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"Sustainable Knowledge Platform for the European Maritime and Logistics Industry"

SKEMA e-Maritime Periodic Study Summary

Dr H McLaughlin - Inlecom

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Contents

Introduction

Maritime transport is a major economic contributor in the EU as well as a necessary component for the facilitation of international and interregional trade on which the European economy is strongly dependent. The EU Maritime Transport Strategy [1] actively supports the efforts of the European maritime sector in offering quality shipping services which in turn shapes the requirements for upgraded maritime transport information management.

In the short to medium term, the most promising development for maritime transport is e-Maritime, which is becoming the focus for the simplification and cohesion of administrative requirements and procedures, with a spill-over into commercial applications.

From the perspective of transport chains, e-Maritime will provide standardisation, interoperability and security of information exchanges that will set the foundations for cooperative networking strategies in intermodal operations. The implications of this are far-reaching:

1. Efficient functioning of intermodal networks, even for interregional services, without incurring massive IT infrastructural costs;

2. A balanced distribution of risk amongst operating participants;

3. The possibility of inter-network linkages becoming feasible;

4. Increased reliability and security of deliveries with reduced unit costs becoming a reality.

E-Maritime has the potential to dramatically change maritime transport and its integration into logistic chains. Those who will take advantage of this opportunity are likely to realise strategic advantages while those that miss out are likely to find themselves lagging behind. Thus, being part of the development of e-Maritime is important for the operators in this domain, commercial and public alike.

The e-Maritime Periodic study explores the issues, challenges and aspirations of electronic based interactions within the maritime industry and with the rest of the logistics chain together with the policy (both existing and future) which will facilitate its development.

Task 1 provides an overview of the objectives and the challenges in the attainment of each. It also identifies existing policy instruments which relate to the e-Maritime initiative. Finally it examines the various reporting requirements contained in current legislation in relation to movement in and out of port, highlighting commonalities, differences and opportunities to rationalise in order to facilitate a 'single window approach'.

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[1] On the 21st January 2009, the Commission adopted the EU Maritime Transport Strategy 2018, COM(2009) 8; and the establishment of the European Maritime Space without barriers, COM(2009) 11. In addition COM(2005) 589 amending Directive 2002/59/EC establishing a Community vessel traffic monitoring and information system of the 3rd maritime safety package was adopted by the European Parliament - 11th March 2009. http://ec.europa.eu/transport/maritime/index_en.htm.

Task 2 reviews the State of the Art in terms of e maritime systems and applications. It begins with an consideration of the examination of these related initiatives (SafeSeaNet, e-Navigation, e-Customs, Intelligent Transport Systems, European Rail Traffic Management System, River Information Services, Telematic Applications for Freight , e-Freight), and other current projects (MarNIS, Freightwise, EFFORTS, Flagship) before considering key enabling technologies for communications and surveillance. A major issue for the e-maritime aspiration is that of standardisation, how it can be achieved and the areas where it is required. Finally there is an examination of the port experience with community systems (PCS) and single windows (PSW) to highlight the issues from a user perspective.

Task 3 focuses on policy options which will fulfil the e-maritime objectives. It builds on the work done in Task 1 which provided the context and explored existing EU policy relating to this area. The European Commission has already introduced a number of policy measures and initiatives which facilitate a move towards an e-Maritime Policy. This task first examines the rationale behind intervention and the form that this may take on a general level. It then examines the specific characteristics of the maritime industry which present opportunities and threats in the policy making process. Finally there is a consideration of the various policy delivery mechanisms for e maritime policy relating to the specific areas of Safety and security; Increasing the competitiveness of the EU maritime transport industry by better administration; Creating a better environment for ship operators; Supporting the development of European Ports as key logistics hubs; Improving seafaring and promoting the profession. The policy options in each area are considered based on the three basic criteria of effectiveness and efficiency in achieving e maritime objectives and potential negative side effects.

Task 4 presents the results of a survey carried out to determine stakeholders' opinions on how the e-Maritime initiative would have the greatest positive effect on the maritime & logistics industry. The survey document was prepared in consultation with SKEMA participants, following a seminar on e-Maritime in the Global Policy Institute in London on the 18th November '08. The survey was presented and completed by 23 participants in the SKEMA workshop held in Dublin Port on the 22nd of January '09. After reviewing the results from the survey and in collaboration with SKEMA partners & Dublin workshop participants, an additional section was added to the survey. The amended survey was presented and completed by 40 participants in the PROPS workshop held in London on the 24th of February '09. The survey consisted of 28 statements with respondents asked to what extend they thought they were relevant.

Task 1: e-Maritime Overview

The task deals with:

- Challenges to be addressed by e-Maritime

- e-Maritime Objectives issues/problems to be addressed

- Identifying the policy instruments relating to e-Maritime

- Conflicts in reporting requirements

1.1 Challenges

1. The maritime transport services sector is heterogeneous and fragmented. Often different stakeholder groups appear to act in isolation from each other according to their own restricted agendas prolonging a culture of intermediaries to carry out tasks which can be easily automated with modern information and communication technologies (ICT).

2. Maritime shipping companies as well as ports have not traditionally invested in information systems primarily because ICT is not viewed as a bottom line item as in other industries such as air transport, road transport, the financial and even the retail sector.

3. The maritime transport sector is heavily regulated with respect to safety, security, environmental protection, competition, customs and labour laws. Complexities arise from the fact that international and national regulations co-exist with inconsistencies and overlapping requirements. The compliance enforcement agencies are also organised in different ways from country to country which hampers efforts to harmonise and simplify applicable laws and regulations and compliance procedures

4. Young people are no longer attracted by a maritime career and Europe is in danger of losing its valuable seafaring skill base. This has implications for both sea and shore based employment. A key issue for recruitment and retention is the lack of continuing professional education and training offered to mariners in a flexible manner at the ship and ashore. The future IMO training requirements now looming large will further impact the time and expense involved with seafarer training. Adapting an e-learning approach to support the professional development of seafarers could provide an effective solution since broadband access is becoming more and more common onboard ship. Other ship-borne applications to improve working and living conditions on board through remote access to shore facilities are also feasible and play an important part in the whole seafarer experience.

1.2   e-Maritime Objectives

Overall e-Maritime should eventually lead to the emergence and consolidation of commercial and public e-services resulting in:

1. Improvements in the European Transport system, resulting in trade facilitation through efficiency gains, greater flexibility and quality maritime transport services;

2. Cost-effective solutions for addressing safety, security and environmental concerns;

3. The long term competitiveness of the European maritime industries.

Upgraded maritime transport information management should promote "coherent, transparent, efficient and simplified solutions in support of cooperation, interoperability and consistency between member States, sectors, business and systems involved in the European Transport System"[2].

Therefore what is needed is a strategic European framework to bring together into a coherent whole concepts, processes, standards and technologies that will enable networking and computer supported co-operation between the principal maritime transport stakeholder groups involved in:

1. Improving the safety and security of maritime transport services and assets and environmental protection.

2. Increasing the competitiveness of the EU maritime transport industry and strengthening the EU presence on the international scene.

3. Integrating sustainable waterborne transport services into efficient and secure door-to-door transport services in Europe and beyond.

