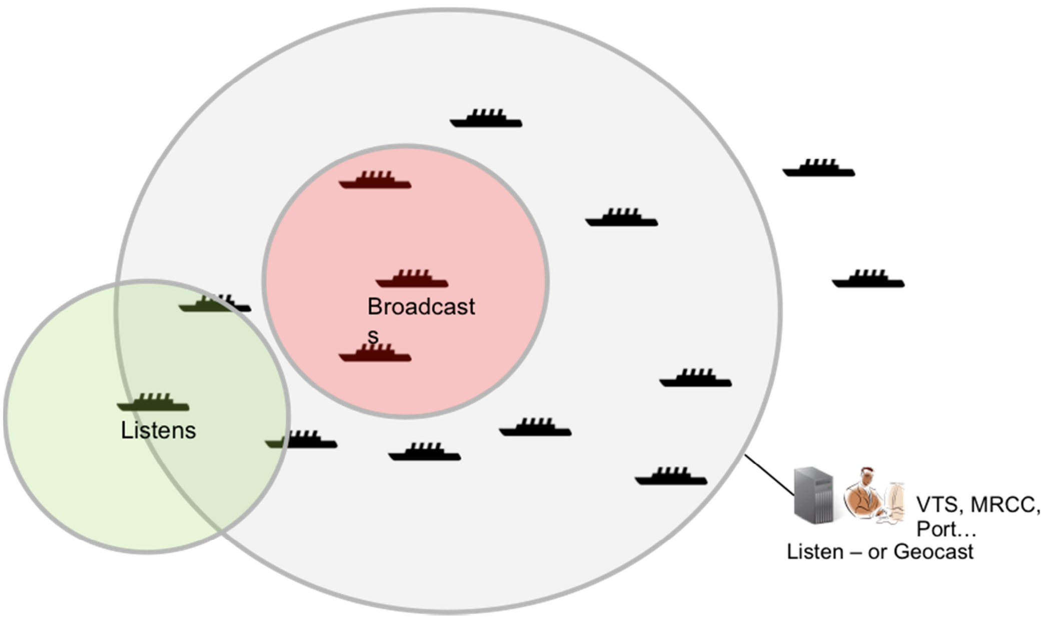

Figure 7, General concept of geocasting.[10]

[9] Project website: https://dma-enav.atlassian.net/wiki/display/MCCT/Maritime+Cloud

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The Maritime Cloud services will be provided to ship/coastal applications via the so-called Maritime Cloud client. This component will enable the proper operation of the Maritime Cloud services – independently of the hardware elements – by providing roaming between various data transmission systems. The client component will act as a local concentrator of information and will be equipped with a link to appropriate sensors, navigation data and telecommunication devices.

6.2.6.1 Project relevance for the E2, WP5 work

The outcome from the project is used in:

- Scenario 1: Exchange of information between ship and port
- Scenario 2: Port information for fine-tuning the voyage plan
- Scenario 3: Seafarers' licences and STCW documents
- Scenario 4: Coordinating the port call
- Scenario 5: Emissions information shared with authorities, ports and potential third parties

6.7 EfficienSea 2 proposal and structure (cloud solution) – other than WP5

EfficienSea 2 (this project) is funded by the EU under the Horizon 2020 framework and will run from 2015 to 2018.

The overall objective is to co-create and deploy innovative solutions for safer and more efficient waterborne operations. With a total of seven specific objectives all interacting within one framework, the project targets the following:

- Create and implement a ground-breaking communication framework – the 'Maritime Cloud' – that will enhance information sharing in and around the maritime sector for smarter traffic management, facilitating a comprehensive e-maritime and e-navigation environment, enabling the maritime internet of things.
- Identify, develop, test and, where possible, standardise and implement e-navigation solutions that will reduce the risk of accidents, especially in dense waterways, as well as increase the efficiency of the transport chain.
- (Develop, test and, where possible, implement e-maritime solutions for automated reporting and efficient port information and, thus, minimise delays and turnaround times as well as administrative burdens) – WP5.
- Create and implement navigational support services and a new self-organizing emergency response solution in remote and difficult environments such as the Arctic in order to reduce the risk of loss of life.
- (Develop solutions to monitor emissions with a focus on SOx and conduct validation trials in the Baltic Sea Region) – WP5.

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[10] Project website: https://dma-enav.atlassian.net/wiki/display/MCCT/Maritime+Cloud

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- Create innovative and cost-effective solutions with novel communication technology to deal with ships' challenge of getting access to information services at a reasonable price, especially in remote places such as the Arctic.
- Set the technical and governance standard for the above areas, particularly in regards to e-navigation solutions.

Within the project, a uniform information exchange platform using internationally recognized data formats will be established on a Maritime Cloud by introducing a new standard of information exchange between ships, ports, commercial entities and international organisations.

This new concept has the potential to set the future standards for a fast and safe information exchange to the benefit of the e-maritime concept.

6.2.7.1 Project relevance for the E2, WP5 work

The outcome from the project is used in:

- Scenario 1: Exchange of information between ship and port
- Scenario 2: Port information for fine-tuning the voyage plan
- Scenario 3: Seafarers' licences and STCW documents
- Scenario 4: Coordinating the port call
- Scenario 5: Emissions information shared with authorities, ports and potential third parties

6.8 MONALISA / MONALISA 2, duration 2010-2015[11]

The MonaLisa project (2010-2013) and its successor – the MonaLisa 2.0 project (2012-2015) – focused on solutions for enhancing the safety and efficiency of the maritime transport chain in the context of Sea Traffic Management (STM). The official output of the MonaLisa 2.0 project and further descriptions can be found at: http://monalisaproject.eu/

These projects have developed target concept and key performance indicators for four STM strategic enablers:

1. Voyage Management services aimed at providing support to individual ships in both the planning process and during a voyage, including route planning, route exchange, and route optimization services.

2. Flow management services aimed at supporting both land organizations and ships in optimizing overall traffic flow through areas of dense traffic and areas with particular navigational challenges.

[11] EfficienSea II, D3.1 – Analysis report on communication and infrastructure final-cs3.

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3. Port Collaborative Decision Making (PortCDM) services aimed at increasing the efficiency of port calls and departures for all stakeholders through improved information sharing, situational awareness, optimized processes, and collaborative decision making during port calls and departures.

4. SeaSWIM (System Wide Information Management) aimed at ensuring interoperability of services.

The MonaLisa 2.0 project was followed by the 'STM Validation Project' (2015-2018) (see section 6.9). The aim is to validate the target concepts using a fleet of hundreds of ships and 13 ports. Note that the 'SeaSWIM' concept has many similarities and significant overlaps with the 'Maritime Cloud' concept. Concrete efforts are being made towards cross project collaboration between the EfficienSea 2 and the STM Validation Project, to establish common infrastructure standards and demonstrate/validate a common solution rather than develop competing solutions. However, the SeaSWIM concept includes several functions or provisions for service definitions. The STM validation project therefore foresees a process of determining which requirements and provisions relate to the core of the Maritime Cloud concept and which are purely STM related.

6.2.8.1 Project relevance for the E2, WP5 work

The outcome from the project is used in:

- Scenario 1: Exchange of information between ship and port
- Scenario 2: Port information for fine-tuning the voyage plan
- Scenario 3: Seafarers' licences and STCW documents
- Scenario 4: Coordinating the port call
- Scenario 5: Emissions information shared with authorities, ports and potential third parties

6.9 STM validation project (Sea Traffic Management), duration 2015-2018

The STM project (Sea Traffic Management) takes a holistic approach to services, making the berth-to-berth voyage efficient, safe and environmentally sustainable. This relies on collaboration between stakeholders, with a focus on real-time information sharing and the emergence of situational awareness. The project aims to demonstrate interoperable, standardized and harmonized services to minimize the use of fuel and maximize the utilization of ports by focusing on the voyage as the central element of analysis and development. Thus STM is developing concepts of:

- Strategic Voyage Management: to optimize the voyage plan before sailing;
- Dynamic Voyage Management: to continuously monitor and adjust the voyage plan;
- Flow Management: to provide situational awareness and optimize throughput in congested areas;

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- Port Collaborative Decision Making (PortCDM): to provide collaboration between key actors within the port, to enable just-in-time arrival, port operations, and hinterland transportation, to improve resource utilization.

To achieve its objectives, STM is developing SeaSWIM, with parallels to System Wide Information Management within aviation.

STM is concerned with increasing efficiency in operations within and between ports. This can be achieved by maximizing the utilization of the facilities in ports and minimizing the use of energy to steam between two ports, constrained by safety considerations. It has been estimated that the bunker cost to steam between two ports constitutes between 35-70 % of a voyage's total cost. From a port gate-to-gate perspective, the actual sea voyage is estimated at 27% of the full cost[12]. In aiming to develop international standards for the exchange of port information, it is important that the EfficienSea 2 project maintains a close link with the STM project to ensure that proposed solutions meet shared objectives of voyage efficiency, safety, and environmental sustainability.

6.2.9.1 Project relevance for the E2, WP5 work

The outcome from the project is used in:

- Scenario 1: Exchange of information between ship and port
- Scenario 2: Port information for fine-tuning the voyage plan
- Scenario 4: Coordinating the port call

6.10 PortCDM, duration 2015-2018

The Port Collaborative Decision Making (PortCDM) is a sub-concept under STM (as described above). The PortCDM may, when fully matured, play a vital role in improving the overall efficiency of the maritime transport chain. Inspired by a similar concept applied for collaborative decision making within and between airports, PortCDM is a way of establishing not only a common view of all available time-based information, but using this information as a tool to create a common situational awareness supporting the involved actors to make more efficient collective coordination of port calls.

[12] IMO, MSC 83 (MSC 83/INF.19), 30 July 2007, Improving the provision and quality of nautical port information.

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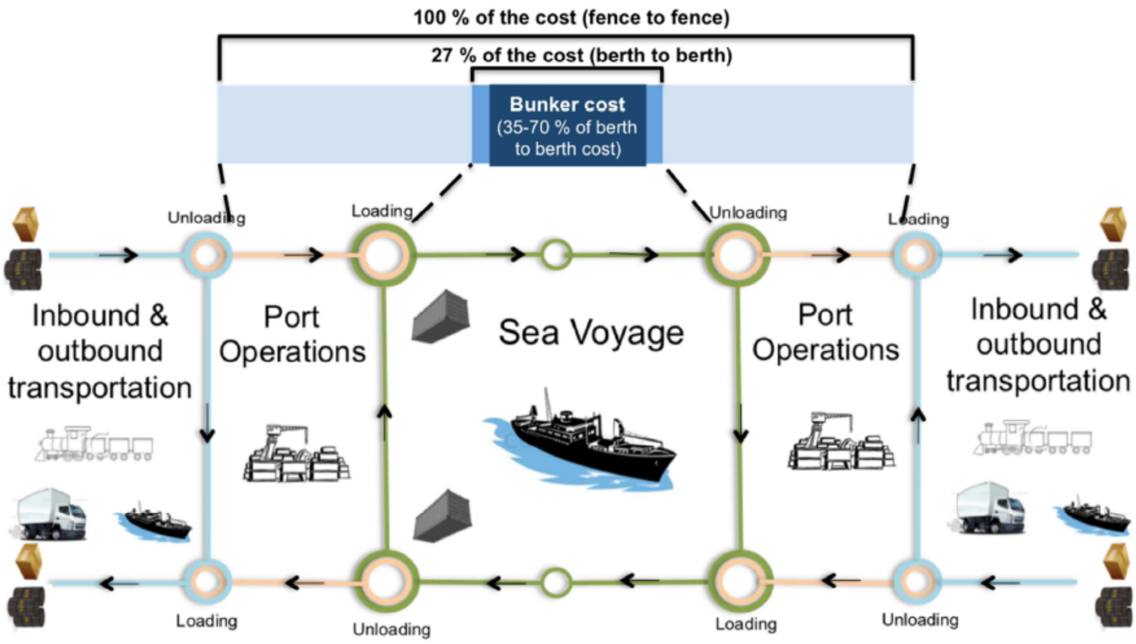

Figure 8, Coordination and communication between port services[13].

Coordination requires that the destination port communicates its resource availabilities to approaching ships and matches this with the ship's needs. Such an integrative approach would close the loop in STM, expanding and acknowledging the need to interact with the port of destination to enable efficient and sustainable sea operations.

Due to the non-uniformity of port operations, an unresolved quest is what to communicate and how digital collaboration could be established, inside the port and in relation to other actors. STM enables ports to subscribe to information about upcoming port calls. A port call message should be initiated automatically as soon as the port of destination is decided by the shipping company and entered into the ship's navigation system by the captain.

A port call has many actors. Thus, there is a need for coordination at a level beyond the single actor. Today, because of a lack of data sharing, it is hard to foresee when a port approach will occur. It is a great challenge to predict when a ship might depart from a berth and thereby give space for a new approaching ship. Data indicate that the expected departure time from a berth deviates much among the different actors who provide a departure forecast.

This could, for example, be caused by very late assignments on additional services, such as a change of lubrication oil or bunker operations. The challenge is thus to overcome this low ability to predict state changes leading to poor coordination of port activities (arrival, activities at berth, and departure).

[13] STM – The Target Concept, MONALISA 2.0 – D2.3.1, 2015.

