Abstract

The European Commission has been actively promoting the competitiveness of the European maritime transport sector and a more efficient use of resources through the better use of Information and Communicating Technologies (ICT), with a core vision to enable seamless communication in the sector. This paper describes how the FP7 eMAR project successfully developed, tested and assessed tools to further streamline maritime operations. These tools included an eMAR Ecosystem, the Inlecom i-Ship Intelligent Ship Reporting Gateway, and two specific interoperable platforms: the DANAOS Collaboration Platform and the InleMar Ecosystem. These applications will help transmit information to all relevant stakeholders (authorities, agents, ship masters, off/onshore shipping company facilities) in an automated and smart manner. The transmitted information, which includes legally required information such as the IMO FAL Forms, as well as business related information, such as Estimated Time of Arrival or Port of next call or availability, will significantly improve not only the shipping related operations but also the entire upstream and downstream supply chain operations.

Keywords: e-Maritime, seamless communication, maritime operations, interoperable platforms, intelligent ship reporting formalities

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1. Introduction

Europe’s e-Maritime initiative focuses primarily on the shore-based facilitation and on the development of electronic technology, processes and services to facilitate the flow of goods over sea, and consequently the ships that carry these goods to and from and around Europe. The European Commission supports the development of applications for administrations, ship operations, ports/terminals, transport logistics and improving life at sea and promoting seafaring.

The European Commission’s e-Maritime initiative therefore aims at optimising maritime related processes and reducing the administrative burden. This will be done by identifying existing practices and regulations and by proposing improvements and simplifications deriving from use of electronic systems and information, making use of Maritime Single Windows and SafeSeaNet. The supporting EU polices and legislation for the implementation and streamlining of maritime operations using advanced Information and Communication Technology is explained as well as the role of Maritime Single Windows.

eMAR project was to support the EC’s e-Maritime initiative and develop an e-Maritime Strategic Framework and to further streamline maritime operations. eMAR successfully delivered market driven solutions for enhanced collaboration in maritime transport, including the e-Maritime Strategic Framework (EMSF), which described processes, recommended standards, and built technologies that enable advanced Information and Communications Technology, based on cooperation among all the maritime transport stakeholder groups. It also delivered an eMAR Ecosystem, the Inlecom i-Ship Intelligent Ship Reporting Gateway, and two specific interoperable platforms: the DANAOS Collaboration Platform and the InleMar Ecosystem.

The two fully interoperable platforms will significantly reduce IT complexities and costs and accelerate wider adoption of advanced information and communication technologies by different users throughout the maritime and the supply chain industry. All of these e-Maritime applications will help transmit information to all relevant stakeholders (authorities, agents, ship masters, of/onshore shipping company facilities) in an automated and smart manner.

Nomenclature

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AnNA</td>
<td>Advanced national networks for administrations project</td>
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<td>COMCIS</td>
<td>Collaborative Information Services for Container Management project</td>
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<td>eCompliance</td>
<td>Electronic compliance project</td>
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<td>e-Freight</td>
<td>European e-Freight capabilities for Co-modal transport project</td>
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<td>EPC</td>
<td>Electronic Product Code</td>
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<td>eMAR</td>
<td>e-Maritime Strategic Framework and Simulation based Validation project</td>
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<td>CRS</td>
<td>Common Reporting Schema</td>
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<td>EMSA</td>
<td>European Maritime Safety Agency</td>
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<td>EMSF</td>
<td>E-Maritime Strategic Framework</td>
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<td>IMO</td>
<td>International Maritime Organisation</td>
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<td>MESA</td>
<td>Maritime Europe Strategy Action</td>
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<td>MSW</td>
<td>Maritime single window</td>
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<td>NSW</td>
<td>National single window</td>
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<td>PCS</td>
<td>Port Community System</td>
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<td>SKEMA</td>
<td>Interactive knowledge platform for maritime transport and logistics project</td>
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<td>SME</td>
<td>Small to medium enterprise</td>
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<td>SSN</td>
<td>SafeSeaNet</td>
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<td>SW</td>
<td>Single window</td>
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<tr>
<td>UN/CEFACT</td>
<td>United Nations Centre for Trade Facilitation and Electronic Business</td>
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<td>UNCTAD</td>
<td>United Nations conference on trade and development</td>
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<tr>
<td>VTMIS</td>
<td>Vessel Traffic Monitoring System</td>
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<td>WCO</td>
<td>World customs organisation</td>
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2. e-Maritime Policies and Legislation