4. Reinforcing the human factor particularly supporting competence development and welfare for seafarers.

The above represent core objectives of the EU e-Maritime initiative[3], seen as a cornerstone for the achievement of the strategic goals of the EU Maritime Transport Strategy 2018. Whereas "e-Maritime" stands for internet based interactions between different stakeholders in the maritime sector which are becoming establishing practices, the EU e-Maritime initiative is aimed at supporting the development of European capabilities, strategies and policies facilitating the adoption of "e-Maritime" solutions in support of an efficient and sustainable waterborne transport system fully integrated in the overall European transport system which encompasses air, rail, road and waterborne transport.

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[2] European Commission (EC) Green Paper "Towards a future Maritime Policy for the Union"

[3] e-Maritime: Concept and Objectives, Christos Pipitsoulis, Project Officer, European Commission, DG Energy and Transport, 26 March 2009 and Deployment of e-Maritime systems, Dimitrios Theologitis, Maritime Transport & Ports Policy; Maritime Security, joint meeting at Short Sea Shipping and Motorways of the Sea   Brussels, 8 July 2009

In achieving these objectives, e-maritime focuses on increasing the operation of maritime administration, ship and port operators and their integration with the other actors in the logistics chain, promoting seafaring both in terms of recruitment, training and welfare.

1.2.1 Administration

e-Maritime is centred on the improvement of administration procedures. The Impact Assessment for the proposal for a new EU Directive replacing EU Directive 2002/6/EC [5] foresaw, amongst others, the following benefits in this initiative:

- Free circulation within the EU ports;

- Less administrative burden, lower costs;

- Faster turnaround times for vessels in ports; enhanced maritime safety; lower waiting times; less costs;

- Faster and more rational administrative operations. Lower administrative costs for Shipmaster;

- To speed up loading/unloading and waiting times of vessels in ports;

- Promotion of maritime transport as a viable alternative to road and rail.

1.2.2 Improved Shipping and Port Operations

E-Maritime aims to improve shipping and port operations by and integrating them into D2D logistics chains. The resultant improvements in efficiency to the commercial organisations involved in these sectors will be the main B2B benefit of e-Maritime.

From the perspective of logistics chains, e-Maritime is expected to provide standardisation, interoperability and security of information exchanges that will provide the foundation for cooperative networking strategies in intermodal operations. The implications of this are far-reaching:

- Efficient functioning of intermodal networks, even for interregional services – without incurring massive IT infrastructural costs;

- A distribution of risk amongst operating participants;

- The possibility of inter-network linkages becoming feasible;

- Increased reliability and security of deliveries with reduced unit costs becoming a reality.

1.2.3 Promoting Seafaring

The maritime industry faces a major challenge in terms of recruitment and on going training of seafarers. It is widely recognised that there is a global shortage of well qualified officers and that training regimes are diverse and often inflexible. The E-Maritime initiative should play a supporting role in addressing these issues, not least because it could help in increasing the level of knowledge about the industry. More specifically it the development of applied e-Learning and training courses for career development both at sea and in land could provide considerable benefits to existing and potential seafarers. In addition the establishment of on board communication and infotainments services makes seafaring life more attractive.

1.3 Identifying relevant policy instruments

An effective e-Maritime system requires common policy and systems which can then be developed or integrated into electronic processes. The Commission is pursuing a number of policies which provide the necessary platform for such development, namely the Integrated Maritime Policy[4], Integrated Maritime Governance in Member States[5] and the European Maritime Transport Space Without Barriers[6].

As well as providing the right environment in which e-Maritime systems can operate, the Commission is directly addressing the issues of standardisation and electronic transmission in the areas of maritime surveillance, cargo tracking, data collection and customs procedures.

Work has already begun on the e-Maritime initiative with EU Policy directed towards an environment of common approaches and integration. Furthermore electronic systems are already being developed for vessel monitoring, cargo tracking through e-freight, e customs and data collection. So far, however, the education and training has not been addressed through e-learning programmes.

Clearly there are a number of challenges ahead in that:

- Electronic systems differ from region to region

- There is a lack of integration of some surveillance systems

- Maritime transport is as yet not sufficiently integrated into the logistics chain to allow for efficient electronic information flow

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[4] COM 2007 575 Final : An Integrated Maritime Policy for the European Union
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0575:FIN:EN:PDF
[5] Integrated Maritime Governance in Member States
http://ec.europa.eu/maritimeaffairs/governance_memberstates_en.html
[6] COM 2009 11 Final: Communication and action plan with a view to establishing a European maritime transport space without barriers
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0010:FIN:EN:PDF

- Commercial and confidentiality issues need to be addressed.

1.4 Conflicts in reporting requirements

The are numerous legislative acts adopted by the European Union requiring pre-notification formalities at the entry into ports or prior to departure. The on-going progress in electronic data processing presents an opportunity to harmonise procedures and address the conflicts between some of this legislation[7].

A comparison of the various reporting forms requested by the various legislation revealed both common elements as well as differences. The presence of commonalities makes it possible to work on the implementation of single reporting form which could avoid duplication of data. Any existing differences such as reporting time, subjects of reporting as well as amount of information requested make implementation of the "single window" concept problematical.

1.5 Summary of Task 1 findings

Task 1 highlights some challenges for the maritime industry and the way in which e-Maritime could address those challenges. The sector is:

- Heterogeneous and fragmented with

- Little investment in information systems.

- Heavily regulated with inconsistencies between international, regional and national legislation.

- Not attracting young people leading to a global officer shortage.

E maritime will address some of the challenges with its objectives of increasing safety and security, competitiveness, integration with the logistics chain and promoting seafaring.

Electronic systems with lessen the administrative burden and cost and lead to faster turnaround times in port. From the perspective of logistics chains, e-Maritime is expected to provide standardisation, interoperability and security of information exchanges that will provide the foundation for cooperative networking strategies in intermodal operations. E-Learning may increase the efficiency and flexibility of training programmes which helps in the initial training and continuing professional education, In addition on board electronic entertainment systems may make seafaring life more attractive.

In terms of policy work has already begun on the e-Maritime initiative.   Existing EU Policy is directed towards an environment of common approaches and integration. Furthermore electronic systems

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[7] Proposal for a Directive of the European Parliament and of the Council on reporting formalities for ships arriving in and/or departing from ports of the Member States of the Community and repealing Directive 2002/6/EC

are already being developed for vessel monitoring, cargo tracking through e-freight, e customs and data collection. So far, however, the education and training has not been addressed through e-learning programmes.

Clearly the major challenges here is in the integration of some surveillance systems, integration into the logistics chain to allow for efficient electronic information flow, and confidentiality of information and the development of a single reporting form to avoid duplication of data and facilitate in the single window approach.

Task 2: State of the Art Review

Task 2 reviews the State of the Art in terms of e maritime systems and applications. It begins with an consideration of the examination of these related initiatives (SafeSeaNet, e-Navigation, e-Customs, Intelligent Transport Systems, European Rail Traffic Management System, River Information Services, Telematic Applications for Freight , e-Freight), and other current projects (MarNis, Freightwise, EFFORTS, Flagship) before considering key enabling technologies for communications and surveillance. A major issue for the e-maritime aspiration is that of standardisation, how it can be achieved and the areas where it is required. Finally there is an examination of the port experience with community systems (PCS) and single windows (PSW) to highlight the issues from a user perspective.