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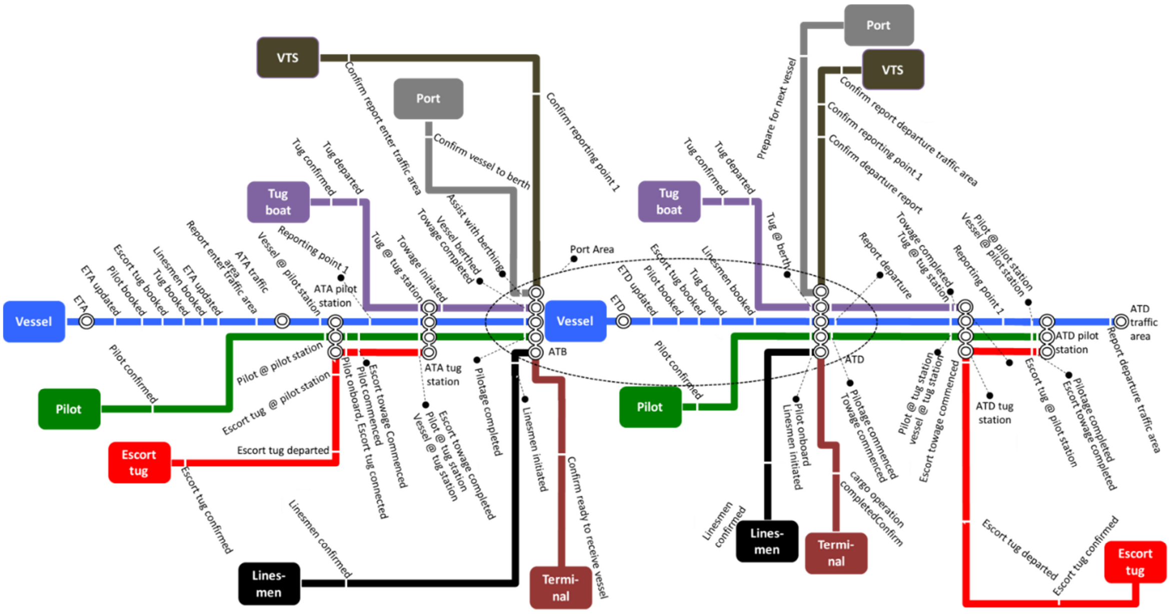

Figure 9, Information exchange during port of call.[14]

The above figure, developed by the PortCDM group, shows the states of information (estimates and actuals) exchanges during the port call.

6.2.10.1 Project relevance for the E2, WP5 work

The outcome from the project is used in:

- Scenario 1: (Parts of) Exchange of information between ship and port
- Scenario 2: (Parts of) Port information for fine-tuning the voyage plan
- Scenario 4: Coordinating the port call

6.11 FLAGSHIP, duration 2011-2014

The EU FLAGSHIP project focused on improving on-board systems and procedures as well as the ship management systems ashore by using efficient communication interfaces.

The rapid development of satellite communication and the Internet have provided the means by which data can be gathered instantaneously and in large amounts, whereby the interface and interactions are even more important.

As part of the project, two different structures for communication were reviewed and discussed; a DNV developed model and the commercial product called SHIPDEX.

[14] PortCDM Concept Description, MONALISA 2.0 – D2.3.1-4.4, 2015, and Lind M., Haraldson S., Karlsson M., Watson R. T. (2015) Port Collaborative Decision Making – Closing the Loop in Sea Traffic Management, Accepted to COMPIT 2015 – Conference on Computer Applications and Information Technology in the Maritime Industries, 11-13 May 2015, Ulrichshusen/Germany.

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6.11.1 DNV product model for ships (2005)

DNV have developed an alternative way to create a functionally oriented ship model[15].

The purpose of the model was to provide a uniform framework for use in DNV's classification work. The framework should be used for structuring governing documentation and for storage, retrieval and analysis of generic and ship specific information.

The model would allow for a common framework for structuring information about the ship and its components. Information produced during the design of the ship can be used for automatic configuration of both control systems and maintenance systems. The information will also be important to ensure safe scrapping of ships. However, the development of such models requires a significant amount of development and standardization.

The system is closely related to a "Universal Decimal Classification" (UDC) based system, but it has somewhat different classes of functions. The main functional classes are listed below.

- 000a General
- 100a Main structure
- 200a Stability, watertight and weather-tight integrity
- 300a Hull equipment
- 400a Propulsion and steering
- 500a Electric power
- 600a Machinery and marine piping systems
- 700a Navigation, communication and control
- 800a Safety
- 900a Environment
- 1000a Dry cargo
- 1100a Liquid and gas cargo
- 1200a Drilling and well intervention
- 1300a Diving

The classification system has more than 2500 entries in its current version. As the system is open and fairly comprehensible, it may be a good alternative as a starting point for a system breakdown.

6.11.2 SHIPDEX (2008)

Shipdex™ (www.shipdex.com) is an international protocol developed to standardise the electronic exchange of technical data, with the aim of rationalising the proliferation of ship technical information, currently supplied in various formats and, as such, not immediately usable in different computer systems.

[15] Vindøy, Vidar. A Functionally Oriented Vessel Data Model Used as Basis for Classification, 7th International Conference on Computer and IT Applications in the Maritime Industries, COMPIT'08, Liège, 21-23 April 2008.

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Shipdex, an abbreviation of 'ship data exchange', intends to improve this situation by providing an open XML-based standard which may be implemented, even in existing systems, by all parties – including ship owners, managers, equipment manufacturers, shipyards, and IT providers.

The protocol has been in use for about 30 years in the military sector (naval, land and aerospace) and adopted more recently by the Civil aviation industry.

It enables equipment manufacturers and shipyards to structure, write and deliver technical manuals in an advanced electronic and standardized format that it is much easier and more effective to produce and to subsequently manage compared to traditional methods of writing technical manuals using word processors.

Shipdex data offer shipowners the opportunity to eliminate or reduce the traditional pain and high costs in retrieving technical information.

The protocol is defined in S1000D using the DNV product model (see above) as the main key in tagging components. The specification is an open standard protocol. S1000D is a very comprehensive system and seems to contain all types of information and messages one could want to use in a maintenance perspective. However, it is fairly complicated and verbose in its implementation and it is not directly applicable as a real-time or near real-time message format.

6.2.11.1 Project relevance for the E2, WP5 work

The outcome from the project is used in:

- Scenario 1: Exchange of information between ship and port
- Scenario 2: Port information for fine-tuning the voyage plan
- Scenario 3: Seafarers' licences and STCW documents
- Scenario 4: Coordinating the port call

6.12 MARNIS, duration 2004-2008[16]

A project (2004-2008) supported by the European Commission through the 6th RTD Framework programme. This project described a Maritime Information Management (MIM) concept, intended to prevent frequent reporting of the same information, through reporting once to a National Single Window and distribution through the SafeSeaNet in a European e-maritime context.

The final project report can be found at the MarNIS_website, MarNIS D2.2.C-1, describing requirements for maritime broadband communication and mandatory communication capabilities. The report concludes: “Passenger ships will probably have passenger demand, revenue generating services and possibly safety as driving forces for even higher bandwidth

[16] EfficienSea II, D3.1 – Analysis report on communication and infrastructure final-cs3.

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requirements. Cargo ships will most likely have efficient operation and legislative requirements as most important driving forces. In all cases it is mainly economic factors that determine the use of communication."

The report notes that communication needs can basically be differentiated between

- Safety critical communication
- Business related communication
- Entertainment

It is further noted that cellular and port broadband networks are likely to play an important role in the future, and that bandwidths in the order of 64kbps are considered 'broadband' for most cargo ships, while the entertainment segment of passenger ships pose quite different requirements.

The "Final report on the MarNIS e-maritime architecture" (MarNIS D-HA3F) presents an architecture supporting the e-maritime solutions proposed by the project, with a focus on generic responsibilities and how these responsibilities are to be fulfilled in a European context.

This report is quite detailed on the needs for role based access control to information services in the e-maritime context.

6.2.12.1 Project relevance for the E2, WP5 work

The outcome from the project is used in:

- Scenario 1: Exchange of information between ship and port
- Scenario 2: Port information for fine-tuning the voyage plan
- Scenario 3: Seafarers' licences and STCW documents
- Scenario 4: Coordinating the port call
- Scenario 5: Emissions information shared with authorities, ports and potential third parties

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7 Port information availability

The data model to be used for the scenarios should, to the extent possible, be based on the S-100 concept as developed by the IHO and recognised by the IMO as a cornerstone of e-navigation. An S-100 type product specification will provide a standard definition of how the information is to be structured that can be adopted for international use.

Based on existing port databases, the plan is to develop the data modelling required to draft an S-100 type product specification. The revision and development will take place in coordination with ports, port organisations, agents and other commercial entities, as well as other port authorities (not involved with the project) in order to reach general acceptance of the whole concept as well as the level of information and format.

The aim of having an S-100 based product specification is that it would be internationally recognized. A standard format and structure for port information would facilitate standardized port information exchange, so that information services would be able to handle a common set of information anywhere in the world.

However, significant challenges will be to firstly gain acceptance of the proposed standard, and secondly to encourage ports to provide the information in the required format. Currently information is held in numerous data formats, spreadsheets, databases and free text. This information will require reformatting – a task that some ports may consider unnecessary. Thus it is not only the availability of the information that is an issue, but whether the relevant organizations are prepared to supply it in a standardized format.

To ease the reformatting task, an information input and management system may be required. This could be designed for ease of information maintenance to support the availability of up-to-date information. It would also provide the export function to ensure that the requirements of the S-100 product specification are met.

7.1 Port data standards

Most ports seem to have their own set of requirements defining which information from a ship entering the port must be supplied and at which time. Typically, the requirements are published on the internet, but the format and the description can vary a lot, and hence it can be quite time consuming to discover exactly what is needed for a specific port. In some cases a form is available, which – when filled in by the seafarers – contains most of the information needed.

Information exchanged between the stakeholders may have a number of formats:

- Type (NSW, customs, immigration, waste, etc.)
- Submission requirements (who, what, where and how?)
- Format (hard copies, FAX, CSV, RTF, PDF, XML, etc.)
- Languages (i.e. Korean & English)

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- Form of layout template (header, footer, field names and placement, etc.)
- Field descriptions (length, units, alpha/num, etc.)

It should be noted that, already now, several commercial products are available that address the ship reporting issue. DNV-GL's "Navigator" product is just one among many which seems to be able to generate about 1600 different reports. Also several shipping lines are developing or have already developed in-house solutions.

The International Harbour Masters Association (IHMA) promotes a Word-template that helps port authorities to structure information about their port into a standardized "Port Information Guide". This guide contains a lot of information that is useful for human understanding of what the port expects, but for automatic, electronic information exchange the information has to be structured as a database. Such an approach will allow a computer aboard the ship to extract the necessary information and assist the seafarers in supplying the wanted information to the port.

To prevent chaos there is a need to develop a common registry that can be used by all developers, not only for ship-board solutions but also for shore-based or cloud based solutions that address the needs of shore-based stakeholders.

This matter will be looked at in other WP5 deliveries.

7.2 Available data from open sources

In general, information provided about ports consists of a navigational section and a port information guide. Such information is presented in different formats either in books or via the internet. Generic safety information for ships is available to all users; however, certain processed information is available on a commercial basis only.

The process of updating such material is in general rather slow, especially when it comes to books, but also as the update rate of web applications may be slow as information providers have various more or less inconsistent templates, etc. to fill in. Information regarding changes in port information is often communicated on a person-to-person basis.

7.3 AVANTI project

AVANTI is a prototype on-line web-based application that provides Access to VAlidated NauTical Information (AVANTI) for port users. It is an initiative of the International Harbour Masters' Association (IHMA), developed in collaboration with the United Kingdom Hydrographic Office. AVANTI helps harbour masters to manage their nautical port information so that it is accessible to port users, thus improving the safety and efficiency of shipping.

Having been initially developed within the Port of Rotterdam, the trial has extended to the ports of Gothenburg (Sweden), Marseille (France) and Luleå (Sweden). The aim of AVANTI is four-fold:

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1. To standardise a definition for port features – this was the genesis of the initiative.
2. To standardise the exchange format to allow ports such as Rotterdam, which manages its port information by means of internal IT systems, to upload to publishers' systems.
3. To provide a database and editing interface to allow smaller ports without sophisticated IT systems to enter, manage and publish their port data in the standard form.
4. To provide a portal that allows customers to access the port information for any AVANTI port.

A proof of concept (POC) system has been developed and is available for a limited number of ports to sign up to (up to about 20) and for shipping companies to use to access port data. This POC system will be used within the E2 project as a demonstrator and test-bed to simulate discussion of user requirements, and to elicit feedback on its use. Note that the development of the AVANTI POC is not an E2 project task.

7.4 Hydrographic offices' publications

Information about ports is available in standard nautical publications from hydrographic offices. These complement information shown in nautical charts that are vital to safe navigation. Relevant publications include:

- Sailing Directions (also called Coast Pilots) contain descriptions and diagrams of the approach to a port, identifying typical local conditions and potential hazards, contact information for port authorities and port views;
- Tide tables and tidal stream atlases for calculating predicted tidal conditions;
- Lights Lists defining navigational light positions and characteristics;
- List of Radio Signals with contact details and procedures for pilots, VTS centres and ports, plus information on national and international ship reporting systems.

Traditionally, such publications were provided as printed books. Increasingly they are becoming available as electronic copies (e.g. pdf copies) or as e-books[17]. They are all updated by Notices to Mariners to ensure that users have the latest information available. Ships required to comply with the SOLAS provisions are mandated to carry updated nautical publications and charts necessary for their voyage. Manual updating of printed products is removed by using digital products. Electronic updates are also more accessible than paper versions, which can only be picked up in port, but ships approaching a port are still vulnerable to not having the most up-to-date information, which may only be available directly from the port.

A recent innovation of the UK Hydrographic Office is Admiralty Port Approach Guides. These are a paper product, printed as standard-size charts, covering the port approach area and

[17] Note that there are three categories: NP1 = paper publications, NP2 = raster publications, NP3 = vector/fully digital publications. The work of the IHO on NP3s within the S-100 framework (e-books…) are not fit for e-Navigation and will have to be replaced at a point in time.