A longstanding problem in the shipping industry is the complexity and time involved in submitting reports when arriving in and departing from ports. Ship operators, masters, agents are still burdened with having to fill in paper documents which include similar information and to distribute them to different government authorities, including ports, maritime safety, security, customs, boarder control, and health authorities. This increases the cost and causes delays, reducing the competitiveness of maritime transport.

The EU began to streamline and standardise ship reporting formalities in 2009 by introducing a number of directives. These included the Vessel Traffic Monitoring and Information Systems (VTMIS) which made every European country responsible for introducing their own SafeSeaNet national application. This meant that all Member States became interconnected via the SafeSeaNet Community system, which provides comprehensive information on the movement of ships and the carriage of dangerous or polluting cargo in European waters.

In 2009 the EU introduced a policy to promote the increased use of maritime transport by creating the “European Maritime Transport Space without Barriers”, COM (2009) 10 final. The aim of this policy was to eliminate or simplify administrative procedures in intra-EU maritime transport, thus making it “more attractive, more efficient and more competitive. The EU Directive 2010/65/EU (Reporting formalities for ships arriving in and/or departing from ports of the Member States) was then introduced. This mandated Member States to adopt the electronic Maritime Single Window initiatives by 1 June 2015. It’s important to distinguish the Maritime Single Window from other single windows, as there have been a number of others in the past, particularly associated with customs clearance.

In accordance with EU Directive 2010/65/EU on reporting formalities, EU Member States are required to implement National Single Windows (henceforth: NSW). These NSWs should serve the purpose of the Directive 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 achieve this, Member States will develop their own NSW linked to SafeSeaNet, e-Customs, and other electronic systems.

In the interest of furthering harmonisation and coordination of reporting formalities within the EU, and in accordance with Article 3(2) of EU Directive 2010/65/EU, the e-Maritime Expert Group (eMS) developed “National Single Window Guidelines” to assist the Member States in achieving the maximum level of harmonisation and standardisation possible, whilst respecting the needs and position of an individual Member State.

2.1. Maritime Single Windows

Although Single Window concepts and solutions were first developed for trade facilitation by Customs, transport Single Windows have been used in recent years, mainly in the maritime sector. Renewed impetus for development of Maritime Single Windows (MSW) has come from the EU Directive 2010/65/EU (commonly known as the “FAL Directive”), which mandates Member States to accept fulfilment of ship reporting formalities in electronic format and their transmission via a single window.

2.2. Single Window Concept

The Single Window (SW) Concept is the main requirement for the implementation of the European Commission Directive 2010/65/EU. It aims to meet the generic goals of simplification and harmonisation of the administrative procedures applied to maritime transport by making the electronic transmission of information standard and by rationalising reporting formalities.

According to the “Single Window and data flow definition” document agreed at the 6th eMS Group Meeting, (Expert group on Maritime administrative simplification and electronic information services), “the SW consists of the user web interface and interfaces requirements, harmonised on the EU level in regard to a common set of services and specific layout, semantics, for submitting the information”. In addition, “the business activity flows used by the Shipping industry for submitting notifications, updating data in the notifications and receiving feedback by the Authorities concerned via the National Single Windows (NSWs) should be harmonised at EU level.”

