MONALISA 2.0 - Activity 4

Report on the Information systems to Support SAR Operations

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1 List of Acronyms

ACO  Air Co-coordinator
AS  Abandon Station
ATM  Air Traffic Management
BLEVE  Boiling Liquid Expanding Vapour Explosion
CEO  Chief Executive Officer
CLIA  Cruise Lines International Association
DNC  Digital Nautical Chart
DNV  Det Norske Veritas
DSC  Digital Selective Call
DVM  Dynamic Voyage Management
EBS  Emergency Breathing System
ECDIS  Electronic Chart Display and Information System
ECTS  European Credit Transfer and Accumulation System
EMSA  European Maritime Safety Agency
EOC  Emergency Operations Centre
EPIRB  Emergency position-indicating radio beacon
EQUASIS  European Quality Shipping Information System
ERCC  Emergency Rescue Co-ordination Centre
ESD  Emergency Shut Down
ETO  Emergency Towing Operation
FAL  The Convention on Facilitation of International Maritime Traffic
FiFi  Fire fighting
GMDSS  Global Maritime Distress Safety System
GPS  Global Positioning System
HMI  Human Machine Interface
HUET  Helicopter Underwater Escape Training
IALA  International Association of Marine Aids to Navigation and Lighthouse Authorities
IAMSAR  International Aeronautical and Maritime Search and Rescue
ICAO  International Civil Aviation Organization
ICS  Incident Command System
ICT  Information and Communications Technology
ILO  International Labour Organization
IMO  International Maritime Organization
IMO NAV  IMO Sub-Committee on Safety of Navigation
IMO MSC  IMO Maritime Safety Committee
JRCC  Joint Rescue Coordination Centre
LNG  Liquefied Natural Gas
LSA  Life Saving Appliance
LT  Local Time
LPG  Liquefied Petroleum Gas
LRIT  Long-Range Identification and Tracking
MARPOL  International Convention for the Prevention of Pollution from Ships
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<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>MCC</td>
<td>Mission Coo-ordination Centre</td>
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<td>ME</td>
<td>Major Event</td>
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<td>MET</td>
<td>Marine Education and Training</td>
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<td>ML 2.0</td>
<td>MONALISA 2.0 Project</td>
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<td>MOC</td>
<td>Maritime Operations Centre (Spanish Maritime Safety and Rescue Agency - SASEMAR)</td>
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<td>MMSI</td>
<td>Maritime Mobile Service Identity</td>
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<td>MRCC</td>
<td>Maritime Rescue Coordination Centre</td>
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<td>MRSC</td>
<td>Maritime Rescue Sub-Centre</td>
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<td>MRO</td>
<td>Mass Rescue Operation</td>
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<td>MSI</td>
<td>Maritime Safety Information</td>
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<td>MST</td>
<td>Maritime Safety Training</td>
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<td>OBP</td>
<td>Open Bridge Platform</td>
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<td>OLRS</td>
<td>On-board life raft recovery systems</td>
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<td>OSC</td>
<td>On-Scene Co-ordinator</td>
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<td>PLB</td>
<td>Personal Locator Beacon</td>
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<tr>
<td>Port CDM</td>
<td>Collaborative Decision Making within and in relation to Ports</td>
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<td>PPE</td>
<td>Personal Protective Equipment</td>
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<tr>
<td>RCC</td>
<td>Rescue Coordination Centre</td>
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<td>RFID</td>
<td>Radio Frequency identification</td>
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<td>SAR</td>
<td>Search and Rescue</td>
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<td>SASEMAR</td>
<td>Spanish Maritime Safety and Rescue Agency</td>
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<td>SCBA</td>
<td>Self Contained Breathing Apparatus</td>
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<td>SES</td>
<td>Safe Evacuation System</td>
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<td>SMC</td>
<td>SAR Mission Coordinator</td>
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<td>SRU</td>
<td>Search and Rescue Unit</td>
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<td>STCC</td>
<td>Sea Traffic Coordination Centre</td>
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<td>STCW</td>
<td>International Convention on Standards of Training, Certification and Watch keeping for Seafarers</td>
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<td>STM</td>
<td>Sea Traffic Management</td>
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<td>SVM</td>
<td>Strategic Voyage Management</td>
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<td>SWIM</td>
<td>System Wide Information Management</td>
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<td>TFEU</td>
<td>Treaty on the Functioning of the European Union</td>
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<td>TKPI</td>
<td>Training key performance indicators</td>
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<td>VHF</td>
<td>Very High Frequency</td>
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<td>VTMIS</td>
<td>Vessel Traffic Maritime Information System</td>
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<td>VTS</td>
<td>Vessel Traffic Service</td>
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2 Document objective

This document focuses on several key areas related to the information systems involved in maritime and port evacuation and search and rescue operations. It concerns the way that they may be integrated in order to optimise operations and decision-making processes during crisis and critical scenarios in maritime and port operations. These tasks were developed during the MONALISA 2.0 project as one of the most relevant contributions to the future maritime information exchange cloud regarding the operational safety aspects.

The document will bring about an understanding of that integrated information systems for safety management will help administrations to drastically reduce fails or weak decisions making. It will also show that it will improve efficiency during the response to critical situations involving passengers, goods, vessels and port terminals and that integrated systems also will contribute to safety management savings and response costs.

Finally, the integration of systems that help improving the information exchange processes, and the response to the accidents, is an approach made under a specific scenario in Spain under the MONALISA 2.0 project scope. In Europe and other in other international regions, the approach may be applied in a different way due to circumstances, political issues, traffic, safety and surveillance regulations that differ from the context of this document.