2.1 Related Initiatives

2.1.1 SafesSeaNet

Directive 2009/17/EC, in the framework of the Third Maritime Safety package, modifying Directive 2002/59/EC for establishing a Community vessel traffic monitoring and information system (the "VTM Directive"). One of the main objectives of the amended Directive is to guarantee that all Member States will be interconnected via the Community maritime information exchange system SafeSeaNet (SSN)[8], in order to obtain a complete overview of the movements of ships and dangerous or polluting cargoes in European waters. The integrated maritime transport strategy opens new horizons for SSN as a core platform to support "upgraded EU maritime transport information management".

Implementation of Directives 2009/17/EC and 2002/59/EC, as well as other provisions from different instruments of European legislation (like the recently approved 2009/16/EC directive on Port State Control) , requires the collection and distribution of various kinds of data. These concern vessel traffic monitoring, dangerous cargo details, vessels' pre-arrival/ arrival and departure notifications, information related to incidents etc. SafeSeaNet improves the exchange through better standardisation and efficient implementation of EU maritime safety legislation.

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[8] SafeSeaNet aims at the collection, storage and exchange of information for the purpose of maritime safety, port and maritime security, marine environment protection and the efficiency of maritime traffic and maritime transport.

By the end of 2009 there were two main applications integrated into SSN, as indicated in the schema below and further outlined here-after:
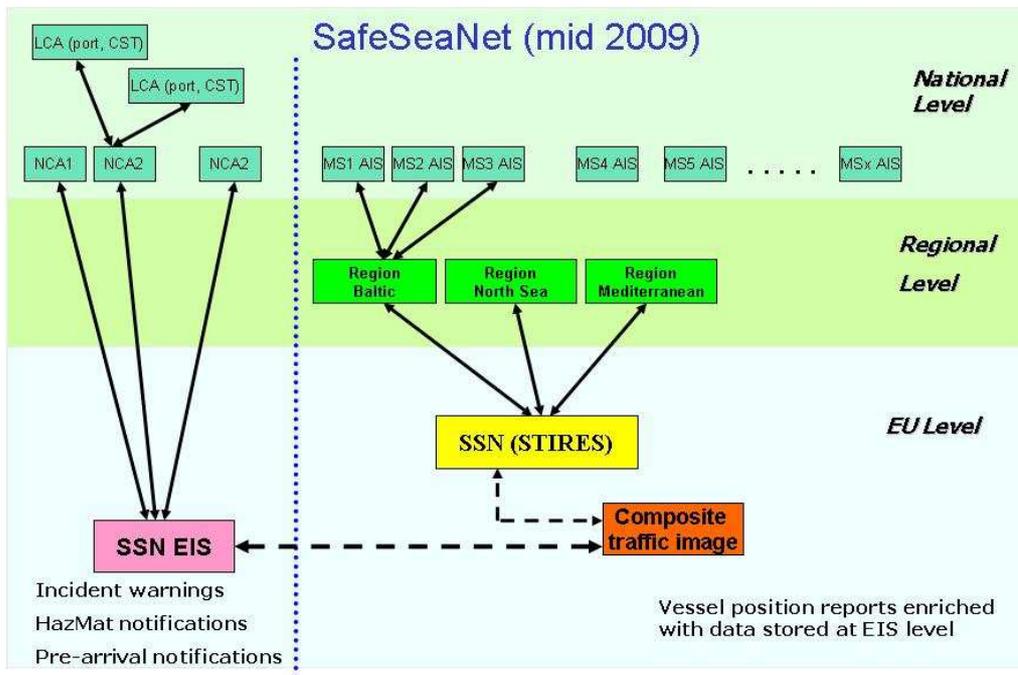

Figure 1: SafeSeaNet applications (mid 2009) – source EMSA

Each member state is responsible for implementing a SSN national application.

The key challenge for SSN developments is provision of enhanced interoperability. At a national level, SSN national nodes are essentially software applications using different implementation approaches which create interoperability. Interoperability support services therefore needed to facilitate synchronisation of SSN national nodes with changes in the SSN central system. It would be necessary to investigate how developments in Service Oriented Architecture and semantic technologies and tools can be efficiently incorporated into future versions of SSN to ease the implementation of changes and new notifications and to ensure interoperability with the Next Generation National Single Windows.

2.1.2 e-Navigation

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

e-Navigation is a concept which encompasses human factors, standards, procedures etc and is more than a system comprising of integrated subsystems and equipments.

The future of e-Navigation will rely heavily on the integration of latest state-of-the-art navigation systems and the incorporation of global navigational satellite systems for communication, positioning information and surveillance – specifically, GALILEO. However, the introduction of new technologies and associated operational procedures will result in the need for adequate training; this will be an important aspect in developing the e-Navigation concept.

2.1.3 e-Customs

The e-Customs Single Window project is aimed at producing functional specifications in 2011. The objective of the Single Window will be to enable economic operators to lodge electronically and once only all the information required by customs and non-customs legislation for EU cross-border movements of goods. The envisaged national single windows will be connected to one another and will be supported by the Single Electronic Access Point (SEAP).

Currently the New Computerised Transit System (NCTS) - Security and Safety Aspects is the first and only fully computerised and operational customs system working in all Member States (as well as in EFTA countries) and is being updated as required by Regulation (EC) 648/2005 and its implementing provisions.

The first phase of the implementation, of an Import Control System, is aimed to provide for the handling of pre-arrival declarations (under security and safety amendment Regulation (EC) 648/2005) and the link of the information with risk analysis.

Industry consultation as part of the SKEMA survey suggests that a top priority for e-Maritime is to provide efficient ways to accommodate customs as well as other mandatory reporting through National Single Windows.

2.1.4 Intelligent Transport Systems

Intelligent Transport Systems (ITS - sometimes known as transport telematics) comprise several combinations of communication, computer and control technology developed and applied in the domain of transport to improve system performance, transport safety, efficiency, productivity, service, environment, energy, and mobility.

2.1.5 RIS and ERTMS / TAF

In the inland navigation and rail sectors, the deployment of the interoperability ERTMS and RIS platforms at EU level is well advanced. The River Information Services (RIS) provides harmonised information services to support traffic and transport management in inland navigation, including interfaces to other transport modes and is progressing under a master plan agreement .

The European Rail Traffic Management System project has been set up to create unique signalling standards throughout Europe[9]; Further technical specifications for interoperability have been adopted for various subsystems such as 'TAF' : Telematic Applications for freight.[10]

2.1.6 The EU Freight Logistics Action Plan and e-Freight

"e-freight denotes the vision of a paper-free, electronic flow of information associating the physical flow of goods with a paperless trail built by ICT. It includes the ability to track and trace freight along its journey across transport modes and to automate the exchange of information for regulatory or commercial purposes. This will be made more practical and affordable by emerging technologies such as radio frequency identification (RFID) and the use of the Galileo satellite positioning system. Freight should be identifiable and locatable regardless of the mode it is transported on. A necessary condition for this is that standard interfaces within the various transport modes are put in place and their interoperability across modes is assured".

Actions include removing regulatory obstacles to co-modality, stimulate learning and exchange of best practice, and promote standardisation and interoperability and investment in transhipment hubs. A key concept in e-Freight is the Single Transport Document that can be generated in the planning stages of transport and communicated to all parties involved regardless of mode.