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providing essential information required for port entry taken from nautical publications (listed above). They are not for navigation, but for planning and general situational awareness during port entry/exit. In addition to extracts from Admiralty Publications, Port Approach Guides include Quick Response (QR) codes to provide easy access to other information such as to current warnings and notices for specific port areas.

Another aid to efficient and safe port entry/exit are voyage planning systems which aim to provide direct links to the necessary information during the planning process. An example is the Admiralty e-Navigator Planning Station. This is a back-of-bridge or office-based PC application that brings together relevant navigational information in one place, thus reducing the time spent on finding the information required for berth-to-berth planning. Current developments are trialling more interactive links to optimize voyage planning through dynamic maintenance of waypoint time of arrival, speed between waypoints and automated update of under-keel clearance at waypoints to ensure safe navigation. Critical waypoints are pilot pick-up points, entry to port, and arrival at the berth or terminal. Linking this to information obtained from ports relating to availability of pilots, traffic congestion within port and berth availability would be a significant contribution to safe and efficient port entry.

7.5 BIMCO World Port (commercial)

The BIMCO World Port is a commercial database for BIMCO members containing details of over 2,500 ports, including up-to-date port conditions. The information is provided by the port itself on an annual basis.

The World Port aims to provide owners/operators with the necessary information before fixing the charter contracts.

At the BIMCO Website, the information related to countries and the specific ports is easily found. Members may log-in to find data concerning the particular port information; however, the site also contains facts about general and local holidays as well as working hours in individual ports; tariffs, taxes and trading restrictions.

The information related to holidays and working hours is published at the end of every calendar year in the form of a hard copy edition as well as website updates covering the following year. The holiday information available on the website will be amended and updated throughout the year, should any amendments be needed

The tariffs, taxes and trading restrictions are updated with relevant information as and when received from our sources, and the more general port information is updated “in turn” as the responsible department will specifically request the information providers in each individual port covered to update the salient information at certain intervals.

The general port information is listed under a specific area or region. One may be able to search for individual ports by choosing first the country, e.g. Spain, then the region (if applicable), e.g. Murcia and finally the port, e.g. Cartagena.

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Under Spain (following the example above), the general information applicable to the country is located and contains, inter alia, specific advice about ballast water, sewage and IMO conventions as well as other headings where data relevant for the particular country are obtained. Furthermore, there are direct buttons to go straight to e.g. the holiday information or trading restrictions.

Having chosen a region (if applicable), it is also here possible to expand the list to search for particular information for this region. In most situations, however, it is relevant to proceed to enter the list of data for a particular port and, once that has been selected as described above, the website gives advice of not just the physical restrictions but also legal and environmental issues as well as general information concerning seafarer issues, documents required, security issues, details of port limits and entrance, contact details for the relevant authorities and a number of other highly relevant subjects. While the majority of the ports list a certain minimum of information, other data may be published only for the ports where it is available.

A recent add-on to the World Port is a vetting scheme of dry bulk terminals. The aim of the scheme is to get an overview of bulk terminals' performance and, if needed, to improve the safety and co-operation between the ship and the terminal.

The information is based on ships' own reporting related to the following five categories:

- Mooring and berth arrangements
- Terminal services
- Terminal equipment
- Information exchange between the ship and the terminal
- Loading and unloading handling

The information gathered is available to BIMCO members via the BIMCO website, thus providing timely guidance to ships, owners and charterers on the actual status and performance of terminals and berths.

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8 Gap analysis

WP5.1-2 has not yet been able to identify gaps between currently available e-solutions as developed as part of the outcome from other research projects and solutions proposed by WP5.1-2. Performing a gap analysis is a great way to determine what the next course of action for the project or process improvement undertaking should be.

Without having determined what type of gap-analysis is appropriate for this purpose, it is likely that we will perform a SWOT analysis ("Strengths", "Weaknesses", "Opportunities," and "Threats"), which can help us balance our e-solution, or an ordinary key steps analysis looking into the environment of the solution.

Although the work developing the gap analysis has not yet started, it is likely that there is a gap when it comes to the international legislative issues. It is expected that the FAL Convention will, in the near future, be amended to include electronic reporting from around 2020. This highlights the relationship between SOLAS and FAL for reporting requirements, as well as for the EU directives.

This together with similar elements will be looked at in later deliverables.

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9 Architecture of the WP5 e-solutions on information exchange

A service-oriented approach for reaching the effects of efficient and safe port calls founded in the five scenarios is proposed in this section. For each of the scenarios, the Maritime Cloud concept is being used as a driver for generating solutions to the scenarios. This includes the possibility to publish emerging services, after the approval process, in a service registry allowing service consumers to discover desired services.

The scenarios build upon the idea that the service provider is allowed, after the approval of the services, to expose its services to the maritime community. To expose a service means that the service is published in a service registry and an approved service needs to meet the certain criteria, e.g. certification, established for ensuring that the service is compliant with the domain that the criteria express.

The exposure of a service enables the service consumer to discover the service based on different criteria of discoverability, such as geo-location, actor identity, etc. In other words, if a given service is available at a geo-location, it will appear on a registry viewable by the consumer. The service registry points at specific service instances, enabling provision and consumption to be realized peer-to-peer. In order to enable authentication and access management, the identity registry is to be used.

Below follow solutions for meeting the addressed challenges in each scenario. These solutions are based on machine-to-machine interaction fully in compliance with the Maritime Cloud and SeaSWIM. For each scenario, sketches outline the relevant information flow and service interactions.

9.1.1 Scenario 1: Distribution of adapted administrative documentation prior to port visit (exchange of information between ship and port)

A service-oriented solution is proposed for reducing the administrative burden on the seafarers. This solution allows multiple service providers to support the ship and/or the agent to use a service provider to compile accurate port documents. The solution stipulates that the compilation of these port documents is based on templates for port documents and pre-arrival documents issued by the port with its port actors. Such a solution would also cater for the different types of information necessary, given that the ship and/or agent provides access to diverse dimensions of the voyage information. The information can be stored either at the shipping company (information owner) or at different associated information storages pointed at by the information owner.

The information being handled directly by the information provider and at other (distributed) sources is to be seen as a “closed entity”.

This also means that the same data would be re-used as a source to compile the port-specific reports. It is also to be acknowledged that this solution provides flexibility in terms of

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whether the shipping company or the agent has interaction with the service providers. In figure 10 below the service interaction logic is depicted.

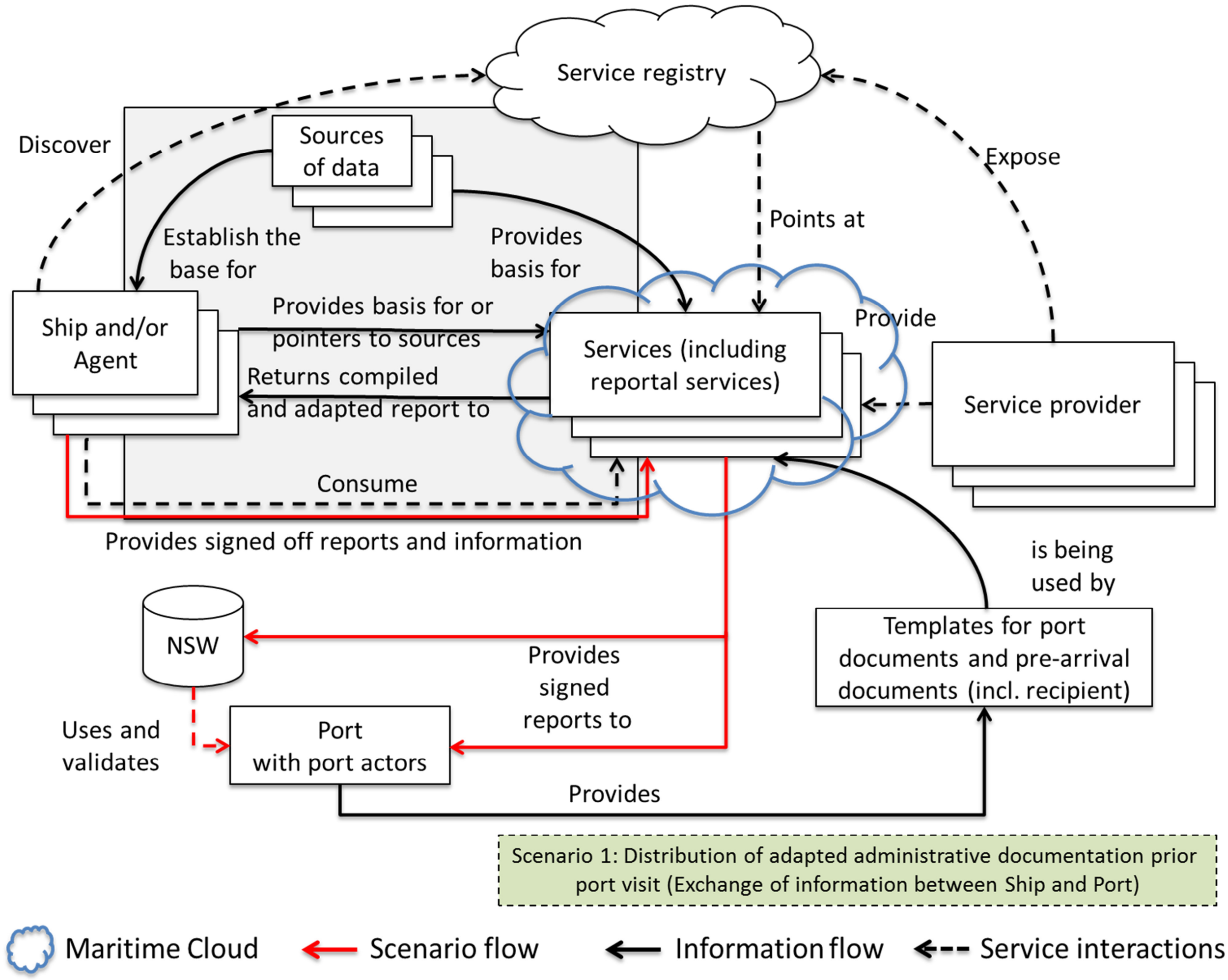

Figure 10: A service-oriented solution for distribution of adapted administrative documentation prior to port visit

This solution also makes it possible to store the signed reports in the National Single Window (NSW) database after having been signed by the ship and/or agent.

Electronic signatures would be introduced, avoiding the need for reports to be printed on paper before being signed. Electronic signatures will make written signatures superfluous. In figure 10 above, it is taken for granted that signed reports are submitted by the service provider, but the ship and/or agent could also submit the report directly to NSW.

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9.1.2 Scenario 2: Preparations prior to the port visit based on navigational safety, port information and available services (port information for fine-tuning the voyage plan)

The solution to scenario 2 has a twofold purpose:

1) to ensure access to different navigational services that are being used to enable a safe approach to port, and
2) to ensure the taking of adequate preparations that are required to berth and unload/load cargo/passengers.

An efficient port call relies on advance planning and the ship's prior acquisition of up-to-date information about the port. In figure 11 below, the service logic interaction for this scenario is being covered.

The different services providing up-to-date information would be acquired from different information sources with instantaneous response. This concerns both navigational information and other information of relevance to make the port approach efficient.

The National Single Window is also one of the data sources. A solution is proposed whereby the port holds an electronic checklist of the preparations required to be made by the ship prior to its arrival at the port. The electronic checklist is to be stored within the National Single Window system, thus becoming an interface between the ship, applicable authorities, and other stakeholders. This checklist contains a possibility for the ship and/or ship agent to mark whether a certain preparation has been made as well as a possibility for the authority to mark that it has received accurate documents related to the different items on the checklist (when relevant).

Some NSW implementations have the checklist functionality for the purpose of primarily providing different stakeholders in the port with information about which information has been approved and which is missing, thus preventing the ship's arrival/departure. This checklist functionality is thus rather a support for the authorities to ensure that the ship is allowed to arrive/leave than a support for the ship to ensure that the appropriate documents have been supplied.