By the definition in Article 2(a) of Directive 2010/65/EU, “reporting formalities” are the information required by three different categories:
- Reporting formalities resulting from the legal acts of the Union;
- FAL forms and formalities resulting from international agreements (such as International Maritime Organization – IMO or International Health Regulation – IHR); and
- Any relevant national legislation.

Each Member State hosts its implementation of the NSW. The NSW collects the reporting formalities information received from the data providers. Each relevant authority receives from the NSW the information it requires. Relevant parts of the information are made available to other Member States via SafeSeaNet (SSN), which involves the central and national SSN systems. Other EU systems should interact with the NSW and direct links between the NSW should also be established.

The development of a NSW is the main requirement for the implementation of Directive 2010/65/EU. The conceptual regional model for implementing the Reporting Formalities Directive is shown in Figure 1 below.

![Fig. 1. Conceptual model of the Reporting Formalities Directive system (NSW Guidelines 2015).](image)

National Single Windows is seen as the way to ensure that operators have a single point of contact for all reporting requirements both relating to vehicle movements and cargo and that information is transmitted automatically to various national authorities, SSN, e-Customs, etc.

The concept of NSW is closely linked to Single Transport Document which is to provide unified content for all reporting requirements and will resolve related legal issues regarding liability and customs procedures. Action towards establishing NSWs and a Single Transport Document are called both by the EU Freight Logistic Action Plan and the European maritime transport space without barriers short term actions, including:

- ‘simplification of customs formalities for vessels only sailing between EU ports’ and ‘clarification of the use of IMO/FAL harmonised forms.
- measures for "National Single Windows" building on Decision No 70/2008/CE introducing a single window for goods-related formalities ensuring that all information necessary for port authorities is lodged once whereby information will be exchanged between vessels and authorities in an electronic format as far as possible.

It is recognised that the eventual solution in this area will emerge through the evolution of different national approaches, SSN and e-Customs developments, possibly influenced by research project outputs. A number of
European projects have been working on the Single Window concept for the maritime transport sector, including: eMAR, AnNa and eCompliance.

The eMAR project proposed a MSW Development Guideline and Checklist in an eMAR White Paper MSW 1, 2013, based on the experience gained with surveys and pilot developments in SKEMA, e-Freight, COMCIS, and more recently in eMAR and eCompliance projects. It was concluded that MSWs are critically dependent on the level of cooperation between authorities, but that success will be measured by how well MSW solutions are accepted by businesses, including SMEs. Koliousis, I., et al, 2014, described the maritime transport administrative complexities in developing and implementing an innovative single window solution for maritime transport.

2.3. National Single Window Prototype

EMSA was delegated to implement action 3.1 regarding the "Evolution of the SafeSeaNet" under the Integrated Maritime Policy (IMP) work programme (C(2012) 1447 final). One of the objectives on this action was to evaluate and demonstrate how SafeSeaNet could support the Member States obligation to set up at national level a single window for reporting and exchanging formalities in accordance with Directive 2010/65/EU. This was done through a demonstration project: the National Single Window Prototype.

The National Single Window (NSW) prototype covered the information flows between:

- The ship data providers (e.g. ship agent/master, shipping company) and the NSW,
- The NSW and public authorities which are responsible for receiving the data from the reporting formalities covered by Directive, and
- The Central SafeSeaNet (SSN) system and the NSW.

Figure 2 provides the general outlook of the information flows between the main stakeholders in the NSW prototype.

2.4. SafeSeaNet

SafeSeaNet is composed of a network of national SafeSeaNet systems in Member States linked together through the central SafeSeaNet. It provides information in near-real-time for around 17,000 vessels operating in and around EU waters on a daily basis. SafeSeaNet is used by Member States to exchange information on the identification, position and status of a ship, times of departure and arrival, incident reports, details on hazardous goods, waste and
cargo residues, and ship security. SafeSeaNet also collects information for the purpose of maritime safety, port and maritime security, for marine environmental protection and the efficiency of maritime traffic and maritime transport.