2.2 Related EU projects

The following four projects provide complementary inputs for the development of e-Maritime.

1. MarNIS has provided the groundwork for information management from the Administrations' perspective
2. Freightwise has established a baseline for the freight transport processes in integrated logistic chains
3. EFFORTS has produced an extensive library of process models to assist the development of interoperable port IT systems
4. Flagship provides results from a ship perspective with a particularly useful ontology based tool to identify applicable regulations to a ship's specific circumstances.

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[9] ERTMS has two basic components: ETCS, the European Train Control System, makes it possible not only to transmit permitted speed information to the train driver, but also to monitor constantly the driver's compliance with these instructions and GSM-R, based on standard GSM but using various frequencies specific to rail as well as certain advanced functions. It is the radio system used for exchanging voice and data information between the track and the train

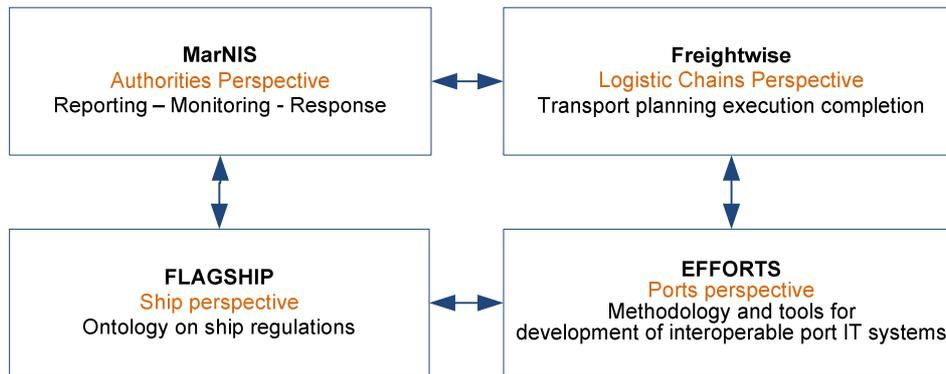[10] http://ec.europa.eu/transport/rail/interoperability/taf_en.htm

Figure 2 e-Maritime Reference Projects

2.3   Key Enabling Technologies

2.3.1 Surveillance technologies

Continuous surveillance of pertinent vessels (including their cargo and personnel) is based on information obtained from tracking systems such as AIS, LRIT etc., earth-observation (EO) satellites[11], and remote sensor systems such as e.g. (autonomous) short-range 'multi-dynamic' radar/sonar facilities, optical (IR) equipment, acoustic arrays, thermal imaging etc., being deployed at strategic positions/platforms (e.g. buoys, UAVs, planes etc.) [12]. Further notable developments relate to containers tracking and tracing solutions make use of Global Navigation Satellite Systems (GNSS) technologies for localization, combined with different telecommunication means (satellite and/or terrestrial) for communication. These combined GNSS-Telecommunication devices are installed on board the containers/swap bodies/etc., and can also be integrated with sensors such as RFID and electronic seals, to enable continuous monitoring of the status of the cargo in addition to remote localisation and tracking. GNSS solutions presently available on the market make use of the Global Positioning System (GPS) for the localization. Prototype solutions based on the use of EGNOS (European Geostationary Navigation Overlay Service)[13] are also available, and were experimented with in live freight transport operations over European logistic chains (in the 6FP projects M-TRADE[14] and MENTORE[15]) and in the Mediterranean basin (in the Euro-MED GNSS project METIS[16]).

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[11] EO satellites with SAR functions owned/operated from the EU are ENVISAT, TerraSAR-X and Cosmo-Skymed . However, these missions may be complemented with non-EU satellites such as RADARSAT-1 and RADARSAT-2 (Canadian Space Agency). Future missions include the Sentinels 1 and 3 constellations (ESA), and the RADARSAT-C upcoming constellation (Canadian Space Agency).

[12] "Examining the creation of a European Border Surveillance System (EUROSUR) -Impact assessment", Brussels, 13.2. 08, SEC(2008) 151

[13] EGNOS, the European Geostationary Navigation Overlay Service, is Europe's first venture into the field of GNSS and a precursor to Galileo, Europe's independent global satellite navigation system currently under development. EGNOS is an open system operational and available for use. On 1st of October 2008, the EC launched the EGNOS Open Service with free access for citizens and businesses.

[14] M-TRADE (Multimodal TRAnsportation supportee by EGNOS, http://www.newapplication.it/mtrade/)

[15] iMplemENtation of GNSS tracking & tracing Technologies fOR Eu regulated domains, 6FP GSA www.gnsstraking.eu

[16] METIS (MEdiTerranean Introduction of GNSS Services)

Substantial effort is currently devoted to enhancing available technology performance in the above areas. In e-Maritime, available surveillance/sensor technologies could be exploited by providing architectural solutions to facilitate their integration in situational awareness services.

2.3.2 Communication technologies

A cost effective means of communication between ships and between ships and shore based operational centres is essential for efficient and safe shipping; communication is also an important part of current major navigation systems such as AIS (Automatic Identification System), LRIT (Long Range Identification System), GMDSS (Global Maritime Distress Safety System) and GNSS (Global Navigation Satellite System. Maritime communications are regulated by the IMO (SOLAS). Both terrestrial (using MF, VHF, UHF and Microwave Frequency Bands) and satellite (using Microwave and Millimetric Frequency Bands) communication systems are available to the maritime sector.

The crucial issue for e-Maritime is improved ship-shore communications for specific applications such as e-navigation, remote condition monitoring, remote damage assessment, remote ship management, crew communications and infotainment, etc. Such usage points to the need for larger frequency bandwidths and this strong demand for broadband is exemplified by INMARSAT reports (August 09) that FleetBroadband users increased from 2600 vessels to 3200 in a period of two months [1].

Advancement in maritime broadband networks is severely lagging behind its land counterpart. What are needed are bearer independent solutions, improved network service quality, significantly higher bandwidth and lower delays.

The state of the art within broadband communication in relation to user needs has been investigated by the MarNIS project in specific application areas. The MarCom project, is aiming at developing a novel digital communication system platform to ensure the proliferation of innovative mobile network applications presently being widely implemented on land-based wireless communication systems.

Currently ship communications are investigated in a number of EU projects, particularly Flagship and SUPPORT which is aimed at developing the communication infrastructure required to serve multiple applications such as general voice and data communications, messaging, surveillance, navigational safety etc.

2.3.3 Data delivery - Spatial Data Infrastructure

In order to facilitate web-enabled access to sensor data and data integration/fusion products, there is a requirement to deliver this data within a Spatial Data Infrastructure (SDI). An SDI includes collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. An SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and citizens. It facilitates the access to geographically-related information using a minimum set of standard practices, protocols, and specifications. There are a number of

Spatial Data Infrastructure initiatives currently being undertaken in Europe including the INSPIRE (Infrastructure for Spatial Information in Europe) Directive[17] and the GMES (Global Monitoring for Environment and Security)[18].