3 Executive summary

One of the main objectives within the MONALISA 2.0 project was to define an activity for comprehensive and integral safety management that would cover the vessel, port and the emergency response operations at sea. This objective was clearly met with a system for advanced information and communications technologies, facilitating the management processes and the exchange of relevant data to support decision-making and emergency management. An integration platform for information systems could be used in the management of safety and emergency responses and would facilitate the response processes when faced with critical situations on large passenger ships at sea and in a port terminal. When a crisis team is called to attend an emergency at sea or to an accident of a big magnitude in a port, the members of the team need huge and precise information and data. Centralised information that is displayed in a common interface shall help to improve the work and decision-making processes to those experts.

The evaluation of the systems established that they are useful and optimal, and that they were at an adequate level of development during the MONALISA SAREX 25-15 implemented on 15th June 2015 in the Port of Valencia.
The conclusions on the effectiveness of these systems and their integration are included in this report.

4 Introduction

The maritime and port community expend large amounts of resources in maintaining the safety levels. This guarantees suitable and efficient operational standards, reduces risks that may affect the infrastructures, the lives of the users and staff as well as the goods and the environment. Maritime states also invest huge amounts of human and material resources in order to face and respond to incidents and accidents that affect maritime and port operations. Even at the current level of development and maturity of the systems that are employed on-board ships, in port safety and security control centres and for VTS and SAR services, the systems still may fail during operation as a result of processes carried out by humans. It has been estimated that around 90% of maritime incidents are caused by human error. Shipping companies, port authorities and vessel traffic services are still un-connected and some risks cannot be detected in advance in a paradoxical reality driven by the lack of coordination and cooperation in terms of information exchange.

During emergencies and SAR operations, considerable effort is spent on communication and real time information exchange. The aim is for the ICT systems to make it possible for relevant shore- and land based actors that involved in decision-making processes to provide suitable orders and guidance during the incidents/accidents response.

Both the stricken vessel, as well as the search and rescue units, must respond in quickly and under extreme environmental conditions. This requires an accurate and effective data exchange.

The Operational Safety activity within the MONALISA 2.0 project covers the important aspect of improving and optimising the response to maritime accidents, and finding a way to integrate existing information systems for safety management on-board ships, in ports and in SAR and National Emergency Coordination Centres.

5 The Spanish Maritime Safety and Rescue Agency (SASEMAR)

Since it come into operation in 1992, the Spanish Maritime Safety and Rescue Agency (SASEMAR) is responsible for the maritime search and rescue services, prevention and fight against marine pollution and maritime traffic control in Spain. To carry out its mission SASEMAR disposes of:

- National Rescue Coordination Centre (N-MRCC), located in Madrid.
• 19 Rescue Coordination Centres (MRCC), distributed by the whole Spanish coastline and the Islands.

• 1 Integral Maritime Safety Centre (CESEMI), located in Gijon, which aim is to provide specialised safety training within the fields of maritime transport and marine environment.

• 6 strategic and underwater bases, where the search and rescue and maritime pollution response material is stored and maintained, and ready to be moved to the area of distress or where the accident has taken place, as efficiently and safely as possible.

• Maritime resources and equipment
  - 14 Rescue, tows and pollution vessels
  - 4 Patrol boats
  - 55 Fast action boats
  - Red Cross vessels joined under a framework cooperation agreement.

• Aerial units
  - 11 Helicopter
  - 6 Fixed-wing aircraft

• Intervention equipment: SASEMAR stores, maintains and repairs underwater equipment for rescue and salvage operations - Remote Operated Vehicles (ROVs), Diving (ROVs), Diving bell, etc., and a permanent Team of five specialised divers (24 hour/365 day).

Since the beginning, SASEMAR has progressively been incorporating marine and aerial resources according to its needs, increasing the number of assets and Strategic Bases. As a consequence, the amount of information to be managed has also become greater and more complex. Apart from all the information that a corporation manages in terms of financial, human resources, etc., SASEMAR needs to store the information concerning all its activities, in an orderly, affordable and usable ways, making it possible to analyse and audit the information at any given time.

The geographical spread of the material and humans in SASEMAR, and lack of an efficient and affordable data exchange with the maritime and airborne units, has led to that major technological challenges have been addressed. The evolution of new technologies, and decreased communication costs, has made important progress in Information Systems for SASEMAR possible.

One of the first systems conceived was the Information System for the Operations Management (SIGO from its name in Spanish language). It was developed to address the challenges of information management, and for the analysis of all the activities that were carried out.
Following the launch of the first version SASEMAR has examined turning SIGO into a Web application based on standardised and customised technologies as the market does not have an application that meets the unique functional requirements of all SASEMAR activities. Information Systems in SASEMAR.

5.1 Context and State of the Art

The Spanish Maritime Safety and Rescue Agency has several information systems where large amounts of information are collected. The SIGO is the platform where MRCC’s are responsible for registering all the information related to the activity, emergency response, availability and traffic of its means. This proprietary system is in fact, a major source of historical information about the Maritime Rescue activity in Spain. All information recorded in this system is textual and typed manually.

In addition, SASEMAR is in charge of the coastal AIS network (Automatic Identification System for Ships) distributed throughout the Spanish coast line and the islands, and is responsible of receiving and storing the positions and movements received from the vessels sailing the Spanish waters.

During emergencies, communications between units that are in the same area are sent via VHF radiofrequency, not performing any automatic data transfer between such units and the MRCCs or the SIGO system. Within the MONALISA 2.0 project, it was decided to conduct a series of developments to improve this issue and provide to all the emergency response elements with the means to enable exchanging information, optimising its quality, providing tools to help decision-making processes, and supplying graphical means to facilitate the work of the users in all these processes.

To achieve these objectives SASEMAR has conducted the following work lines:

- **Modification and adaptation of SIGO**: SIGO is an information system used in SASEMAR for operations management of maritime emergencies. It includes information concerning the maritime traffic, the aerial and maritime units and the response operations. It also provides the data from the results of the response activities such as recovery of people. Work has been done to improve the quality of information and covering deficiencies of the system during the registration of persons affected by major emergencies (MRO). To open the platform to allow the access from the units and to input and register the information available from them and are not regularly in the MRCCs, to thereby provide a quick exchange of this information collected from the emergency response, updated and in real time.