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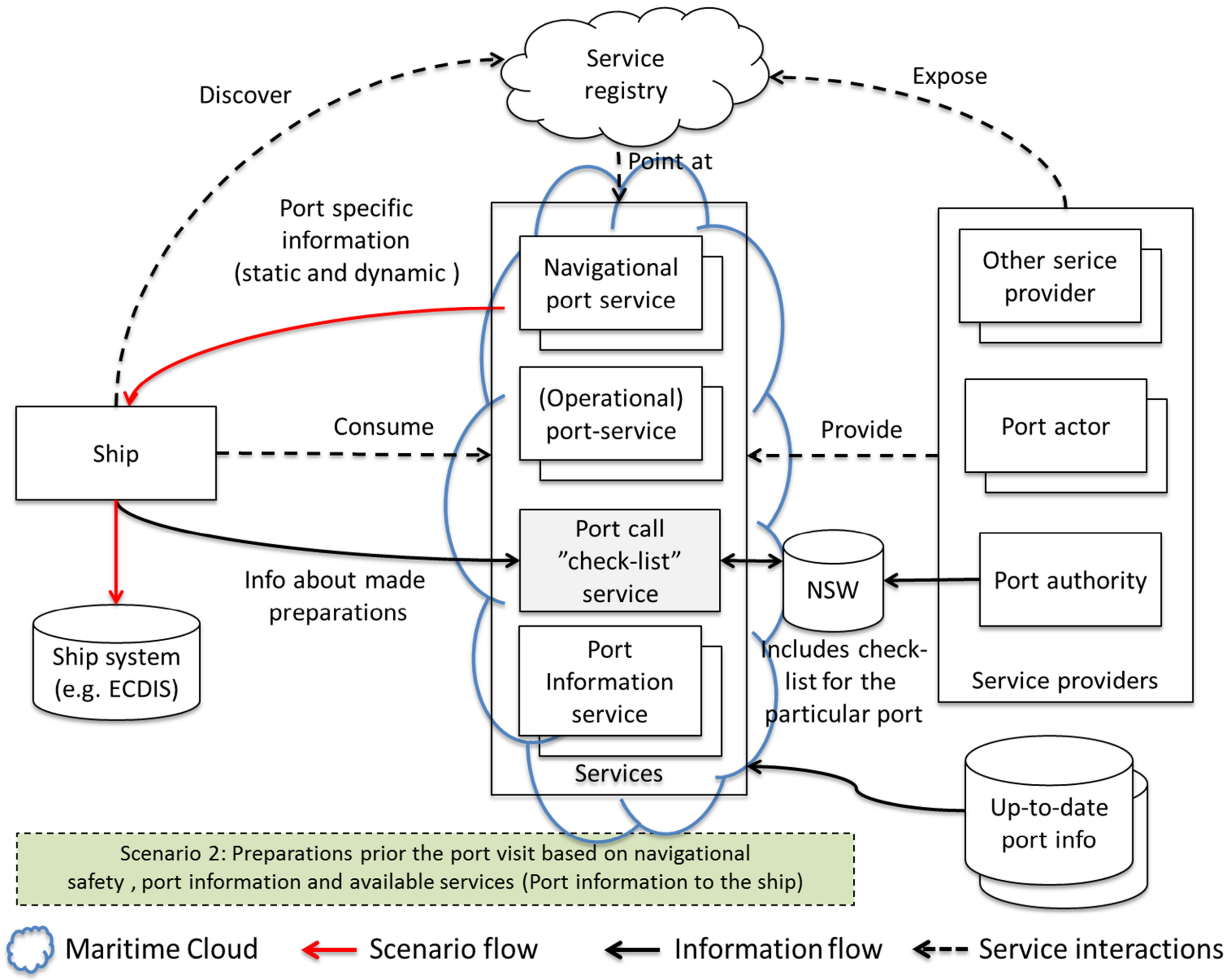

Figure 11: Preparations prior to the port visit based on navigational safety, port information and available services

Port related information is distributed via navigational port services and (other) port information services providing static and dynamic port specific information. Different operational port services are also exposed prior to the port call and form a basis for making an agreement in order to ensure an efficient service realization during the port call.

Because the output from information services is based on multiple data sources, there is incongruence between different sources of information. It then becomes essential that the service provider takes the responsibility for validating the correctness of the information used for providing the service output. Although the service provider will always claim that his information is correct, the solution should ensure that all information is registered with an appropriate time stamp as well as the necessary information about the provider of the information (affiliation/originator). In case of redundant information, the end-user should establish a prioritized list of information providers.

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9.1.3 Scenario 3: Seafarers' licences and STCW documents

In order to ensure up-to-date information about the qualifications of seafarers, services keeping track of, and providing information about the qualifications/necessary training could reduce the administrative burden imposed on the seafarer, ship operator, training course provider, and authorities. Different service providers could be used for the purpose of keeping records on seafarers' qualifications, thus helping the ship/manager keep track of the qualifications of the seafarers engaged. In the service-oriented solution depicted in figure 12, the certificate becomes the nexus for the seafarer, ship/manager, authority, and training course provider.

The solution does not rely on one service only. Rather the seafarer could choose to use different service providers to help him/her keep track of his/her certificates. Preferably, this should also be combined with the use of an electronic "Discharge Book" carried by the seafarer. The solution sketched in figure 12 does not restrict the solutions to one localized "Discharge Book", as e.g. a microchip or in a smartphone with connectivity to the seafarer's preferred provider of certificate services. The same information about the seafarer's qualifications will thus be stored in multiple places (redundancy).

This also means that the seafarer would provide information to the ship/manager about which service instance to access in order to get information about his/her qualifications and to provide updated information about the seafarer's qualifications. The seafarer thus needs to grant access to information about himself/herself to the ones asking for information. When the authorities request information about the qualifications of specific seafarers associated with a ship, the ship/manager would provide a record of the seafarers by providing pointers to the certificate services used by the seafarers.

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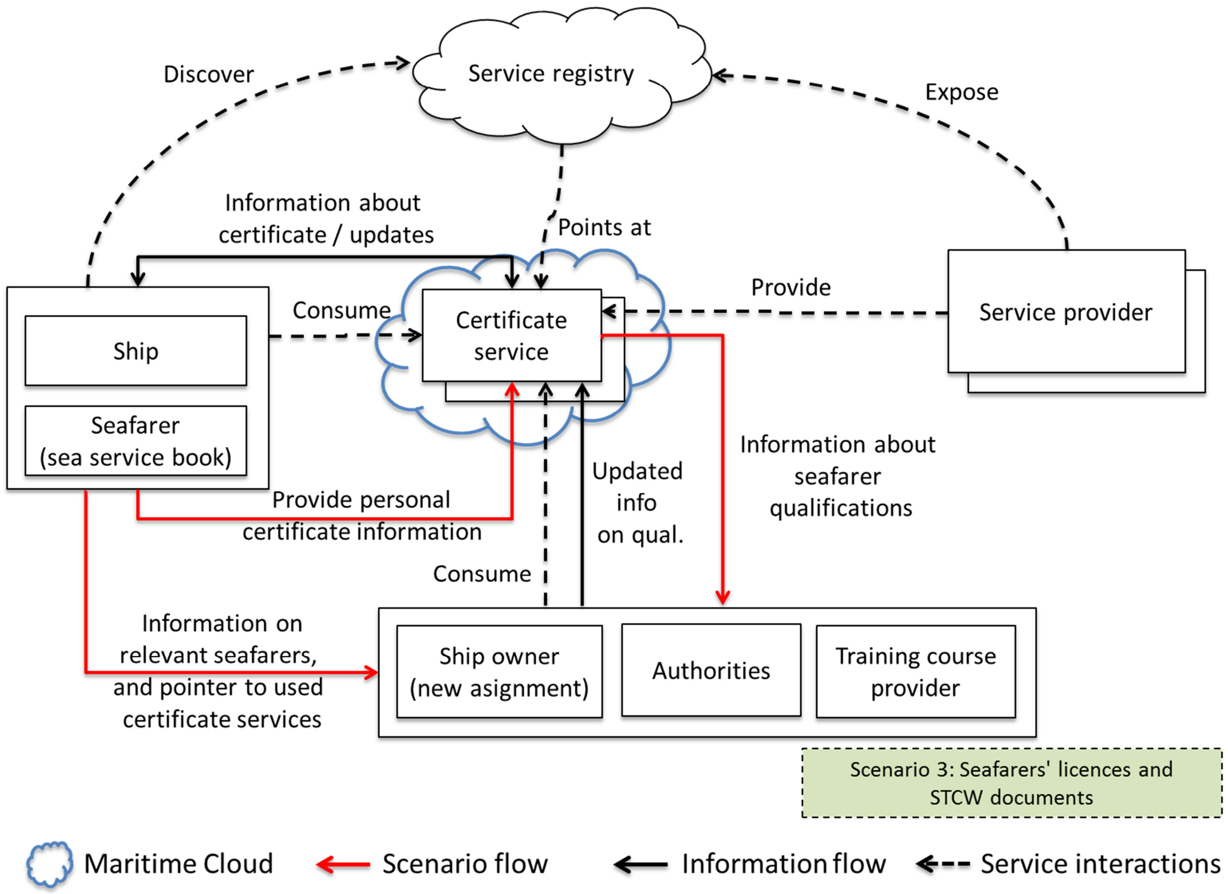

Figure 12: A service-oriented solution for authority approval of seafarers' documentation on qualifications

9.1.4 Scenario 4: Coordinating the port call (information related to the role of the agent)

In order to ensure that the port call is as smooth as possible, with minimal waiting times, high efficiency, optimal resource utilization, and a fast turnaround time, situational awareness needs to be provided for. Building on the concept of Port Collaborative Decision Making (PortCDM), as part of the Sea Traffic Management (STM) concept, as proposed by MONALISA 2.0[18], PortCDM services are proposed to be used as a basis for the agent and other port actors to enable a well-coordinated port call. Time-related port call information is one important source of information that is necessary for creating a basis for settling contracts, and to ensure a smooth and efficient port call.

PortCDM provides information services enabling actors involved in port calls to share real-time data from different information sources for the purpose of enhanced coordination. The data concern time-related port information about different actors' estimates of when a particular event is about to occur and the actual occurrence of that event.

[18] PortCDM Concept Description, MONALISA 2.0 – D2.3.1-4.4, 2015;
PortCDM Validation Report, MONALISA 2.0 – D2.7.1, 2015;
STM – The Target Concept, MONALISA 2.0 – D2.3.1, 2015.

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The information is aggregated into images for situational awareness, enabling different actors to optimally plan and carry out upcoming operations. PortCDM is a concept facilitating digital collaboration among actors operating in and around the port as well as digital collaboration between the ship and the port as a hub. PortCDM could therefore be used for monitoring port calls from the moment they are declared and for recording states that are planned for. By enabling port operators to collaborate and thereby provide the information required as regards planning, decision-making and execution, the proactive communication between the stakeholders will be eased. The PortCDM concept builds upon instant information sharing, giving all actors the same picture based on the information derived from the different systems (including NSW) used by the different operators, thereby reducing the burden imposed on the agent and giving him/her a more strategic and monitoring role.

In figure 13 below, PortCDM is depicted as a service-oriented solution allowing service providers to provide the PortCDM (compliant) services consumed by the different actors associated with the port call. These PortCDM services are complemented by services for sharing other types of information as well, thus enabling the port visit to be agreed upon and performed according to expectations.

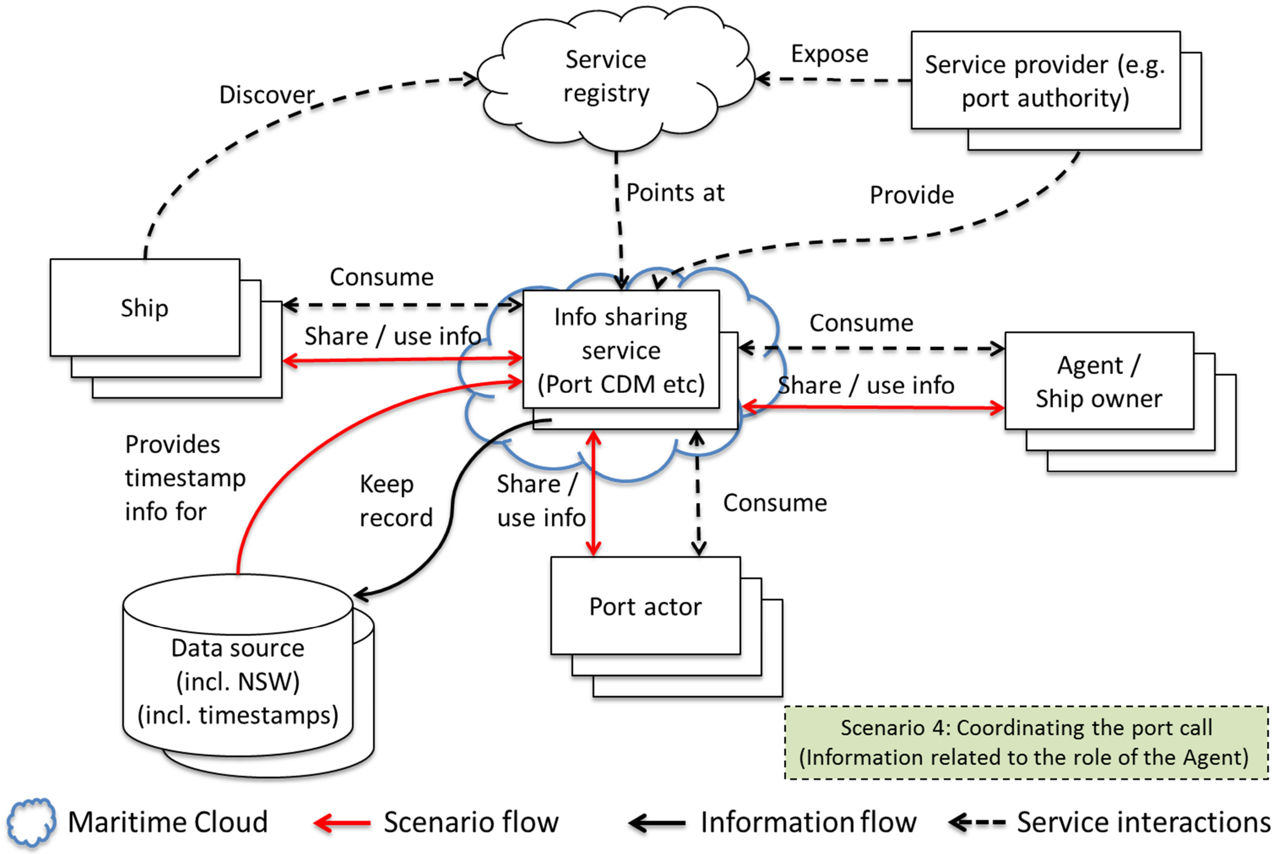

Figure 13: PortCDM as a service-oriented solution for enabling well-coordinated port calls based on (instant) situational awareness

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9.1.5 Scenario 5: Emission information shared with the authorities

New regulations on the reporting of sulphur emission data require solutions that keep the administrative burden to an absolute minimum for the ship owner. In the service-oriented solution depicted in figure 14 below, services are offered for the ship owners' provision to the relevant authorities of either raw data or crafted reports according to templates issued by some associations (such as e.g. the IMO). It is likely that the National Single Window is being used for storing these reports. The reports can, however, also be submitted directly to the Administration and then passed on to the NSW. The solution also allows for forwarding the emission data to third parties – be it the public or a journalist – in anonymized form for further analysis or publishing.