2.3.4 Semantic Toolset for Interoperability and Services Management

The publication and discovery of Web services[19] have been tackled in several different ways so far. While the community agrees on WSDL and BPEL, as description and composition languages, respectively, the efficient and effective *exposition* and *retrieval* of Web services are still open problems. For example, UDDI[20] and ebXML[21] are probably the two most "known" registry solutions, the lack of a winning solution points to the distributed publication of services as a way to improve both exposition and retrieval.

Even if all the main registry standards have moved towards distributed approaches, the information about available services must be moved closer to their possible users, and this must be done in a user-centric way.

Specific features of semantic interoperability solutions for e-Maritime will be:

1. An e-Maritime ontology (extending maritime transport ontologies under development in reference projects) which will provide the formal terminology for all the information interchanges between all the stakeholders involved in port security management;

2. Support for semantic annotation of e-Maritime web services using SAWSDL standards and e-Maritime ontologies.

3. Support for runtime interoperability among different stakeholders by means of mediation of SOAP (Simple Object Access Protocol) messages through elevation to the ontological level and semantic mediation.

4. Port security specific inference-based mechanisms for automated discovery and integration of suitable services to support specific stakeholder goals/ tasks.

The Web Service Metadata Interchange standard (WSMI) provides the means to store e-Maritime models using the XMI specification to allow models to be exchanged across UML Editors and even metamodel Editor .

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[17] Smits, P., et al., 2007, INSPIRE Work Programme Transposition Phase 2007-2009, INSPIRE Consolidation Team, European Commission

[18] European Commission, 2005, Global Monitoring for Environment and Security (GMES): From Concept to Reality, COM(2005) 565 final

[19] Garofalakis, J., Panagis, Y., Sakkopoulos, E., Tsakalidis, A.: Contemporary Web service discovery mechanisms. Journal of Web Engineering 5(3), 265–290 (2006)

[20] UDDU: Universal Description, Discovery, and Integration, http://uddi.xml.org

[21] ebXML: Electronic Business using eXtensible Markup Language, http://www.ebxml.org

2.4 Standardisation

Standardisation is a necessary step in the development of interoperable electronic systems. Since shipping is international industry, international standards should be the goal where possible.   In practical terms this will mean ISO or IEC standards. ITU may be relevant for some radio communication standards, although e-Maritime can be expected to deal more with how communication is used than the radio-technical details. In Europe, CEN, CENELEC and ETSI correspond to ISO, IEC and ITU. It should be noted that the World Trade Organisation has developed treaties that favour international standards over regional [WTO95]. These treaties are relatively weak, but they may cause problems if regional standards are thought to interfere with open international trade.

The main standards that have been identified relate to interoperability, but some also deal with performance.

- A general reference model or architecture for e-Maritime, defining roles, functions, processes, domains etc.

- Legal dictionary/Ontology for legal documents and commercial contracts

- New standard contracts to make use of improvements in realisation e-Maritime.

- Standardised radio-communication facilities near shore and in port. Both frequencies and protocols must be agreed on.

- Information model for interoperability between administrations' information networks and databases

- Standard assessment criteria for safety, security and environmental risk, based e.g., on Shipping KPI.

- National single window implementation standard, implementation guideline or similar. Should also consider port to port or similar exchanges.

- Information and message models to fit the standard SW implementation guideline. Can be based on ISO 28005-2

- Information and message models for interface between national/European single window and port single window.

- Information and message models for interface between ship and port single window.

- Information models and message standards for electronic reporting and logging on board ships.

- Information and message models for inter-domain ship to shore communication (ship, owner, technical, administrative etc.)

- Information and message models for inter-domain ship to shore communication (ship, charter, owner, technical, administrative etc.)

Such standards map into a system of standards as shown below which relate to e-Freight, and e-Navigation as well as e-Maritime.
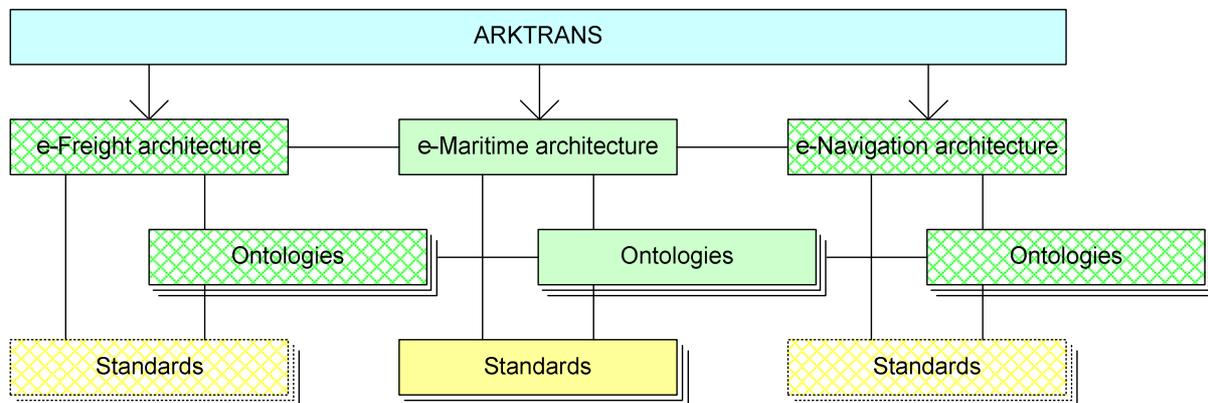

Figure 3 – Human factors in integrated operations

It is proposed to build the basic architectures on the ARKTRANS model and it is expected that e-navigation as well as e-Freight will do likewise. This helps to provide a certain level of interoperability between the different initiatives from the start.

The three architectures must be harmonized and this is indicated by the relationship lines. There are also links to other initiatives for customs and security, but these are not shown in the figure.

For the e-Maritime standard one or more ontologies need to be developed. The ontology should in principle be part of the architecture, but as the architecture may not be suitable for standardisation due to its dynamic nature, it may make sense to make the ontologies separate and proper standards.

Note that one ontology could be a complete and integrated information model for all of e-Maritime. It is not clear if this is practically feasible, but it would help to provide interoperability between different application specific standards. As one can see from the table, a number of suggested standards will require individual data models and there is a danger that information elements that could be the same in different models get different definitions.

Ontologies in the different architectures need to be similarly harmonized, in areas where domains overlap. The architecture and the ontologies will provide the common ground for interoperability between standards.

2.5 Port and National Single Windows Inventory

This task also develops an inventory of the reporting transactions carried out by European Sea Ports using their electronic data processing systems. Based on a survey of European Ports, the study reveals that although the port systems manage many transactions, the ports and the providers of

these systems are trying to improve performance by planning changes to meet expectations for the future.

In order to meet the e- maritime objectives of improved the safety and security and enhanced environmental protection, ports are expected to include into their systems:

- A better tracking of dangerous goods.

- Fairway services.

- Related oil spill prevention services.

- Adoption to actual demands of sea traffic regulations.

To increase the competitiveness of the EU maritime transport, administrative procedures need to be simplified. Improvements here would include:

- Inclusion of all the transactions in one Web Portal.

- Replacement of Port Single Window by a new Port Community System to satisfy all maritime stakeholders in a single window e-portal.

- Extension of the system at National Level. The service is free of charge.

- Inclusion of regulation of government bodies.

- Ensuring the systems involved work together in an optimal way.

- Development of new standards and messages.

- Extension of interfaces with river port and inland multimodal platforms.