- **SARMAP**: is a Search and Rescue Model from ASA employed in SASEMAR that provides rapid predictions of the movement of drifting objects and missing persons at sea. SARMAP includes the ability to deploy search & rescue units (SRUs) with search patterns and calculate probability of containment (POC), probability of detection (POD), and probability of success (POS). The integration of this tool in the SIGO system makes possible to create simulations about objects’ drifts at sea, based on weather data, currents, etc., in specific times and geo-located. This utility is a prerequisite for optimising time and resources during searching actions. This
tool will be very useful for finding rafts; drifting objects or even people in areas such as it has been defined as a test in the mass evacuation exercise (MRO) within the MONALISA 2.0 project.

- **Integrated Web Viewer**: this tool centralises and integrates over a GIS, all the information collected by the SASEMAR AIS network and the information from SIGO, providing an application that facilitates real-time display of data generated by both systems, the availability of the units deployed and their position, the identification of the emergency attended, etc. In major emergencies where there are many units working simultaneously, it is useful to have a global view, with real-time information from the units, their activity and the vessel traffic in the area.

- **NAVSAR-12**: A customised navigation system from Sainsel that allows to provide the response units with a communications system and an electronic chart display system (ECDICS), adapted to the size and ergonomics of such type of units, and to the rest of the fleet, in standard format. In turn, the MRCC’s and National MRCC are provided with consoles from which a bidirectional communication between control centres and the units facilitating its implementation into the emergency response unit, allowing the previous data loading from the control centres, and it is fully integrated within the navigation systems in the unit. Among the features available there are functions for sending images, videos and voice in real time from the units and sending searching patterns and/or possible objects’ positions from the MRCC’s to the units.

- **SAFETRX**: this is a mobile application from CARE Systems that provides to all non SOLAS ships an application running over mobile devices and tablets, and let them save a travel plan and in the case of not arriving on time, start a protocol and warnings which ultimately reported to the nearest MRCC, the last known position of the ship when it has not reached its destination. With this utility SASEMAR tries to reach all those yachts that have no legal obligation to carry AIS, and are involved in a large number of emergencies attended by SASEMAR annually. Within the framework of 2.0 MONALISA project, the SafeTRX operator console allows to locate and seek to include units that are in the area as vessels of opportunity to assist in the rescue and evacuation during the event of a situation defined as MRO.

- **Web platform to share emergency related information**: A webpage designed to allocate in a unified place all the information from the different organisms that participate in the emergency. This is a web service is regularly updated with official reports on the progress during an emergency response action. It can be consulted both by the public and by those affected or involved in the emergency. The interface is easy to access and user friendly, as the users can follow gradually the progress and monitoring the management of the situation, accessing options such as frequently asked questions, interest and specific queries or look for relevant information concerning the first aid, rescue and care emergency agencies involved.
5.2 Safety Information Integration Project

Each one of the systems from SASEMAR are being optimised to respond to a massive emergency at sea or in coastal waters, according to the objective of the project is described MONALISA 2.0. Although the systems are mutually independent and have a specific role in a wide range of response operations, they are used in order to cover all the variables and parameters associated with the incident by the corresponding system. The emergency management can be more flexible as centralising information flows and communications, makes possible to monitoring in real life the provision of resources and means necessary, supervise the rescue and the attention of those affected, manage the possible solutions in towing or manoeuvring the stricken vessel and finally, communicating the results of the operation regularly and efficiently.
The specifications and functions of the systems are as follows:

### 5.2.1 Information System for Operations Management SIGO

The SIGO, Information System for the Operations Management, is the main tool from where SASEMAR, manages all the information concerning the activity of all maritime and air units as well as attending to emergencies, control of maritime traffic and pollution at sea.

This platform has been designed to be handled and fed by the MRCC's operators with information that will progressively recorded or exchanged. The fact that the reporting and the information fed to the system is manually performed by the MRCC operators makes this work be very tedious and prone to human error. Another drawback is that some of the information produced or managed in the units, is completed in other forms, which are added to the reports of emergencies / interventions a posteriori.

The new adaptation and optimisation of SIGO seeks to eliminate these problems, lightening of the burden of additional workload to the MRCC's staff, and having a more complete information in the application.

To achieve this, the amount of information that can be completed within the SIGO has expanded and the access opened to the units involved in the emergency in the way they can fill all the information possible on the spot. This improvement has led to a new scenario in which information systems to support SAR operations are more complete providing more updated data and information, taking a step forward in achieving a real-time application. Moreover, the MRCC’s operators can devote more exclusively to the operational management of the emergency so because they have more concise and early information.
The improvements on the SIGO system were:
Based on the functional requirements and their analysis, the ICT Department starts the works for the development of functional models to meet the new needs involved in the operations management.

Modifications have been made as a function depending on the number of potential victims in the incident that in turn affect the total number of people and means involved in the emergency management.

5.2.1.1 VTS Near miss reporting
Integration of VTS near miss reporting in the operations management and information system.

It is accepted that the benefits derived from VTS can be of considerable value and when properly implemented outweigh the cost of provision. A VTS can significantly improve the efficiency of Vessel Traffic movements and thereby enable the port to increase the utilisation of its facilities and increase the return on their total investment. However, as already discussed the implementation of a VTS can minimise risks and reduce accidents and thereby avoid the costs associated with rectifying the situation that follows an accident. These costs are difficult to accurately assess. However a VTS system can provide the appropriate management information for the VTS Authority to enable it to truly assess safety within the VTS area using near miss reporting.
Use of near miss reporting VTS-MRO

Depending on the geographical location during a MRO scenario the VTS should maintain the traffic image and safe waterways throughout the emergency; this might require changes to vessel routes, diverting traffic, anchorage areas, establishing exclusion zones.