The NSW prototype allows for the submission of messages which are compliant with the latest release of SafeSeaNet (version 3). In addition, it is designed to automatically receive ship details and location code updates from the central reference databases of SafeSeaNet.

3. The eMAR Project

The main objective of eMAR was to support the EC’s e-Maritime initiative and develop an e-Maritime Strategic Framework - a target operational model for Maritime Transport (i.e., a description of processes, actors, rules, information flows and other domain entities) pertaining to common industry interests (positioning, innovation, sustainability performance) and business benefits (efficiency and quality) for realising in the short or long-term. It was expected to develop an e-Maritime Platform to provide a comprehensive software infrastructure to support the management and implementation of the e-Maritime Strategic Framework, and to provide a broad range of typical e-Maritime services such as security and safety management, legislation and regulation compliance, shipping, port operations, and transport logistics.

3.1. e-Maritime Strategic Framework (EMSF)

eMAR successfully delivered an e-Maritime Strategic Framework (EMSF) – Figure 3, bringing together processes, standards and technologies that will enable IT-based co-operation between the principal maritime transport stakeholder groups. The framework consolidates processes and messages exchanged in ship operations including interactions with ports and logistic chains, with a focus on compliance with the Directive 2010/65/EU on ship Reporting Formalities, which involves establishing and using Maritime Single Windows.

![Fig. 3. EMSF interlinks shipping processes with logistics and port operations.](image)

The e-Maritime Strategic Framework (EMSF) is aimed at supporting better regulation and improved communications in the EU maritime transport sector, further fostering transparency and market function effectiveness. The EMSF is a reference domain model that describes information exchange requirements for different user-communities, for example the EMSF interlinks shipping processes with logistics and port operations, Figure 3. The EMSF is available to download from the eMAR project website.
3.2. eMAR Ecosystems

eMAR has provided solutions and infrastructure that support interoperability and cooperation for improved collaboration and business relationships. eMAR’s Ecosystems transform Business processes to eMAR software services, which are accessible through the Internet and they consist of two pylons:

i. The Business ecosystem involving the business communities producing and consuming services and exchanging information compliant with the EMSF messages, and

ii. The Technology ecosystem utilising semantically enhanced ICT infrastructure that supports interoperability and cooperation between software services, enterprise systems and intelligent objects. Business ecosystems are integrated value chains formed by the business relationships between participating organisations. Digital Business Ecosystems (DBE) comprise of the business participants both providers and consumers of information and services, as well as the ecosystem assets used in their interactions and collaboration such as applications, services, business models, training and support.

3.3. The DANAOS Collaboration Platform

The Danaos platform provides a place to publish and use software services related to shipping. It acts as a node in the e-Maritime Network and offers a directory of e-Maritime services that are already used by a number of shipping companies in their day to day operations – see Figure 5.

This platform has been developed to:

i. Promote collaboration amongst Shipping Companies

ii. Enable integration between the various in-house systems that shipping companies currently use

iii. Link business activities with other business partners and third parties, live, thought an active shipping directory

iv. Socialise professionally via messages, forum postings, conferencing, etc.
Fig. 5. The Danaos Platform as a node in the e-Maritime Network.

The DANAOS Platform offers a unique architecture that gives to a company full control over interaction. Ecosystem participants can choose the right mixture of cloud-based or office-based tasks, in order to tailor their processes according to their needs, from start to finish.

3.4. InleMar Ecosystem

The InleMar Ecosystem supports shipping organisations to creating their own corporate ecosystems compatible with the e-Maritime Strategic Framework – see Figure 6. This allows fast connection to various sources of online data, interoperability with other compliant ecosystems and applications, and agile development of application portals for their users, unifying internal and external content.

InleMar connectivity technologies enable shipping companies to upgrade their existing IT systems in a fast and cost effective manner. They can then use their new collaboration platforms to streamline existing business relationships, create new collaborative models of work, and set up new services.