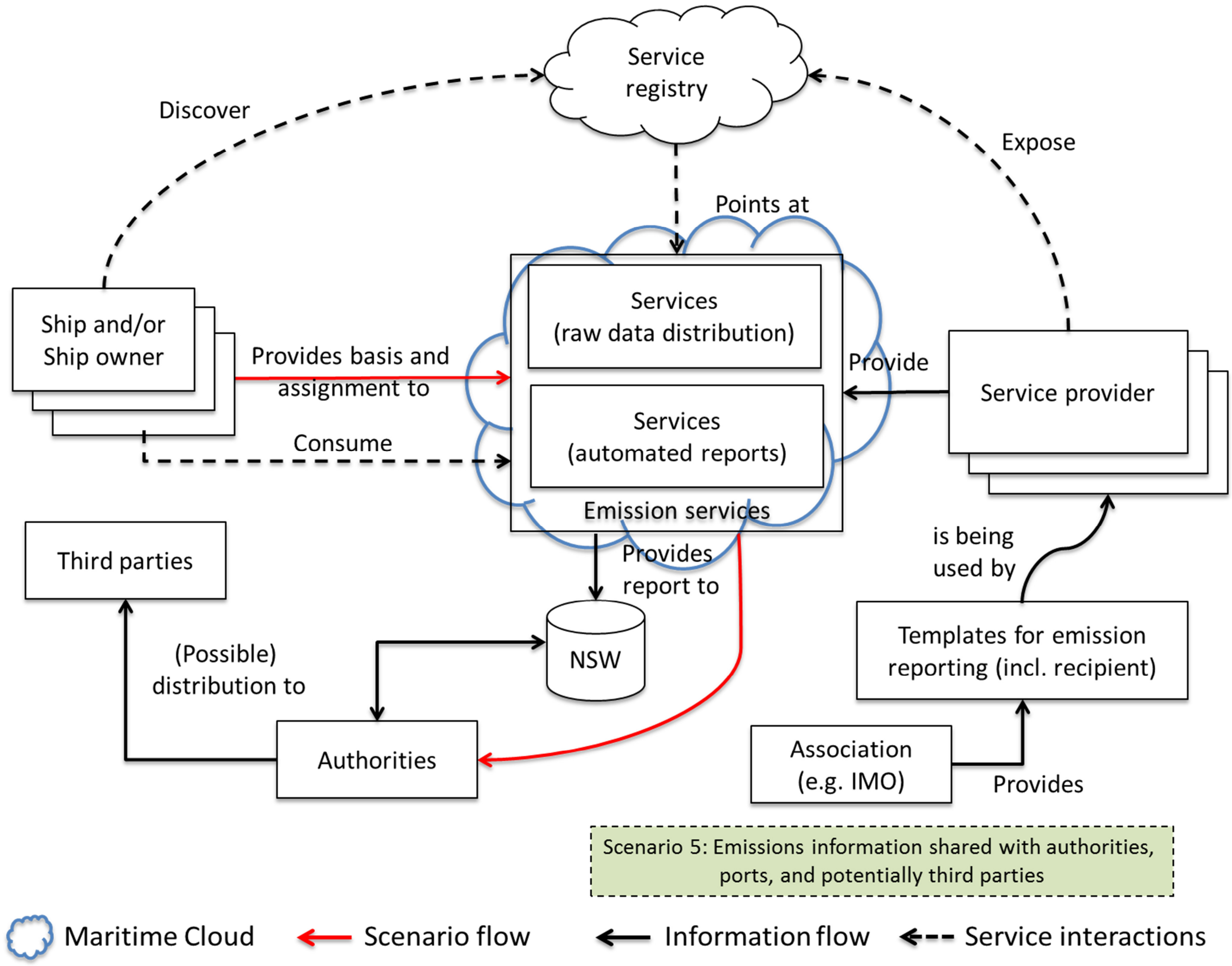

Figure 14: A service-oriented solution to emission reporting

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9.2 Overall architecture

In order to enhance the exchange of information between the relevant stakeholders, thereby enabling efficient, safe, environmentally sound and approved port visits, a service-oriented approach has been proposed. One of the core requirements is that the administrative burden should be kept to a minimum, so information should be registered only once and then others' need for information should be met by granting them access to already registered information. Furthermore, administrative information, navigational information, and information about upcoming and occurred events is needed for the realization of different services. Up-to-date information should be ensured as well as real-time updates of such information that is necessary for ensuring well-coordinated operations. Support for the various port actors is also needed to ensure that all preparations are made prior to a port visit.

Collectively, this gives rise to an architecture that connects service providers and service consumers in a peer-to-peer realization of services where different information sources and information services are exposed, discovered, and consumed. Service consumers, service providers, and information owners need to be authenticated. Empowered by a framework of maritime service infrastructure building on the Maritime Cloud components, especially the Identity Registry and the Service Registry are proposed for meeting these challenges, thus enabling secure information sharing among the parties involved. In principle, this means that the architecture should build upon the components depicted in figure 15 below.

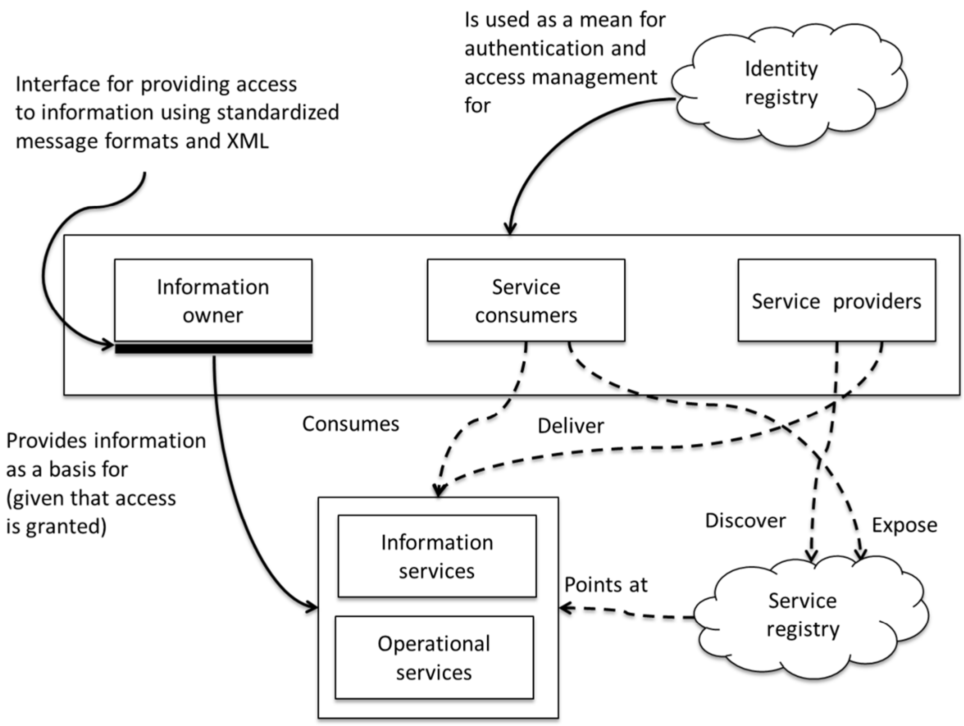

Figure 15: Basic foundation for a service-oriented architecture building on the Maritime Cloud

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The figure above also indicates the need to ensure standardized interfaces, connectors, for information owners providing data for service consumption. Such interfaces would build upon standardized message formats (such as the route exchange format (RTZ), S-100, etc.) together with the XML format and a desired functionality for access management and authentication. Thus, there must be a functionality in the interfaces ensuring that the information is stored and controlled, while access to it is provided by the information owner when the service consumer is granted access (via the service provider). Examples of information sources that would adopt such a functionality for providing access to information are the Arctic Web, the Baltic Web, and the National Single Window. Different interfaces are most likely needed for accessibility to different information components. In figure 16 below, a solution is depicted where the service consumer utilizes different connectors in his/her consumption of services. A service provider also acts as the service consumer. Examples of information owners/service providers are the ships' onboard systems, the National Single Window, the PortCDM information service system, etc. Consequently, this means that access to information is carried by information services, i.e. information as a service.

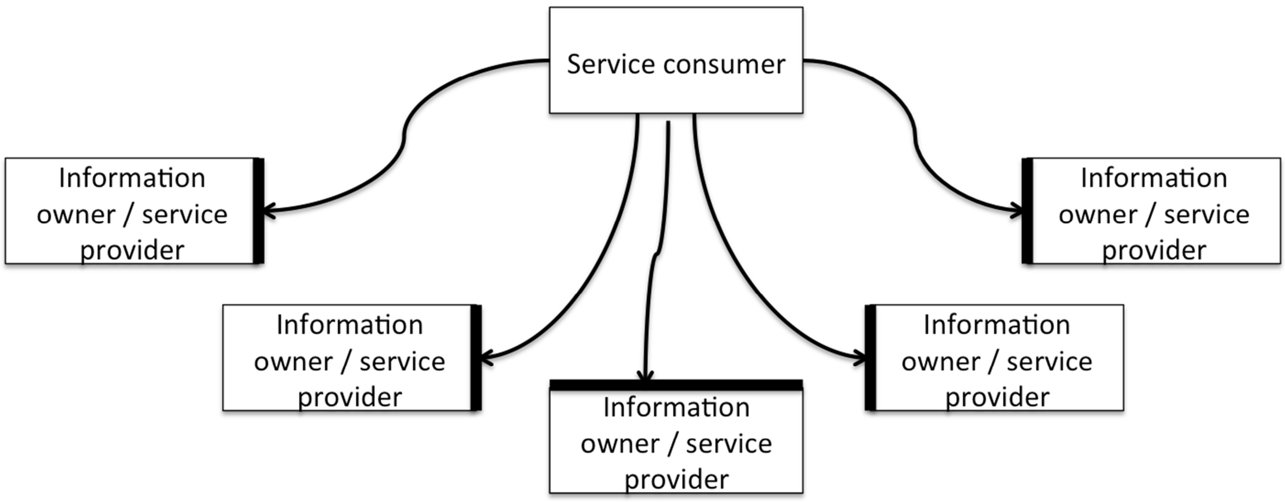

Figure 16: Basic foundation for a service-oriented architecture building on the Maritime Cloud connectors

In figure 17 below, the actors, services, and information sources identified for this activity (WP5, T5.1-2) are depicted and placed in the context of the Maritime Cloud. The “new” common port database concept and structure mean that different information sources need to be used (such as sources of timestamp related information, port navigational information, up-to-date port information, voyage information, AIS data, and the NSW interface) to ensure the availability of the different services that are to be provided and consumed by different actors.

This further means that it is not proposed to use one single common database for enabling efficient, safe, and environmentally sound port visits. A service-oriented structure is proposed to ensure that information sources and services are provided in a distributed way.

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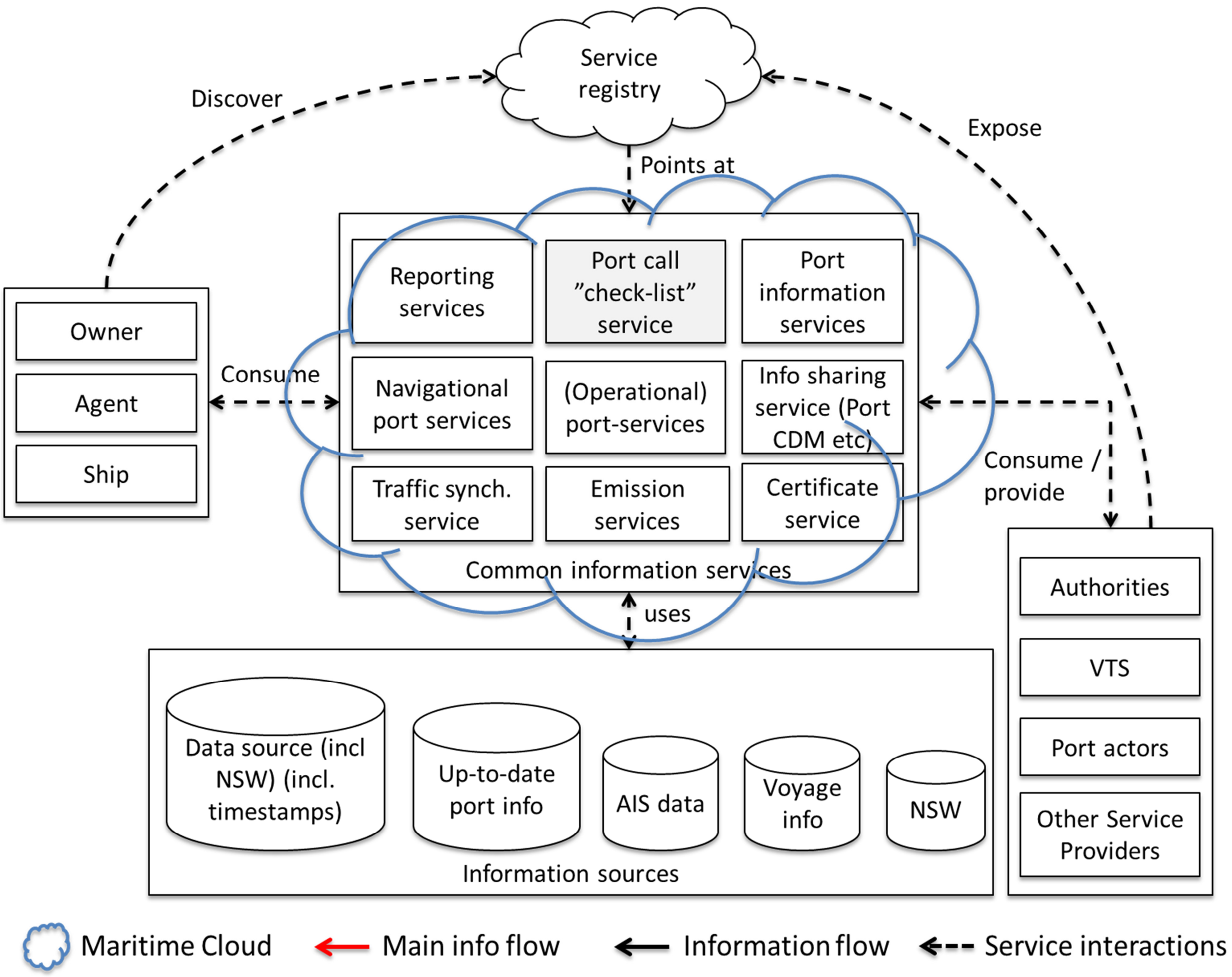

Figure 17: Proposed architecture for solving the challenges of the activity (WP5, T5.1-2)

Further, this architecture also allows for third-party service providers to both access information sources in their efforts to provide competitive services and to expose their compliant services to potential consumers. This is, however, also based upon the idea that solutions are provided for third party service providers to acquire experiences from service consumers as well as initiatives for refinement/new needs of services.