It is more important than ever to keep track and report as soon as possible those near miss situations that might affect the performance of the whole operation. For instance a close quarter situation detected and reported.

Benefits

1. When information existing in hard copies is freed from the physical limitations of paper, and transformed into an electronic document, it becomes a strategic resource.

2. The time saved retrieving electronic documents is enormous.

3. Early identification, distribution and documentation of any VTS related incident during MROs.

Improvements

SASEMAR has worked in the improvements to the SIGO, based on the above requirements and limitations as first priority in order to optimise the agency response to an MRO scenario.

5.2.1.2 SAR operator logbook

Implementation of operator’s Electronic Logbooks in the SIGO. The purpose of the logbook scheme in general is to provide the head of the MRCC or key supervising personnel with a tool to quickly assess and ensure that operators on duty have sufficient experience, maturity, and judgement to perform assigned tasks. This evaluation is paramount during MROs, where quick personnel adjustments might be needed to ensure sufficient skilled personnel. The need to train and maintain a level of preparation for SAR operations is vital to ensure that MRCCs have team members with the correct knowledge and skills to undertake operations that they may be requested to participate in. Before the last updating, the system in use was based in paper logbooks for documenting training and qualifying activities. The former system in use presented some limitations:

- Limitation 1: Single copy physical limitation
- Limitation 2: Supervisors need to visit the Control Room to read the logbook
- Limitation 3: It is difficult to search in paper logbook
- Limitation 4: Difficult process to keep logbook updated both at the MRCC and at the Maritime operations centre
- Limitation 5: Physical logbooks require large storage space over time.
**Improvements**

SASEMAR has identified the above limitations in its internal operations software management system, as first priority requirements, in order to optimise the agency response to an MRO scenario.

During an MRO scenario supervisors have to be able to access the operators’ logbooks and at a glance decide if the staffing level is sufficient or if correcting actions and adjustment need to be planned. In order to achieve this objective the logbook should be implemented electronically in the SIGO.

### 5.2.1.3 SITREP process improvement

Review of the present process to create, distribute and update situation reports in the SIGO. Situation Reports (SITREPs) are used to report information about a particular SAR incident. MRCCs use them to keep other MRCCs, MRSCs, and appropriate agencies informed about the cases that are of immediate or potential interest or as a briefing tool where an MRCC is requesting assistance or action(s) from another MRCC or organisation. The OSC uses SITREPs to keep the SMC aware of mission events. Search facilities use SITREPs to keep the OSC informed of mission progress. The OSC addresses SITREPs only to the SMC unless otherwise directed. The SMC may addresses SITREPs to as many agencies as necessary, including other MRCCs and RSCs, to keep them informed.

Often a short SITREP is used to provide the earliest notice of a casualty or to communicate urgent details when requesting assistance. A more complete SITREP is used to pass amplifying information during SAR operations.

**Impact of SITREPs during MROs**

A SITREP format has been adopted internationally which is intended for use, along with the standard codes for international communications between MRCC. Therefore the importance of the SITREP format cannot be over emphasise, especially during complex SAR operations.

**System limitations improvements**

The system previously in use has been improved to overcome the following limitations:

- **Limitation 1:** SITREPs were generated and stored manually. In order to introduce it in the system the SITREP had to be saved and then uploaded.
- **Limitation 2:** SITREPs shared between MRCCs had to be uploaded in the SIGO or sent via email or fax to the MRCC.
- **Limitation 3:** Each SITREP concerning the same casualty should have been numbered sequentially, but SITREPS were currently stored as individual documents. Queries were often difficult and might have led to operational confusion.
Limitation 4: The incident types that should be reported to SafeSeaNet may be found in Article 65 and 69 of Directive 2002/59/EC as amended. An Incident Report should be generated in specific cases like reports related to ship safety and seaworthiness. Safety related incident reports should be sent using SITREP form according to Article 16.1.a as described in Article 17.1.1 and 17.1.b.

At present SASEMAR’s operators can send the SITREP directly to SafeSeaNet through the SIGO, but because the SITREP format is not fully integrated in the system, follow up and update of the incident reports is limited, a task to be improved in the near future.

5.2.1.4 Emergency statistics

The statistics will be managed based on the columns on the database fed and referred to passengers, assisted people; deceased before the alert, deceased, rescued, disappeared, and evacuated, recorded in the reports and will be made taking the values of the new fields in the database, listed in the affected tab as TOTALs, except from those who have been saved by their own means.

Statistics/emergencies module based on the records and columns of the database

- Filtering
- Listing
- Exportation to Excel files

5.2.2 Integrated Information Web Viewer

Under the definition of Dashboard, this viewer based on ESRI technology is intended to represent on a geographic information system, operational emergency response actions, centralising and displaying the most relevant and of interest aspects to a multidisciplinary group that can set up a crisis room. It is well known that not all actors involved in the management of a maritime emergency know or are experts in this type of incidents, for that reason, it is necessary to have a platform friendly design that facilitates viewing the scenario and thus, allowing decision-making processes in a more agile and efficient way.

The web viewer based on ESRI technology allows to represent on screen:

- The operation of the units deployed
- Operation of the bases and units
- Response time of the actions taken
- Further details and information on the units
- Filtering and geo-referenced information searching options
- Marking and representing coordinates of interest
- Defining the range rings as measurement parameters
- Positioning of icons and labels for performance analysis processes
- Angle measurements
- Measurements of delays and distances
- Information about response times in specific operations
- Identifying functions by distinctive icons units used or deployed

Figure 3. Operations Viewer functions
5.2.3 Search & Recue Model and Response System SARMAP

The planning of every single SAR operation is essential and critical to the successful completion of a mission. The use of an application such as SARMAP reduces the time
and effort that are invested in planning, thus eliminating a great deal of human error and increasing precision, keeping in mind that no mobile objective can ever be found, independent of its characteristics if the search area is erroneous.