- Increasing of the scope of information needed by all users of port community.

- Following management advisory service and publications.

- Interface to new control transit system.

Analysis reveals that the advantages of the single windows systems outweigh the disadvantages. These advantages mean great progress in the efficiency of ports services and maritime procedures, merchant and administrative, providing a huge incentive to maritime transport and its sustainable development, promoted by e-Maritime Initiative. They also mean the breaking down of some of the barriers that have hampered maritime transport. However, the weaknesses and threats have to be faced. The cost of the systems could be prohibitive and deprive certain ports of the opportunity to improve their output, leaving them at a disadvantage.   Such systems quickly become obsolete without continual updates and embracing of the new technologies. The issues of confidentiality of information also need to be addressed. It should also be emphasised that the Single Window development has a huge potential as long as its use remains free. The diversity of systems used by

European ports and the level of satisfaction with these systems may also prove to be an obstacle in the development of a global system.

PCS and PSW have contributed to the improvement of maritime transactions and consequently the competitiveness of the ports and the promotion of maritime transport, in accordance with e-Maritime aims. But, still there are some issues to be resolved in the development of a more uniform approach which can easily be accepted by all stakeholders.

2.7 Task 2 Summary of Findings

Task 2 has reviewed the State of the Art in terms of e maritime systems and applications. There are already a number of EU initiatives which are essential to e-Maritime aspiration namely SafeSeaNet, e-Navigation, e-Customs, Intelligent Transport Systems, European Rail Traffic Management System, River Information Services, Telematic Applications for Freight and e-Freight. Other related projects such as MarNis, Freightwise, EFFORTS, Flagship provide complementary inputs for the development of e-Maritime. MarNIS has provided the groundwork for information management from the Administrations' perspective; Freightwise has established a baseline for the freight transport processes in integrated logistic chains; EFFORTS has produced an extensive library of process models to assist the development of interoperable port IT systems; Flagship provides results from a ship perspective with a particularly useful ontology based tool to identify applicable regulations to a ship's specific circumstances.

Great strides have been made in the development of surveillance and communications technology. There are still some issues in terms of interoperability and accessibility. Information about available services must be moved closer to their possible users, and this must be done in a user-centric way. However, the means to store e-Maritime models and allow these models to be exchanged is available.

Interoperable electronic systems depend on the development of appropriate standards. The concept of e-Maritime will require significant changes in the way businesses operate and that may be very difficult to implement on a world wide level, at least from the start. The long term goal should be international legislation. However, as shipping is international, one should in aim for international standards where possible. This applies although legislation may first be implemented on European level. In practical terms this will mean ISO or IEC standards. ITU may be relevant for some radio communication standards, although e-Maritime can be expected to deal more with how communication is used than the radio-technical details. In Europe, CEN, CENELEC and ETSI correspond to ISO, IEC and ITU. One should also note that the World Trade Organisation has developed treaties that favour international standards over regional [WTO95]. These treaties are relatively weak, but they may cause problems if regional standards are thought to disturb open international trade.

In terms of efficiency , Port Community Systems and Port Single Windows have contributed to the improvement of maritime transactions and consequently the competitiveness of the ports and the promotion of maritime transport, in accordance with e-Maritime aims. But, still there are some

issues to be resolved in the development of a more uniform approach which can easily be accepted by all stakeholders.

Task 3: e-Maritime Policy

Task 3 discusses policy relating to e-maritime by considering industry characteristics, the merits of the various policy options and the adequacy of existing policy. The objective of the European e-Maritime initiative is to promote "coherent, transparent, efficient and simplified solutions in support of cooperation, interoperability and consistency between member States, sectors, business and systems involved in the European Transport System"[22]. The e-maritime initiatives are mostly concerned with increasing efficiency in that they are improving knowledge, ensuring adequate standards, and dealing with externalities.

Maritime is an international industry but policy has to be implemented at a national level. Consequently international and national regulations often co-exist with inconsistencies and overlapping requirements.   Compliance is often a matter for national agencies which hinders efforts to harmonise and simplify applicable laws and regulations. The fragmentation and competitiveness of the industry has created a lack of transparency which often leads to inefficiencies – poor level of information sharing, lack of systems integration and a need for standardisation. It could also be argued that the maritime transport industry is lagging behind other sectors in adopting modern ICT technologies.

Policy development must take account of these issues of transparency, monitoring, technical complexity, stakeholder buy-in as well as potential risk and existing policy.

The discussion and analysis reveals that policy already in place or in development provides the essential framework for e-maritime. The Integrated Maritime Policy and the Common Maritime Space without Barriers address many of the issues that are relevant to e-maritime in the encouragement of integrated and simplified electronic systems. However, there are 3 main areas where policy is still needed:

1. To address areas of concern particularly over data security and protection.

2. To achieve the necessary level of standardisation

3. To persuade stakeholders of the benefits and thus ensure wide adoption of the e-maritime approach.

Areas of concern mainly relate to security of information ands confidentiality issues. Some formal regulation is required to ensure that these issues are taken seriously and that there is some element of legal redress. It is possible that existing Directives relating to IT may cover the e-maritime issue. Alternatively, co-regulation would be that it provides a degree of certainty due to the legal provisions whilst also encouraging a flexible approach to implementation. The legislation can set out

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[22] European Commission (EC) Green Paper "Towards a future Maritime Policy for the Union"

the framework to address the challenges relating to trust, acceptance and security - setting objectives and conditions for monitoring and enforcement, whilst the detailed means to achieve the objective is decided upon by the stakeholders.   Allowing this level of control to stakeholders help build trust and buy –in.

Standardisation will play an important role in the uptake of new technologies. Standards need to be monitored to ensure that they are developed in an open, transparent and consensual manner with adequate participation of stakeholders.   Recommendations could be issued to achieve the required level of standardisation in consultation with stakeholders. These are commonly used by the Commission to encourage action in a particular sector and can signal that the EU thinks action should be taken in an area and provide a 'warning' to industry that it needs to act or face the likelihood of future legislation.

A recommendation to establish a single window with integrated data systems may also provide the strong call to action on this aspect of e-maritime if take up continues at its current pace.

Many other aspects of e-maritime could be achieved effectively by promotion, information and guidance. This 'light-touch' approach is designed to provide the information which enables the industry actors to make an informed decision. In order for information campaigns to be effective, it is vital that the right message reaches the target audience. This approach could take a number of forms such as pilot studies, conferences and seminars and other promotional material. Industry actors are focussed on commercial considerations. It is therefore important to make the benefits of e-Maritime very visible to companies.

In the case of e-learning for maritime, support could be provided through research and consultancy programmes There are already some examples where funding has been provided for pilot programmes. These could be extended to cover a wider area of maritime learning through EU research and consultancy projects. Within the remit of current European projects, theses themes could be included in scheduled workshops / conferences relating to the purposes, advantages and catalytic effects of e-learning. It would also be useful to establish life-long learning / continuous professional development structures to encourage new entrants into the industry using e-learning.

In all policy deliberations, the international nature of the industry has to be recognized and policy formulated with sufficient consultation with international partners and with sufficient regard to the existing international standards. To this end, it is noted that The Commission has also published a strategy document which sets out the way to ensure that the EU exert stronger influence in the international arena on maritime affairs in order to strengthen the global governance of the oceans and seas.