This Ecosystem offers a convergence of enterprise portals and cloud management environments from a user centric perspective, creating new horizons for collaboration in shipping and bringing the goals of e-Maritime a step closer to reality. As new cloud applications and services in a particular domain emerge, the users can access them seamlessly while maintaining a consistent interface.

3.5. i-Ship Intelligent Ship Reporting Gateway

The intelligent Ship Reporting Gateway (i-Ship) is an innovative software application, enabling ship representatives to fulfil their reporting obligations to European and International maritime and custom authorities. i-Ship can be used to automate reporting formalities in a timely and correct manner taking into account the type of ship and the voyage.
i-Ship is a collaborative web-based reporting environment, designed to meet the needs of ship managers and their business associates. It acts as a common gateway to all reporting nodes (Port Systems, Single Windows, Customs), providing a single link for shipping companies to submit their reporting formalities.

![Diagram of i-Ship](image)

3.6. Common Reporting Schema (CRS) Harmonising Reporting Formalities

The Common Reporting Schema was further developed in the eMAR Project to provide compatibility with NSW models; it remains simple and extensible.

![Diagram of CRS](image)

Trade and Transport Single Windows provide significant advantages to both businesses and regulatory authorities. As European member states prepare National Single Windows in accordance with the Directive 2010/65/EU, it is recognized that the key to successful implementation is a unifying ship reporting model.

The Common Reporting Schema (CRS), as the name implies, supports a unified solution for regulatory information management associated with trade and transport at both national, EU and international levels. CRS was extended in eMAR to provide the data model and messages for Directive 2010/65/EU compliant NSWs, with knowledge of current standards and international e-reporting systems such as e-NOA US and e-PANS Singapore. It is harmonised with EU initiatives such as the AnNA project and data mapping activities carried out by the European Commission.

A major advantage of CRS is that it is structured to represent accurately both cargo and ship/voyage perspectives. It has been constructed taking into account the main international standards, particularly WCO and EPC. CRS is part of the eMAR Strategic Framework (EMSF) and therefore supports interoperability with e-Maritime applications.
4. Conclusions

The main results achieved by eMAR for enhanced collaboration in maritime transport included: the e-Maritime Strategic Framework (EMSF), eMAR Ecosystems, the DANAOS Collaboration Platform, InleMar Ecosystem, i-Ship Intelligent Ship Reporting Gateway, and a new version of the Common Reporting Schema (CRS) Harmonising Reporting Formalities. As in many other successful projects eMAR has built on the developments and experience gained from previous projects, including surveys and pilot developments.

The e-Maritime Strategic Framework (EMSF) will support better regulation and improved communications in the EU maritime transport sector, further fostering transparency and market function effectiveness. In this respect, the EMSF will play an important role in creating future digital eco-system environments where models can fully represent the complexity of interactions within the maritime transport sector. The EMSF models were created in an open and collaborative way, integrating existing models in the maritime and logistics sector, to support solutions for efficient and sustainable waterborne transportation, integrated in the overall EU transport system. As maritime transport is to be integrated into door-to-door transport services, it is imperative that the same ICT infrastructure is used for all modes of transport.

The EMSF is synchronised with on-going developments, particularly SafeSeaNet (SSN), eCustoms, EU security and environment programmes, and IMO initiatives (in particular e-navigation) to maximise potential synergies.

Acknowledgements

The authors would like to thank the contributions of the MESA Thematic Technology Group 4 (TTG4): e-maritime, and for the help of the eMAR coordinator and the partners that were responsible for the development of the E-Maritime Strategic Framework and the interoperable platforms.

This paper reflects the content of a R&D success story within the European Coordination and Support Action MESA.

The MESA project is funded by the European Union under the 7th Framework Programme (FP7/2007-2013); Grant Agreement No. 604857. The output reflects the views of the authors, and the European Commission cannot be held responsible for any use which may be made of the information contained herein. More information is available at www.waterborne-tp.org

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