9.2.1 Comments on authentication, access management and cyber security

The service-oriented solutions founding the architecture builds upon the idea that information exists at different places. This also requires mechanisms for managing access to these different information sources. The owner of the information needs to be in charge of deciding who can access the information needed, which in turn requires authentication mechanisms. This means that the information owner needs to make the information available to the service provider acting on behalf of the service consumer in his/her realization of information services. The service consumer's access to information sources would thus determine the quality of the service. One example of this would be a port which, as a service consumer, would need to have a BIMCO membership in order to access the BIMCO port database (as a

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commercial source of information). This means that a BIMCO membership comes with a nomination of being a collaborator.

E-solutions build upon mechanisms for authentication. The solutions and architecture derived for meeting the challenges of activity WP5, T5.1-2, build upon mechanisms for service accessibility and authentication following the Maritime Cloud concept. It must thus be possible for the information provider to be ensured that the information consumer is verified.

The same goes for the identity of the information provider. Some information sources are publically available, while others require secure and advanced authentication mechanisms. The solutions and architecture elaborated on above allow for different security levels.

Thus, the architecture complies with solutions for digital signatures and e-certificates similar to the ones regulated by EU legislation, in line with the IMO's position of allowing certificates to be in electronic format. In accordance with EU legislation, electronic certificates are treated as equivalent to traditional paper certificates, provided that the certificates and the website used to access them conform with the IMO guidelines (FAL.5/Circ.39/Rev.1) and that specific verification instructions are available on board the ship.

The IMO has agreed that electronic certificates viewed on a computer should be considered as meeting the requirements to be "on board" according to the Procedures for Port State Control, 2011 (resolution A.1052(27)).

The same reasoning holds for the security in connection with the transmission of information between the provider and the recipient of information. Depending on the level of commercial sensitivity in the information and/or the level of operational sensitivity of the information, different principles of cyber security[19] need to be adopted.

9.2.2 Comments on standard messaging and information reliability

Maritime data models are one of the components of the maritime information and communications technology (ICT) architecture. Information and communications technology (ICT) is often used as an extended synonym for information technology (IT). It is a more extensive term (i.e. more broad in scope) that stresses the role of unified communications and the integration of telecommunications (telephone lines and wireless signals), computers as well as the necessary enterprise software, middleware, storage, and audio-visual systems, which enable users to access, store, transmit, and manipulate information.

This is especially important when information is being transmitted using different means of air-borne communication links. However, the solutions and the architecture build upon services being exposed for discoverability, enabling peer-to-peer interaction between service providers and service consumers.

It is also to be expected that different information sources would be cross-referenced in order to assess the validity of, especially, operational information. Consequently, this means that

[19] See e.g. The guidelines on cyber security onboard ships, produced by BIMCO, CLIA, ICS, INTERCARGO, and INTERTANKO, January 2016.

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connectivity to different sources of information needs to be ensured and that information can be acquired using standardized message formats.

Below is a brief description of what is at hand.

9.2.2.1 e-navigation data models

In e-navigation it has been decided to use the CMDS (Common Maritime Data Structure) in the IHO S-100 format. S-100 is based on the ISO 19100 series of geographic information standards. While ISO 19100 is mainly intended for geospatial data, S-100 handles, e.g., data integration standards such as the IEC 61162-1.

The ISO 19100 is a series of standards (43 in total) for defining, describing, and managing geographic information. The series of standards specifies methods, tools and services for management of information, including the definition, acquisition, analysis, access, presentation, and transfer of such data in digital/electronic form between different users, systems and locations.

- ISO/TC 211 – Geographic information/Geomatics

9.2.2.2 IEC 61162-1 Navigational data network protocol

The IEC 61162-1 standard contains definitions for a large number of text messages that are used to exchange data between instrumentation and computers in a navigation data network.

There are plans to make this data model even more explicit through a new IEC standard that can then be aligned with new e-navigation standards.

- IEC 61162:1995 Maritime navigation and radio communication equipment and systems

Standard IEC 61162 is divided into four parts:

- Part 1: Single talker and multiple listeners
- Part 2: Single talker and multiple listeners, high-speed transmission
- Part 3: Serial data instrument network (Also known as NMEA 2000)
- Part 4: Multiple talkers and multiple listeners (Also known as Lightweight Ethernet)

9.2.2.3 Trade Single Windows

Trade Single Window implementations require that different parties from different parts of the world exchange information through a common gateway. This obviously requires standardization and the development of data models is part of this effort.

Currently, at least three more or less different data models may be of interest.

The oldest and possibly still most important is the United Nations Trade Data Element Dictionary (TDED), which also includes the ones used to implement the Maritime Single Window. TDED is also standardized as ISO 7372.

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- ISO 7372:2005, Trade data interchange – Trade data elements directory. Edition 3.

The UN/CEFACT Core Components Library (CCL) could be said to be a further development of the TDED into a wider scope and with a more abstract specification. Currently, about 6000 elements are defined in the CCL, but not all TDED elements are explicitly included. The definition is also much more extensive and contains a number of fields for various functions.

- UN/CCL version 15B, 2015, Core Component Library

The WCO (World Customs Organization) data model has also developed a model. It is similar to the two models above and has, to a large degree, been harmonized with both of them. The model and associated documentation are not freely available.

The definition structure is somewhat different from that of the two others, but contains more or less the same information elements, including a cross reference to TDED and CCL, where applicable.

- Single Window Data Harmonisation V2, 2014, WCO Data Model, Single Window Data Harmonisation

9.2.2.4 Maritime Single Window and ISO 28005-2

The UN Trade Data Element Dictionary (explained above) contains data elements for ship clearance into and out of port. However, they have been developed in the context of international trade and are, therefore, not always appropriate for the ship management industry.

Through a series of EU projects, MarNIS and Efforts, a new data model for a maritime single window was researched and developed in order to gain state of the art electronic port clearance.

The standard ISO 28005 – Security management systems for the supply chain – Electronic Port Clearance (EPC), consists of two parts:

- ISO 28005-1:2013 Security management systems for the supply chain – Electronic port clearance (EPC) – Part 1: Message structures.
- ISO, (2011). ISO 28005-2:2011, Security management systems for the supply chain – Electronic port clearance (EPC) – Part 2: Core data elements.

It can be purchased from www.iso.org or from national standards organisations.

These standards supply mechanisms to implement an XML based SW system, covering requirements in the FAL Convention as well as various other reporting requirements.

FAL 39/INF.2, 2014, ISO TC8 on technical options for implementing electronic certificates.

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9.2.3 Templates and protocols for port information exchange

The origin of the data within the various data sources creates an array of problems and legal obstacles when developing an overarching view.

The concept is like a virtual database. The virtual database does not contain any data, but links up to “information providers” from where one could collect the data. If “one” has been granted access to the data, e.g. via a license to a certain service, you will be able to receive the data in the report generator. If not, the fields in the reporting template will remain empty.

Note that a Maritime Cloud extracted report may consist of input from more than one information provider.

WP5 considers a number of report “templates” to be located in the so-called Maritime Cloud, all related to the five scenarios as described in this deliverable. The data will not be uploaded to the Maritime Cloud, but located on a shore server. If “one” has access to the data, the template will harvest the data into the report.

9.2.4 How to ensure and secure the information

The basic concepts for handling security cover the transmission and storage of data. The transmission of data is managed in E2, Work Package 3 (WP3) "Maritime Cloud", which will provide basic security through encryption of transmitted data. This will include standard methods from existing encryption software and tools such as SSL/HTTPS.

Secure transmission of data can also benefit from the results of the MonaLisa1 and MonaLisa2 projects regarding secure and reliable data transmission between entities, using tools developed as part of those projects, such as the open source Uniproxy.

Storage of data in a secure manner should use standard available practices and tools, such as layered access to data on a need-to-know basis.

9.2.5 User registry

The Service Registry is a central part of the e-solution. A registry contains service specifications according to an envisioned service specification standard.

The Service Registry aims at improving the visibility and accessibility of available maritime information and services. This enables service providers, consumers, and regulatory authorities to share a common view on service standards and provisioned services. The Service Registry does not provide any actual maritime information, but a specification of various services, the information they carry, and the technical means to obtain it. The Service Registry also provides the mechanisms to manage the life cycle of service specifications and service instances.

The basic concepts for handling the user registry (authentication and authorization) for data access and data transmission must use standard methods and tools. For data transmission this is partly managed in WP3 "Maritime Cloud".

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For data transmission between entities (as opposed to individual users), this was demonstrated in the Mona Lisa projects using the Uniproxy tool with specific focus on the authentication part.

For data access, authentication can be combined with username/passwords and digital certificates for individual users and entities. Authorization should be handled on a need-to-know basis.

9.2.6 Data volumes

The establishment of a common port database in compliance with the S-100 data format will allow for a data volume reduction and a bandwidth efficient data exchange between ship and port. The S-100 format is not necessarily efficient in terms of data volume, but the S-100 product specification may allow for the use of embedded Word documents.

A low data rate connection – such as VDES under development in EfficienSea 2 – could be sufficient or, when a higher data rate connection via satellite is used, less airtime is required, leading to lower cost.

Today many ports have a Word document that can be downloaded and filled in by the seafarers, and subsequently be transmitted to the port. As an example, Copenhagen-Malmoe Port has a 1-page form, about 180 kB in Word format. If it is saved in pdf format, the size is reduced to 25 kB, and further reduction is expected if S-100 is used.

By using a standardized port database, it can also be avoided to transmit the Word form to the ship, since the ship only needs to know which parameters the port requires, and hence only codes for these parameters are transmitted to the ship.

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10 Reduction of administrative burdens

One of the prioritized solutions to be addressed by e-navigation is reducing the administrative burden imposed on the bridge team in connection with ship reporting.

Regardless of the good initiatives taken by the IMO, many ship owners and seafarers recognise that there is a movement towards increased digitalisation in this field. It is believed that the potential for relieving the administrative burdens relating to port calls has not been fully utilized yet. Hence, it is foreseen that a reduction of the administrative burdens will in itself constitute a sufficient contribution to a business case to allow for implementation of the e-solution.

This was documented by a number of inquiries facilitated by the Danish Maritime Authority in 2011-2012, demonstrating that the administrative burdens associated with routine tasks are perceived as big by the business at large. The potential for easing the burdens is therefore high. Similar results were produced by a world-wide IMO survey on administrative burdens conducted by an IMO Steering Group in 2013 which, among other things, pointed to port formalities as a major time consumer.

Example: A container ship calling at six harbours within the Schengen area is required to fill in no less than 80 documents, all of which need to be stamped and signed. The requirement stands, even though it is the exact same information that is handed over repeatedly. In many countries, bureaucracy of this type is even worse as various authorities demand the same basic data in a different format in each port – sometimes even on forms in local languages.

Expanding the example, a container ship carrying 200 containers that all need to be unloaded in Danish ports will have to fill in around 20 pages of information; and that is in the event that the ship has announced its arrival in advance, and that it is coming from another port within the EU.

A similar survey from Belgium shows that ships, when reporting to the various authorities, submit a lot of redundant information when calling at a port. The table below explains the occurrence of redundant information.

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Table 6, List of documents to be submitted

Information reported at one port call:	Occurrences
Ship's name	15
Signature of master	10
IMO/MMSI identification number	9
Date of signature	9
Call sign	8
Planned arrival time	6
Port of departure	6
Date of departure	5
Length of ship/overall length	5
Name of master	5
Date of arrival	4
Total number of persons on board	4
Last port of call	4

It is clear from the table, that the number of redundant occurrences is way too high. A similar picture is seen when it comes to information related to port entry. Th submission of redundant information adds to the administrative burden.

For all the five scenarios described earlier in this report, the administrative burden must be measured before and after the implementation of an e-solution. However, in order to quantify the administrative burden involved in the daily operation – e.g. by the seafarers on board, by the ship owner ashore or by the flag Administration – the interactions must be specified and measured.

The WP5 have discussed this part with experts on the human element, and it seems that no evaluation (solution) fits all purposes. Hence, WP5 has to look into the quantification case-by-case. In general, the WP5 will make use of specific interviews and questionnaires in order to measure the administrative burden before and after the implementation of a given solution. The WP5 will, where possible, interact and liaise with the experts on the human element in order to fit the questionnaires for the purpose.