Task 4: Stakeholder Surveys

As a contribution to the Periodic Study on e-Maritime, a survey was carried out to determine stakeholders' opinions on how the e-Maritime initiative would have the greatest positive effect on the maritime & logistics industry. The survey consisted of a 28 statements with respondents asked to what extend they thought they were relevant.

The statements are shown in rank order below based on the percentage of respondents who thought that the particular statement was relevant to e-maritime.

1. e-Maritime could contribute to the **efficiency and competitiveness of maritime transport** through a paperless flow of information on the transportation of goods.

2. e-Maritime could contribute to the **efficiency and competitiveness of maritime transport** by means of a simplification of administrative reporting through a 'single window' reporting interface.

3. e-Maritime could be closely related to **the e-freight initiative**, which deals with the framework for delivering electronic freight-related messages and the content of the messages, thus providing an electronic flow of information associated with the physical flow of goods.

4. e-Maritime could contribute to the **efficiency and competitiveness of maritime transport** by means of the provision of single transport document for all modes.

5. e-Maritime could assist in achieving and implementing **harmonized standards in Europe for port and customs clearance**.

6. e-Maritime could support the **promotion of innovation in transport logistics** through greater use of information & communication technologies.

7. e-Maritime could support the objective of achieving a **European maritime transport space without barriers** to facilitate intra-European maritime transport and to put it on an equal regulatory footing with land transport, thus achieving a level playing field between transport modes.

8. e-Maritime could **facilitate cooperation between all competent authorities** having an interest in maritime traffic and the transport of goods in EU waters.

9. e-Maritime could be supportive of an **integrated approach,** encompassing legal, organisational, technological and human factors for port and coastal **safety** solutions.

10. e-Maritime could be supportive of an **integrated approach,** encompassing legal, organisational, technological and human factors for port and coastal **security** solutions.

11. e-Maritime could improve the **efficiency & sustainability of freight transport in urban environments** through facilitating the tracking and monitoring of freight movements bound for or from ports.

12. e-Maritime could help to improve **the quality of logistics services** by addressing many of the bottlenecks[23] that create unnecessary obstacles to the efficient flow of goods with respect to maritime transport.

13. e-Maritime could be supportive of an **integrated approach,** encompassing legal, organisational, technological and human factors for port and coastal solutions for environmental protection.

14. e-Maritime could be supportive of **reinforcing vessel traffic monitoring** within Europe **through the availability and quality of electronic information.**

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[23] **Bottlenecks** can be classified as being Infrastructural Bottlenecks (chronic or temporary), Regulatory Bottlenecks (direct or indirect), Supply Chain Dysfunctional Bottlenecks (labour, corporate, or information).

15. e-Maritime could advance the objective of achieving **Green Transport Corridors** by supporting the certification and auditing of energy efficiency systems in transport operations and networks, based on the determination of the **carbon footprint** for door-to-door transport of a unit of cargo for different transport modes and combination of modes using acceptable computational models.

16. e-Maritime could advance the objective of achieving **Green Transport Corridors** by supporting the certification and auditing of energy efficiency systems in transport operations and networks, based on facilitating the introduction of **energy efficiencies** that would reduce carbon footprints and improve overall operational efficiencies because of the ubiquitous nature of energy usage.

17. Through the availability and quality of electronic information, e-Maritime could support the effectiveness of Port State Control through the availability of their information to agencies that have a legitimate interest in maritime safety and surveillance.

18. e-Maritime could assist in the provision of information relevant to the formulation of **strategic decisions on infrastructural developments,** based on the relationships between transport efficiency, the facilitation of trade and the consequential increase in wealth generation.

19. e-Maritime could be supportive of the formulation of optimal **transport strategies for different freight segments** in a transport corridor, based on cargo flow data for the freight segments and the transport preferences of shippers.

20. e-Maritime could support the **Lisbon Objective** of the EU becoming the most competitive knowledge-based society in the world by 2010.

21. e-Maritime could be supportive of **raising safety standards for ships and seafarers through two-way information flows and risk profiling** of different situations.

22. e-Maritime could be supportive of the **formation of strategic alliances in intermodal transport networks** through the presentation of Service Level Agreements (SLAs) that have proven to be successful under different circumstances and that take cognizance of the risk exposures of different stakeholders.

23. e-Maritime could facilitate the **detection and management of illicit and dangerous cargoes** by customs and harbour authorities respectively, through profiling of ship manifests presented in a standard digitized format.

24. e-Maritime could be supportive of the **formation of strategic alliances in intermodal transport networks** through the determination of the benefits and risks to the different stakeholders of participating in an effective alliance.

25. e-Maritime could be instrumental in carrying out **integrative training programmes** for the diverse range of participants[24] in the transport & logistics industry, such training programmes being prepared and monitored by a cooperative group of European universities and colleges.

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[24] Participants in the transport & logistics industry: People engaged in ship operations, port & terminal operations, haulage operations, train operations, freight forwarding, stevedoring, ship & port agencies, regulatory functions including customs, health & safety, security, police and animal welfare.

26. Through the availability and quality of electronic information, e-Maritime could be supportive of **emergency response activities, such as Search & Rescue (SAR) and Oil Pollution Response Centres (OPRC)**

27. Through the availability and quality of electronic information, e-Maritime could **provide back-up for shipmasters and ship crews**, hence reducing the possibility of excessive pressure or of exploitation.

28. e-Maritime could be supportive of the **formation of strategic alliances in intermodal transport networks** through the identification of structural hindrances to the formation of an alliance, the costs of such hindrances to stakeholders and possible solutions for their resolution.

The e-Maritime statements that were used in the survey are not necessarily the totality of options for e-Maritime. They do, however, provide a basis for examining the objectives and activities of e-Maritime. For analysis, the e-Maritime statements were put into three generic groups based on the general area to which the statement related. The table shows that most stakeholders considered that e-maritime had the greatest role to play in increasing efficiency.

Groups	Generic Grouping of e-Maritime Statements	No. of Occurrences
1	Improved Maritime Transport & Logistics Efficiencies	16
2	Improved Regulatory Efficiencies	9
3	Improved Safety, Security, Environmental Management Efficiencies	5
	Total	30

Note: The total number of occurrences is 30, two more than the number of statements (28). This is because two statements are applicable to more than one generic group.

Periodic Study Summary

In the short to medium term the most promising development for maritime transport is e-Maritime, which is becoming the focus for the simplification and cohesion of administrative requirements and procedures, with a spill-over into commercial applications.

From the perspective of transport chains, e-Maritime will provide standardisation, interoperability and security of information exchanges that will set the foundations for cooperative networking strategies in intermodal operations. The implications of this are far-reaching:

1. Efficient functioning of intermodal networks, even for interregional services, without incurring massive IT infrastructural costs;

2. A balanced distribution of risk amongst operating participants;

3. The possibility of inter-network linkages becoming feasible;

4. Increased reliability and security of deliveries with reduced unit costs becoming a reality.

The e-Maritime Periodic study explores the issues, challenges and aspirations of electronic based interactions within the maritime industry and with the rest of the logistics chain together with the policy (both existing and future) which will facilitate its development. In so doing it highlights the issues that must be addressed in order to achieve the e-maritime objectives.