In any case the use of these tools cannot eliminate the experience and intelligence of a controller, the main objective of a SAR application is to allow the MRCC operator the flexibility to complete the dual task of planning/execution as many times as necessary, until an operation has been concluded by providing the most effective and efficient plans (always when used appropriately). This means the analytical capacity of an operator \( r \) is fundamental.

**Figure 6. SARMAP Functions**

SARMAP is a tool from ASA meant to assist search and rescue operations (SAR), specifically the decision making process during a SAR incident, the evaluation of a situation or the planning process of necessary operations (search patterns). SARMAP allows us to:

- Integrate diverse, geographically referenced information that is variable throughout a time frame (Information from an emergency, oceanic and meteorological condition).
• Estimate the possible location of objects or persons based on a calculation of how long they've been adrift, using external factors such as wind and currents.
• Represent, locate and distribute resources and items that are available.
• Generate search patterns, collecting the information from the origin, position of the datum's and search areas for the purpose of maximizing the probability of locating persons or objects that are adrift.

Table 1. Main components of a modelling tool like SARMAP summary

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>FUNCTION</th>
<th>EXAMPLE IN SARMAP</th>
<th>REQUIRES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numeric Models</td>
<td>Makes simulations and predictions</td>
<td>A model of persons adrift</td>
<td>User input</td>
</tr>
<tr>
<td>Static information</td>
<td>Environmental information</td>
<td>Coast line, depth</td>
<td>Previously collected and added to the GIS</td>
</tr>
<tr>
<td>(no variation in time)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic information</td>
<td>Reduces a determined process</td>
<td>Wind, Currents</td>
<td>Continuously acquired or deferred in time, integrated with the GIS</td>
</tr>
<tr>
<td>(vary in time)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GIS</td>
<td>Manage all of the information in one graphical interface</td>
<td>Layers of cities, information regarding winds and currents</td>
<td>The user needs to add the information that he or she requires to the GIS</td>
</tr>
<tr>
<td>Graphical Interface</td>
<td>The framework where all of the functionalities of the tool are combined</td>
<td>The visual interface that is actually used in SARMAP</td>
<td></td>
</tr>
</tbody>
</table>

This type of tool can be helpful in the following two situations that are included amongst the activities of MONALISA 2.0:

• **As support in an emergency situation:** In a real life situation the tool should allow for the integration of limited information related to an incident, this information can originate from numerous sources to generate an immediate first response.
Simulation and Training: in a pre-established situation the tool can integrate multiple sources of information; even though the information may be redundant it can allow an evaluation to be more precise.

5.2.3.1 About SARMAP

SARMAP is a GIS-based search and rescue model used to predict the path of different floating objects in marine or fresh waters. SARMAP includes the ability to deploy search and rescue units (SRUs), set their search patterns, and calculate the probability of containment (POC), probability of detection (POD), and probability of success (POS). The SARMAP model may also be run in Backtrack mode to determine the potential origin of found objects.

SARMAP drift calculations are determined using either of two methods:

- **Monte Carlo** or Particle Method.

The IAMSAR solution is limited to single point Last Known Position initialisation, but does allow multiple search objects in a scenario. The Monte Carlo solution allows for more flexibility and in general is believed to provide a smaller and more accurate search area. The Monte Carlo solution allows for:

- Multiple search objects (often referred to as targets) in a single simulation
- Initialisation based on single point Last Known Position (LKP) or track line
- Probability cells
- Probability of Containment (POC) based on probability

Several integrated components comprise the SARMAP model system. The model itself predicts the movement of various floating objects (sailboat, raft, surfboard, etc.) on the water surface. For these calculations, the model relies on environmental data such as wind and currents, physical data such as the proximity of shorelines, and the drift characteristics of the floating object in question. Each of these types of data can be input and edited using the appropriate SARMAP component.
Scenarios are the means of organising model data and parameters into unique collections. A scenario in SARMAP is a collection of information that defines a model simulation. This information includes a definition of the search and rescue scenario (date, location, type of missing object, etc.), the environmental data files (land-water boundary, winds and currents) used in the simulation, and the search and rescue units deployed, all saved under a unique scenario name. Any of the data files that comprise a scenario may belong to a single scenario or to many scenarios.

Before a model simulation is run, a scenario is only the set of input forms defining the input data. After the execution of a model simulation, a scenario also has model output (search object’s predicted trajectory and search area) associated with it. Thus, the term scenario describes both the inputs and the outputs of a model simulation. There is
always one active scenario. The active scenario name is displayed at the top of the screen, and the components of the scenario can be viewed in the map window. SARMAP also includes an embedded Geographic Information System (GIS). The GIS is used to store, display and analyse any type of geographically referenced data. Types of data often included in the GIS are place names and navigational aids. These data are not necessarily used by the model, but they are often helpful in analysing and interpreting model results. SRUs are included as a special type of GIS object that can be deployed in various search patterns with different operating constraints to determine the probability of success of a given search.

5.2.3.2 Winds and currents through EDS

One of the improvements in comparison with previous years is the possibility of using environmental data server or EDS (Environmental Data Server) to download winds and currents data exclusively for the area and the duration of the stage. Regarding the task presented in the SARMAP, now with EDS data are obtained faster and easier as the number of steps is reduced to be followed to obtain such data. EDS provides us with the minimum data necessary for our simulation, thus reducing the size of data to manage.

![Figure 8. SARMAP: Call to the model Menu, tab winds: result of a request to EDS (indicated in red "Download Complete"). The sources of data available for the area of the stage appear in the list on the left and are presented with the name of provider - product. In the Centre a representation of the downloaded data, and left appears listing the steps of time included in the downloaded file. The resulting file is stored locally for later use.](image)
5.2.3.3 The EDS Server

The EDS is housed in the computer services of SASEMAR and its mission is to provide regularly - 24 h / 7 days - environmental data to all the CCS of SASEMAR. The original version of the server was created to give support to the search and rescue operations of the North American Coast Guard (USCG) within the framework of the program of planning and optimisation of operations (SAROPS).