This will be reported in detail in coming deliverables from WP5.

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11 What is the next step in WP5?

Here, follows a brief description of the remaining deliverables from WP5.1-2.

Founded in the scenarios and the proposed architecture, a number of different trials and validation efforts are needed. This will be looked into in the remaining deliverables within WP5.1-2.

11.1 D5.1 Draft S-100 product specification for common port reporting

Due in month 18, coordinated by the UKHO.

Some of the scenarios will be tested in order to demonstrate the potential of an international standard for port information exchanges. The product specification will include the definition of required features (e.g. berth) and associated attributes (e.g. berth length, depth, height). It will also include conceptual features such as berth services with attributes describing the services available. It will include information that is sent to the port (i.e. required by the port from the ship) and information sent from the port (i.e. required by the ship).

Data modelling to define the relationships between the necessary features and attributes will be conducted to inform the drafting of a prototype product specification for port information exchange. The use of such a product specification will be explored to determine its applicability to the full extent of port information exchange. This specification will also be matched with emerging initiatives taken in different projects focusing on port information exchanges of different types (e.g. AVANTI, Timestamp standardization efforts, and Port call message standardization efforts performed within STM). Demonstrations of the concept of an international standard will be provided to ascertain the potential advantages to both data providers and data consumers. By promoting a standard, the following advantages are expected:

- More efficient management of data by data providers
- Improved accessibility
- Improved data content and range of data availability
- Improved understanding of data by users.

11.2 D5.2 Demonstration of prototype application for automated port reporting

Due in month 33, coordinated by Gatehouse.

The port database/register where ports can indicate which information is required from the ship is established and made accessible online. The register can also be downloaded and stored as a local copy.

When a ship is planning a port call, the operator opens an application and enters the name of the port. The application then generates a form with fields for the information needed for that

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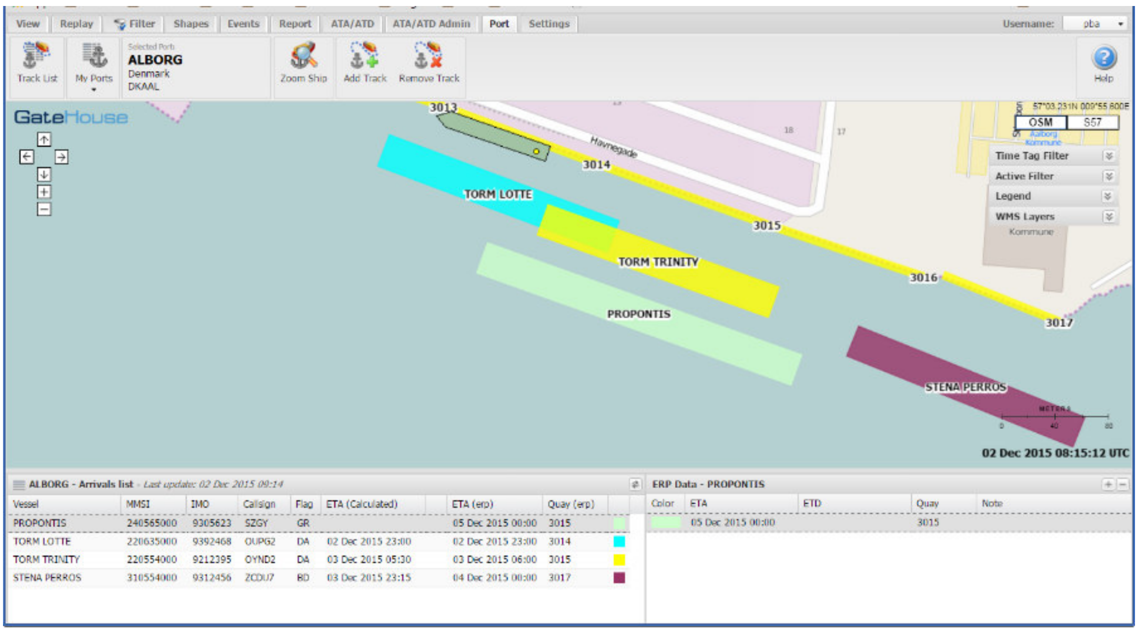
specific port. The application also fills in fields already known (name, numbers, flag, etc.). The seafarers fill in the rest and attach the necessary certificates. Certificates could also be attached automatically. The application checks that the form is complete and, if that is the case, a “Send” button is activated. The form is stored (e.g. as a pdf-file) on the computer and the information is transmitted in a standardized format to the port authority via any available radio connection.

The port receives the information reported by the ship from the central database service. This includes static information like MMSI, IMO number, name and dynamic information like last port, ETA, cargo, etc. The port demonstrator is a hosted web service that provides the following features:

1. Map overview of the port and AIS targets (if AIS streams are available).
2. Positioning of all reported arriving ships.
3. Validation of the ETA by calculating a true ETA from the current position. This is done by dividing the earth into segments and for each segment calculating the typical travel time. This is done on the basis of historical AIS data and takes account of the type of ship and the time of year. This enables the port to validate berth timeslots in good time and act upon delays or early arrivals.
4. Notifications when the reported ETA and true ETA differs by more than a port-specific threshold.
5. A berth map showing graphically the berth allocation plan.
6. A viewing facility showing all reported information.



A

Figure 18, Mock-up showing actual berthing and allocation slots

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11.3 D5.3 Development of a new common port database concept and structure

Due in month 10, coordinated by BIMCO.

Deliverable D5.3 is this report. No need to describe further.

11.4 D5.4 Online tests of ship data transfers (report on the results)

Due in month 30, coordinated by BIMCO.

Online tests will be carried out, demonstrated and evaluated on-board a ship and by ports according to the described scenarios. During the tests, the administrative burden will be measured in order to justify that the given e-solution can reduce the burden imposed on the stakeholders.

11.5 D5.5 Prototype database of online port data (report of the results)

Due in month 34, coordinated by BIMCO.

Based on existing port database sources, the e-solution is to develop a multi-source port database by use of a data model drafted via the S-100 type product specification. The revision and development will take place in coordination with ports, port organizations, agents and other commercial entities, as well as other port authorities (not involved in the project) in order to reach a general acceptance of the concept as a whole as well as the level of information and the format.

The initiatives of the Maritime Cloud, NSW, PortCDM, BIMCO database, and AVANTI will be included in this work.

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12 Conclusions

The service-oriented solutions forming the architecture build upon contemporary initiatives and solutions. A service-oriented architecture enabling accessibility to multiple information sources is the main stream today. Such a service-oriented architecture would allow third party service providers to engage in innovative service development. In a sector highly characterized by autonomy and competition, it is essential that solutions build upon different information sources being in control of who can distribute the information. The solutions explored to meet the requirements in activity WP5, T5.1-2, build upon the following foundations:

1) The information owner should be in control of his/her information.
2) The use of the Service Registry and Identity Registry in the Maritime Cloud concept for service exposure and discovery for the establishment of peer-to-peer interaction.
3) The total amount of information sources used by the information services constitute the common port database concept built upon in activity WP5, T5.1-2.
4) Information should stay with the information owner, for which reason the Maritime Cloud concept is to be interpreted as a service cloud rather than a data cloud.
5) Principles of authentication and access management building on the Maritime Cloud are used to ensure that the right actor is allowed to access/distribute information.
6) Service providers compile reports based on templates issued by the port/associations enabling adapted reports using the same information sources.
7) Integration with existing data sources in the port environment, such as e.g. the National Single Window, by means of standardized interfaces.
8) Multiple information services for the same purpose are exposed and discoverable creating a marketplace of services.
9) Invitation to third party developers to provide complaint and innovative services to be discovered and consumed.

Mariners and shipping lines are in need of less information of higher quality. Therefore, port information needs to:

1) Be defined. Many port related matters, such as admission policy or general port information, have never been defined as it has never been a part of nautical publications or charts;
2) Be captured via unique numbers per section of the port;
3) Have one information owner;
4) Be kept up-to-date with a minimum of human interface by using international exchange formats.

Now, the solutions provided for the different scenarios, building on the Maritime Cloud concept and the common architecture, need to be validated by test-bed implementations. It needs to be confirmed whether the solutions give rise to the desired effects of e.g. reduced administrative burdens, the emergence of innovative and valuable services, and in the long run enabling efficient port visits where involved parties are synchronized in their operations. It is foreseen that the efforts to develop proof-of-concept services would be low since many

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components necessary for the solutions are already in place or being pursued by means of contemporary efforts.

By use of the E2 established High Level User Group, the WP5 will perform a cost benefit assessment taking into account a prioritization of the five scenarios. The benefits of a given e-situation or business-related action will be summarized and the costs associated with the solution will be determined.

Based on the cost benefit assessment, the WP5 will prioritize the three most beneficial scenarios to industry, and deploy e-solutions related to these scenarios.

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13 Appendix 1 – List of maritime stakeholders

As referred to in section 4, the individual stakeholders are a complex group of actors. Below, these actors are explained in brief and simple terms.

13.1 Ship

It may be unnecessary to define the terms ship and cargo, whereas it is more relevant to explain seafarers and passengers.

13.2.1.1 Seafarers

Seafarers are the personnel on board the ship. They may originate from any region in the world. English is the common language in international trade and required by all parts of the shipping industry, although some seafarers may prefer to speak their mother tongue. Some seafarers are already familiar with electronic solutions, whereas e-solutions may be new to others.

13.2.1.2 Passengers

A passenger ship is a merchant ship whose primary function is to carry passengers. According to the IMO (SOLAS), passengers are persons who are not part of the crew on board. If a ship carries more than 12 passengers, it is a passenger ship.

13.2 Commercials

A number of stakeholders are involved in international trade with the objective of getting a certain commodity from "A" to "B": The shippers seek partners to assist them in getting the cargo to the consignees (receivers) and, while these two may also be the actual respective exporter and importer of the cargo, other companies like freight forwarders may have this role. Furthermore, the commodity may be sold to others, effectively involving traders, who may again resell the cargo, either prior to the loading of the ship or while it is underway.

Such a chain is mainly common for the shipment of bulk commodities, whereas the shipment of e.g. consumer goods packed in a container may take place directly between the producer exporting the cargo and the importer at the receiving end.

In any event, the transportation of the cargo requires a party responsible for providing the ship for the particular job. Many different types of stakeholders may be directly involved with the ship, and the most important ones are briefly described in the following:

13.2.2.1 The ship owner – the registered owner of the ship

Usually a term used to describe the company that fronts the ship in the shipping market. The operator may only be controlling the ship for a short period; on the other hand, the ship may even be painted in this company's colours if the ship is on a long-term contract. While the operator may not own the ship, there are numerous ways and types of contracts which may enable the operator to utilize the ship commercially. An operator may have just a few ships or

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such a company may control a large fleet, perhaps being a mixture of owned ships and ships owned by others which this company controls.

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 in the Bahamas with seafarers from the Philippines and a number of other countries.

13.2.2.2 Company

The shipping company refers to the party that uses ships to transport freight or passengers. There are different kinds of shipping companies and they can use their own ships or charter ships from other subjects.

13.2.2.3 Charterer

The charterer of a ship is the stakeholder entering into a contract with an "owner" of a ship. Such a contract may be for the hiring of the ship for a certain period; then the charterer would also be an "operator" or "owner" once they contract for external cargoes to be shipped by a particular ship.

The charterer may also hire a ship for a period solely for transportation of its own cargoes; however, since the ship is a "commodity" in itself, it is common to use the ship for internal as well as external cargoes.

A charterer may also have access to a single cargo for which he will contract for space on board a ship. This may be a full or a part cargo on the particular ship and the governing contract will set out where the cargo is loaded and discharged and the relevant details in this connection. The owner of the ship will take care of the operational part of the venture and the charterer will have less risk and responsibility compared to hiring a ship for a certain period.

13.2.2.4 Ship operator

The ship operator is responsible for managing the ship's performance and works in close collaboration with the on-board master and with the charterer and ship owner.

13.2.2.5 Broker

A shipbroker is acting as an intermediate person (company) with the purpose of bringing owners and charterers together.

While some brokers are closer to the cargo side, others generally work as "owners' brokers". Many provide services to both. The successful broker will have access to a wide range of market information and contacts to owners and charterers. Just like in any other business, brokers are often chosen based on their success rate and their ability to create results for their principals.

The remuneration for the broker's work is referred to as a commission (brokerage). This is a certain percentage of the freight or hire paid under the contract in question.

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13.2.2.6 Agent

The shipping agent is the person or organization that the owner (operator) has appointed to act as its representative in the ports where the ship will call. On behalf of the owner, the agent will handle all the necessary work in the port, including arranging for berthing and departure, contact with and payment of local authorities as well as looking after the owner's interests in all matters. This may include assisting with e.g. seafarers' transfers and customs declarations.

The agent will provide its principal with all relevant information about the ship's port call during the port call but also in advance and after departure. Further, it updates all other relevant stakeholders with information about the ship's estimated time of arrival (ETA), berthing prospects, and other matters related to the ship's itinerary.

13.2.2.7 Ship manager

When a ship is hired for importing and/or exporting goods, a ship management team may be required to maintain and operate the ship. The function of the management team is to provide the owner with support throughout the charter of the ship.

Most management companies provide the owner or operator with seafarers on board. Most management companies also offer other services like inspection prior to purchase, supervision during building, crew management and supply and ship lay-up solutions, visa of ships entering and leaving the port, management of foreign ships, ship maintenance management and technical ship management.

13.2.2.8 Cargo owner

In international trade, a cargo owner (or Beneficial Cargo Owner, BCO) is an importer that takes control of its cargo at the point of entry into a country. The BCO does not utilize a third party source like a freight forwarder. Typically, BCOs are large companies that import products regularly and, thus, they have an in-house department for import procedures. There is normally close communication between the cargo owner and the ship as well as with the owner/manager of the ship.