The challenges for the industry are:

1. The maritime transport services sector is heterogeneous and fragmented. Often different stakeholder groups appear to act in isolation from each other according to their own restricted agendas prolonging a culture of intermediaries to carry out tasks which can be easily automated with modern information and communication technologies (ICT).

2. Maritime shipping companies as well as ports have not traditionally invested in information systems primarily because ICT is not viewed as a bottom line item as in other industries such as air transport, road transport, the financial and even the retail sector.

3. The maritime transport sector is heavily regulated with respect to safety, security, environmental protection, competition, customs and labour laws. Complexities arise from the fact that international and national regulations co-exist with inconsistencies and overlapping requirements. The compliance enforcement agencies are also organised in different ways from country to country which hampers efforts to harmonise and simplify applicable laws and regulations and compliance procedures

4. Young people are no longer attracted by a maritime career and Europe is in danger of losing its valuable seafaring skill base. This has implications for both sea and shore based employment. A key issue for recruitment and retention is the lack of continuing professional education and training offered to mariners in a flexible manner at the ship and ashore. The

future IMO training requirements now looming large will further impact the time and expense involved with seafarer training. Adapting an e-learning approach to support the professional development of seafarers could provide an effective solution since broadband access is becoming more and more common onboard ship. Other ship-borne applications to improve working and living conditions on board through remote access to shore facilities are also feasible and play an important part in the whole seafarer experience.

Overall e-Maritime should eventually lead to the emergence and consolidation of commercial and public e-services resulting in:

- Improving the safety and security of maritime transport services and assets and environmental protection.

- Increasing the competitiveness of the EU maritime transport industry and strengthening the EU presence on the international scene.

- Integrating sustainable waterborne transport services into efficient and secure door-to-door transport services in Europe and beyond.

- Reinforcing the human factor particularly supporting competence development and welfare for seafarers.

The above represent core objectives of the EU e-Maritime initiative[25], seen as a cornerstone for the achievement of the strategic goals of the EU Maritime Transport Strategy 2018. Whereas "e-Maritime" stands for internet based interactions between different stakeholders in the maritime sector which are becoming establishing practices, the EU e-Maritime initiative is aimed at supporting the development of European capabilities, strategies and policies facilitating the adoption of "e-Maritime" solutions in support of an efficient and sustainable waterborne transport system fully integrated in the overall European transport system which encompasses air, rail, road and waterborne transport.

There are already a number of EU initiatives which are essential to e-Maritime aspiration namely SafeSeaNet, e-Navigation, e-Customs, Intelligent Transport Systems, European Rail Traffic Management System, River Information Services, Telematic Applications for Freight and e-Freight. Other related projects such as MarNis, Freightwise, EFFORTS, Flagship provide complementary inputs for the development of e-Maritime. MarNIS has provided the groundwork for information management from the Administrations' perspective; Freightwise has established a baseline for the freight transport processes in integrated logistic chains; EFFORTS has produced an extensive library of process models to assist the development of interoperable port IT systems; Flagship provides results from a ship perspective with a particularly useful ontology based tool to identify applicable regulations to a ship's specific circumstances.

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[25] e-Maritime: Concept and Objectives, Christos Pipitsoulis, Project Officer, European Commission, DG Energy and Transport, 26 March 2009 and Deployment of e-Maritime systems, Dimitrios Theologitis, Maritime Transport & Ports Policy; Maritime Security, joint meeting at Short Sea Shipping and Motorways of the Sea   Brussels, 8 July 2009

Great strides have been made in the development of surveillance and communications technology. There are still some issues in terms of interoperability and accessibility. Information about available services must be moved closer to their possible users, and this must be done in a user-centric way. However, the means to store e-Maritime models and allow these models to be exchanged is available.

Interoperable electronic systems depend on the development of appropriate standards. The concept of e-Maritime will require significant changes in the way businesses operate and that may be very difficult to implement on a world wide level, at least from the start. The long term goal should be international legislation. However, as shipping is international, one should in aim for international standards where possible. This applies although legislation may first be implemented on European level. In practical terms this will mean ISO or IEC standards. ITU may be relevant for some radio communication standards, although e-Maritime can be expected to deal more with how communication is used than the radio-technical details. In Europe, CEN, CENELEC and ETSI correspond to ISO, IEC and ITU. One should also note that the World Trade Organisation has developed treaties that favour international standards over regional [WTO95]. These treaties are relatively weak, but they may cause problems if regional standards are thought to disturb open international trade.

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Policy development must take account of these issues of transparency/confidentiality, monitoring, technical complexity, stakeholder buy-in as well as potential risk and existing policy. Policy already in place provides the essential framework for e-maritime. The Integrated Maritime Policy and the Common Maritime Space without Barriers address many of the issues that are relevant to e-maritime in the encouragement of integrated and simplified electronic systems. However, there are 3 main areas where policy is still needed:

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Areas of concern mainly relate to security of information ands confidentiality issues. Some formal regulation is required to ensure that these issues are taken seriously and that there is some element of legal redress. It is possible that existing Directives relating to IT may cover the e-maritime issue. Alternatively, co-regulation would be that it provides a degree of certainty due to the legal provisions whilst also encouraging a flexible approach to implementation. The legislation can set out the framework to address the challenges relating to trust, acceptance and security - setting

objectives and conditions for monitoring and enforcement, whilst the detailed means to achieve the objective is decided upon by the stakeholders.   Allowing this level of control to stakeholders help build trust and buy –in.

Standardisation will play an important role in the uptake of new technologies. Standards need to be monitored to ensure that they are developed in an open, transparent and consensual manner with adequate participation of stakeholders.   Recommendations could be issued to achieve the required level of standardisation in consultation with stakeholders. These are commonly used by the Commission to encourage action in a particular sector and can signal that the EU thinks action should be taken in an area and provide a 'warning' to industry that it needs to act or face the likelihood of future legislation.

A recommendation to establish a single window with integrated data systems may also provide the strong call to action on this aspect of e-Maritime if take up continues at its current pace.   Many other aspects of e-maritime could be achieved effectively by promotion, information and guidance. This 'light-touch' approach is designed to provide the information which enables the industry actors to make an informed decision. In order for information campaigns to be effective, it is vital that the right message reaches the target audience. This approach could take a number of forms such as pilot studies, conferences and seminars and other promotional material. Industry actors are focussed on commercial considerations. It is therefore important to make the benefits of e-Maritime very visible to companies.

In the case of e-learning for maritime, support could be provided through research and consultancy programmes There are already some examples where funding has been provided for pilot programmes. These could be extended to cover a wider area of maritime learning through EU research and consultancy projects. Within the remit of current European projects, theses themes could be included in scheduled workshops / conferences relating to the purposes, advantages and catalytic effects of e-learning. It would also be useful to establish life-long learning / continuous professional development structures to encourage new entrants into the industry using e-learning.

The recurring issues throughout the study are those of interoperability, integration and cost. Policy and standards are essential to addressing these challenges. However, all the deliberations must recognise the international nature of the industry and the need to formulate solutions with participation of international stakeholders and with sufficient regard for existing measures.   The study has revealed that there is a perception that e-Maritime will lead to greater efficiency within the sector and this is a good basis on which to promote the e-Maritime reality within the maritime and wider community.