The main functions of EDS are:

- Gathering data: the EDS collects daily multiple sources of data, winds and currents, observations and predictions of models, for different sea areas provided by various public and private institutions.

- Homogenisation of data: data provider or each institution tends to provide the information in a different way, both in formats and data structure, and methods of distribution (web servers, FTP, OPeNDAP, etc.). Therefore it is necessary to perform basic control of the availability of the sources, the homogenisation of data, quality control, etc.

- Redistribution of data: data are stored regularly, remaining at the disposal of the users. When a user OILMAP or SARMAP sets a stage, a request for the information necessary for this scenario (winds and currents) is generated. The file that is obtained from the EDS is ready to run the simulation and can be used in following cases.

- In order to use the EDS it is necessary OILMAP and SARMAP tools connected to the EDS server through the network of SASEMAR (Internet/Intranet connection). The tools available both in the still as they are prepared for such a connection in the classrooms of the Virtual Campus.

5.2.3.4 EDS data catalogue

The EDS is a server that retrieves and redistributes data homogenised. When the user requests data from some source / data provider that is not available for the area/time of interest, EDS notifies the user by means of a notice. It is useful for us to know that sources/suppliers are included in EDS, and what are its main features such as coverage, frequency, resolution, horizon of prediction, etc.

The following table includes the list of those sources and data products that exist today as well as those that are expected to include throughout the 2012. The majority of data providers have been ESEOO (eseoo.org) project, providing winds and currents both at the national level (Puertos del Estado, AEMET), as regional/autonomous (MeteoGalicia, University of Cantabria, Basque AZTI/country, etc.).

Some providers make available various products (such as AEMET MeteoGalicia). By connecting us to the EDS, on the tab WINDS or CURRENTS in the call menu list of
sources and available data products appears to model in the left pane. The nomenclature is "Supplier – product": e.g. ESEOO - HNR-GIB.

**Table 2: Winds available in the EDS data products**

<table>
<thead>
<tr>
<th>SUPPLIER</th>
<th>PRODUCT</th>
<th>REGION</th>
<th>NAMING</th>
<th>RESOLUTION HORIZONTAL</th>
<th>INTERVAL FORECAST</th>
<th>HORIZON FORECAST</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLOBAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NCEP/NOAA</td>
<td>GFS</td>
<td>Global</td>
<td>NCEP-GFS</td>
<td>~45 Km</td>
<td>1 h</td>
<td>75 h</td>
</tr>
<tr>
<td>REGIONAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AEMET</td>
<td>ONR</td>
<td>Atlantic</td>
<td>ESEOO-ONR-ATL</td>
<td>~15 Km</td>
<td>3 h</td>
<td>72 h</td>
</tr>
<tr>
<td>AEMET</td>
<td>ONR</td>
<td>Mediterranean</td>
<td>ESEOO-ONR-MED</td>
<td>~15 Km</td>
<td>3 h</td>
<td>72 h</td>
</tr>
<tr>
<td>AEMET</td>
<td>ONR</td>
<td>Canary</td>
<td>ESEOO-ONR-CAN</td>
<td>~15 Km</td>
<td>3 h</td>
<td>72 h</td>
</tr>
<tr>
<td>LOCAL/HIGH RESOLUTION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AEMET</td>
<td>HNR</td>
<td>Gibraltar</td>
<td>ESEOO-HNR-GIB</td>
<td>~5 Km</td>
<td>3 h</td>
<td>36 h</td>
</tr>
<tr>
<td>AEMET</td>
<td>HNR</td>
<td>Mediterranean</td>
<td>ESEOO-HNR-MED</td>
<td>~5 Km</td>
<td>3 h</td>
<td>36 h</td>
</tr>
<tr>
<td>Meteo-Galicia</td>
<td>HNR</td>
<td>Galicia-Cantabric</td>
<td>WRF-ARW</td>
<td>~4 Km</td>
<td>1 h</td>
<td>48 h</td>
</tr>
</tbody>
</table>
Figure 9. Coverage map of models from winds of AEMET SASEMAR EDS Server available
Table 3: Products of current data available in the EDS.

<table>
<thead>
<tr>
<th>SUPPLIER</th>
<th>PRODUCT</th>
<th>REGION</th>
<th>NAMING</th>
<th>RESOLUTION HORIZONTAL</th>
<th>INTERVAL FORECAST</th>
<th>HORIZON FORECAST</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLOBAL</td>
<td>NCOM</td>
<td>Global</td>
<td>NCEP-NCOM</td>
<td>~ 12 Km</td>
<td>1 h</td>
<td>78 h</td>
</tr>
<tr>
<td>MyOcean (2012)*</td>
<td>MyOcean-IBI</td>
<td>Global-Atlantic</td>
<td>MYO-IBI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MyOcean (2012)*</td>
<td>MyOcean-MOON</td>
<td>Global-Mediterranean</td>
<td>MYO-MOON</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REGIONAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PdE</td>
<td>ROMS</td>
<td>North Atlantic</td>
<td>ESEOO-ATL-N</td>
<td>~ 5 Km</td>
<td>1 h</td>
<td>48 h</td>
</tr>
<tr>
<td>PdE</td>
<td>ROMS</td>
<td>South Atlantic</td>
<td>ESEOO-ATL-S</td>
<td>~ 5 Km</td>
<td>1 h</td>
<td>48 h</td>
</tr>
<tr>
<td>PdE</td>
<td>ROMS</td>
<td>Canarias</td>
<td>ESEOO-CAN</td>
<td>~ 5 Km</td>
<td>1 h</td>
<td>48 h</td>
</tr>
<tr>
<td>PdE</td>
<td>ROMS</td>
<td>Mediterranean</td>
<td>ESEOO-MED</td>
<td>~ 5 Km</td>
<td>1 h</td>
<td>48 h</td>
</tr>
<tr>
<td>LOCAL/HIGH RESOLUTION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MeteoGalicia</td>
<td>MOHID</td>
<td>Surroundings Cabo Corrubedo</td>
<td>MOHID Arousa</td>
<td>~0,3 Km</td>
<td>1 h</td>
<td>48 h</td>
</tr>
<tr>
<td>MeteoGalicia</td>
<td>MOHID</td>
<td>Ría Vigo and Pontevedra</td>
<td>MOHID Vigo</td>
<td>~0,3 Km</td>
<td>1 h</td>
<td>48 h</td>
</tr>
<tr>
<td>UniCan</td>
<td>OPROMS</td>
<td>Cantábrico</td>
<td>ESEOO-OPROMS</td>
<td>~ 1,3 Km</td>
<td>1 h</td>
<td>48 h</td>
</tr>
<tr>
<td>AZTI</td>
<td>ROMS</td>
<td>Cantábrico</td>
<td>ESEOO-AZTI</td>
<td>~ 2,2 Km</td>
<td>1 h</td>
<td>48 h</td>
</tr>
<tr>
<td>MEASUREMENTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PdE</td>
<td>CODAR**</td>
<td>Galicia/Gibraltar</td>
<td>PDE-CODAR</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* The current forecast data generated by the Consortium MyOcean are available since the second half of 2012 (myocean.org.eu).
** Current measurements data obtained by high frequency coastal CODAR (HF) radar are available since the second half of 2012.
5.2.4 NAVSAR – 12