13.3 Port services

Port services relates to the physical transfer of goods and passengers between sea and land and ancillary services. In this report, we have distinguished between the service and delivery of e.g. bunker. Port services are closely linked to the logistics (defined later).

13.2.3.1 Port authority

Port authority is a governmental or quasi-governmental (managed privately) public authority for a special-purpose district. The port authority is usually formed to operate ports and other transportation infrastructure.

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Many port authorities are financially self-supporting. In addition to owning land, setting fees, and sometimes levying taxes, port districts can also operate shipping terminals, airports, railroads, and associated facilities.

Port authorities are usually governed by boards or commissions, which are commonly appointed by governmental

13.2.3.2 Tugs

Tugs are used to assist the ships in berthing and unberthing, either physically or for stand-by service only. Different sizes and types of ships require different services and the port authority may have declared a minimum level of service depending on the size of the ship.

13.2.3.3 Pilotage

The pilot is a local expert called for by the ship with good knowledge of the 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-based entities, such as port officers, and the tugs that are assisting during berthing.

Usually pilots are 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.

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

13.2.3.4 Stevedores

Stevedores are involved in the loading and discharging of ships. They may be employed by the port or the specific terminal and will often be servants of the cargo interests.

The activities may include: conventional loading, grab discharge, handling of ro/ro ships, handling of containers by stationary and mobile harbour cranes, cargo planning, lashing & securing.

A close dialogue with the ship and agent is necessary in order to optimize the operation as much as possible.

13.2.3.5 Mooring/linesmen

The linesmen assist with the mooring of the ship on berthing and unmooring at the time of departure from the berth.

13.2.3.6 Cranes

Often cranes are required for loading and unloading cargoes, whether in bulk, break-bulk or containers. Many ports have shore cranes specifically aimed at the particular cargoes handled at the relevant berths that are able to load and unload even the largest ships which can fit alongside the individual berths.

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Not all ports, however, have a wide range of cranes on shore. Often ships calling at such ports are required to have cranes on board which will be used for loading and discharging the cargoes. This is most frequent on smaller and medium-sized dry bulk carriers which transport a number of different commodities between both large and small ports.

Trucks working in the terminal has not been mentioned as a key stakeholder, as the ship normally not “communicate” directly with trucks.

13.2.3.7 Waterways

Important waterways for shipping are e.g. the Suez Canal, the Panama Canal and the Kiel Canal. Common for these canals is that they enable ships to take shorter routes to their destinations, thus saving time and fuel. The Malacca Strait, the Bosporus, Strait of Gibraltar and other restricted waterways may have characteristics that are similar to canals.

13.2.3.8 Customs

Customs is an authority or agency in a country responsible for collecting fees and tariffs when controlling the flow of goods. Normally, this includes animals, transports, personal effects, and hazardous items, into and out of a country.

13.2.3.9 Port State Control

Port State Control (PSC) is the inspection of foreign ships in other national ports by PSC officers (inspectors) for the purpose of verifying that the competency of the master and officers on board and the condition of the ship and its equipment comply with the requirements of international conventions (e.g. SOLAS, MARPOL, STCW, etc.) and that the ship is manned and operated in compliance with applicable international law.

13.2.3.10 Security ISPS

In the wake of the 9/11 attacks in the USA, the IMO, decided to develop, recommend and implement a set of security measures applicable to ships and port facilities around the world. These measures, called International Ship and Port Facility Security Code (ISPS) are implemented through SOLAS, chapter XI-2 to enhance maritime security.

As per the code, each of the entities above, are required to place appropriate security officers/personnel on each ship, in each port facility and in each shipping company to prepare and to put into effect the security plans that will be implemented. The ISPS Code consists of two parts & three levels of security.

The security levels are implemented by the local port authority under consultation with the authorities. The security level adopted by the port facility must be co-ordinated with the ship.

13.2.3.11 Occupational health & safety

The maritime working environment comprises the physical, ergonomic, chemical, biological, psychological and social elements which could lead to occupational accidents, injuries and diseases. Seafarers face demanding working conditions, isolation, long hours of work, rigid organizational structures and high levels of stress and fatigue.

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The occupational health and safety authority may do inspections on board during the port of call.

13.2.3.12 Immigrations

When seafarers are approaching or leaving a port, the “movement” is normally monitored by immigration authorities under a variety of names and arrangements. Normally, the immigration authorities will check the appropriate documentation, thus verifying that a person is entitled to enter the country.

13.2.3.13 Locks & bridges

Not all ports are located on the open sea, and in many places ships must pass through locks or under bridges to get to their destination. This requires careful planning with regards to the maximum size allowed as well as the actual stowage of the ship to ensure that the ship does not damage any installations on its way.

13.4 Statutory authorities

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

13.2.4.1 Flag States

The flag State is the state under whose laws a ship is registered or licensed. The flag State has the authority and responsibility to enforce regulations on ships registered under its flag. This includes inspection, certification, and issuance of a considerable number of documents.

As such the flag State administration both handles requests from ships and delivers a substantial amount of data to ships, which again involves large amounts of paperwork. Digital solutions are being developed by many flag States to reduce the administrative burdens for all the parties involved, but much room for improvement and harmonization of data handling still remains.

13.2.4.2 Port State

The port State is the state whose authority applies in whatever port a ship has entered. The port State holds considerable authority over ships from all flags which enter and leave its ports. This involves various reporting requirements to ships entering and leaving ports as well as direct control of compliance with national and international regulation through Port State Control (PSC).

PSC is the inspection of foreign ships in other national ports by PSC officers (inspectors) for the purpose of verifying the competency of the master and officers on board. The PSC also verifies the condition of the ship and its equipment to comply with the requirements of international conventions (e.g. SOLAS, MARPOL, STCW, etc.) and that the ship is manned and operated in compliance with applicable international law.

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Much like flag States, port States handle much data going to and particularly coming from ships, and as such, there is a great potential for reducing the burdens through digitalization of paperwork.

13.2.4.3 Coastal States

A coastal State has the national jurisdiction in a given sea area. This means that coastal States apply regulation and enforce it inside its jurisdiction, which may lead to some reporting requirements and possibly other cases of data being transmitted between ship and shore. This works more or less in the same way as described under port States and involves the same issues, although in general much less information is involved.

13.2.4.4 VTS (Vessel Traffic Service)

In 1985, the IMO adopted a resolution on guidelines for Vessel Traffic Services (VTS), with the aim of providing active monitoring, information services, traffic organization, and navigational assistance to ships in confined and busy waters. The VTS partners with the authorities in order to avoid e.g. pollution of coastal waters.

13.2.4.5 Recognized Organizations (classification societies)

For the owner and the ship, the classification society is in the position next to the flag State. The role of the Class is extremely important in the implementation of maritime regulations and, according to SOLAS Chapter II-1, Reg. 3-1, ships must be designed, constructed and maintained in compliance with the structural, mechanical and electrical requirements of a classification society, which has been recognized by the flag State. These are called recognized organizations, (ROs) (acting on behalf of the authority). The ROs issue many of the ships' certificates and hence there is close collaboration between the owner/ship, the flag State authority and the Class.

13.5 Commercial and contractual compliance

Compliance is an increasingly prevalent business concern, partly because of an ever-increasing number of regulations that require companies to be vigilant about maintaining a full understanding of their regulatory compliance requirements. For shipping, especially when operating world-wide, compliance is of huge concern. If the ship is not in compliance with the regulations, the insurance companies will simply not pay in case of an accident.

13.2.5.1 P&I clubs

The protection and indemnity (P&I) club is the insurance company for the ship that deals with the cargo. The P&I's focus is on avoiding violation of IMO regulations, usually due to cargo mishandling. The IMO has published plenty of regulations regarding cargo operation for the majority of cargoes. Inappropriate stowage, carriage and/or cargo operation may, however, cause a ship to become unseaworthy. In such a case, a P&I club could put significant commercial pressure on its insured ships by withdrawing the insurance coverage.

In close collaboration between owners and operators, the role of a P&I club is the mutual protection of his operation against such a risk.

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13.2.5.2 Hull & machinery insurance
Hull & machinery insurance is a form of marine insurance that covers the “hardware”, i.e. the ship including the machinery and equipment. The ship is covered for its full value and the insurance would cover “total loss”, the need for repair if the ship is damaged, salvage expenses as well as expenses paid for minimizing or preventing damage which would otherwise have been covered under this insurance.

Besides the actual cover for damage to the ship, cover may be taken out for additional risks (e.g. war risk insurance if the ship is trading in areas where this is applicable).

13.2.5.3 Labour & unions
Many seafarers and other employees in the transportation industry are organized in labour unions. A number of local trade unions have joined forces in the Global Federation of Unions where the International Transport Workers’ Federation (ITF) is an important factor.

13.2.5.4 Salvors
Salvage may be defined as the act of saving a ship or its cargo from the perils of the sea. While salvage may be done by volunteering salvors, it may also be done by a professional company specializing in salvage.

13.2.5.5 Banks and Financiers
Banks and Financiers are commonly involved in ship financing and many large banks have specialized shipping departments.

13.6 Logistics
Logistics and port services are closely related, but logistics relates to the transfer of goods, provision of water, provision of electricity, provision of bunker, waste disposal or warehousing.

13.2.6.1 Ship supply
This may cover both the supply of stores, equipment needed for cleaning or preparing cargo holds, food for the seafarers, fresh water and all other items which must be taken on board locally. Some suppliers (or ship chandlers) may also be able to supply spare parts to the ship, if needed, or the technical department may order spare parts for delivery to the port where it will be handled by the agent or a local supplier.

13.2.6.2 Freight forwarders
A freight forwarder or forwarding agent, also known as a *non-vessel operating common carrier* (NVOCC), is a person or company that organizes shipments for individuals or corporations to get goods from the manufacturer or producer to a market, customer or final point of distribution. Forwarders contract with a carrier or often multiple carriers to move the goods. A forwarder does not move the goods, but acts as an expert in the logistics network. These carriers can use a variety of shipping modes, including ships, airplanes, trucks, and railroads, and often multiple modes for a single shipment

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13.2.6.3 Ship waste

Ships are disposing all kinds of waste when at port. The waste is delivered to the port reception facilities. Under international legislation (IMO, MARPOL Annex V and EU Directive 2000/59/EG), all seaports are obliged to facilitate adequate port reception facilities for ships' waste.

The Harbour Master (port authority) are normally the key contact providing a responsible and safe, smooth, sustainable and secure handling of shipping.

13.2.6.4 Bunkering

All ships need fuel, and providing *bunkers* (fuel) to ships is an industry of its own. Many players will be involved in the contracts for supplying ships with the required bunkers of the correct specifications and it is not uncommon that a shipowner contracts with one company that eventually buys the bunkers from a different supplier who may again contract with a local supplier delivering fuel to the ship.

13.2.6.5 Repair / Maintenance

Ships should be at sea, with downtime reduced to an absolute minimum. However, machines and systems break down. Thus, port services for repair and maintenance are offered round-the-clock in order to avoid cost of staying an additional day.

13.2.6.6 Surveys

"Surveys" cover a variety of different issues. The ship may be surveyed for hold cleanliness to ensure it is ready for receiving the cargo contracted for. There may be a need for a draft survey to establish the quantity of cargo on board the ship. If the ship encounters a damage, there may be a need to have a Class surveyor inspect the ship and evaluate the extent of damage. A P&I surveyor may be used to evaluate cargo damage or to assist the owner and master if there is fear that cargo damage or shortage may incur.

In other words, there are numerous reasons why a particular survey may be performed and it is important to ensure that a capable surveyor is employed.

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14 Appendix 2 - Abbreviations

Abbreviation	Explanation
AIS	Automatic Identification System
AVANTI	Access to VAlidated NauTical Information
BDN	Bunker Delivery Note
CEMS	Continuous Emissions Monitoring Systems
CoC	Certificate of Competency
DNV	Det Norske Veritas, now DnV-GL
E2	EfficienSea 2
ECA	Emission Control Area
ECDIS	Electronic Chart Display and Information System
(UN/)EDIFACT	United Nations/Electronic Data Interchange For Administration, Commerce and Transport
EMSA	The European Maritime Safety Agency
ENCs	Electronic Navigational Charts
ENSI	Enhanced Navigation Support Information
EU	European Union
FAL	The IMO Facilitation Committee
GML	Geographic Markup Language
GNSS	Global Navigational Satellite System position
IALA	The International Association of Marine Aids to Navigation and Lighthouse Authorities
IHMA	The International Harbour Masters Association
IHO	The International Hydrographic Organization
ILO	The International Labour Organisation
IMO	The International Maritime Organization
IMP	Integrated Maritime Policy
ITF	The Global Federation Unions of which the International Transport Workers' Federation is a part
M2M	Machine-to-Machine concept
MARPOL	The International Convention for the Prevention of Pollution from Ships
MGO	Marine Gas Oil
MMS	Maritime Messaging Service
MMSI	Maritime Mobile Service Identity
MSW	The Maritime Single Window
NSW	National Single Window
P&I	The protection and indemnity club
PM	Particulate Matter
POC	Proof of Concept
PSC	Port State Control
QR	Quick Response codes
R&D	Research and Development
RO	Recognized Organizations (acting on behalf of the Authority)
SECA	Sulphur Emission Control Area

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SIP	Strategy Implementation Plan
SOLAS	The International Convention for the Safety of Life at Sea
SOx	Sulphur Oxide
SSN	SafeSeaNet
STCW	The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
UDC	Universal Decimal Classification
UTC	Universal Coordinated Time
VTS	Vessel Traffic Services
WP5	Work Package 5

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