NAV SAR-12 Navigation System has been designed by SAINSEL to support the functions of navigation in search and maritime rescue vessels by facilitating operations through automation processes, improving safety, ergonomics, and functions simplicities in order to carry them out with guarantees, and also providing other resources for the coordination of the units involved in the SAR operations.

The best official digital cartography together with the functionality of a certified WECDIS navigation system provide the basis for a set of functions specifically designed for search and rescue operations.

The use of AIS channel as a means of SAR message exchange offers a reliable communications solution available, without extra effort in the naval environment for the exchange of information between a Coordination Centre and one or more rescue vessels and/or aircrafts.

For non-SAR data exchanges, the system incorporates an additional data network that lets sending information from the environment of each ship to the Coordination Centre. Furthermore, through this channel, the system can be integrated into a rescue nationwide network.

The system functionality is provided by the MiniWECDIS systems (a trademark of SAINSEL) that, by its small size, can be installed in small ships and helicopters where the space is limited.

Navigation Functionality
This functionality emphasises the use of official nautical charts, on which the vessel is presented together with all the information from on-board navigation sensors, configuring an integrated navigation system. In this way, the system integrates and displays on the official nautical charts (ENC or DNC), the information of on-board navigation sensors (GPS, Gyro, Log, Anemometer, Sounder), the ARPA tracks from the navigation radar and the AIS tracks, providing an accurate picture of the scenario in which the vessel or unit operates.
SAR Functionality

The specific SAR functionality of the system is implemented in a particular menu of the application, which is accessible through the corresponding function key.

A set of SAR functions is available to support the search actions:

- “Go”: Edition and sending of the coordinates of a target.
- “Square Pattern”: Edition and sending of search pattern by expansive square.
- “Parallel Pattern”: Edition and sending of parallel search pattern.
- “Sectors Pattern”: Edition and sending of search pattern by sectors.
- “History”: Access and recovery of SAR operations history.

Thanks to these functions, the ground coordination centre can send automatically to a vessel or helicopter an order to go to a specific point (Datum), or send a search pattern to be executed by the target unit.

To that end, the coordination centre equipment, on the one hand, includes functions of edition and sending of the corresponding messages, which are transmitted via AIS or satellite, and the target unit, on the other hand, includes the capacity to automatically receive those messages and show their content on screen to the operator, allowing him to accept them or not.
If accepted, the corresponding target point or search pattern is automatically presented graphically in its specified geographic position. Furthermore, those messages can be edited locally on the on-board computer, and even sent to other units.

![NAVSTAR - 12, SAR functionality](image)

**Search Pattern functionality**
The procedure for generating and sending is the same for all the search patterns, not only if it is done from the Coordination centre by means of the SARMAP tool, but also if it is done from a vessel. The edition of each type of search pattern has a separate menu where the necessary data is introduced and a shipping management is directed to a MMSI.

Apart from the search patterns, other aids such as the course vector presentation obtained from the direction of the target provided by the on-board radio-goniometer, facilitate the location and allow reducing the operations' time and effort.
A tool for measuring the distance and azimuth, which is accessible with a single mouse click facilitates the verification of information on screen if necessary.

The presentation of the whole operation past track allows to analyse retrospectively the operation, as well as to make changes in vessel motions, taking into account the distance travelled until a certain time.

Another function, "History", allows saving all generated circuits in order to play them when necessary and also control.
5.2.5 SAFETRX

SafeTrx is a free Smartphone App for both Android & Apple iOS devices (iPhone, iPad) that monitors a journey, alerts designated contacts should a journey go overdue and provides a Web-based user interface for SASEMAR to rapidly assist in locating an overdue vessel.

Directly from the user’s Smartphone, he/she can enter the journey details and set off knowing that should him/her not return by the time given, the Emergency Contact will be alerted and advised to initiate appropriate action. Since SASEMAR SafeTrx app periodically sends the user’s location data back to the company servers, SASEMAR response team can get help directly to him/her, and quickly.

http://www.safetrxapp.com/

App disclaimer:
This application doesn’t replace GMDSS (Global Maritime Distress Safety System) equipment on board.

The information and functions provided in this application are provided on the understanding that users exercise their own skill and care with respect to their use.

Filling a critical gap in the maritime situational awareness picture
SafeTrx provides a means for non-SOLAS vessels to file Sail Plans. The system provides boat users who don't have or use AIS on board with a cheap, easy, automated and reliable means to keep the SAR authorities informed of their voyage plans and
location. SafeTrx is the first data source that focuses on leisure craft users without AIS to contribute to the European Maritime Safety Agency (EMSA) IMdatE maritime situational awareness picture.

**Shortens the uncertainty phase in overdue cases**
At the core of SafeTrx is the Monitoring Console, a web-based interface for SAR authorities to rapidly assist in locating an overdue vessel. Position, speed and heading information obtained from the Smartphone’s GPS is transmitted periodically back to the SafeTrx server. With access to critical location data, boater, vessel and emergency contact information, SafeTrx shortens the uncertainty phase in an overdue case and reduces SAR response times as a result.

**Early warning system**
SafeTrx’s intelligent warning system activates timely alerts on overdue Sail Plans. A Sail Plan that exceeds its Estimated Time of Arrival (ETA) triggers an escalation procedure that notifies the boater and their designated contacts ashore. SAR authorities are notified through the Monitoring Console alerting function and the system will also activate an email alert to the MRCC overseeing that area. The overdue escalation process is fully customised to follow the SAR authority’s existing Standard Operating Procedures (SOP).

**Efficient resource management**
The success of a SAR incident response depends greatly on the ability to direct SAR resources as efficiently as possible. SafeTrx supports SAR authorities in meeting this challenge with a system capable of extracting all the relevant knowledge to sustain interoperability between the many agencies engaged in SAR operations. SAR operational support tools such as SitRep generation, temporary third-party console access and quick incident sharing allows for more efficient resource management and deployment.

SafeTrx was one of the technologies that featured in the SAREX MONALISA 2.0 Mass Rescue Operation (MRO), which took place in Valencia, Spain. Lead by SASEMAR, the large-scale SAR exercise simulated a fire caused by a mechanical failure on a large passenger vessel in transit from Palma de Mallorca to Valencia. SafeTrx was used to identify nearby vessels of opportunity that could assist in the MRO. A Red Cross vessel running the SafeTrx software simulated a passing vessel in the exercise offering assistance to the SAR response.
5.2.6 Web platform to share emergency related information

SASEMAR needed to provide coverage about the maritime disasters and emergencies, publishing in the shortest time over a website, information to the press and citizens. This platform links a different web domain to every emergency.

The purpose of this platform is to publish a web based information channel in a short space of time, to serve as a means of communication during an emergency. Therefore, the web platform provides a number of features, sections and functions that are presumably necessary when the web is activated and published.

The web platform creates as many information as the users want and need at any time. The platform is a web generation tool that can live independently, and easily be to manage by the rescue team.

The platform generates a modular, expandable and features selectable web. The presentation of content corresponds to predefined sectors. The home page submits an excerpt of each section, and each section has its own page. In addition, a number of design decisions may be taken in order to adapt the website to the event in question: colour, header representative image of the event, etc.

Main Functions and Features

- Last minute/hour information
- News
- Press area
- Frequently asked questions (FAQs)
- Downloads
- Contact information
• Interest links
• Links to social media and networks
• Information reception function/forms for the relatives, citizens’ questions

The access to the web platform is: http://emergencias.salvamentomaritimo.es/
6 Conclusions

The innovations developed and implemented by SASEMAR under the MONALISA 2.0 Project are conceived, designed and developed for internal use, but a parallel work has been made in order to exchange data and information with other national agencies exclusively, particularly in the field of national maritime safety strategy.

SASEMAR has taken advantage of work that has been done with several commercial tools in order to integrate them in a global management system for an efficient response to maritime emergencies. The integration tests, and their results during the SAREX MONALISA 2515, have demonstrated that the next developments must be driven in the direction of implementing the integrated operations management system that is capable of serving other organisms at national and/or international level, and as the emergency management tool of the Sea Traffic System.

The different centres, operators, chiefs and operational staff benefit by the improvements in the effectiveness of the work as certain processes that are performed are simplified. An increased number of automated processes reduce the manual workload when critical situations must be managed.

A SAR operation that is supported by an information systems allows the coordinators to send commands to the MRCC operators, automate certain tasks related to chart display, allow navigation information, including multimedia data from the scene and the exchange of the automated search patterns to the units, to be sent. These
functionalities reduce the workload in-situ, enabling to the rescue staff to concentrate on the practical issues of the operation. At the end of the operations, the potential information losses or posteriori reporting mistakes can be reduced considerably.

Enabling a communication and information channel, like the web platform, has made it possible to contribute to the reporting of incidents/accidents to the media, citizens, victims’ relatives and services involved with official information.

SARMAP is a key technology to be used in a crisis centre in order to calculate the adrift of a life raft, objects and persons. Having introduced high quality wind and current data is key in large scale rescue operations.

NAVSAR 12 was tested in the maritime units SAR Mesana, Clara Campoamor, Salvamar Pollux and Guardamar Calliope. The system allowed dynamic management of these mobilised units. In this way, maritime units directly received the search patterns from the Land Centre. The Valencia MRCC Chief, Antonio Padial remarked that NAVSAR 12 is an extremely helpful tool that has to be tested a bit more in order to adapt it to the Coast Guard needs in a near future.

The Web Viewer as a tool to integrate the information in a georeferenced way for the SAR units, demonstrated to be a user friendly and simplified instrument to maintain a dynamic and comprehensible picture of the SAR scenarios. This tool boosts the capability and efficiency in the planning of SAR operations. One of the advantages during the exercise was the possibility to include the search patterns in the tool and the way that they were performed.

The SafeTRX tool also demonstrated its potential usefulness during large-scale crisis scenarios. When a large sea disaster happens, any additional mean to help evacuating or rescuing people in a coordinated way is of high value.

For more details on the results of tests made during the SAREX MONALISA 2515, please go to the “D.4.2.6 Report on the massive SAR operations in coastal areas”.
39 partners from 10 countries
taking maritime transport into the digital age

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

SAFETY - ENVIRONMENT - EFFICIENCY

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

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